



# Nail in the Coffin

## Nassim Taleb, Author of the Black Swan

This article is the anti-matter mirror image and continuation of the article “Elie Ayache, author of the Black Swan,” from the previous issue. The reader is kindly referred to it

In the previous instalment, we analyzed the Black Swan as a context-changing event. Normally, we are never aware of the context; we just blend into it. Ordinary language is non-contextual. We just talk of objects and their properties and of general phenomena as if they were independent of the context of their manifestation. Thus, the fundamental “context-changing” event is the event that will make us aware of the necessity of making the context explicit again, let alone the possibility that it may change on us. This Black Swan of all Black Swans has, in fact, already occurred. Its name is *Quantum Mechanics*.

### Meta-contextual prediction and backward causality

The quantum phenomenon has the peculiarity of not being separable from its context of manifestation. Depending on the experimental set-up (or context of experiment) the quantum object may disclose itself either as particle or as wave, and there is no way we could counterfactually argue, in one context, what the object might have been in the other. Contexts of measurement of canonically conjugate variables (such as position and momentum) are not commutative, and this means that the traditional Kolmogorovian probability calculus does not apply to compute their statistics. What is needed is a *meta-contextual predictive formalism*, also known as the *wave function*. Quantum probability is not defined on the classical Boolean algebra, but on a richer structure known as an “ortho-algebra.” Ortho-algebras admit of the Boolean algebras only as substructures; this means that the traditional probability calculus, or Born’s rule, can only apply inside each separate context. When the context is not yet determined, we get the strange “interference of probability” term.

Expressed in plain, ordinary language, the consequence of this contextual dependence is that *the causes of the quantum phenomenon cannot serve to predict it, because they are only defined after the fact, relatively to the very circumstances of manifestation of the phenomenon*.<sup>1</sup> How we make sense of this is by realizing that the notion of causality is in fact specific to our non-contextual language. It gives way when the language gives way. Thus, the only kind

of “prediction” that may involve causes in quantum mechanics is *retro-diction* — or the very kind of narrative Taleb is calling a fallacy. Here lies Taleb’s true Black Swan (unsuspected, even by him). What seems only anecdotal from his point of view and aims at showing the little we can do when confronted with the Black Swan (this helpless backward narrative) is, from mine, a turning point: the necessity to drop traditional epistemology and to engage in proper philosophical critique. This is the *least* we could do.

The *a posteriori* reconstruction of the chain of cause and effect was first proposed by the young German philosopher mathematician Grete Herman in 1935.<sup>2</sup> Herman’s aim was to salvage the category of causality, recognized by Kant as one of the conditions of possibility of knowledge, in front of the quantum phenomenon. A more modern move, unencumbered with Kantian categories, would consist in dissociating causality and predictability. Physicists were classically used to verifying causal hypotheses by experimentally checking their expected consequences. Prediction was thus confused with the possibility of knowledge of causes.

Prediction is more general than causality and Quantum Theory is in fact a meta-contextual, non-causal, theory of predictions. It is an *empirical* generalization of knowledge whereby the prominence of the context is finally recognized.<sup>3</sup> With his charge against the narrative and his belief in the randomness of the world as sole, unnarrated, reality, Taleb is, by contrast, blocked in representational knowledge. “Try to limit the ‘because’ to situations where it is derived from experiments, not backward-looking history,” he writes (120).<sup>4</sup> The lesson of Quantum Theory is almost exactly the opposite. Here, no “because” can be derived from experiments, but, if you insist, *only* from backward-looking reconstructions! And the beauty of the thing is that it can be rigorously shown that any predictive theory relative to phenomena with mutually incompatible contexts will be “essentially indeterministic.”<sup>5</sup> This is *direct* indeterminism, not requiring the intermediary representation of hidden variables or hidden mechanisms which would “generate” randomness (in Taleb’s parlance).

