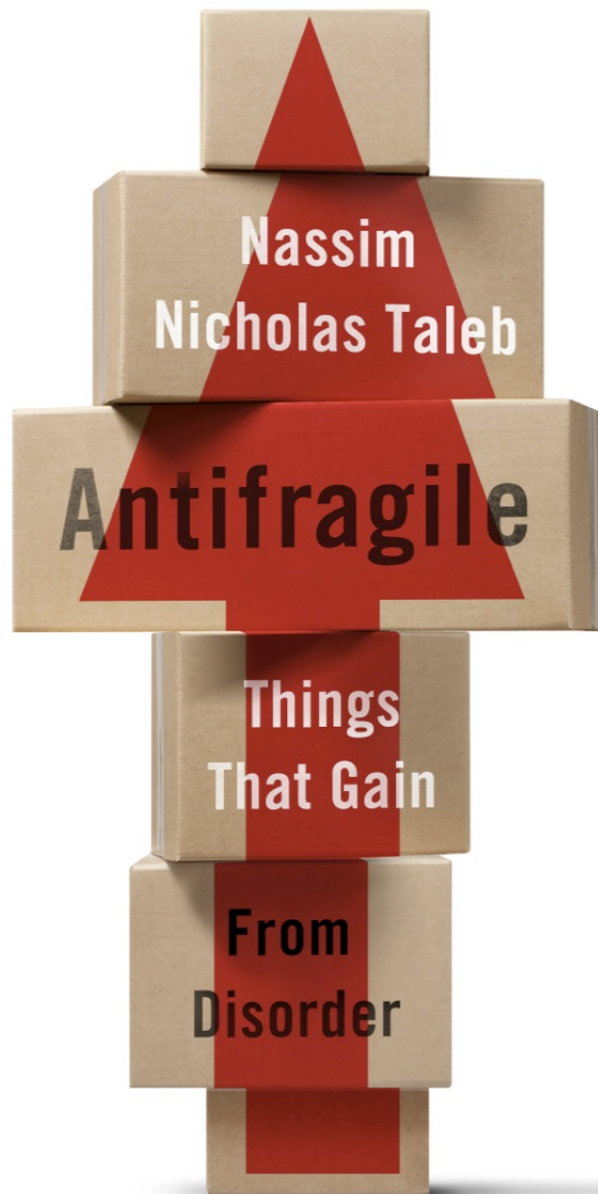




Prologue

I- HOW TO LOVE THE WIND

Wind extinguishes a candle and energizes fire.

Likewise with randomness, uncertainty, chaos: you want to use them, not hide from them. You want to be the fire and wish for the wind. This summarizes this author's non-meek attitude to randomness and uncertainty.

We just don't want to just survive uncertainty, just about make it. We want to survive uncertainty and, in addition –like a certain class of aggressive Roman Stoics –have the last word. The mission is how to domesticate, even dominate, even conquer, the unseen, the opaque, and the inexplicable.

How?

II- THE ANTIFRAGILE

Some things benefit from shocks; they thrive and grow when exposed to volatility, randomness, uncertainty, opacity, adventure, disorder and stressors. Yet, in spite the ubiquity of the phenomenon, there is no word for the exact opposite of fragile. Let us call it antifragile.

Antifragility is beyond resilience or robustness: the resilient resists shocks and stays the same; the antifragile gets better. It is behind everything that has changed with time: evolution, culture, ideas, revolutions, political systems, technological innovation cultural and economic success, corporate survival, good food recipes (say, chicken soup or steak tartare with a drop of cognac), the rise of cities, cultures, legal systems, equatorial forests, bacterial resistance... Even our own existence as a species on this planet. And antifragility determines the boundary between what is living and organic (or complex), say the human body, and what is inert, say a physical object like the stapler on your desk.

What is antifragile loves randomness and uncertainty, which also means – crucially – a love of errors, a certain class of errors. Antifragility has

a singular property of allowing us to deal with the unknown, to do things without understanding them —and do them well. Let me be more aggressive: we are largely better at doing than we are at thinking, thanks to antifragility.

It is easy to see things around us that like a measure of stressors and volatility: economic systems, your body, your nutrition (diabetes and Alzheimer's disease seem to come largely from lack of randomness in feeding and absence of the stressor of occasional starvation), your psyche. There are even financial contracts that are antifragile: they are explicitly designed to benefit from market volatility.

Antifragility makes us understand fragility better. Just as we cannot improve health without reducing disease, or increase wealth without first decreasing losses, antifragility and fragility are degrees on a spectrum.

By grasping the mechanisms of antifragility we can build a systematic and broad guide to *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.

It is far easier to figure out if something is fragile than predict the occurrence of an event that may harm it. Fragility can be measured; risk is not measurable. This provides a solution to what I've called the Black Swan problem — the impossibility of measuring the risks of rare events and predicting their occurrence. Sensitivity to harm from volatility is tractable, more so than forecasting the event that would cause the harm. So we propose to stand our current approaches to prediction, prognostication, and risk management on their heads.

In every domain or area of application, we propose rules for moving from the fragile towards the antifragile, through reduction of fragility or harnessing antifragility. And we will see that we can detect antifragility (and fragility) using a simple test of asymmetry: anything that has more upside than downside from random events (or certain shocks) is antifragile; the reverse is fragile.

