

# Radical uncertainty, non-predictability, antifragility and risk-sharing Islamic finance

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## 1. Introduction

Recent reports (including those of the International Monetary Fund and the World Bank) on world economic and financial conditions point to trends that are indicative of systemic fragilities and vulnerabilities. These trends include: (i) with a few exceptions, economies across the world are stagnating; (ii) unemployment is widespread and growing; (iii) private investment is sluggish; (iv) productivity is declining; (v) commodity prices are low and increasingly volatile; (vi) global debt is growing and governments have increasingly resorted to financial repression; (vii) there is large and growing liquidity with no place to go; (viii) financialization (the decoupling of the financial from the real sector) is proceeding unabated; (ix) global trade is shrinking; (x) emerging market economies, which had provided a cushion for the world economy during and immediately after the crisis, are now facing considerable instability; (xi) inequalities in income and wealth distribution are worsening across the world; (xii) macroeconomic policies have been unable to reverse or even slow down the course of adverse economic and financial trends; (xiii) international financial institutions appear to have failed in their mandates to stabilize the international financial system and reigniting growth and development; and (xiv) political/policy uncertainty across the globe has intensified. These and other factors influence the global economy considerably and

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adversely, thus rendering it even more fragile at a time of optimistic hope that a sustained recovery could have been beginning. An additional list of environmental and ecological factors has led some to believe that conditions have been created for the emergence of a 'perfect storm'.<sup>1</sup>

How did the world economy get to this point? There is no single explanation that is met with widespread consensus. This has caused alternative explanations to emerge. They include, *inter alia*, secular insufficiency of aggregate demand, secular stagnation due to slowed innovation, quality of labor falling far behind innovation, policy mistakes, moral failure, and debt-leverage explanations.<sup>2</sup> Sorting out these explanations is outside the scope of this paper. Since the crisis, however, the debt-leverage view seems to have gained progressively larger support among academics and policy makers.<sup>3</sup> The analytic engine of the debt-leverage narrative is the following chain of causation: credit → debt → leverage → fragility → instability → financial crisis. The solution that emerges from this narrative is to limit credit.<sup>4</sup> But what is the cause of excess credit? Ever since Irving Fisher, 1933, there have been scholars and policy makers who have argued that there is an important missing link at the beginning of this chain of causation: the fractional reserve system of banking. To render the financial system of capitalist economy less fragile, this view argues, it is necessary to adopt a 100% reserve banking system.<sup>5</sup> Including

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<sup>1</sup> See, for example Johnson, 2011, p. 19, who argues that: "our world is headed into a Perfect Storm of an interconnected financial, ecological and social crisis. Almost all forward-looking assessments demonstrate that business as usual and incremental improvements will not be sufficient to take us to a future world blessed by equitable prosperity, safety, security and contentment."

<sup>2</sup> See Lo, Rogoff, 2015, for a summary presentation of alternative views.

<sup>3</sup> See Nesvetailova, 2007; Fostel, Geanakoplos, 2008; Reinhart, Rogoff, 2009; Schularick et al., 2010; Sanchez et al. 2011; Jorda et al., 2012; Reinhart et al., 2012; Buttiglione et al., 2014; Mian, Sufi, 2014; IMF, 2014; Rogoff, 2015; Turner, 2016; and Rasmus, 2016.

<sup>4</sup> For a succinct presentation of this view see Turner, 2016.

<sup>5</sup> If not 100%, some recommend at least something as close to 100% as possible. For a summary of arguments for and against this position, see King, 2016. For a more detailed coverage of arguments, see Phillips, 1992; Allen, 1993; Keen, 2011; Borio, 2012; Kumhoff, Benes, 2012; Smith, 2013; Pettifor, 2013 (in this piece, Pettifor argues

this link would render the chain of causation: fractional reserve system → credit → debt → leverage → fragility → instability → financial crisis.

Beyond these explanations, however, there is a view that argues fragility/instability is an inherent characteristic of a capitalist economy.<sup>6</sup> Marx provided the first thorough analysis of the dynamics of the evolution of capitalism (its laws of motion). In his vision, the source of capitalism's instability was, for the most part, the result of interactions between the rate of surplus value, the organic composition of capital and the falling rate of profits. The latter determines investment; the fall in the rate of profit leads to a reduction in investment in productive economic activities and to crisis. Marx (and contemporary Marxists) saw that the origin of a crisis in the real sector of the economy propagates to the financial sector, even though in volume 3 of *Capital*,<sup>7</sup> he analyses finance and credit as non-productive sources of profit aside from surplus value.

By contrast, Keynes recognized the potential importance of financial variables, especially interest rate, credit and speculative investment, in rendering capitalism fragile and unstable. Keynes argued that capitalism suffers from two 'evils'. First, it is unable to produce full employment and, second, it creates unequal distribution of income and wealth; the "villain of the piece," however, was interest rate;<sup>8</sup> Keynes proposed the "euthanasia" of this mechanism.<sup>9</sup> It is worth remembering that 2/3 of the title of the *General Theory* was addressed to *Interest and Money*. Nonetheless, as Pettifor points out, "Keynes's theories and policies were quickly buried—with the

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that it is debt – the loans made by banks that then create deposits – that gives the banking system the power to create money "out of thin air", pp. 11-17, p. 26); British House of Commons, 2014; Cochran, 2014; Prescott, 2014, 2016; and Dow et al., 2015. See also a proposed solution in Askari, Mirakhor, 2015.

<sup>6</sup> See Vicarelli, 1984.

<sup>7</sup> See Marx, 1974, pp. 391-450. See also Lapavistas, 2013.

<sup>8</sup> See Keynes, 1932. See also Tilly, 2015.

<sup>9</sup> See Keynes, 1932, 1933, 1936, especially chapters 12 and 24; Pettifor, 2013. A case can be made that the works of Piketty and his colleagues are validation of Keynes's view on the second, "evil" of capitalism and the role of the "rentier"; see Piketty, 2014.

acquiescence of both Keynesian ‘friends’ and the encouragement of Monetarist foes” (Pettifor, 2013, p. 15). Crucially important is the total disregard of Keynes’s emphasis on the role of interest rate mechanism and of the “rentier” in hindering savings/investment coordination and economic justice.<sup>10</sup> This is true even in the writings of one of his most ardent followers, Hyman Minsky.

