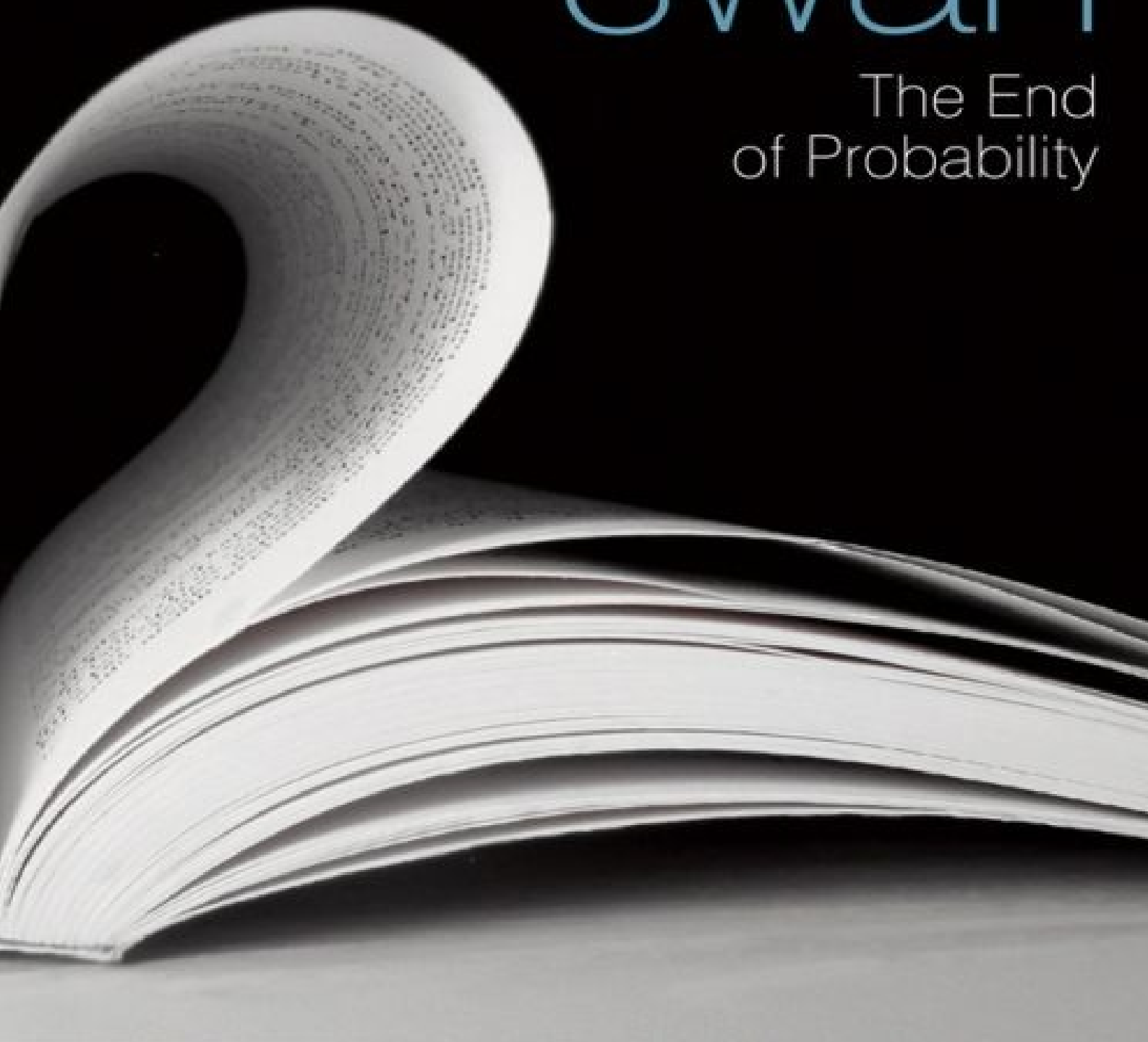


Elie Ayache

the blank
swan

The End
of Probability



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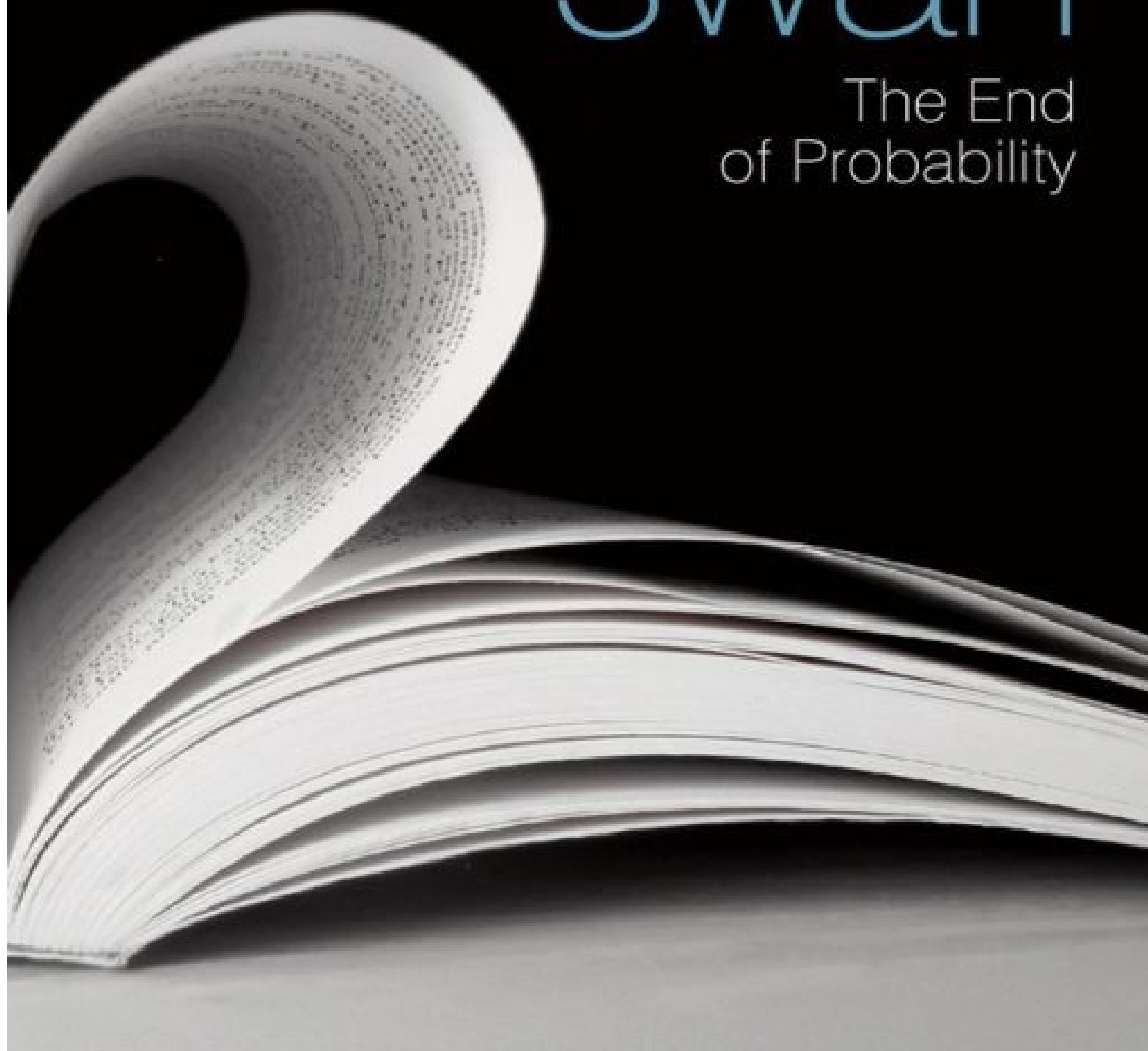


Table of Contents

[Title Page](#)

[Copyright Page](#)

[Dedication](#)

[Praise](#)

[Introduction](#)

[Part I - Writing and Event](#)

[Chapter 1 - Writer of The BLANK Swan](#)

[1.1 PREDICTION VERSUS PRESCRIPTION](#)

[1.2 GENERALIZING PREDICTION](#)

[1.3 THE DERIVATIVES MARKET](#)

[Chapter 2 - The Writing of Derivatives](#)

[2.1 FIRST STEPS ON THE SURFACE](#)

[2.2 INTRODUCING CONTINGENCY](#)

[2.3 THE PRICING SURFACE](#)

[Chapter 3 - The Event of the Market](#)

[3.1 FROM STATES OF THE WORLD TO MARKET PRICES](#)

[3.2 THE BLACK-SCHOLES-MERTON PARADIGM](#)

[3.3 THE CRITIQUE OF DERIVATIVE PRICING THEORY](#)

[3.4 THE NECESSITY OF META-CONTEXTUAL ASCENT](#)

[Chapter 4 - Writing and the Market](#)

[4.1 PIERRE MENARD](#)

[4.2 READING AND WRITING](#)

[4.3 APPROACHING THE MARKET](#)