Crucially, if antifragility is the property of all those natural (and complex) systems that have survived, depriving these systems of volatility, randomness and stressors will harm them. They will weaken, die, or blow up. We have been fragilizing the economy, our health, political life, education, almost everything... by suppressing randomness and volatility. Just as spending a month in bed (preferably with an unabridged version of *War and Peace* and access to *The Sopranos*' entire eighty six episodes) leads to muscle atrophy, complex systems are weakened, even killed when

deprived of stressors. Much of our modern, structured, world has been harming us with top-down policies and contraptions (dubbed “Soviet-Harvard Illusions” in the book) which do precisely this: an insult to the antifragility of systems.

This is the tragedy of modernity: those trying to help are often hurting us the most.

If about everything top-down fragilizes and blocks antifragility and growth; everything bottom-up thrives under the right amount of stress and disorder. The process of discovery (or innovation, or technological progress) itself depends on antifragile tinkering, aggressive risk bearing rather than education. The record shows that it is better to be dumb and antifragile than smart and fragile.

Which brings us to the largest fragilizer of society, and greatest generator of crises, absence of “skin in the game”. Some become antifragile at expense to others by getting the upside (or gains) from volatility, variations and disorder and exposing others to the downside risks of losses or harm from them. And such *antifragility-at-the-cost-of-fragility-of-others* is hidden — given the blindness to antifragility by the Soviet-Harvard intellectual circles, this asymmetry is rarely identified and never taught. Further, as we discovered during the financial crisis that started in 2008, these blowup risks-to-others are easily concealed owing the growing complexity of modern institutions and political affairs. While in the past people of rank or status were those and only those who took risks, had the downside for their actions and heroes were those who did so for the sake of others, today the exact reverse is taking place. We are witnessing the rise of a new class of inverse heroes, that is, bureaucrats, bankers, Davos-attending fakes, and academics with too much power, and no real downside and accountability. They game the system while citizens pay the price.

At no point in history have so many non-risk-takers, that is, those with no personal exposure, exerted so much control. The chief ethical rule is the following:

Thou shalt not have antifragility the at the expense of other’s fragility.

III-THE ANTIDOTE TO THE BLACK SWAN

Black Swans (capitalized) are large-scale unpredictable and irregular events of massive consequence—unpredicted by a certain observer, and such unpredictor is generally called the “turkey” when he is both surprised and harmed by these events. I have made the claim that most of history comes from Black Swan events, while we worry about fine-tuning our understanding of the ordinary, hence develop models, theories, or representations that cannot possibly track them or measure the possibility of these shocks.

Black Swans hijack our brains making us feel we “sort-of” or “almost” predicted them, because they are retrospectively explainable. We don’t realize the role of these Swans are in life because of this illusion of predictability. Life is more, a lot more labyrinthine than shown in our memory —our minds are in the business of turning history into something smooth and linear, which makes us underestimate randomness. But when we see it, we fear randomness and overreact. Because of this fear of randomness, and thirst for order, some human systems, by disrupting the invisible or not so visible logic of things, tend to be exposed to harm from Black Swans, almost never get any benefit from them. You get pseudo-order when you seek order; you only get a measure of order and control when you embrace randomness.

Complex systems are full of interdependencies —hard to detect — and nonlinear responses. Nonlinear means that when you double the dose of, say, a medication, or when you double the number of employees in a factory, you don’t get twice the initial effect, but rather a lot more or a lot less. Two weekends in Philadelphia are not twice as pleasant as a single one —I’ve tried. When the response is plotted on a graph, it does not show as a straight line (“linear”), rather as a curve. In such environment, simple causal associations are misplaced; it is hard to see how things work by looking at single parts. Manmade complex systems tend to develop cascades and runaway chains of reactions that decrease, even eliminate, predictability and cause outsized events. So the modern world may be increasing in technological knowledge, but, paradoxically, it is making things a lot more unpredictable. Now for reasons that have to do with the increase of the artificial, the move away from ancestral and natural models, and the loss in robustness owing to complications in the design of everything, the role of Black Swans is increasing. Further, we are victims to a new disease, called in

this book *neomania*, that makes us build Black Swan vulnerable systems — “progress”.

Further, an annoying aspect of the Black Swan problem —in fact the central, and largely missed point —is that the odds of rare events are, simply not computable. We know a lot less about hundred-year floods than five-year floods—model error swells when it comes to small probabilities. *The rarer the event, the less tractable and the less we know about how frequent its occurrence* —yet the rarer the event, the more confident these “scientists” involved in predicting, modeling, and using PowerPoint in conferences with equations in multi-color background have a tendency to go about it.

It is of great help that Mother Nature —thanks to its antifragility — is the best expert at rare events, and the best manager of Black Swans; in its billions of years it succeeded in getting here without much command-and-control instructions from an Ivy-league-educated director. Antifragility is not just the antidote to the Black Swan; understanding it makes us less intellectually fearful in accepting the role of these events as necessary for everything, history, technology, knowledge, everything.

Robust is Not Robust Enough

Consider that mother nature is not just “safe”. It is aggressive in destroying and replacing, in selecting and reshuffling. When it comes to random events, “robust” is certainly not good enough. In the long run everything with the most minute vulnerability breaks given the ruthlessness of time —yet our planet has been around for perhaps four billion years and, convincingly, robustness can't just be it: you need perfect robustness for a crack not to end up crashing the system. Given the unattainability of perfect robustness — we need a mechanism by which the system regenerates itself continuously by using, rather than suffering from, random events, unpredictable shocks, stressors, and volatility.