While Minsky has made a valuable contribution to the understanding of the relationship of finance and real sectors of economy and the fragility inherent in it, in none of his work, spanning 25 years, does he place much emphasis on the adverse impact of the workings of the interest rate mechanism and of the role of the “rentier”, so crucial in Keynes’ monetary theory. This even though Minsky considers debt as the factor that drives the evolution of capitalist finance from robust to hedge, to speculative, to Ponzi finance, leading to crisis. Nevertheless, Minsky’s contribution in advancing the notion of “fragility” of finance and the role that debt plays in creating fragility is indisputable.<sup>11</sup> Minsky’s solution for reducing the fragility of the system was to call for big government with an even bigger role for the central bank. He saw the two as “capable of checking and reversing fragility, instability, and its negative real economic consequences by means of appropriate fiscal-monetary policies. The idea that such policies may not successfully mitigate fragility is not considered” (Rasmus, 2016, p. 409).

For those like Turner, 2016, and others, who consider interest rate-based debt as the main source of financial fragility and economic instability, reduction in credit-debt is a solution to reduce fragility. A case can be made, however, that this is not a sustainable solution as long as the current financial system is dominated by risk transfer since this regime, under right conditions such as those prevailing before the 1929 crash or the 2007-2009 crisis, switches to one of risk shifting,

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<sup>10</sup> While most contemporary Keynesians ignore his views on interest rate, some were highly critical of his position on the positive role that the elimination, or “euthanasia” of this mechanism could have on the economy; see for example Turgeon, 1996, pp. 1-2.

<sup>11</sup> See Minsky, 1982, 1986, 1995. See also Rasmus, 2016, pp. 391-416.

where the risk of speculative and Ponzi financing are shifted to third parties (tax payers) without their knowledge or consent. A more comprehensive solution would be to replace the risk-transfer/risk-shifting financing with risk sharing as proposed by Islamic finance (Askari et al., 2012; Askari, Mirakhor, 2015). The position of the sacred texts of Islam on prohibiting interest rate-based risk transfer systems (or interest rate based debt financing) is summarized in a legal maxim: “no gain without risk.”<sup>12</sup> We argue that the maxim is analogous to Taleb’s argument for a financial system anchored on “skin-in-the-game”, as it renders a financial system antifragile.<sup>13</sup> In this paper, we make an attempt to map the key characteristics of risk-sharing Islamic finance (RSIF) onto Taleb’s key concept of antifragility: skin-in-the-game. The concept of antifragility developed from Mandelbrot’s<sup>14</sup> work on fat tails, power laws, non-normal alpha stable distributions and multifractals; Kahneman, Tversky,<sup>15</sup> 2001, on prospect theory; and Taleb’s,<sup>16</sup> 2007, 2012, 2015, work on the consequences of miscalculation of outlier events under the problem of induction (Black Swans). While the salient features of the concept have emerged recently and in the wake of the 2007-2009 crisis, its intellectual roots date back to much earlier times, as shown by Taleb.<sup>17</sup>

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<sup>12</sup> This is a loose English rendering of the Arabic form of the maxim: “*al-ghunm-bi-al-ghurm*.” Islam is often represented as prohibiting all debt: see for example Turner, 2016. This is a misunderstanding. Islam prohibits interest rate based debt only and encourages non-interest based lending.

<sup>13</sup> See Taleb, 2014.

<sup>14</sup> The late Benoit Mandelbrot is best known as the inventor of fractal mathematics and for describing the potential applications of fractals to nature and to design.

<sup>15</sup> Daniel Kahneman 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.

<sup>16</sup> Nassim Nicholas Taleb’s 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.

<sup>17</sup> One may note a resemblance in the process of development of the concept of Black Swans and fragility developed by Taleb and “far-from-equilibrium states” in thermodynamics. On the latter, see Prigogine, 1997.

## 2. Time, uncertainty and antifragility

Early in his book, *The End of Certainty*, Ilya Prigogine, 1997, presents Popper's dilemma that, on the one hand, human common sense tells us that events are caused by their predecessors (determinism) and, on the other hand, the same common sense says we are free to choose between alternatives (Popper, 1982, p. xix). The dilemma, Prigogine argues, relates to the role and meaning of time and the question: is the future determined (certainty) or will it unfold by pure chance? He asserts, based on the ubiquity of irreversibility and on Whitehead's process philosophy, that humans are "the children of the arrow of time"<sup>18</sup> and that between the Newtonian determinism and the quantum world of pure chance there is a "narrow path", one that is "no longer based on certitudes, but rather possibilities." (p. 183). The end of certainty (and reversibility of time) is also the end of the idea that the present can predict the future based on past events.

The idea of irreversibility is due to the Second Law of thermodynamics—the Entropy Law. In the second half of the twentieth century, in an erudite book titled *The Entropy Law and the Economic Process*, economist Nicholas Georgescu-Roegen (1971) argued that economic processes are "intimately connected with the Entropy Law" (p. xiii). Georgescu-Roegen's philosophical orientation is very much aligned with that of Prigogine, mainly Bergson on time, Whitehead especially on process philosophy, and Popper's position on anti-determinism. In a much-neglected essay, eight years after the publication of Georgescu-Roegen's book, economist Walter Weisskopf, 1979, discussed the relevance of the Newtonian and Heisenbergian paradigms to economic processes. In an imaginative ontological framework, Weisskopf argued that classical and neoclassical

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<sup>18</sup> Prigogine, 1997, p. 3. His view of time was much influenced by the philosopher Henri Bergson who argued: "the more deeply we study the nature of time, the better we understand that duration means invention, creation of forms, continuous elaboration of the absolutely new" (Bergson, 1943, p. 11). Some other economists, including Veblen, Keynes and Schumpeter, held similar views; see Zhelaeva, 2015. On process philosophy, see Whitehead, 1978.

economics were trapped in the Newtonian deterministic paradigm as reflected in the idea of equilibrium. Unpredictability and uncertainty surrounding human behavior, hence economic processes, require consideration of the Bergsonian view of time as “duration” or as a dynamic flow; understanding that the current state of economic processes and systems is