Part II - Absolute Contingency and the Return of Speculation

Chapter 5 - The Necessity of Contingency

5.1 AGAINST SPECULATION

5.2 SPECULATIVE MATERIALISM

Chapter 6 - Passage to the Future

6.1 FROM POSSIBILITY TO INEXISTENCE

6.2 THE PASSAGE

6.3 THE FUTURE

Chapter 7 - Necessity of the Future

7.1 A MODEL WORLD

7.2 THE IMPLIED ABSOLUTE

Chapter 8 - Necessity of Writing

8.1 RADICAL SPECULATION

8.2 THE PRICING ALTERNATIVE

8.3 FROM THE MARKET TO WORK

Part III - Flight to Sydney, or the Genesis of the Book

Chapter 9 - The Mathematics of Price

9.1 THE ABSOLUTE WITHOUT THOUGHT

9.2 THE ABSOLUTE WITHIN THOUGHT

Chapter 10 - Barton Fink

10.1 THE PLEDGE

10.2 THE TURN

Chapter 11 - The Narrative Adventure

11.1 THE LINE OF FLIGHT

11.2 THE POINT OF THE WORLD

Chapter 12 - Out of the Box

12.1 THE PURPLE GASTROPOD

12.2 THE POINT OF RETURN, THE POINT OF INVERSION

12.3 HOW TO BE A WRITER

Chapter 13 - The Prestige

13.1 FINDING THE MARKET, BINDING THE BOOK

13.2 ABSOLUTE DETERRITORIALIZATION

Chapter 14 - The Geographical Process

14.1 THE FIELD OF RUINS

14.2 LANDING ON THE MARKET

Part IV - Conversion of Credit into Equity, or the Genesis of the Market

Chapter 15 - History of the Market

15.1 THE CONVERSION

15.2 POSSIBILITY VERSUS CONTINGENCY

15.3 THE MARKET

Chapter 16 - From Debt to Equity

16.1 DEDUCTION OF THE CONTINGENT CLAIM

16.2 DEDUCTION OF THE EXCHANGE

16.3 DEDUCTION OF PRICE

Chapter 17 - The Market and the Philosophy of Difference

17.1 THE PIT OF PRICE

[17.2 THE MARKET AND TIME](#)

[17.3 THE MARKET AND DIFFERENCE](#)

[Chapter 18 - Future of the Market](#)

[18.1 THE CATEGORY OF PRICE](#)

[18.2 THE STEP BEYOND](#)

[18.3 PLACE AND CONTINGENCY](#)

[18.4 CONCLUSION](#)

[Appendix 1 - The Logic and Mathematics of Regime Switching](#)

[Appendix 2 - From 'Being and Time' to 'Being and Place' with Jeff Malpas](#)

[Bibliography](#)

[Index](#)

The BLANK Swan

The End of Probability

Elie Ayache



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To serge, without whom not

The subject is immense,
requiring every order of knowledge and endless information.
Besides, when such a complex whole is in question,
the difficulty of reconstructing the past,
even the recent past,
is altogether comparable to that of constructing the future,
even the near future;
or rather, they are the same difficulty.
The prophet is in the same boat as the historian.
Let us leave them there.

Paul Valéry

The necessary book is subtracted from chance.

Maurice Blanchot

Introduction

This is a book about writing, pricing and contingent claims. I hold that the writing process and the pricing process are two special kinds of processes that do not take place in possibility or probability, like the traditional stochastic processes. They fall completely outside prediction. As processes, they keep re-creating themselves and differentiating themselves, yet they do not unfold in chronological time. For this reason, their Swan bird, or the event that gives them wings, is BLANK. It is neither Black nor White; it is neither loaded with improbability nor with probability. It can only be filled with writing, as when we say 'to fill in the blanks'.

Likewise, the medium of contingent claims - that which transmits them and translates them into prices - is something I call the *market*. This cannot be covered by probability theory or derivative valuation theory. The medium is of the nature of writing, and the trader of contingent claims is a writer and a creator. He doesn't predict the market (or its generalization, which is history) or try to anticipate it. The market is his *work*, as when we say that the book is the work of the writer or the poem is the work of the poet.

It was during the period in which I was an option market-maker on the floors of LIFFE (London International Financial Futures Exchange), in 1990-95, and MATIF (Marché à Terme International de France), in 1987-90, that I learnt what it really meant to be a market-maker, or a 'local' (as we say) and how far the open outcry market (which is the only true form of market to my eyes and the only place where contingency, as a meta-probability, can truly strike) can be from the masquerade and total degeneration of probability to which we were recently led by the Collateralized Debt Obligation (CDO) blunder and the subsequent rout, and will be led by any other form of complex derivative that we cannot calibrate to the market. I believe this whole branch is going to drop off the tree, and the only way to reconstruct a market and return to the market is to go back to the place (and probably the times) where individuals (locals) *make* the market, as opposed to big institutional players who never understood how to make money in the market in the first place.