The antifragile gains from prediction errors, in the long run. So you follow this idea to its conclusion, then many things that gain from randomness (what I call *philostochastic*, “loves randomness”) should be dominating the world today —and things that are hurt should be gone. Well, they do. We have the illusion that the world functions thanks to programmed design, university research, and bureaucratic funding, but there is compelling —very compelling —evidence to show that this is an illusion, the illusion I call *lecturing birds how to fly*. Technology is the result of antifragility, exploited by risk-takers, with nerd-driven design taking the backstage; and we will have to refine historical interpretations of growth, innovation, and many such things.

On the Measurability of (Some) Things

Fragility is quite measurable, risk is not so at all, particularly risks associated with rare events¹.

We can estimate, even measure (anti)fragility, while we cannot measure risks and probabilities of shocks and rare events, no matter how sophisticated we get.

Risk management —as practiced— is the study of an event taking place in the future, and only some economists and other lunatics can claim —against experience—to “measure” the future incidence of these rare events, with fools listening to them—against experience. But fragility and antifragility are part of the current property of an object, a coffee-table, a company, an industry, a country, a political system. We can detect fragility, see it, even in many cases measure it, or at least measure comparative fragility with a small error while comparisons of risk have been (so far) unreliable. You cannot say with any reliability if a certain remote event or shock is more likely than another (unless you enjoy fooling yourself), but you can state with a lot more confidence that an object or a structure is more fragile than another should a certain event happen. You can easily tell that your grandmother is more fragile to abrupt changes in temperature than you, that some military dictatorship is more fragile than Switzerland should political change happen, that a bank is more fragile than another should a crisis occur, or that a poorly built modern building is more fragile than the Cathedral of Chartres, should an earthquake happen. And you can even make the prediction of which one will last longer.

Instead of a discussion of risk (which is predictive and sissy) I advocate the use of the notions of fragility which is not predictive —and, unlike risk, has an interesting word that can describe its functional opposite, the nonsissy concept of antifragility.

To measure antifragility, there is a philosophical-stone like recipe used a compact and simplified rule that allows us to identify it across domains, from health to the construction of societies.

~~We have been unconsciously exploiting anti fragility, and, consciously, rejecting it— particularly through the educational system.~~ⁱⁱ

¹ Outside of casinos and some narrowly defined areas, rather manmade situations and constructions.

The Fragilista

I said that our idea is where to avoid interference with things we don't understand. Well, some people are prone to the opposite. The fragilista belong to that category of persons who are usually in suit and tie, often on Fridays, face your jokes with icy solemnity, and tends to develop back problems early in life sitting at a desk, riding airplanes, and studying newspapers. He is often involved in a strange ritual, something commonly called "a meeting". Now in addition to these traits, he defaults to thinking that what he doesn't see is not there, or what he does not understand does not exist. At the core, he tends to mistake the unknown for the nonexistent.

The fragilista falls for what I call the *Soviet-Harvard delusion*, the (unscientific) overestimation of the reach of scientific knowledge. Because of such delusion, he is what is called a *naive rationalist*, or sometimes, just *rationalist*, in the sense that he suspects that he believes that the *reasons* behind things are automatically accessible to him or what body of what he calls science is currently in existence. And let us not confuse rationalist and rational —the two almost always the exact opposite of each other. Outside of physics, and generally in complex domains, the reasons behind things have had a tendency to make themselves less obvious to us, and even less to the fragilista. This property of natural things to not advertise themselves in a user manual are alas, not much of a hindrance: some fragilistas will write the user's manual themselves, thanks to their definition of "science".

So thanks to the fragilistas, modern culture has been increasingly building blindness to the mysterious, the impenetrable, what Nietzsche called the Dionysian, in life.

Or to translate Nietzsche into the less poetic, but no less insightful Brooklyn lore, this is what our character Fat Tony calls a "sucker game".

In short, The fragilista (medical, economic, social planner) is one who makes you engage in policies and actions, all artificial, in which *the benefits are small and visible, and the side effects potentially severe and invisible*.

There is the medical fragilista who overintervenes in denying the body's natural ability to heal and gives you medications with potentially very severe side effects; the policy fragilista (the interventionist and social planner) who mistakes the economy for a machine that continuously needs fixing (by him) and blows it up; the psychiatric fragilista who medicates children; the soccer-mom fragilista; the financial fragilista who makes people use "risk" models that destroy the banking system; the military fragilista who disturbs

complex systems; the risk manager fragilista who makes system blow up; the predictor fragilista who makes you take more risks, and many more.^{1 2}

Where Simple is More Sophisticated

A complex system, contrary to what people believe, does not require complicated systems and regulations and intricate policies. The simpler, the better. Complications lead to multiplicative chains of unanticipated effects. Because of opacity, an intervention leads to unforeseen consequences, followed by apologies about the “unforeseen” aspect of the consequences, then to another intervention to correct the secondary effects, leading to an explosive series of branching “unforeseen” responses, each one worse than the preceding one.

Yet simplicity has been difficult to implement in modern life because it is against the spirit of a certain brand of people who seek sophistication so they can justify their profession.ⁱⁱⁱ

Less is more and usually more effective. Thus I will produce a small number of tricks, directives and interdicts throughout the chapters —how to live in a world we don’t understand, or, rather, how to *not be afraid* to work with things we patently don’t understand, and, more principally, in what manner should we work with these. Or, even better, how to dare to look at our ignorance in the face and not be ashamed of being human —be aggressively and proudly human. But that may require some structural changes.