“essentially in a far from equilibrium state is a better identification of the dynamics of economic progress and evolution: the dynamics of real time. If we accept the fact of disequilibria and that every judgment is at best the expression of a probability, then accepting and managing uncertainty becomes the key issue” (Giarini, 2011, paragraph 2.2).<sup>19</sup>

Starting from the first half of the twentieth century, economists focused on decision under risk and uncertainty. In this context, the year 1921 marked the appearance of two books on the subject – Keynes, *A Treatise on Probability* and Frank Knight, *Risk, Uncertainty and Profit* – which are considered the beginning of the continuous debate on the role and impact of time and knowledge in the predictability of future economic processes and events. Disregarding the ideological orientation of the two pioneers, their views on the predictability of the future, developed independently, are remarkably similar. Both made a distinction between risk and uncertainty. Both related risk to probability. There is some nuanced difference between the two on the way probabilities could be determined, but for both risk was the probability of occurrence or non-occurrence of an event. The difference between the two is more pronounced in their conception of uncertainty. While for both, the uncertainty of an event relates to the degree of knowledge of the decision maker, Knight considered uncertain events as those for which probabilities exist but which cannot be calculated due to limits on knowledge on the parameters of the probability distribution (Knight, 1921, p. 233). Keynes, on the other hand, considered that many economic, business and finance events whose future is “very uncertain” (Keynes, 1936, p. 148) in the sense that about them “there is no scientific basis on which to form

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<sup>19</sup> See also Purser, Petranker, 2004.

any calculable probability whatever. We simply do not know" (Keynes, 1937, p. 213). In subsequent literature, the first notion of uncertainty became known as "Knightian uncertainty"<sup>20</sup> and Keynes's notion became known as "radical uncertainty."<sup>21</sup>

Given the wide variety of conceptions of uncertainty developed since 1921, Orlean, 2010, has made an attempt to simplify. He argues that the core difference between the risk and uncertainty of an event is the degree of knowledge about the future occurrence or non-occurrence of the event. In turn, that knowledge is constrained by the cognitive capacity to know. Radical uncertainty relates to this constraint on the current knowledge's ability to predict the future. Hence, argues Orlean, it should be called "epistemic uncertainty" (*ibid.*, p. 22). Moreover, he argues, Popperian epistemology maintains that calculating the objective probability of falsification of current knowledge based on knowledge that the future could provide is not possible.<sup>22</sup> Orlean, 2010, p. 23, suggests that epistemic uncertainty can refer to knowledge that extends current understanding or to knowledge that invalidates current knowledge. The estimation of the probability of both types is "purely subjective." It is this subjectivity

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<sup>20</sup> Since the publication of Daniel Ellsberg's, 1961, seminal paper, the Knightian uncertainty became known as "ambiguity" and a large body of literature deals with the issue. See for example the following papers and their list of references: Erbas, Sayers, 2006; Erbas, Mirakhor, 2007, 2013; Gilboa et al., 2008; Siniscalchi, 2008. On radical uncertainty see the following papers and their list of references: Garrone, Marchionatti, 2007; Roncaglia, 2009; Marsay, 2015; Ormerod, 2015; King, 2016.

<sup>21</sup> Over the last four decades the notion of uncertainty has been further expanded to include numerous types. In a comprehensive paper, Dequech, 2011, provides an analysis of the typology of the concept of uncertainty in economic literature. See also Dow, 2015.

<sup>22</sup> Interestingly, Georgescu-Roegen, 1971, p. 122, observed that the debate on the discussion of uncertainty has created confusion between "imperfect" and "incomplete" knowledge. The former "refers to a particular piece of the extant knowledge" while the latter "refers to knowledge as a whole." On this basis, he argues that: "risk describes the situations where the exact outcome is not known but the outcome does not represent a novelty. Uncertainty applies to cases where the reason why we cannot predict the outcome is that the same event has never been observed in the past and, hence, it may involve a novelty." Clearly, Black Swan events resonate in Georgescu-Roegen's conception of radical uncertainty. On the notion of "radical novelty", see Orlean, 2010, p. 22.



that is the essence of “estimation” or “expectations” at the heart of Knightian and Keynesian conceptions of uncertainty that renders any prediction of the future hazardous, particularly when the predictive models do not take into account the social costs of the emergence of extreme events.<sup>23</sup> The seminal paper by Kahneman, Tversky, 1979, led to more research in experimental areas, the upshot of which was the wide acceptability of the proposition that humans’ view of the future under conditions of uncertainty is not well defined, hence making probabilistic models of behavior under uncertainty problematic. Thus, Orlan argues that there are intrinsic limitations to estimation of risk in finance that “derive from the nature of economic time, which is opaque and radically uncertain.” Past observations do not provide “a sufficient basis for predicting the future [...] there is no objective basis allowing for scientific estimation of risk”. The failure of risk-prediction models was one of the causes of the crisis (*ibid.*, p. 1 and p. 26). Economic and financial forecasting seems somehow to treat arguments forwarded by philosophers such as Hume and Popper, for instance the latter’s criticism of induction, with not so “benign neglect”. As Roncaglia, 2012, argues “however large the data base on which we rely, it is impossible to infer from the past that the future will conform to any pattern shown in the past” (p. 442). Nonetheless, forecasting continues to flourish with complicated models.<sup>24</sup> In the meanwhile fragilities, structural breaks, Black Swans and model risks (the risk of loss resulting from using models to make decisions under uncertainty) continue to appear and surprise the forecasters. Literature, particularly since the crisis, notes two different forms of radical uncertainty; one referring to the predictability of future economic and financial events, and the second, referring to the statistical “model” uncertainty used to predict future events,

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<sup>23</sup> De Finetti, Ramsey, 1931, considered independent founders of the subjective approach to probability, criticized both Knight and Keynes. De Finetti wrote in Italian, hence his writings were not available to the English-speaking researchers for some time. See Roncaglia, 2012, and Feduzi et al., 2013.

<sup>24</sup> For an introductory coverage of these models see Brooks, 2014.

especially those that attempt the estimation of financial risk. Both have had their share of criticism.<sup>25</sup>

### 3. Antifragility

One of the most severe critics of forecasting models in economics and finance (both before and after the crisis) is Taleb, who instead advocates

“nonpredictive decision making under uncertainty in business, politics, medicine, and life in general—anywhere the unknown preponderates, any situation in which there is randomness, unpredictability, opacity, or incomplete understanding of things” (Taleb, 2012, p. 4).