Moreover, the quantum theory of prediction is not restricted to the elementary particles. Its formalism can extend over to other domains involving context-dependent predictions. I have recently contributed a chapter to a book showing its applications in the human sciences.<sup>6</sup>

“Yes Nassim, it ain’t just physics! The purpose of this philosophizing is not to show that the market behaves like particles. Rather, it is to unpack the exact meanings of the terms ‘prediction’ and ‘causality’ which may have originated in physics and may have wrongly been transposed to our field. I am not the one using them in the human sciences, after all! As a matter of fact, my philosophy of the market consists in abandoning them altogether. Prediction is not suited for the market because the market and dynamic trading are, to my mind, what should *replace* prediction and knowledge of the future (probable or improbable). My Black Swan to you is that prediction and probability (and equally, improbability) may just have to end!”

### **Possibility, capacity, and the derivatives market**

In the end, Taleb’s gift to me is that the three attributes of the Black Swan that he lists at the beginning of his book — its extreme improbability, its extreme impact and the backward narrative — all come down to one: the necessity to generalize knowledge beyond context obliviousness and beyond the strictures of non-contextual language. So my point is not that there aren’t Black Swans, or lucky fools, or eternal turkeys, or any of the animals of Taleb’s menagerie. It is simply that we are offered the opportunity, with derivatives markets, to rethink probability in a way that is no less revolutionary than in Quantum Mechanics — even to rethink the event and history as a whole — and that this seems to me more promising than just writing *about* Black Swans.

We all know that Taleb started his career of thinker/doer in the financial markets. It is there that his Black Swan intuition was first vindicated (the October 1987 crash) and that he first put to quantitative practice the strategy of conservatism vis-à-vis Black Swans that can hurt him and of dynamism vis-à-vis Black Swans that can profit him. His next philosophical move, from

the Black Swans of markets to the Black Swans of history, I would then describe as a passive, or *outside*, generalization. It amounts to saying: Just as extreme events occur in the market, just so they occur in history.

It seems to me, on the contrary, that if Taleb had followed the thread of writing of the market *from inside* — and by this I literally mean the thread of the *written traded instruments*: the derivatives, not the underlying or the question of the “true” probability distribution — and if he had worried more

**“Yes Nassim, it ain't just physics! ... My Black Swan to you is that prediction and probability (and equally, improbability) may just have to end !”**

about capacity than about possibility (following the distinction I have established in my previous column), then the market would have appeared to him as the beginning of the answer rather than the beginning of the problem.

Changes of context, I hold, are a constitutive necessity in the derivatives markets. Recall that derivatives start out as the bearers of pure possibilities and those possibilities (of paying off at a future date, in a fraction of space) are all they have. A first change of context occurs when this ethereal and deferred possibility is *taken over* by the actuality of trading. This is when we realize that derivatives were not made to (possibly) pay off later but to *actually trade now*. (From this curious interplay of future and present, you should expect something unusual to follow for prediction.) The problem is thus transformed, from the *possibility* of paying off different amounts, at maturity, depending on different values of the underlying, to the *capacity* of trading, now, at different implied volatility levels (to cite the simpler case of vanilla options).

When possibility (and the corresponding probability distribution) is taken over by actuality, it becomes a capacity (and probability becomes irrelevant). For instance, Taleb only sees probability in the Black-Scholes-Merton model. He only sees the

underlying Gaussian distribution and, as a consequence, he dismisses the derivatives technology as a whole, based on his blanket rejection of Gaussianity and the necessity to adopt distributions of the Mandelbrotian type instead. By contrast, I only see capacity in Black-Scholes-Merton. The capacity of inverting the model against the option traded price and of inferring implied volatility (thus ignoring completely the “real” underlying probability distribution). This is simply the capacity of using the model as an *option trading tool*.

In a move which is typical of the double bind between technology and the Black Swan, and in Gene Kranz’s immortal words, traders show in fact that they don’t care what the Black-Scholes-Merton model was *designed* to do, but that they care what it *can do*.<sup>7</sup>

### **Market mechanics**

Further changes of context occur when the *actual* price patterns of the traded derivatives force us to adopt alternative models where the underlying is not just a diffusion but may admit of jumps, or volatility is stochastic, or may itself jump, or the jumps may be stochastic in turn, etc. (This is unrelated to the question of whether the underlying follows a jump-diffusion process in “reality,” or stochastic volatility, or even a scalable probability distribution.) You may see in this the mere concretization of model risk. I prefer to call it the *risk in writing* (that risk, remember, which is in excess of probability and representation) and I embrace it all the more heartedly that it is actually *coextensive* with the market (even definitional of it) and does not originate in some external source.