What I propose, rather, is a roadmap modify our man-made systems to let the simple —and natural— take its course.^{iv}

But simplicity is not so simple to attain. Steve Jobs figured out that “*You have to work hard to get your thinking clean to make it simple*”. The Arabs have an expression for trenchant prose: *no skill to understand it, mastery to write it.*^{v vi}

¹ Indeed, the political discourse is lacking a concept. Policy makers aim at the timid concepts of “resilience”, “solidity”, not antifragility, hence stifling the mechanisms of growth and evolution; we didn’t get to where we are thanks to resilience. And, what’s worse, we didn’t get to where we are today thanks to policymakers —but the tinkerers’ appetite for risks and errors.

² Hayek did not get his idea about organic price formation into risk and fragility. For Hayek, bureaucrats were inefficient, not fragilistas. This discussion is taking the notion of organic formation of knowledge and the process into the next level.

IV-THIS BOOK

The journey to this idea of antifragility was, if anything, nonlinear.

I suddenly realized, one day, that fragility — which had been lacking a technical definition — could be expressed as *what does not like volatility*, and that *what does not like volatility does not like* randomness, uncertainty, disorder, errors, stressors, etc. Think of anything fragile, say objects in your living room like the glass frame, the television set, or, even better, the china in the cupboards. If you label them “fragile”, then you necessarily want them to be left alone in peace, quiet, order, and predictability. A fragile object would not possibly benefit from an earthquake or the visit of your hyperactive nephew. Further, everything that does not like volatility does not like stressors, harm, chaos, events, disorder, “unforeseen” consequences, uncertainty, and, critically, time.

And antifragility flows —sort of— from this explicit definition of fragility. It likes volatility et al. It also likes time. And there is a powerful and helpful link to nonlinearity: everything nonlinear in response is either fragile or antifragile to a certain source of randomness.

The strangest thing is that this obvious property that *anything fragile hates volatility*, and vice versa, has been sitting completely outside the scientific and philosophical discourse. Completely. And the study of sensitivity of things to volatility is the strange business specialty in which I spent most of my adult life, two decades —I know it is a strange specialty, I promise to explain later. My focus in that profession has been on identifying items that “love volatility” or “hate volatility” ; so all I had to do is expand the ideas from the financial domain in which I had been focused to the broader notion of decision making under uncertainty across fields, from political science to medicine to dinner plans¹.

And in that strange profession of people who work professionally with volatility, there were two types of professionals. First category, academics, bureaucrats and commentators who study future events and write books and papers; and, second category, practitioners who instead of studying future events, try to understand how things react to volatility (but practitioners are too busy practicing so they don’t usually write books, articles, papers, speeches, equations, theories, and get honored by Highly Constipated and Honorable Members of Academies). The difference between the two

¹ The technical term I used for “hates volatility” was “short vega” or “short gamma”, meaning harmed should volatility increase, and “long vega” or “long gamma” for those that benefit. It is critical that I never believed in our ability to forecast volatility, as I just focused on how things react to it.

categories is central: as we saw, it is much easier and much simpler to understand if something is harmed by volatility —hence fragile — than try to forecast harmful events, such as these oversized Black Swans. But only practitioners (or people who do things) tend to spontaneously get the point.

Only One Book

This make this book my central work. I’ve only had one master idea, each time taken to its next step, the last step —this book — being more like a big jump. I am reconnected to my “practical self” and soul of practitioner as this is a merger of my entire history of practitioner and “volatility specialist”, combined with my intellectual interests in randomness uncertainty, both of which had previously taken separate paths.

My writings are not standalone essays on specific topics, with a beginning, an end, and an expiration date; rather, they are non-overlapping chapters from that central idea, a main corpus focused on uncertainty, randomness, probability, disorder, and what to do in a world we don’t understand, a world with unseen elements and properties, the random and the complex; that is, decision making under opacity.^{viiviii}

So the relationship of this book to *The Black Swan*, would be as follows: in spite of the anachronism (and the fact that this book takes the Black Swan idea to its natural and prescriptive conclusion), *Antifragile* would be the main volume and *The Black Swan* its back-up of sorts, and a theoretical one, perhaps even its junior appendix. Why? Because *The Black Swan* (and its predecessor *Fooled by Randomness*) were written to convince us of a dire situation, and worked hard at it; this one starts from the position that one does not need convincing that 1) Black Swans dominate society and history (and people, because of *ex post* rationalization, think of themselves capable of understanding them); 2) as a consequence, we don’t quite know what’s going on, particularly under severe nonlinearities; so we can get to practical business right away.

No Guts, no Beliefs

To accord with the practitioner’s ethos, the rule in this book is as follows. I eat my own cooking. I have only written, in every line I have composed in my professional life, about things I have done and the risks I have recommended to others were risks I have been taking myself. I will be the first to be hurt if I am wrong. I had warned about the fragility of the banking system in *The Black Swan* and was betting on the collapse; otherwise I felt it would not have been ethical. That personal stricture applies to every

domain, including medicine and technical innovation. It does not mean that one's personal experiences constitute a sufficient sample to derive a conclusion about an idea; it is just that one's personal experience gives the stamp of authenticity and sincerity of opinion. Experience is devoid of the cherry-picking that we find in studies, particularly those called "observational", ones in which the researcher finds past patterns, and, thanks to the sheer amount of data, can therefore fall trap to inventing a good narrative.