Non-predictive decision-making proposals involve a “Triad” of “Fragility-Robustness-Antifragility” (*ibid.*, p. 135) as an alternative to traditional risk management and as a more reliable method of evaluating long-term survivability of financial systems (as well as the survivability of all other systems that are affected by fat tails). Antifragility refers to a resilient state of a system in which shocks from Black Swans<sup>26</sup> strengthen, rather than weaken, the health of the system. For a financial system, antifragility is a calculable unit of measurement of the resilience of the system to survive *negative* fat tail events and to gain from *positive* fat tail events. In option trading terms, antifragility implies *long gamma*.<sup>27</sup> In the statistics domain, antifragility is the sensitivity of the right tail to changes in the scale of

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<sup>25</sup> Criticisms of the first type such as those leveled against macro-econometric models are older than the criticisms of models. See for example Alchian, 1950; Marschak, 1953; Hayek, 1964; Locus, 1976; Bewley, 1988; Von Mises, 1996; Brock et al., 2003; Manski, 2007; Roos, 2015; Dow, 2015. Research on model uncertainty is roughly two decades old. Roncaglia, 2012, succinctly reviews criticisms of statistical modeling before and after the crisis. See also Onatski, 2008; Rizzi, 2008; Ziliak, McCloskey, 2008; Danielsson, 2002, 2008; Danielsson et al., 2014.

<sup>26</sup> A Black Swan is an outlier event of defining (negative or positive) impact, with the impact being defined/explained only after the occurrence of the event.

<sup>27</sup> Gamma is the second partial derivative of the change in the price of the option with respect to the change in the underlying asset price.

the distribution (while fragility is a similar sensitivity of the left tail), as shown in figure 1 (Taleb, 2012). 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 that an antifragile function will result in more benefit than harm from random events. Figure 2 (from Taleb, 2012) shows how, for an antifragile function, as the severity of the stressor increases, gains end up accelerating; for a fragile function, the results are the opposite.

Antifragility emphasizes that 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, and adjusting payoffs of exposure in such a manner as to be positively affected by such risks. This contrasts with the current methods of risk management that utilize past data to predict the future occurrence of risks, and then allocate economic, financial and regulatory resources to cater to such risks. The result is a financial system repeatedly subjected 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 hazards – too many risks being *hidden* in the left tail by the risk manager. 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.

Table specifies 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 the real-sector versus the financial sector, among other things. He praises the antifragile nature of venture capital and the importance of heuristic knowledge gained by humanity as incorporated into the various religions in the form of prohibition on interest. Some of Taleb's important ideas map directly to principles of Islamic finance. His idea of "skin-in-the-game" corresponds to the Islamic legal maxim "no gain without risk" (*al-ghunm-bi-al-ghurm*), fragility of debt and conversion of debt to equity

Figure 1 – Statistical definition of fragility and antifragility

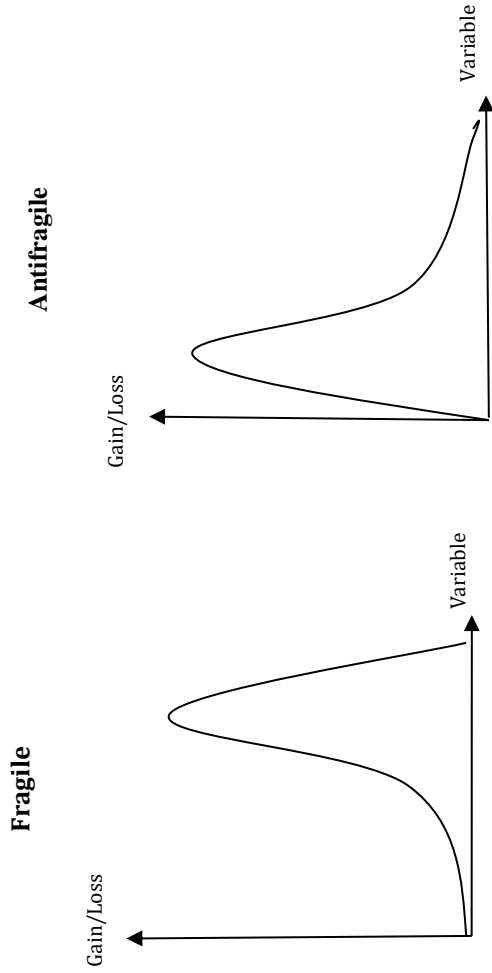
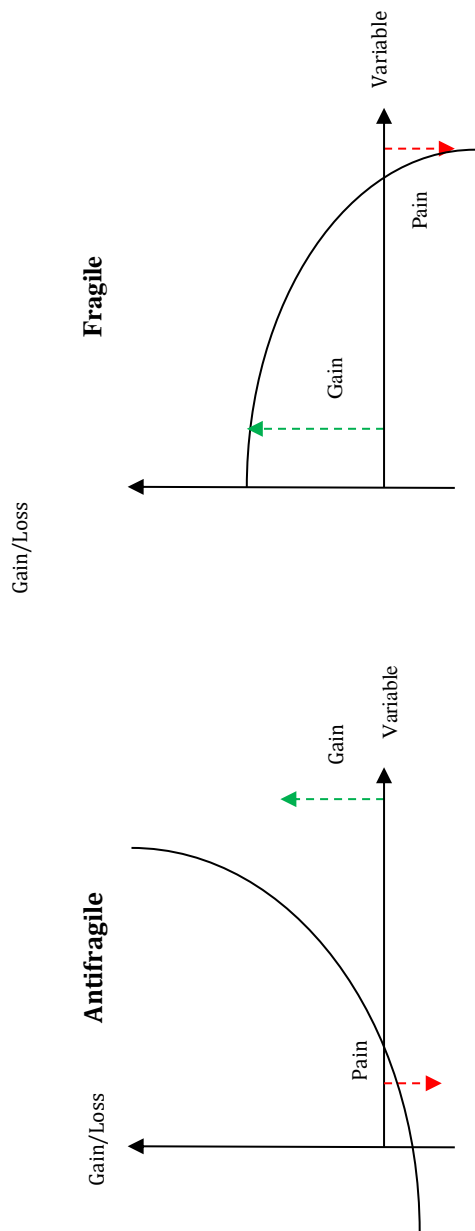


Figure 2 – Measurement of antifragility: concave versus convex functions



relate to prohibition of interest (*riba*), risk hiding in the tail relates to prohibition of asymmetric information (*gharar*), speculation on the unpredictable nature of fat tail events relates to prohibition on speculation (*maysir*), his emphasis of real-sector activities corresponds the Islamic requirement (verse 275 of chapter 2 of the Qur'an) that interest rate based debt contracts be replaced with real asset-based contracts (*al-bay'*) and his advocacy of venture capital maps directly to Islamic risk-sharing contracts (*mudaraba/musharakah*). Taking Taleb's views on antifragility into consideration, we argue that risk-sharing Islamic finance (RSIF) has a higher probability of surviving shocks originating from Black Swans since it explicitly embraces the idea of skin-in-the-game, making Islamic financial systems antifragile.