Market Mechanics are indeed different from Quantum Mechanics in that the alternative contexts follow each other in time, rather than stand

on a equal footing under the umbrella of the wave function that articulates them, and that the process of context change (which we have called the process of writing/trading in Menard's case<sup>8</sup>) is inherent in *the very process of trading of those written instruments known as derivatives*.

You need a certain context to dynamically replicate and price a certain derivative (for instance, you need a stochastic volatility model, consistent with the vanilla smile, to dynamically replicate and price a barrier option), and the pricing/trading of that derivative soon forces you to overstep the context (as soon as it trades, the market forces drive the barrier option away from the value of its replicating strategy). And while the choice of context, in Quantum Mechanics, is not part of the time evolution of the wave function but is determined by the “performative break” of the experimenter who decides, in the actuality of his laboratory, to conduct this measurement rather than that one, thus breaking the symmetry of the meta-contextual level, the change of context, in Market Mechanics, is *internal* to the process of writing/trading, even is its goal. As a result, knowledge cannot be generalized, in Market Mechanics, the same way as in Quantum Mechanics: as the replacement of causal prediction by meta-contextual, non-causal prediction. Prediction and knowledge have to be dropped altogether in Market Mechanics, or rather, they have to be replaced by trading and market immersion.

To repeat, the market is a trading/writing capacity. As such it replaces probability. Only this capacity has to engulf and implicate the trader completely, and can no longer *only* concern his knowledge.

### Price and the implicate ontology

Thus, I can no longer view the market price processes (of underlying and derivatives alike), as pure numerical trajectories, as just “a succession of numbers in time, a sort of historical document containing numbers instead of words,” as Taleb writes (20). And how I must disagree with him, when he precedes this by writing that the “philosophy of history and the philosophy of knowledge [and not just the market] seem inseparable from the empirical study of times series data”!

Options prices may have historically existed before Black-Scholes-Merton and the advent of dynamic replication. However, options markets came into existence (their *being* took place) only when a market-maker was able to *be there* in the midst of the underlying price process in order to trade it dynamically as the option replication strategy, and thereby to price the option.<sup>9</sup> Option replication thus implies a dynamic trader and implicates him in the price process. Not only that, but the option market-maker is now able, thanks to his implication-by-replication, to gain a foothold in the options markets and to imply volatility against the option price. Implying volatility makes him aware of the stochastic nature of implied volatility and of the direct evidence of the option volatility smile and it prepares him to the next context where different states of volatility will be assumed. In implying volatility and in electing to switch to the next context, he exercises his *trading capacity*.

This capacity of context change has been imprinted on the derivatives market since the October 1987 crash. To my mind, the explanation of the volatility smile does not lie in probability (finding the right model or the right probability distribution) but in the capacity of changing, or *exchanging*, the model (see below). In this sense, the volatility smile is a permanent mark of the derivatives market and has nothing to do with the dynamics of the underlying or the long run.<sup>10</sup>

In every single dot of the time series of derivatives prices, there is, therefore, this whole capsule containing the replication, the implication (of the trader), the implying of volatility from the derivative price and the potential context change. In every point of the price process there is the capacity of changing the context, that is to say, of changing the whole stochastic process. All this is due to the nature of *price*.

Only because it is a price, because it has *traded* (or *can* trade) and has received the “validation stamp” of the market, is the option price “firm” enough to act at once as an input, rather than an output, of our model. Because it bears the mark of the exchange, each derivative price *exchanges at once* every derivative pricing theory or algorithm that we may hold, or any underlying probability distribution we may have assumed, against the

*givenness* of the price (this is a much more radical overturning of Platonicity that Taleb's: this is *relying on fundamental exchange as only ground*, instead of stable forms and categories; at the same time, the exchange buys us another sort of buoyancy).

For this reason, the price *cannot be generated* (“generator” is but a Platonic idea) and it cannot be a process.