Probability theory is bad for the market as it eventually leads to the metaphysical extremity of the CDO and to the blanket rejection of all probability models by someone like Nassim Taleb, author of *The Black Swan*. I think the real intellectual scandal that the whole 'culture' of the market is facing today is that traditional financial theory can only understand profit in the market through an imperfection of some kind or other: either by an arbitrage opportunity, or asymmetric information, or monopoly, or Knightian essential uncertainty, etc. (not to mention sheer luck). What is lacking is an account of how to make money in the market as a *perfect medium of contingency*, not as an imperfect case of probability theory.

Apart from rebuilding a market that may emerge as a true vehicle of speculation (in the good almost philosophical sense of the world), i.e. as *technology of the future*, I believe that a critique like the one I undertake in this book can revolutionize the philosophy of probability. Indeed, it is not in probability (or worse, by luck) that money shall be made in the market, but *outside* probability, in the medium and continuum that I can find no better way to describe than to compare it with the medium of the creation of literary work.

The reason why my book is called *The BLANK Swan* is that *it is not* the opposite of *The Black Swan* as a hasty critic of Taleb's book would tend to think. *The White Swan* would be the opposite of *The Black Swan* and Nassim himself, in a characteristically witty passage of his own book, considers the possibility that somebody some day would write a diatribe against him with the title *The White Swan*.

My book is not a direct criticism of Nassim's; therefore it is not opposed to it in colour. Rather, it criticizes the whole background or framework of thought in which one would assume that Black Swan and White Swan are opposed to each other.

The Black Swan is the perfectly unexpected event; the White Swan is the perfectly expected event. Underlying both is the category of prediction and prevision, which is the real object of my criticism. The Black Swan refers to something we cannot see or foresee (it is black) and the White Swan to something evident and clear. Although opposed, the two are predicated on the idea of *content* of vision, or *content* of mind, or *content* of expectation.

My observation is that Black Swans are said to be *unpredictable* only insofar as the framework of the whole register of prediction is maintained. For instance, Nassim's book is crammed with the framework of prevision, only he argues that there is something - the Black Swan - that typically evades that framework. My criticism consists in suggesting that if Black Swans constantly evade prevision, as Nassim warns us, then we should be able to define them and deal with them *completely independently of prevision*. Why even keep the framework of prevision when we keep talking about something that constantly evades it?

Like I said, Nassim has to maintain this framework (of prevision) because this is the stuff his book is made of, or the stuffing his bird is filled with, only negatively so. In other words, they are full of prevision, only Nassim constantly argues against it. What would become of Nassim's book and the whole concept if prevision was eliminated altogether? What if we completely eliminated the content of vision, i.e. both the colours White and Black? What if we eliminated the whole context of colour and of content? Hence the BLANK Swan.

It is not with prevision (either of Black or White) or prediction that we should deal with the Black Swan or define it, but with something else, which, in the course of my book, turns out to be *writing* and whose quantitative avatar is the market. Writing is something we produce without previous knowledge or prevision or prediction. Writing is quicker than thought and vision. It is a material process, when vision and prevision are only conceptual. Writing transpierces the page it is marked on. It is real. It is a process that eventually transports us to the future, making us attain and fulfil our promises (think of the derivative payoff as a promise that the seller of the derivative has *written* to the buyer), yet at no point is it based on prediction or forecast.

The market, whose other name is the 'pricing process', is such a process. Hence my idea is that the market (or writing) should be the way we deal with Black Swans, not the place where we complain helplessly against them (as Taleb does).

Taleb famously declares that he now belongs to the exclusive 'club of single-idea people'.¹ These are people who realize one day that they have been carrying a single idea all along in their heads, and this is when they start writing books about it. Taleb's single idea is that our idealization of the world, what he calls the 'Platonic' (theoretical representations, models, schemas, classified patterns, or more generally well-organized knowledge that we see with the eye of our mind), keeps rising to the surface systematically hiding from our sight the underlying intractable and nonrepresentable reality. 'It is wh

we do not see Black Swans,' he writes, 'we worry about those that happened, not those that may happen but did not.'² The consequence for the reality known as the 'market' is that no Platonic form, no formalization of the unpredictable, or, technically, no probability theory or model, shall ever apply to it.