Further, in writing, I feel corrupt and unethical if I have to look-up a subject in a library as part of the writing itself. This acts as a filter —it is the only filter. If the subject is not interesting enough for me to look it up *independently*, for my own curiosity or purposes, and have done so before, then I should not be writing about it at all, period. It does not mean that libraries (physical and virtual) are not acceptable; it means that they should not be the *source* of any idea. Students pay to write essays on topics for which they have to derive knowledge from a library as a self-enhancement exercise; a professional who is compensated to write and taken seriously by others should use a more potent filter. Only distilled ideas, ones that sit in us for a long time, are acceptable —and those that come from reality.

It is time to revive the not well known philosophical notion of *doxastic commitment*, in which we can only call beliefs those for which we are committed enough to take personal risks and go beyond words.

If You See Something

Modernity has replaced ethics with legalese, and the law can be gamed with a good lawyer.

So I will expose the transfer of fragility, rather the theft of antifragility, by people "arbitraging" the system. These people will be named by name. Poets and painters are free, *liberi poetae et pictores*^{ix} and there are severe moral imperatives that come with such freedom. First ethical rule:

If you see fraud and do not say fraud you are a fraud.

Just as being nice to the arrogant is no better than being arrogant with the nice, being accommodating towards anyone committing a nefarious action condones it. ^x

Further, many writers and scholars speak in private, say after half a bottle of wine, differently from the way they do in print. Their writing is certifiably fake, fake. And much of the problems of society comes the "other

people are doing it”. So if I call someone a dangerous ethically-challenged fragilista in private after the third glass of Lebanese wine, I will be obligated to do so here.

Calling people and institutions fraudulent in print, when they are not (yet) called so by others carries a cost, but is too small to be a deterrent. After the great Benoit Mandelbrot read the galleys of *The Black Swan*, a book dedicated to him, he called me and quietly said: “In what language should I say “good luck” to you?”. I turned out to be antifragile to all manner of attacks: the more attacks I got from the Central Fragilista Delegation, the more my message spread as it drove people to examine my arguments. I am now ashamed of not having gone further.

Compromising is condoning. The only modern dictum I follow is one by George Santayana: *a man is morally free when (...) he judges the world, and judges other men, with uncompromising sincerity*. This is not just an aim but an obligation. ^{xi,xiii}

Defossilizing Things

Second ethical point.

I am obligated to submit myself to the scientific process simply because I require it from others, but no more than that. When I read empirical claims in medicine or other sciences, I like these claim to go through the peer-review mechanism, a fact-checking of sorts, an examination of the rigor of the approach. Logical statements, on the other hand, do not require such mechanism: they can and need to stand on their own legs. So I publish technical footnotes of these books in specialized, and academic outlets, and nothing more (and limit it for statements that require proofs or more elaborate technical arguments)¹. But for the sake of authenticity and to avoid careerism (the debasing of knowledge by turning it into competitive sports), I ban myself from publishing anything outside of these footnotes.

After the publication of *The Black Swan* in 2007, and after more than the twenty years as a transactional trader and businessman in what I called the “strange profession”, I tried what one calls an academic career. And I have something to report— actually that was the driver behind this idea of antifragility in life and the dichotomy between the *natural* and the alienation of the *unnatural*. Commerce is natural, fun, thrilling, lively, and natural; academia as currently professionalized is none of these. And for those who think that academia is “quieter” and an emotionally relaxing

¹ These are now aggregated under the title *Technical Papers Associated With Antifragile and The Black Swan* as a freely available electronic book on the web.

transition after the volatile and risk-taking business life, a surprise: when in action, new problems and scares emerge every day to displace and eliminate the previous day's headaches, resentments, and conflicts. A nail displaces another nail, with astonishing variety. But academics (particularly in social science) seem to distrust each other; they live in petty obsessions, envy, and hatreds, with small snubs developing into grudges, fossilized over time in the loneliness of the transaction with a computer screen and the immutability of their environment. Not talking about the level of envy I have almost never seen in business ... My experience is that money and transactions purify relations; ideas and abstract matters like "recognition" and "credit" warp them, creating an atmosphere of perpetual rivalry.

Commerce, business, Levantine souks (though not large-scale markets and corporations) are activities and places that bring their best in people, makes most of them forgiving, honest, loving, trusting, and open-minded. As a member of the Christian minority in the Near-East, I can vouch that commerce, particularly small commerce, is the door to tolerance —the only door in my opinion, to any form of tolerance. It beats rationalizations and lectures. Like antifragile tinkering, mistakes are small and are rapidly forgotten.

I want to be happy to be human and be in an environment in which other people are in love of their fate —and never, until my brush with academia, did I think that it was a certain form of commerce. The biologist-writer and libertarian economist Matt Ridley made me feel that it was truly the Phoenician trader in me (or, more exactly, the Canaanite) that was the intellectual.

V- SUMMARY

Antifragility is composed of six books and a notes section.

Why "books"? The novelist and essayist Rolf Dobelli's first reaction upon reading my ethics and *via negativa* chapters, which I supplied separately, was that each should be a separate book and published as short or medium length essay. Someone in the business of "summarizing" books would have to write four or five separate descriptions. But I saw that they were not standalone essays; it is the applications of the idea, going either deeper, or in different territories: evolution, politics, business innovation and scientific discovery, economics, ethics, epistemology and general philosophy. So I call them books, rather than sections. Books to me are not expanded journal articles, but a reading experience; and the academics who tend to read in order to cite in their writing —rather than read for enjoyment, curiosity, or simply, because they like to read— tend to be

frustrated when they can't summarize it in one sentence that connects it to some existing discourse in which they have been involved.