As there is ultimately no difference, *in the market*, between underlying and derivative (when we imply volatility from the option price, aren't we *deriving* the underlying from the derivative?), this implicate dimension, disrupting the notion of process, is present in all price series, and not just of derivatives. In fact, it says that in every price there is *implicit* the whole market because the capacity of context change, which is implicit in every traded (derivative) price, is in the end just the reflection of the tradability of that price, regardless of its derivative nature. It is, therefore, impossible to frame the price series from the outside, in a framework of infinite time and “infinite” probability. And it doesn't make sense to speak of the “long run.”

I don't think we have time, then probability, and then a price process which makes its way through time and through probability. On the contrary, we have the price series, and in every single price there is implicit a whole time, a whole market and a whole trading room (and this is *bigger* than probability: this is the *capacity* of changing the context where probability has first to be defined). Also, remember, from Heidegger's *Being and Time*, that infinite time is derivative on primordial, finite temporality, not the opposite.

### Technology of the future

Just as the question of being could only be posed from out of the finitude of the entity which was alone able to understand being (just as the site of being-there was the only place where being could take place),<sup>11</sup> derivatives markets are the only site where the question of the market and of probability can properly be posed. Why? For at least the reason that probability has finally found a concrete usage. Not the usage of implying volatility or probability distributions from the market prices of derivatives, but of produc-

ing a derivative delta hedge which will result in further concrete action. *Probability is thus folded back into the market.* (So, this is even better than the empirical “bottom-up” approach of things that Taleb is encouraging so ubiquitously. This is a “bottom-down” approach. When you consider that probability is not itself empirical after all — surveying possibilities, instead of facts, as if from above, is indeed the archetypical “top-down” view of the world — the derivatives market will appear to you as the ultimate terrestrial, four-wheel drive, predictive machine.)

If I had one thing to say to the defence of the Gaussian, it is that it gave us the Black-Scholes-Merton model, which gave us dynamic replication and implication, which gave us implied volatility, which gave us the capacity of context change or, simply, immersion in the derivatives market. (To repeat, we don’t care about the “real” probability distribution of the underlying, or whether such a thing exists at all.) As for the market — that other nebulous entity — it finally receives an *implicit definition* at the hands of the derivatives market mechanics. The market is the perpetual process of context change and the “there” of being of the dynamic trader. What’s even better, it receives it *through* the probability and its surpassing!

Generally, I think the market is the only site where the question of prediction, that is to say, of the future and of history, can properly be posed (it cannot be posed — let alone answered — under Taleb’s “infinite” metaphysical vision, and expectancy of outside Black Swans). The market is the technology of the future (“*techné* belongs to bringing-forth, to *poiesis*; it is something *poiëtic*,” writes Heidegger).<sup>12</sup> In this, it surpasses knowledge. Derivatives prices (or generally, prices) are the forward-looking narrative we’ve been long waiting for. They literally help us infer the future. The bad news is that this inference is not concerned with knowledge. Its only business is to immerse us back in the market and in the exchange.

Recall that the exchange is the ultimate non-Platonic “category.” For this reason, it is the royal avenue into the future, which, I agree with Taleb, is the least Platonic category of all (135). In sum, the only use of derivative

technology is to further the trading, not to further the knowledge.

Taleb too recognizes the distinction between *epistémé* (knowledge) and *techné*, between “know-what” and “know-how” (146). Which is why I am inclined to think that, having started as a derivative trader and thinker, he really came close to flying my Black Swan — only he was *Foiled by Randomness* instead of seeing that randomness didn’t really matter, and he was distracted away from the course of *Dynamic Hedging* by the regress to representational scepticism.

As a matter of fact, when it finally comes to uttering the last word on uncertainty, Taleb confesses that probability is no longer relevant. Instead of focusing on the extreme “improbability” of the rare event, the knowledge of which, he says, may be impaired by “fundamental limits” — doesn’t Taleb here simply mean to say that Black

## Probability should be eliminated by the only true dynamics: that of total immersion in the derivatives markets

Swans fall beyond the given context? — he recommends that “we focus on the payoff” (210), or in other words, only on the impact. “This idea that in order to make a decision you need to focus on the consequences (which you can know) rather than the probability (which you can’t know) is the *central idea of uncertainty*,” he writes (211). Hedging the payoff, irrespectively of the probability, is the basic idea behind the strategy known as *static hedging* in the derivative literature.