Single and simple as this idea may be, I say it is still composed of two parts: probability and the market. One can further simplify the idea by eliminating one of the parts. The idea I defend in this book is that the market should *replace* probability. Thus I end up with the market as the only part and the only idea.

The reason why probability or prediction doesn't apply to the market isn't that the market is too complex or too human or too chaotic. The reason is simply that the market should be the *alternative* to prediction in matters relating to the future. It remains to say, of course, how we can relate to the future without outside prediction. Trying to answer this question is the stuff my own swan is made of.

Part of the difficulty is that if the market remains single, with only itself to apply to itself, then the apparent tautology will dazzle the thinker and will prevent him from discerning the difference and the differential meaning of the market. Saying that the market is the only way to predict the market, that immersion in the market is the only way to relate to the future of the market, hardly seems informational. By contrast, my argument would have been more compelling and much riskier if I had contended that the market is the technology, not only of its own future but of the future at large, and that the mathematics of price - which I hold should replace the mathematics of chance and probability - consequently apply to all kinds of historical events, those belonging to the future of the market as well as to the future of humanity. After all, Taleb has written about the role of chance in the market *and* in life, as the subtitle of his pre-*Black Swan* book indicates.

I will not be nearly as ambitious in the present book. I will limit myself to the market and to the analysis of contingency as it takes place there (the contingency of market prices - what else? - which, fittingly enough, are the prices of contingent claims). When I take up topics of seemingly broader scope than the market (such as philosophical speculation in Part II and literary creation in Part III), I will always refer them back to the market or to my personal experience as a market-maker or market-technologist.

I will stick with the uniqueness and the singularity of the market (which constitutes the singularity of my subject), but will extract my differential meaning from sharp distinctions I will have to make within the strict field of contingent claims and of their pricing technology - distinctions not necessarily visible to the naked eye, such as between possibility and contingency, prediction and writing, derivatives and contingent claims, virtual and possible, etc.

Contrary to history or life, the market possesses a single metric: the up or down movements of market prices. This can be a source of confusion and oversimplification, and is probably the reason why we import numbers from a foreign field, probability theory, in order to account for the numbers in the market. However, this coincidence in numbers can also be a blessing, as it eventually allows us to frame our criticism of probability and prediction with all the greater precision, provided the distinctions I listed above are made.

It is those distinctions, rather than the singular occasion that made me realize them (the market that will stand ready for generalization to fields that may be strictly superior to the market, either in scope or importance or degree of human concern. In this way, it will truly appear from inside, from

the *internal difference* that the market is in itself quite independently of the things of different scope and different order to which it may later be externally compared, that the market is indeed a general *category of thought* that surpasses the strict acceptation of the financial market. It is no wonder, from this perspective, that I should draw heavily on the work of philosophers of event and difference such as Bergson, Deleuze and Badiou.

Perhaps the main distinction on which the whole book hinges is the one between possibility and contingency, or, correlatively, between the (theoretical) value of a derivative and the (market) price of a contingent claim. This distinction becomes clearest in the last part of the book, thanks to the *conversion*, and the three preceding parts can be read (or listened to) as different voices or different variations on the same theme, leading to the final movement, like in a symphony.

In a sense, the three parts say the same thing; they are three voices of the market that do not equivocate on its notion. On the contrary, they say the market in the same sense. *Univocity* of the market and of contingency is indeed the main theme of this book.

The three preparatory parts are different approaches and travel towards the culmination of the book which appears, in the final part, to be the *genesis* of the market. Think of the three parts as occurring in the context of discovery and of the concluding part as taking place in the context of justification.

In Part I, the totality of themes is introduced. In Part II, contingency is given a firm philosophical basis (even an absolute status), which will secure the way to think of it independently of possibility, even independently of thought itself.

Part III is literally a travel to the 'land of the market'. It traverses at once all the relevant spaces: geographical, literary and the space of the book itself. In fact, it is a narrative adventure or a kind of reverie, which the strictly mathematically or philosophically inclined reader may wish to skip at first reading. Nonetheless, it is the part I personally prefer and in which I have travelled the farthest I could. There are outer reaches in this exploration that even I do not yet quite understand.

Part IV is the promised land, or the new world finally reached. It illuminates the whole book like a beacon. If the reader isn't afraid of travelling at infinite speed, as Deleuze would say, and discarding, right at the entrance, any prejudice or preconceived idea he may have about the pricing of contingent claims and their market, he or she is welcome to engage in Part IV directly and to read independently of the rest. From a talk I have recently given, I have discovered that the reader (listener) may be all the more prepared to assimilate a given idea that the idea is truly revolutionary and radically new and that it has not the slightest resemblance or even the remotest relation with anything he or she may be familiar with. Of course, the idea has nevertheless to be consistent.