The sequence is as follows.

The Appendix to this prologue presents: the Triad as a table, a comprehensive map of the world along the fragility spectrum.

Book I, *Introduction to Antifragility* presents the new property and discusses evolution and the organic as the most natural antifragile system. It also looks at the tradeoff between the antifragility of the collective and the fragility of the individual.

Book II We introduce Fat Tony and his intuitive detection of fragility. We present the foundational asymmetry of things grounded in the writings of Seneca, the Roman philosopher and doer. Two chapters constitute the central technical section —the plumbing of the book —mapping fragility (as nonlinearity, more specifically convexity effects).

Book III, *The Denial of Antifragility* describes what happens when we starve systems —mostly political systems— of volatility. It discusses this invention called the nation state, as well as the idea of harm done by the healer.

Book IV, *The Intelligence of Antifragility* presents the mysterious property of the world, how a certain asymmetry is behind things, rather than human “intelligence”; how optionality drove us here. It is opposed to what I call the Soviet-Harvard method. And Fat Tony argues with Socrates about how we do things one cannot quite explain.

Book V, *Via Negativa* shows the wisdom and effectiveness of subtraction over addition (acts of omission over acts of commission). The section introduces the notion of convexity effects. Of course the first application is to medicine. I only look at medicine from an epistemological, risk-management style approach —and it looks different from there.

Book VI, *The Ethics of Asymmetry* grounds ethics in transfers of fragility, with one party getting the benefits and the other one the harm — and problems with absence of skin in the game.

The end of the book are notes and a technical appendix. I relegate most of the graphs there for those who need visual representations.

APPENDIX: THE TRIAD, OR, A MAP OF THE WORLD AND THINGS ALONG THE THREE PROPERTIES

Now we aim —after some work —to connect in the reader’s mind, with a single thread, elements so seemingly far apart, such as Cato the elder, Nietzsche, Thales of Miletus, the potency of the system of city states, the sustainability of artisans, the process of discovery, financial derivatives, antibiotic resistance, bottom-up systems, Socrates’ invitation of over-rationalize, the psychologist Herb Simon, obsessive love, Darwinian evolution, the mathematical concept of Jensen’s inequality, the option theory of Louis Bachelier, the idea of ancestral heuristics, the works of Joseph de Maistre and Edmund Burke, Wittgenstein’s anti-rationalism, the fraudulent theories of the economics establishment, tinkering and bricolage, terrorism exacerbated by death of its members, an apology of artisanal societies, the ethical flaws of the middle class, Paleo-style workouts (and nutrition), the idea of medical iatrogenics, the glorious notion of the magnificent (*megalopsychon*), my obsession with the idea of convexity (and my phobia with concavity), the late 2000s banking and economic crisis, the misunderstanding of redundancy, the difference between tourist and flâneur, etc. All in one single —and I am certain, simple —thread.

How? With the classification called the Triad that we will discuss next.

Things Come in Triples

In the Prologue, we saw that the idea is to focus on fragility rather than predicting and calculating future probabilities, and that fragility and antifragility came on a spectrum of varying degrees. The task here is to build a map of exposures. (This is what is called “real world solution”, though only academics or non-real world operators use the expression “real world solution” instead of, simply, “solution”).

The Triad classifies items in three columns along the designation

FRAGILE**ROBUST****ANTIFRAGILE**

Recall that the fragile wants tranquility, the antifragile grows from disorder, and the robust doesn't care too much. The reader is invited to navigate it to see how the ideas of the book apply across domains. Simply, in a given subject, when you discuss an item or a policy, the task is to find in which category of the Triad one should put it and what to do in order to improve its condition. For example: the centralized nation state is on the far left of the Triad, squarely in the fragile category, and a decentralized system of city-states on the far right, in the antifragile one. By getting the characteristics of the latter, we can move away from the supposedly undesirable fragility of the large state. Or look at errors. On the left, in the fragile category, the mistakes are rare and large when they occur, hence irreversible, to the right the mistakes are small and benign, even reversible and quickly overcome. They are also rich in information. So a certain system of tinkering and trial and error would have the attributes of antifragility. If you want to become antifragile, puts yourself in the situation "loves mistakes" —to the right of "hates mistakes" — by making these numerous and small in harm —we will call this process and approach the "barbell" strategy.

Another entry. Take the health category. Adding is on the left, removing on the right of it. *Removing* medication, or some other unnatural stressor — say, gluten, fructose, tranquilizers, nail-polish or some such substance— by trial and error is more robust than *adding* medication, with unknown side effects, unknown in spite of the statements about "evidence" and shmevidence.

As the reader can see, the map uninhibitedly spreads across domains and human pursuits, such as culture, health, biology, political systems, technology, urban organization, socioeconomic life, and other matters of more or less direct interest to the reader. I have even managed to merge decision making and *flâneur* in the same breath. So a simple method would lead us to both a risk-based political philosophy and medical decision-making.