Conversely, the minimal interpretation of probability is that it can be seen as just the way of injecting dynamics back into the picture (it allows us to play off the payoffs *before* they actually pay off, by evaluating them dynamically). Indeed, the fear is that static hedging and suspension of belief, such as advocated by Taleb, might simply lead to a total resignation from the market. Even dynamic strategies that aim at reducing the risk of large losses by minimization of the fourth moment of the P&L (instead of second) under fat-tailed distributions result in optimal

delta hedges that vary much less with the money-ness of the underlying.<sup>13</sup> While certainly a blessing for transactions costs, this kind of alternative strategy might end up secluding the trader from all the market action.

I don’t think stoicism and suspension of belief are the right way to eliminate probability. Probability should be eliminated by pushing forward the dynamical view, not by regressing to the static view. Probability should be eliminated by the only true dynamics: that of total immersion in the derivatives markets.

The dynamic derivative trader needs dynamic replication and the corresponding heritage of Black-Scholes-Merton; he needs to minimize the second moment in order to retain the linearity of the pricing operator and to remain as close to the market as he can; however, his effective dynamics will be the context-changing

dynamics of recalibration (not the theoretical dynamics of the given model) and this is what cannot be accounted for by probability, but only by capacity. Probability is eliminated, in my view, because it is replaced by the derivatives markets *as technology* and by the appropriate meta-contextual pricing tool.

Reality is *the technology*, not the distant, uninteresting, “unsurprising” Black Swan that we’d better leave to write itself by itself. The market is our context-changing vehicle and we have the means to embark in it. The whole trick is to really envision it as a *technology* where both the trader and the quantitative tool are embarked (the technology of the future) and no longer as an object *for* knowledge or *for* prediction. Note that both Taleb and Mandelbrot, who seem to worry so much about the reality of the underlying dynamics, have suspiciously nothing to say about the only reality there is: the *trading* of derivatives — or the derivatives market envisioned as the all-encompassing technology.

Taleb reports an interesting conflict between technology and prediction. Having remarked, after Karl Popper, that history can be reread as the history of technological innovations that have most impacted our world<sup>14</sup>, he writes: “Prediction requires knowing about technologies that will be discovered in the future. But that very knowledge would almost automatically allow us to start developing those technologies right away. Ergo, we do not know what we will know” (173). My comment: This simply shows that the technological time line is inappropriate for, and does not even cross, the line of knowledge and prediction. Researchers, engineers and discoverers who are embarked on a technological “voyage” are not embarked on any kind of narrative, either backward or forward looking. *Techné* is an altogether different ball-game than *epistémé*. Now think what the situation would be if the technology in question is supposed to replace prediction altogether!

### Context change and the necessity of jumps

If history is the major context-changing process, then the market’s comparative advantage is its single metric. No matter how many times the context changes, it has all to translate into the up or down movements of the price index. (History has many more dimensions, by comparison.) Since Black Swans are defined as extreme events, and we expect extreme events to cause jumps in the market price (what else?), it remains to be seen whether context changes will tend to coincide with market price discontinuity.

From the “infinite” probabilistic point of view of Taleb and Mandelbrot, Brownian motion is prosecuted because it doesn’t exhibit the appropriate fat tails. Scalable probability distributions are proposed instead, and several social or human arguments are offered by the two authors for support. In Mandelbrot, however, there is the suggestion that scalable laws in financial markets are only a plausible mechanism for explaining the tendency of price movements to amplify changes in expectation, and that their only observable and, ultimately, desirable consequence is to induce price discontinuity. Sooner or later, Mandelbrot explains, the

exogenous economic variable driving market anticipations is known with certainty (I will not comment on the metaphysical commitment to hidden variables, here), and prices undergo a sudden correction due to unrealized expectations.<sup>15</sup> In another instance, Mandelbrot writes: “The ‘fat tails’ symptom is intimately linked to the symptom of ‘price discontinuity’.”<sup>16</sup>