Perhaps I can introduce this idea along the following lines. I will start with a question. Imagine you are writing a foundational book on options (or on derivatives generally - let us not yet call them 'contingent claims'), a script that begins from scratch, literally from genesis, as if you were writing the history of that world. Can you say what options are, what meaning they have, that is to say *what difference they make*, or what they are meant for, without using the notion of possibility or probability?

Imagine you are a speculative philosopher, and by this I mean that you wish to build your system of philosophy and your ontology from scratch, and that the notion of possibility is not available to you. Possibility and possible worlds are metaphysical constructs. As such, they don't exist. Perhaps we can make them exist. Perhaps it will turn out we cannot talk of markets or of options without talking

possibility. Still, my question is for the moment: ‘Can we conceive of options, of their meaning and their destination, without thinking of possibility?’

Options are contingent claims. The vanilla call option pays $(S - K)$ if the stock price S is above the strike price K at the expiry of the option, and 0 otherwise. The formula ‘If . . . then, else if . . . then’ is the formula of contingency. It points to a dissymmetry in the otherwise indifferent space; it points to a difference. It also points to an event: something that can be, but that can be otherwise. This ‘making a difference’, or contingency, is the essence of options. This is the creative act of options, the productive difference they are made of.

Possibility has nothing to do with this. Contingency is of this world; possibility is of another world. There are even philosophers of the modern speculative brand (e.g. Quentin Meillassoux) who abhor metaphysics and the language of possibility and necessity as the totalization of possibilities, yet who believe that the world is only made of contingency and that the only necessity there is in the material world is the necessity of contingency. (I examine Meillassoux’s work at length in Part II.)

Possibility is only the metaphysical channel that we have invented in order to guide us through contingency. While contingency is all difference and shift and dislocation, possibility is but the (very understandable) move to fold that difference back on identity and on presence. The proposition of possibility is the following: Why don’t we imagine a process, a sequence of possibilities, that takes us back to that contingency?

Possibility is a representation and, as such, it re-presents, it pins back on the presence of mind, the pure difference that contingency is supposed to make. Therefore, before I have even started talking about market completeness and the threat of redundancy of derivatives, you can tell that possibility, as a metaphysical notion, in itself already contains the germs of completeness or the death of the market. Possibility is already an attempt to bring back within the confines of representation, and to domesticate, the utter otherness of contingency.

In a world that is only made of contingency, it is only natural that we should invent options and derivative contracts. It is only natural that we should circulate, today, things that we know will *make a difference in the future*. This is why I have always thought of derivatives and derivatives markets as the *technology of the future*. Thus we write those derivatives contracts, and in their writing (the ‘If . . . then, else if . . . then’ formula) there is nothing even remotely related to possibility. It is the pure material writing of contingency. It is pure difference. Writing is difference, as Derrida would say.

However, writing, as we all know and as Roland Barthes suggests, is only the prelude to an *exchange*.³ Typically, we write contracts when we are about to exchange something for fear that, when we no longer hold what we used to possess, in the interval of the exchange, but have let go of it in order that the counterparty may receive it, the counterparty might disappear, thus alienating us of our property.

Therefore, my next statement, as I am sure one can guess already, is that we write derivatives, those pure formulas of contingency, *only insofar as we wish that the difference they will make in the future may make a difference today*. Instead of wondering at their present value, we immediately go and see what difference they make in front of somebody *else*. This is the most direct statement that I could think of, to the effect that we write derivatives for the sole purpose that they may be exchanged and admit of a price. Price is a differential, not a splendid present value as general equilibrium theory holds. To price something is to trade something in order *to earn a difference*. It is to make

difference.

In the very essence of derivative writing, in its very meaning, the fact is embedded that they should admit of a price. The link is immanent and material. *We don't need possibility or metaphysics to travel from the derivative payoff to its present price.* To be a derivative is to admit of a price. That is to say, *to add a price*, a new state of the market-world, to the existing prices.

Possibility and probability and stochastic processes, all these constructs, are themselves derivative concepts, that is to say secondary. They came later. Contingency and price (or market) came first. Market (both of the underlying asset and of any stratum of overlying derivative you care to write on it) is the original entity (note that 'underlying' will henceforth be used as a noun). Absent possibility and stochastic process, there is no way to talk of replication other than as static or intrinsic or model-independent. Creating a new derivative payoff - and by 'new' I mean that this payoff is not statically replicable with the existing ones - is only meaningful to the extent that it will bring to the table, i.e. to the market, a new price: that is to say a new 'making a difference today' by something that 'will make a difference in the future in a new way' (say an innovative, path-dependent or knock-out payoff).