#### 4. Risk-sharing Islamic finance

The Islamic financial system is based on risk sharing rather than risk transfer/risk shifting, which is the chief characteristic of the debt-based financial system. In Islamic finance, debt creation is constrained by the prohibition of interest. In conventional finance, the axiom of self-interest implies that while economic agents do take risks they are also motivated to transfer risk to others; thus, gaining the potential upside benefit of the risk while passing on any potential downside loss to someone else.<sup>28</sup>

Every society faces certain amounts of risk. There are three different ways in which risk can be managed: it can be *shared*, *transferred* or *shifted*. Only one of these methods acts as an agent of

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<sup>28</sup> It is often argued that one reason for the dominance of debt over equity contract is that debt is cheaper. This argument ignores the large hidden costs of debt. With the self-interest axiom, it can be argued that a debt contract is an impossible contract because of the incentive for default by borrowers. To make debt contracts possible, society bears a huge administrative, legal, and punitive force apparatus costs to enforce debt contracts. These costs constitute a huge subsidy to creditors. This is in addition to the costs of collateral to the individual debtor. For other costs of debt, see Lazzarato, 2011.

antifragility; the remaining two make the financial system fragile. Due to its reliance on risk sharing as a mechanism of risk management, prohibition of asymmetric information and speculation, RSIF becomes antifragile, while interest rate-based debt finance (IRDF), by relying on risk shifting and risk transfer, is inherently fragile. Risk sharing is defined 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. Risk transfer refers to a risk management technique where the risk of a contract is passed by one of the parties to the contract to another. An example is a bank deposit contract where the depositor passes the risk to the bank. In turn, the bank passes the risk to a borrower. Another example is an insurance contract in which an insurance company accepts the transfer of risk from its clients in exchange for a fee. 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. Under a *takaful contract*, the risk is not transferred but shared amongst a pool of participants, while under conventional insurance the risk is transferred from the policyholder to the insurance company. Risk shifting refers to the tendency of financial institutions facing distress to shift the risk from equity holders to debt holders without the explicit knowledge of the latter. This is possible in corporate finance because of the separation between ownership and management. When management realizes that there is financial stress, it resorts to borrowing rather than issuing additional shares, since the potential profits accrue to equity holders while the downside risk accrues to debt holders. The risk implicitly *shifts* from equity holders to debt holders. One of the main causes of the Great Recession was the massive indulgence in speculation by risk shifting through interest-only and *ninja* (no income, no jobs, and no assets) loans, by subprime mortgage lenders facing shocks to their investment portfolios due to the tightening of monetary policy. The ultimate risk shift was that from the financial institutions to the taxpayers without the latter's knowledge or consent.

Taleb's notion of skin-in-the-game is functionally equivalent to

the Islamic finance rule that risk taking is the basis of gain. Hence, an antifragile financial system in which all parties to contracts have skin in the game functions very much like RSIF. Taleb, 2012, considers that debt makes a financial system fragile, equity makes the system robust and skin-in-the-game as in venture capital makes the system antifragile (Taleb, 2012, p. 26; for a full discussion see chapter 23). Avoidance of skin-in-the-game results in a free option while presence of skin-in-the-game results in an avoidance of moral hazard. An absence of skin-in-the-game results in the agent receiving upside gains while the principal is left holding the bag with the downside risks. Islamic finance demands skin-in-the-game from *all* participants through society-wide risk sharing. There are vehicles in contemporary conventional finance that are based on skin-in-the-game – the non-speculative stock market, venture capital hedge funds, to name a few. However, only a small percentage of humanity is wealthy enough to participate in these skin-in-the-game vehicles of conventional finance. Islamic finance argues that if the interest rate mechanism continues to be a mechanism for allocating financial resources, financial systems remain fragile and crisis prone (Askari, Mirakhor, 2015). Moreover, Islamic finance affirms that this mechanism leads to distributional problems and injustice as Keynes, 1932, 1936, and Piketty, 2014, have argued (Askari et al., 2012; Maghrebi et al., 2016)

## 5. Risk-sharing bank structure

The liabilities of a risk-sharing Islamic bank are divided into two distinct categories – demand deposit accounts and investment accounts. Demand deposit accounts are set up on the principle of safekeeping (*wadi'ah*) with management fees charged by the bank under an agency contract (*wakala*) mechanism. Depositors place their money into these accounts and do not receive any interest; they are only provided with safekeeping and accessibility (ATMs, online access, to name a few) facilities. The bank charges the depositor a periodic fee for providing these facilities. The bank cannot utilize the deposits for any of



its own purposes; in fact, the bank cannot even touch the deposits. Simply said, demand deposits cannot be loaned out. They sit with the bank on an 'as-is' basis and can be withdrawn as needed by the depositors. Theoretically, all the depositors of the bank can simultaneously take out all their demand deposits from the bank without creating the danger of a bank run. Investment accounts operate on a risk-sharing basis. Such accounts can be set up as partnerships (*mudaraba/musharaka*) and/or agency contracts (*wakala*). There are many different mechanisms available for utilization of the deposits in the investment accounts: project financing, venture capital, mutual funds and brokerage facilities, to name a few.

## 6. Islamic finance and antifragility framework

Figure 3 shows the qualitative framework, covering antifragility characteristics against which risk sharing can be evaluated. The various characteristics of antifragility are shown in blue.<sup>29</sup> The (dashed) lines in red indicate the qualitative knowledge gap we attempt to fill. Each of the characteristics of antifragility is explained below, along with an evaluation of RSIF with respect to that characteristic.