If jumps are really the one observable, non metaphysical (and local) consequence that fat tails and scalable laws are (only) here to guarantee, then jumps are also accountable from my finite context-changing point of view. I first observe that jumps are consequential for the device that first allowed the market-maker to insert himself and implicate himself in the given pricing context, i.e., dynamic replication. Jumps necessitate an adaptation of the dynamic hedging strategy, which can no longer be perfect but only optimal.<sup>17</sup> As a matter of fact, one can safely say that jumps are the only thing that makes a difference, the only substantial criticism that was levelled against Brownian motion *as used in the derivative pricing technology*. When it comes to derivatives markets, whose advent we owe to dynamic replication in my view,<sup>18</sup> Taleb’s Black Swan, Mandelbrot’s scalable laws, and Haug’s chapter 2 in *Models on Models* all come down, in the end, to an apology of jumps. Even history owes its movement to jumps. “History does not crawl, it jumps,” writes Taleb.

How jumps are recovered — even required — in my contextualist, a-probabilistic perspective is by noting that if there were no jumps, then the variance swaps and, generally speaking, all the subsequent variance derivatives, would be statically replicable by the vanilla options, and would fade away as perfectly redundant instruments.<sup>19</sup> Unsurprisingly, the crowd of quants has rushed headfirst into just this narrow alley, thus denying the variance swap and the option on variance the capacity of acting as independent calibration inputs and of changing the context on the vanillas. So jumps do not just separate continuous Brownian motion from discontinuous price movements, or the Gaussian from the fat tails, in my non probabilistic, non metric view of the world. They separate a world of redundancy and perfect replication from a

world where each derivative that was ever written has a *trading room* reserved for it. In other words, they separate a world of market (what I have called the risk of writing) from a world of vacuous replication and no market. Changes of context entail jumps, in my view, because the absence of jumps would imply the absence of context changes — as far as variance derivatives are concerned. (This should already give you a hint that what is deemed unexpected, intractable and disruptive in Taleb’s infinite metaphysical-historical perspective, namely the Black Swan, is on the contrary expected and desired, in my finite market-perspective, as the one guarantee that the thread of writing/trading and its context changes shall *not* be disrupted. “No jumps” is the discontinuity to me!)

### Variance swaps and options on variance

Taleb’s rejoinder to the “jump panacea” is that it just won’t help to assume jumps. For how are we going to predict that which matters most in the jump, namely its size? Certainly not from the observation of the distribution of jumps over a historical time series (326)! As it turns out, the variance swap is the perfect instrument for inferring the size of the Poisson jump. Since the theoretical value of the variance swap collapses to the portfolio of replicating vanillas in the absence of jumps, the observed disconnect between the market price of the variance swap and the market price of the portfolio of vanillas will exactly measure the jump. Note that the vanilla volatility skew is also sensitive to the jump, however it cannot really discriminate between its intensity and its size because it is only their product that affects the vanillas from a distance. Being a series of one-day options written on the square of the daily return, the variance swap is mainly affected by the size of the jump, and joint calibration of an appropriate derivative pricing model against *both* the vanilla smile and the variance swap price structure will pin down the market implied values of Brownian volatility, and of the sizes and intensities of the Poisson jumps.<sup>20</sup>

You would be surprised to see the results! Typical jump sizes I found by calibration to contemporary market data are minus 40 per cent,

even on equity indices: more dramatic than a repetition of the October 1987 market crash! On equity single names, they can reach as far down as minus 85 per cent. People typically object that the historical probability distribution of the underlying does not seem to support such outrageous evidence. They tend to forget that my jumps are predicted under the risk-neutral probability distribution, as they are inferred from traded derivative prices. These prices reflect the risk premium that derivative traders seem to be willing to pay as insurance against these kind of jumps (maybe they have learned the lesson of the Black Swan), and so, it doesn't matter whether such jumps have occurred or will occur! (Note that the size of the jump is preserved under the change of measure.)