It is fine that we should devise algorithms, as a matter of fact devise the whole metaphysical notion of possibility and probability, in order to compute present values of derivatives. I even think that tools that allow us to value and dynamically replicate derivatives are a constitutive part of the creation and growth of derivative markets (see chapter 3). However, given how I have straightened up the genesis of markets, going directly from contingency to price without the mediation of possibility, it should be clear that derivatives can have as their only meaning and destination that they may trade in a market and never end up perfectly replicable and redundant.

Therefore, when the Black-Scholes-Merton framework of option valuation - to only cite the paradigmatic case - shows that the option value is perfectly reducible to a number called volatility and to a deterministic replication strategy, this doesn't mean the end of the game. On the contrary, this is just one way of slicing the price, and if this designates anything and puts pressure on anything, it designates that the thing called 'volatility' as the thing that you should expect, by virtue of the first principle that options must trade, to become stochastic.

Does this mean that the underlying process has changed and that you must now assume a process with stochastic volatility? No! Nothing has changed. The market is the eternally contingent and eternally self-differentiating thing it has always been; it is the *single dice throw* that you will never find in a fully settled and developed representation of states of the world. It is your valuation tool that needs to change and evolve and differentiate⁴ - unless you combined your valuation tool with your trading skills and finally came up with the *universal pricing tool* that, hopefully, would never need changing, namely you the trader.

Part I

Writing and Event

Writer of *The BLANK Swan*

1.1 PREDICTION VERSUS PRESCRIPTION

1.1.1 My private *Black Swan*

Taleb has surprised me by giving me *The Black Swan* I expected most.⁵ For there to be a gift and surprise, there must be a difference and an exchange. I couldn't have given myself *The Black Swan* that I expected most (even though *The Black Swan* was, in a sense, already given to me, as I was acquainted with it and none of its themes came as a real surprise to me), for the reason that it takes two to make a gift and a giving, let alone an exchange. Not to mention that I couldn't have personally written *The Black Swan* or even imagined that something like it could ever be written. What could there be to record, indeed, on the subject of the extremely improbable and of its impact, beyond the fact that the event goes down in history and records itself by itself when it occurs, all the deeper and the more indelibly that it was precisely improbable and had such a great impact?

I should thank Taleb for allowing this book - *The Black Swan* - 'to write itself', as he himself says in the prologue; it is only because *The Black Swan* is out now and because it is written that there could be material at all for my surprise. Recall that *The Black Swan* that I know best and am most acquainted with - the private *The Black Swan* I know so well that I could have written it myself - couldn't possibly have surprised me *in thought* (not forgetting my intimate belief that it shouldn't be written). In order to surprise me, it had to leave me and to differ from me; it had to leave my mind and assume the spaced and very different (almost strange) shape of the written material. In a way, one of the biggest surprises is when we come upon our own thoughts in a text that is not our own.

The literary work reverses the category of probability. True, a totally unexpected text may be thrilling, but what is more thrilling (and perhaps most thrilling) is that the material we are reading should fulfil us and correspond perfectly to what we want and what we expect - almost to the point of total coincidence - yet that the writing, this finite thread we are following word after word and spacing after spacing, should make it totally improbable and almost unimaginable, at every juncture, that such a thing should be written. This is why the greatest thinkers can make us the gift of the thoughts we expect most and understand best - our own thoughts - literally by writing them, by surprising us with the improbability, not of the thought but of the written text. This is why Wittgenstein is able to write in the preface of the *Tractatus*, that only the reader who has had similar thoughts can understand his book.⁶ This is why he is able to write an *impossible* book, surprising us all the more that what was once impossible for thought becomes possible in writing, even necessary.⁷ This is why Pierre Menard is able to progress towards the only and, for this reason, most expected outcome of his writing process, Cervantes' *Quixote*, without giving up the element of surprise and improbability at any point.

1.1.2 Pierre Menard's trading room

Menard did not rewrite the *Quixote*, for then there would have been no risk in his enterprise. He truly wrote it. This tells us that there could be risk in writing without there being probability, or even possibility. From the point of view of possibilities, there is none facing Menard except to end up writing the *Quixote*, which is another way of saying that he faces no possibility at all.

I express this by saying that *writing is a capacity, not a possibility*. What Menard has done, in the process of his writing, is probe a space of variation of a new kind; he has hollowed out a trading room strictly independent of the space of possible alternatives to the *Quixote*. Only in the writing of future unknown texts is capacity confused with possibility, for the thought is then that the writer could have equally written another text. The tradability and the element of improbability in writing (what I have called the risk of writing) are then confused with the variability of the outcome *within the space of alternative outcomes*. In his endeavour of writing an existing text, Menard has managed, by contrast, to bring risk and probability apart again. Or rather, this is what Borges has managed to do, for Menard's whole work and whole existence are, of course, totally incredible.