The Triad in Action

Note that fragile and antifragile here are relative terms not quite absolute properties: one item to the right of the Triad is more antifragile than another to the left. For instance, artisans are more antifragile than small businesses, but a rock star will be more antifragile than any artisan. Debt always put you on the left, fragilizes economics systems. And things are antifragile up to a

certain level of stress. Your body benefits from some amount of mishandling, but up to a point —it would not overly benefit too much from being thrown down from the tower of Babel.^{xiii},^{xiv}

The Golden Robust: Further, the *robust* here in the middle column is not equivalent to Aristotle's "golden middle", such as, say, generosity being the middle between profligacy and stinginess—it can be, but it is not necessarily so. Antifragile is desirable, in general, but not always as there are cases in which antifragility will be costly, extremely so. Further, it is hard to consider robustness as always desirable — to quote Nietzsche, one can die from being immortal.^{xv}

Finally, by now the reader, grappling with a new word, might ask too much from it. If the designation *antifragile* is sort of vague and limited to specific sources of harm or volatility, and up to a certain range of exposure, it is no more and no less so than the designation *fragile*. Antifragile is relative to a given situation. A boxer might be robust, hale when it comes to his physical condition, and improve from fight to fight, but he can easily be emotionally fragile and break into tears when dumped by his girlfriend. Your grandmother might have or have had opposite qualities, fragile in built but equipped with a strong personality. I recall the following vivid image from the Lebanese civil war. A diminutive old lady, a widow (she was dressed in black), chastising militiamen from the enemy side for having caused the shattering of the glass in her window during a battle. They were pointing their guns at her: a single bullet would have terminated her but they were visibly having a bad moment, intimidated and scared by her. She was the opposite of the boxer: physically fragile, but not in character.

The Disorder Brothers

One technical comment. We kept saying thus far that fragility and antifragility mean potential gains or harm from exposure to *something*, where that *something* has been a lot of things before.

It happens that uncertainty, disorder, and the unknown have, for our purposes of antifragility, similar, even the same, functional properties, even if you have to find them in separate buildings of the university campuses and some philosophaster who has never taken real risks in his life or worse, never had a life, would inform you that “they are *clearly* not the same thing”. So the next list presents the equivalence between a set of terms that, in real life appear to be categorically different; they may be philosophically distinct but in practice, and for the purpose of antifragility, they are completely

equivalent in effect: antifragile systems benefit (to some degree) from, and the fragile is penalized by, all of them.

The Disorder Brothers: i) uncertainty, ii) variability, iii) imperfect, incomplete knowledge, iv) chance, v) chaos, vi) volatility, vii) disorder, viii) entropy, ix) time, x) the unknown, xi) randomness, xii) turmoil, xiii) stressor, xiv) error, xv) dispersion of outcomes.

We called them brothers, because, like a collection of family members, they collectively share something Ludwig Wittgenstein called a “family resemblance”: one shares a trait with one sibling, another trait with another sibling, to constitute a large family. There are crisscrossing chains of commonalities between them—even if they do not directly link to “disorder” in the strict sense. Also, you may connect them implicitly, but not explicitly^{xvi}; but the links between them is robust.

To use a scientific approach and terminology, these family members the same “phenomenology”, that is, the same observed effect in practice even though the theories around such effects may vary. (We put theories in the fragile category, and phenomenology in the robust one. Theories are superfragile; they come and go, then come and go, then come and go again; phenomenologies stay and I can’t believe why people don’t realize that phenomenology is “robust”, useable, and theories are unreliable for decision-making—outside physics—while overhyped because they help academics get a job promotion)¹².

Let us switch back from jargon to colloquial Lebanese. The best way to understand the commonalities is by use of the following rule. Randomly pick items from the Triad in Table 1, say ii), variability, xi), randomness, and i) uncertainty. The antifragile should benefits from all in the same manner. Accordingly, I treat, in practice what is unknown as equivalent to what is random, variable, or volatile—they have an identical effect for a decision-maker. The random is necessarily volatile and variable, but the variable is not necessarily random; the effect remains the same when it comes to fragility. Incomplete understanding and randomness are exactly the same in

¹ Actually things are not that bad. In my mathematical definition, I could link them all to “semi-vega-sensitive”, meaning similarly exposed to a measure of lower or upper dispersion in the distribution of outcomes.

² In physics, even if the theories look radically different, their errors against reality get smaller and smaller over time, so one can say that theories tend to converge. Those who said “Newton was wrong” meant more likely “imprecise”. In social science, the errors usually swell from theory to theory, with no convergence.

real life: if something is certain and nonrandom, but you can't guess what it is and crucially can't predict its occurrence, because you don't know much about it, then it is exactly the same as random^{xvii}.

Now, why item ix), time? Well, time is functionally similar to volatility: the more time, the more events; consider that if you can suffer limited harm, and are antifragile to small errors, time brings the kind of errors or reverse errors that end up benefiting you. This is simply what your grandmother calls experience. The fragile breaks with time¹.

Now the Triad.

TABLE 1 THE CENTRAL TRIAD: THREE TYPES OF EXPOSURES

	FRAGILE	ROBUST	ANTI FRAGILE
Mythology –Greek	Sword of Damocles,	Phoenix	Hydra
Mythology- New York and Brooklyn	Rock of Tantalus Dr. John, Dr. Robert C. Merton (formerly Harvard, now MIT)	Nero Tulip	Fat Tony, Yevgenia Krasnova ²
Black Swan	Exposed to negative Black Swans		Exposed to positive Black Swans
Businesses	New York: Banking system		Silicon Valley: “Fail fast”, “Be foolish”.
Biological &	Efficiency	Redundancy	Degeneracy

¹ More technically, we are focusing on the second order effect, rather similar across these phenomena. Stress may or may not be random, but has the effect of inducing a variation, like randomness. Further, perhaps the only field that has been able to theoretical merge most of these concepts is the one called “information theory”, partly thanks to the notion of entropy as measure of both disorder and incomplete information.