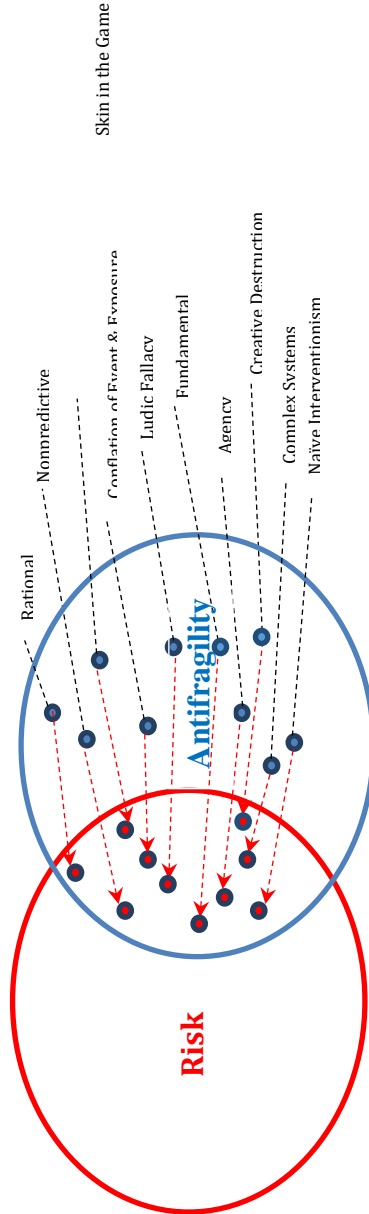
### 6.1 Skin-in-the-game

Skin-in-the-game and "*no gain without risk*" form the locus where antifragility meets and overlaps with RSIF. The details of this overlap have been explained in an earlier section. The rest of the characteristics of antifragility and RSIF flow out from these two characteristics respectively.

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<sup>29</sup> This is a subset of the complete list of characteristics of antifragility. To keep the scope manageable, we concentrate only on this list.

Figure 3 – Qualitative framework



## 6.2 RSIF and complex systems

Complex systems tend to be fragile, especially in the domain of social sciences, in which a significant amount of human interventions are 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 what we have said in the previous paragraphs, 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.<sup>30</sup> Such parts commit a large number of errors at an individual (subsystem) level. However, they will be resilient at the system 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.<sup>31</sup>

Fragile financial systems rely on debt, leverage and on upfront rewards before the completion of projects. Apart from interdependencies, the largest issue with complex systems is the presence of nonlinearities. Hence, it is extremely difficult to make correct predictions about complex systems. Therefore, risk management of such systems is also extremely difficult primarily because due to 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 thanks to its antifragility.

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<sup>30</sup> 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 out in one attempt.

<sup>31</sup> For a readable book on these issues see Sanders, 1998.

RSIF 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, interest rate-based derivatives cannot exist under Islamic finance, as they violate the prohibitions on interest, and asymmetric information/moral hazard (*gharar*). This, in and of itself, reduces the complexity of the financial system. In addition, the structure of the banking system as described above places constraint on the system to create the credit → debt → leverage → financial fragility → crisis nexus discussed earlier. The structure of the complete financial system under risk sharing reduces a great deal of complexities. A compelling case has been made that regulation of a RSIF system operating within the confines of an institutional framework governed by prescribed rules would be less complicated and more effective than a risk-transfer and debt-dominated financial system (Askari et al., 2012). A major lesson learned from the experience of the 2007-2009 crisis is the need for greater attention and to focus regulation on asset markets and the potential systemic risks 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 investment intermediaries (rather than credit intermediaries) or risk *sharers* with their own skin-in-the-game. The market would take care of the rest via price discovery based on the real sector rate of return.

### *6.3 RSIF and naïve interventionism*

Naïve interventionism refers to the preference to do something rather than do nothing. It is a by-product of a problem with the experts, where unqualified or under-informed experts feel the need to intervene in a system without correctly understanding the complex nature of the system. Humans have an inherent tendency to

underestimate the randomness of systems due to an incorrect evaluation of the system's complexity and subsequent volatility. As discussed earlier, it is especially the case in finance, where the field of quantitative finance exists to design models on which interventionism is based and carried out on a regular basis at all levels. If the mathematical models are themselves incorrect, then interventionism can cause great harm.

One of the ways in which naïve interventionism harms systems is a desire of experts to artificially suppress volatility by portraying a system that seems calm at the surface. However this system contains unseen risks that accumulate under the surface and are referred to by Taleb, 2015, as *silent* risks. The accumulation of these silent risks makes the system vulnerable to Black Swans. Systems that are fragile depend on the expectation that events follow an exact course, as planned. They cater for as little deviation as possible. For such systems, deviations are more harmful than helpful requiring systems to rely on predictive systems, hence leading to fragility.

RSIF will be more volatile at the subsystem (individual bank or individual investor) level than conventional finance. However, it will be less volatile at the system level. The history of conventional finance is replete with naïve interventionism (Reinhart, Rogoff, 2009), which has occurred so often that it has now become standard practice and is considered *essential*. At the top of this list are three actions taken regularly by governments that routinely fragilize the financial system – lender of last resort (LOLR), deposit insurance and bailouts – aimed to prevent the collapse of the system. An RSIF system does not require these types of interventionism. It does not support LOLR, deposit insurance or bailouts. This is not a trivial point. The market forces decide which RSIF banks survive and which fail. Each RSIF bank is itself tied to the market forces via *the no risk-no gain principle*, thereby minimizing the agency problem. The structure of each bank, as discussed earlier, obviates the need for LOLR, deposit insurance and bailouts.

#### *6.4 RSIF and the agency problem*

The agency problem refers to the situation in which the interest of the agent is not aligned with the interest of the principle. The problem occurs because of asymmetries. There is an information asymmetry between the agent and the principle, where the agent has more information about the day-to-day operations of the firm than the principle. 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-offs and the survival of the firm. This was apparent during the crisis, where subprime loans were made as bankers stood to receive bonuses in the short term. Another good example is the CDOs sold to individual investors for the same reasons, that is immediate bonus payments, irrespective of the damage caused to investment banks or to investors. Systems with agency problems will eventually blow up, as the global financial system has been doing periodically, without being able to resolve the problem. Lack of skin-in-the-game combined with acceptance of too-big-to-fail is a sure recipe for disaster. For this reason, the current conventional system exists in a perpetual state of fragility.