### The “derivative-derivative” trader

To repeat, derivative technology is not a means to extracting knowledge about the future. All it does is enable me to remain implicated in the market, and able to sustain its writing/trading process, through its successive changes of context (or Black Swans). What I must not allow is that the traded price of some derivative (which may be Black Swan-sensitive) changes so much and diverges so much on me that I am no longer able to “ride” it, that is, to take it as my *given* calibration input in order to value something else and trade something else. Hopefully, there is money to be made in the process and this “something else” I am valuing may be priced differently in the market, hence may offer me a trading opportunity. Models are needed to detect arbitrage opportunities and to ride them for a while. However, the market is the ultimate given and it is not long before the market price of that “something else,” if it persists in diverging, forces me to recalibrate the model and to change my context as well as my perception of the arbitrage opportunity (provided, of course, the model can accommodate such readjustments).

From which we see that the *true* derivative trader (the one who insists on riding the derivative, not the underlying or the long run) is not after the Black Swan *as such*, but after the context-changing nature of the Black Swan (which, like we said, is the essence of the Black Swan). Here lies my difference with Taleb. Taleb's

underlying, metaphysical basis is the “generator” of the Black Swan: reality, history, the future, etc. Surely, his business is not to predict the Black Swan, and he rightly reprimands those who ask him to do so. However, his philosophical stance is predicated on the existence and the fact of the Black Swan. He keeps referring to its generator. By contrast, what I retain in my “derivative” basis is something differential, something literally derivative, namely, the context-*changing* nature of the Black Swan (what, in a Derridian paradoxical way of speech, I have called “its essence”).

To gauge the difference between Taleb and me, I will actually propose to you to play on the identity of words and their underlying metaphysics, rather than their difference. Imagine if I told you that this “essence” of the Black Swan, this context-changing feature, is what actually *makes* it (a Black Swan), what literally produces it, what generates it; in other words, that its context-changing nature is the *true generator* of the Black Swan (in a different sense of “generator,” of course, than Taleb's). It is not the generator of the Black Swan in the sense of cause but of form: in the sense of writing. Now imagine that the derivative trader is not worried about the underlying generator of the Black Swan (Taleb's), but about this derivative one. He is a kind of *derivative-derivative* trader. He doesn't pursue or await the Black Swan; he doesn't even live in a world where Black Swans *just* happen; he tracks the Black Swan *through* the changes of context, thanks to the context-changing property of derivative recalibration. In short, he pursues its writing (and writing, we said, is the essential context-changing process).

### Bringing the Black Swan to nest

Hence my equation: As derivatives are written on the underlying, pursuing their trading is *writing* the underlying Black Swan. As writing/trading is the essential context-changing activity (recall Pierre Menard) and the Black Swan is essentially a change of context, it is, then, as if we were gaining a state of “rest” relative to the Black Swan, by thus following the thread of writing. It is as if we had managed to stabilize ourselves in the context of the Black Swan (not the contexts *before* it or *after* it — which are the only contexts available in

the *metaphysical* perspective of the Black Swan) and thus were able to prescribe it at last (not to predict it).

Recall the evasive nature of the context “of” the Black Swan: We say of unpredictable events (those unpredictable in the sense of not belonging to our previous domain — the Black Swans) that *they can only happen*. By this, we do not mean that they will happen with certainty, but that, given that there is nothing we can say about them before they happen (we cannot predict them, or even conceive them), there is nothing they can do *except* happen. This sounds both trivial and very deep. Through writing and its trading room (its allowance for context change), and given the precious little that the writing process has to do with causality, with possibility or even with the flow of time (Pierre Menard), it is as if we were turning the formal “can only” of the Black Swan<sup>21</sup> into a material certainty again, and thus prescribing, or writing, the Black Swan.