There is more to the *space* of trading/writing (I've called it a 'room') than just the collection of 'preconceived' alternative texts. Consider that Menard was absolutely equipped with the algorithm of perfect replication of the *Quixote* (since the *Quixote* already existed), yet he managed to trade it - I won't say 'to change it', for he didn't, or 'to lose it then earn it back', for he didn't either - as I said he just *wrote* it). The risk in trading/writing extends beyond probability. We can even define risk as that which *sways and trades*, after probability is done with and saturated. The market takes place - starts - after the end of probability. It is the end that *can* start (the 'can' of capacity, not of possibility).⁹

1.1.3 Probability, replication, context and beyond

Probability is always defined relative to a given context or collection of states of the world.¹⁰ In replicating the derivative in all possible states of the world, the derivative pricing model exhausts probability and saturates the context. However, this is not yet trading. Trading the derivative is precisely what *happens next*. It puts into play the parameter (or parameters) whose fixity was the guarantee of fixity of the context and of the corresponding dynamic replication. For instance, option trading is a volatility play and volatility is assumed to be fixed by the replication algorithm of Black-Scholes-Merton.

Note that derivatives were written *in order to trade* (not in order to conceal payoffs in a sealed envelope that would be opened only at expiry). Derivatives are the natural offspring of the market and are the stuff the market is made of. (In a way, therefore, the market is also their produce: in fact derivatives and the market are identical and not just hierarchically, or genetically, related.) Thus we see that trading (the process that is supposed to record a value, as of today and day after day, for the derivative that was once written and sentenced to have no value until a future date and unless

fraction of space) will never be the reiteration and the replication of the values that were initially planned for the derivative by the theoretical stochastic process and its prescribed dynamics.

The derivative valuation model is supposed to prescribe a value today, and every day, from the values the derivative is supposed to receive in the intervening states of the world, and in this it may seem indeed that the model is giving back to the derivative the present value it was once denied on account of its derivative nature and of the instruction to pay off in a future that may never be present and in a state of the world that may never be realized. The irony, however, is that this making-present of the deferred value of the derivative has no other present to be imprinted against but the present of the market and the actuality of trading. Derivative valuation models are *intended for* derivative trading and pricing, despite what all the academics working and theorizing in the field may have to say about that. Yet we saw that the trading of the derivative, or in other words its market, will by necessity take place and extend in this ‘improbable’ space we have called the *trading room*, and which is by definition absent from the replication plan and from probability.

I propose that risk, or the market, or contingency, is always posterior to context, possibility and probability. It always comes after probability, which is also a way of saying that context and probability are needed in the *first place*. Indeed, the market-maker wouldn’t be pricing the derivatives and trading them were it not for the derivative valuation model and the dynamic replication algorithm which implicate him in the price process of the derivative.¹¹

Some have proposed that risk is all *model risk*. This is certainly compatible with my proposition and even derivative on it (where ‘derivative on’ means ‘derives from’; I will maintain this usage throughout the book, even though it may sound odd to the reader, because of the financial connotation of ‘being a derivative written on’.) However, I think this attitude is reductive of risk, in the last instance. It tends to put the model at centre stage and to depict risk only negatively and derivative relative to the model. By contrast, my proposition of contingency exceeds the model and goes beyond it. It doesn’t counter the model but requires it. Contingency takes place *after* the model (as it takes place after the context and the probability), and for this reason it cannot limit itself to the model or be called ‘model risk’.

1.1.4 Contingency

Contingency is the writing/trading thread that we keep pursuing despite the fact that the context has been saturated by replication. Rather, the thread of derivative *writing* and *trading* (these two interchangeable sides of the destination of derivatives) is what the market is all about: the market as a writing process that is irreducible to a stochastic process; the market as a writing capacity, as a *medium of contingency*, that is irreducible to a writing possibility.

This is something I state of the market at large and not just of the derivatives market: what the market means in its *essence*. When you think of it, the story of the derivatives (which it would be more appropriate to call ‘contingent claims’, as we will definitely do, later) or equivalently the story of dynamic replication in *Pierre Menard* has only helped us separate the context from what exceeds it and helped us distinguish between possibility and contingency. It put this distinction in all the great relief since it was *necessary* both to have the context and to trade through it (i.e. to change it) in order to ascertain the writing and the risk of writing, both of which are alternative definitions of the market.

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