Agency problem is significantly reduced under RSIF through its emphasis on the no risk-no gain principle that ensures that the depositors, as investors, keep a strict check on the activities of the bank as their investments are directly at risk. Depositors will have direct motivation to oversee bank funding on the asset side. In case of deposit accounts, the agency problem is limited under RSIF, as deposit accounts cannot be invested. In case of investment accounts, the bank itself must have skin in the game in all securitized investments. Based on this, a risk-sharing Islamic bank has no mechanism or motivation available to indulge in agency problems (other than via outright fraud), since all moral hazards would have been removed by the design of the system.

### 6.5 RSIF and fundamental asymmetry

The defining characteristic of antifragility – convexity – is an extension and generalization of the concept of fundamental asymmetry. The latter refers to there being more upside than downside to volatility and that, in turn, implies antifragility. Conventional banks have a negative asymmetry due to large amounts of debt, combined with significant moral hazard, resulting in excessive speculation. Excessive debt causes conventional banks to have limited room to maneuver into gaining from any upside opportunities that may arise. Lack of equity participation results in moral hazard because bank managers have nothing to lose from the downside and everything to gain from the upside. This encourages the bank to speculate with *other people's money*,<sup>32</sup> leading to a situation where the conventional banking system ends up in a fundamentally negative asymmetric position. The fundamental asymmetry implements a *barbell* approach, which is simultaneously hyper-aggressive and hyper-conservative; it corresponds to the strategy of putting all of one's eggs in two baskets. The first step to make is to limit the downside (before moving towards increasing the upside). This results in reduced exposure to negative Black Swans.

In case of RSIF, demand deposits have neither upside nor downside. In terms of asymmetry, demand deposits are neutral; they cannot be used to benefit from a positive upside opportunity because demand deposits cannot be utilized for investments. At the same time, demand deposits cannot be loaned, therefore they cannot be impacted negatively by a downside movement. Basically, demand deposits of a risk-sharing Islamic bank are *symmetric*, neither positively nor negatively asymmetric. The investment side of RSIF, on the other hand, is fundamentally positively asymmetric; the upside benefits outweigh the downside losses.

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<sup>32</sup> Two interesting related papers are Jones, 2013, 2014.

### 6.6 *RSIF, complexity, radical uncertainty, and the non-predictive approach*

A predictive approach relies on statistical models of forecasting to predict the future and then on risk management techniques like VaR to calculate the risks/rewards before the financial institution makes its decisions for capital allocation. As discussed earlier, 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 may employ). This is harmless if the errors (in the tails) in prediction have a minor and/or calculable impact. It is, as we have seen during the recent financial crisis, disastrous if the errors are Black Swans. In such a situation, it is safer to plan a future without relying on predictions.<sup>33</sup> This implies the construction of systems in a manner that would make them adaptable to disorder, thereby making them robust to changes of future outcomes.

Social systems, with their many variables and/or with extensive human interactions – consisting of emotions, fears, aspirations and desires – also become unpredictable under the Prospect Theory of behavioural finance. There is lack of predictability of causality or even of the direction of causality, and it is impossible to know effects in advance. Since behavior cannot be predicted, systems cannot learn. People tend to be forced to make predictions that are *almost* correct, as opposed to predictions that are *totally* correct. As Taleb suggests, a “totally correct” prediction is an oxymoron, since it 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. Non-predictive systems must be on the lookout for anomalies and outliers. Single outliers (Black Swans) can decisively impact the complete model.<sup>34</sup>

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<sup>33</sup> See, however, Mittnik et al., 2000; Brooks 2014. See also Danielsson, 2002, 2008.

<sup>34</sup> Space limitation does not allow us to deal with some major issues involved in forecasting, such as the complexity (see for example, Arthur, 2015), non-stationarity



A non-predictive approach concentrates on the means rather than on the end, since it aims to avoid loss (and/or outright destruction), rather than concentrating on return. RSIF relies on market forces for price discovery. It does not rely on ex-ante fixed interest rates for decision-making about the amount of credit that will enter the system.<sup>35</sup> Market forces are completely non-predictive; hence, no amount of planning can be carried out in a predictive manner. Because of this, the dynamics around RSIF ensure that it can only function in a non-predictive manner, since price discovery by the market is always non-predictive. In addition, RSIF's profit-making via partnerships connects the real sector to the financial sector via a non-predictive relationship, namely entrepreneurship, allowing the rate of return to finance to be determined by the rate of return to real activities (Askari et al., 2012). Thus, RSIF places hard constraints on the financialization – dominance of the real sector by finance – that is plaguing the conventional system.

### 6.7 RSIF and the conflation of event and exposure

It is important to appreciate the difference between the concept of event and that of 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*, that is the world of  $x$ . As per antifragility, we cannot understand  $x$

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(see Georgescu-Roegen, and Weisskopf), and non-ergodicity (see Davidson, 2011, and Syll, 2013) of economic and financial data.

<sup>35</sup> There is a striking paradox in the belief system of free-market thinkers who argue for market determination of all prices except that of financial resources whose price is determined by non-market means. The slogan of the so-called Washington consensus during 1990s was 'get the prices right', and their mantra was liberalization of everything except the financial system, which would remain under the constraints imposed by policy determination of interest rate, despite the logic of theoretical arguments on "financial repression" advanced in the 1970s. The interest rate fetish presently continues to impose massive financial repression on economies with zero or negative interest rates and misallocate financial resources throughout the global economy.

(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 systems and in our environment. An unpredictable  $x$  of massive consequence is a Black Swan and will, sooner or later, hit every (fat tailed) system. Since it cannot be predicted, its impact can be destructive. What can be adjusted is  $f(x)$ , which should be modified in such a way that the left tail impacts of  $x$  are minimized or, if possible, even totally neutralized/bounded.<sup>36</sup> This can be accomplished by making the system – the entity experiencing  $x$  – as antifragile as possible. A pre-requisite of this is to ensure that  $x$  and  $f(x)$  are not combined (*conflated*), during the analysis, in such a manner that it becomes impossible to differentiate one from the other.