² Dr John, Nero Tulip, Fat Tony, and Yevgenia Krasnova are characters in *The Black Swan*. Dr Robert C. Merton is an MIT economics professor (serious, mechanistic, boring) singled out for being the main representative of a school of thought producing Black Swan blindness and his destructive and fragilizing role in the fabric of society. He is the archetype of the *fragilista*.

	FRAGILE	ROBUST	ANTI FRAGILE
Economic Systems			(functional redundancy)
Errors	Hates mistakes	Mistakes are just information	Loves mistakes
	Irreversible, large (but rare) errors, blowups		Produces reversible, small errors
Science/Technology	Directed Research	Opportunistic research	Stochastic Tinkering (antifragile tinkering or bricolage)
Dichotomy event-exposure	Studying events, measuring their risks, statistical properties of events	Studying exposure to events, statistical properties of exposures	Modifying exposure to events
Science	Theory		Heuristics, practical tricks
Human Body	Mollification, atrophy, “aging”, sarcopenia	Mithridatization Recovery	Hormesis, Hypertrophy
Ways of Thinking	Modernity	Medieval Europe	Ancient Mediterranean
Human relationships	Friendship	Kinship	Attraction ^{xviii}
Ancient Culture (Nietzsche)	Apollonian	Dionysian	Balanced mixture of Apollonian and Dionysian
Ethics Regulation	The weak Rules	The magnificent Principles	The strong Virtue
Mathematics (functional)	Nonlinear-Concave	Linear	Nonlinear-Convex
Mathematics (probability)	Left-Skewed (or negative skewed)	Low volatility	Right-Skewed (or positive skewed)
Option Trading	Short Volatility, gamma, vega	Flat Volatility	Long volatility, “gamma”, “vega”
Knowledge	Explicit	Tacit	Tacit with convexity

	FRAGILE	ROBUST	ANTI FRAGILE
Epistemology	True-False		Sucker-Nonsucker
Life and Thinking	Tourist Personal and intellectual		Flâneur with a large private library
Financial dependence	Corporate employment, Tantalized class	Dentist, dermatologist, niche worker, minimum wage earner	taxi driver, artisan, prostitute, F** you money
Learning	Classroom	Real life, pathemata mathemata	Real life and library
Political Systems	Nation-State; Centralized		Collection of City-States; Decentralized
Social System	Ideology Post-agricultural Modern Settlements		Mythology Nomadic and hunter-gatherer tribes
Knowledge Science	Academia Theory	Expertise Phenomenology	Erudition Evidence-based phenomenology
Psychological Well-Being	Post traumatic syndrome		Post traumatic growth
Decision Making	Model-based probabilistic decision making	Heuristic-based decision making	Convex heuristics
Thinkers	Plato, Aristotle, Averroes	Early Stoics, Menodotus of Nicomedia, Popper, Hayek, Burke, Wittgenstein, John Gray	Roman Stoics, Nietzsche, Nietzsche perhaps Hegel (sublation), Jaspers
Economic Life	Econophasters Cults	Anthropologists	Religion
Economic Life (effect on economic life)	Bureaucrats		Entrepreneurs
Reputation	Academic,	Postal employee,	Artist, Writer

	FRAGILE	ROBUST	ANTI FRAGILE
(profession)	Corporate executive, Pope, Bishop, Politician	Truck driver, train conductor	
Reputation (class)	Middle Class	Minimum wage persons	Bohemian, aristocracy, old money
Medicine	<i>Via positiva</i> Additive treatment (give medication)		Via Negativa Subtractive treatment (remove items from consumption, say cigarettes, carbs, etc.)
Philosophy/Science	Rationalism Separable	Empiricism	Skeptical, subtractive empiricism Holistic
Economic Life Finance	Short Option	Owner operated	Long Option
Knowledge	Positive Science	Negative Science	Art
Stress	Chronic stressors		Acute stressors, with recovery
Decision Making	Acts of commission		Acts of omission (“missed opportunity”)
Literature Business Food	E-Reader Industry Food Companies	Book Small Business	Oral Tradition Artisan Restaurants
Finance Finance	Debt Public Debt	Equity Private debt with no bailout	Venture Capital Convertible
General	Large	Small but specialized	Small but not specialized
General	Monomodal		Barbell
Risk taking	Markowitz	Kelly criterion	Kelly criterion

	FRAGILE	ROBUST	ANTI FRAGILE
Legal System	Statutory law, Legal Code		using finite bets Common Law, equity ¹
Regulation	Code of regulations		Heuristic regulations
Finance	Banks, Hedge funds managed by econophasters.	Hedge Funds (some)	Hedge Funds (some)
Business	Agency Problem		Principal Operated
Noise-Signal	Signal only		Stochastic resonance, simulated annealing
Model Error	Concave to errors		Convex to errors
Education	Soccer mom	Street life	Barbell: Parental library, street fights
Physical Activities	Organized sports. gym machines		Street fights
Urbanism	Robert Moses, Le Corbusier		Jane Jacobs

¹ I thank Alberto Mingardi for making me aware of Bruno Leoni's works showing the robustness of judge-based law (owing to its diversity) as compared to explicit codifications.