RSIF manages the issue of conflation of event and exposure;  $x$  and  $f(x)$  do not impact deposit accounts neither in a positive nor 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 the other hand, in case of investment accounts under RSIF,  $f(x)$  is unknown and unpredictable, driven by a price discovery process operating under market forces. This ensures a clear demarcation between  $x$  and  $f(x)$ ; the latter only impacts investment accounts, and in a manner in which the risks around  $f(x)$  can be managed. In RSIF, banks take equity positions in all the investment projects they finance, alongside investment account holders. In addition, investments are securitized into short, medium, and long-term securities. This ensures that the portfolio exposures of Islamic banks remain within certain risk profiles;  $f(x)$  remains within manageable boundaries.

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<sup>36</sup> This should be done organically and not artificially.

### 6.8 RSIF and the ludic fallacy<sup>37</sup>

The ludic domain implies probabilities that work in well-defined games, where the rules of the game 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. Therefore, 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, for example). Rules for a ludic environment are set up ahead of time with clearly calculated probabilities. Rules and skills are not transferable from the ludic domain to the ecological domain. However, current risk management techniques do not differentiate between the ludic and ecological domains.<sup>38</sup> There is an explicit assumption in today's financial risk management techniques 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.

Behavioral finance has shown the financial world to be ecological and not ludic.<sup>39</sup> RSIF works in the ecological domain of financial markets. The market discovery process decides *all* rates under risk sharing. The system, by its foundational design, does not allow any pre-defined ludic rates, contrarily to conventional finance, whose existence is based on ex-ante interest rates that are pre-determined. In RSIF rates of return for finance are determined ex-post based on the rate of return for real activities that finance facilitates. The only ex-ante item is the ratio on which the profit/loss distributions will occur between the partners – for example between investment account holders and the bank on the liability side, and the bank and the entrepreneurs on the asset side. Actual profits and losses are based on

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<sup>37</sup> The word “Ludic” comes from the Latin “ludus”, meaning games. Ludic fallacy was identified by Taleb, 2007, to refer to the rules of use (abuse/misuse) of games of chance to model uncertainties in real life events. See also Taleb, 2015, pp. 184-185.

<sup>38</sup> This is the Achilles' heel of contemporary risk management (including the Basel standards).

<sup>39</sup> See Blyth, 2009; Haas et al., 2013.

market returns from the real sector in a non-ludic manner.

### *6.9 RSIF and rational optionality*

Rational optionality refers to not being locked into a pre-planned program. It allows an individual, a system or an institution to change direction without excessive losses. In finance, it corresponds to combining the benefits of optionality with a rational framework. The *rational* part of rational optionality refers to not repeating the same mistake; trial with small error, and subsequently learning from the errors. Such a system encourages bottom-up decision making (via tinkering) over top-down planning along the same ideas of convexity we have seen, and is a by-product of adapting non-predictive approaches to decision-making.

A good example of rational optionality is venture capital. The basic concept of venture capital is based on many small losses combined with a small number of huge profits. The worst 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 structure of RSIF maps to the idea of rational optionality, with one possible caveat. Deposit accounts 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 accounts and move it to investment accounts when convex opportunities arise. The rest of the funds are invested into partnership investment accounts that are directly linked to the real sector similarly to venture capital. The one caveat that does exist relates to prohibition of debt-based options in any antifragile portfolio.

### 6.10 RSIF and creative destruction

Creative destruction implies that some subsystems need to break for the overall system to improve. One of the best ways to ensure creative destruction is via entrepreneurship, because it adds randomness and volatility to the economy. Creative destruction turns the concept of success on its head. The regular failure of entrepreneurs becomes a great strength for the 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, others learn from it and adapt, thereby becoming stronger and more antifragile. The failures happen relatively early, while the successes are long-term. Creative destruction generates dynamism in the economic system, increasing healthy competition and reducing systemic risks. It has been difficult for society to internalize the idea of creative destruction in finance (specifically banking). People fear the negative impacts of banking failure. This has resulted in a status quo, based on paranoia, where destruction of *any* kind – creative or otherwise – is controlled artificially through LOLR, FDIC (and eventually by bailouts). Risk-sharing Islamic banks will be exposed to creative destruction and will benefit from this phenomenon. The deposit accounts in a risk-sharing Islamic bank cannot fail as they are kept in safekeeping by the bank. The investment accounts can fail, as can be expected in market dynamics. However, even in this case, they are set up in such a manner that their risk exposure is limited to operational risk and to the possibility of market price disclosure risk, which implies that risk-sharing Islamic banks can fail without violating any of the rules of creative destruction.

## 7. Conclusion

The crisis of 2007-2009 and the present fragilities and vulnerabilities of the global economy have brought forth great

concerns that growing complexities in the socio-economic environment, which is governed by radical uncertainties, have exacerbated the weaknesses and limitations of predictive statistical models. Scholars such as Hume and Popper have long been raising these fundamental philosophical questions regarding induction, and Nassim Nicholas Taleb, in his discussion of how to render a system antifragile without the need to resort to predictive methods, has presented the world with an alternative. Our goal in this introductory paper has been to show that risk sharing Islamic finance shares the characteristics defined by Taleb for an antifragile system, by mapping some characteristics of antifragility onto those of risk-sharing Islamic finance (RSIF). A first step in this direction was to define a key insight around which such a connection could be established, namely by relating *the principle of "no risk-no gain"* from Islamic finance to the concept of skin-in-the-game from antifragility theory. From here, the relationship was extended to other characteristics of the two frameworks, to show that RSIF overlaps with antifragility over these characteristics; we therefore conclude that RSIF is antifragile. It is worth mentioning that the broader case for an antifragile system includes another important characteristic that has been articulated by Taleb, namely soul in the game (Taleb, 2012, pp. 396-397) and concern for social justice. These are eminent characteristics of RSIF. It is the authors' hope that emerging research on antifragility, combined with the emerging research on RSIF, can have a lasting impact on the field of finance by laying the foundations for a compelling case that it is time for humanity to replace the dominant debt-based risk transfer/risk shifting financial system with a system in which everyone shares the risks faced by society.

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