Inherent in writing is its excess over possibility: the trading room and the margin of manoeuvre which were operating at full capacity in the unusual case of Pierre Menard and which are, in the normal cases, largely eclipsed by the specific possibilities of the future text. This excess and this margin are precisely adapted to bailing out the change of context. For this reason, they are liable to capture, in the Black Swan, that which makes its outlandishness and its distance *before* making its improbability, and thus to write it. It is as if the market (this trading/writing process which, according to my favourite characterization, is always *what happens next*) had the property of “pulling” the Black Swan that *can only happen*, thus succeeding to it and succeeding against it.<sup>22</sup> (It is as if we were saying that the market, whose actuality is to trade the future, had the property of making the future happen “ahead” of time and ahead of its Black Swans.) In this sense, we can say that Taleb has always fallen on this side of the context change, and always fallen short of the context change. He cannot predict, of course, nor can he prescribe. He hasn't written anything and what he offers me is not a writing material but a “writing formal”: the white page on which to write the Black Swan.

## The regime-switching model as meta-contextual pricing tool

The key is to provide our *derivative-derivative trader* (the trader who tracks the Black Swan through its formal “differential” generator: the context-changing feature) with the right tool to keep up with the writing/trading process and to keep his distance with probability. From what we said before, this kind of tool is not so much concerned with the underlying as it is with 1) calibration against the given prices of a set of liquid derivatives, 2) the subsequent (optimal) replication and pricing of the derivative of interest, and 3) the eventual overstepping of the given context by recalibration against the market price of that derivative, now considered as a given calibration input. This set of “horizontal” rules has everything to do with the contexts, and nothing to do with the vertical impact of the underlying Black Swan or with the distribution of the underlying in the long run. In previous publications, I have suggested that the regime-switching model is a plausible implementation of such a meta-contextual pricing tool.<sup>23</sup> As I explain in the Espen Haug interview: “The key observation regarding the regime-switching model is that it is self-similar under its own stochasticization. It incorporates its own meta-model ... Since stochastic variables are expressed in regimes, regimes of regimes are also regimes. So all we have are regimes ... Recalibration and expansion of the state space occur whenever they occur and they put new names on the regimes. Since the regimes have no predefined names, it is not clear that the new, richer stochastic model and its larger state space [i.e. the new context] were not with us all along, only we didn’t distinctly perceive them.”<sup>24</sup>

Regime-switching is the model I have used in my examples of calibration against volatility surfaces and variance swaps of equity indices and single names. Since the regimes carry no name and no particular structure of stochastic volatility or jumps prior to calibration, it is up to calibration to the derivative prices to impose on them the appropriate names and structures, possibly of the wildest sort. Black Swan regimes can truly surface, which would remain totally invisible in models with predefined structure and context, such as Heston, or classic jump-diffusion. And

the probability distributions that are generated are delightfully fat-tailed. Typically, options on variance turn out twice as expensive as in the traditional stochastic volatility models.

It all comes down, then, to determining the extent to which derivative prices can prescribe (not predict — remember that market prices are only the trading/writing channel into the prices that will trade next, not indicators of probability), or in any case, sustain, the Black Swan. And Black Swans matter only to the extent that they affect those derivatives prices and impact their pricing contexts.

Surely, the Black Swan will induce a major price discontinuity and a jump in the underlying. And the ultimate test is to see whether the market will remain liquid following the jump. (In my market-oriented perspective on the Black Swan, the Black Swan of all Black Swans would indeed be the total breakdown of the market.) But then, remember that jumps were really the only substantial, conceptual barrier separating us from the Black Swan. So it all depends how you understand the barrier. People who haven’t integrated the jumps and ways to calibrate them in their models would typically want to argue that a jump is not a price discontinuity, but a short and intense illiquidity episode. Had the market been liquid “in the interval,” they argue, then prices would have traded continuously. I wish to argue, on the contrary, that if jumps are incorporated in our model and in our minds as *true* price discontinuities, then chances are we will feel comfortable enough to restore the liquidity after the jump, or rather, to never have lost it in the first place.<sup>25</sup>

## “Transcendental deduction” of the derivatives market

This brings me to the closing of my two-wing Black Swan column where I wish to argue that the answer to the Black Swan problem is the derivatives market *as technology* (and by this I mean the technology which includes the derivatives, the meta-contextual pricing tool and the trader using the tool and trading the derivatives).

The derivatives market is truly my *ground* and my sole thread (in other places, I have called it my “floor”<sup>26</sup>). Only because it is given and avail-

able, for me to come back to it when needed and recalibrate my meta-contextual pricing tool against its given derivative prices, am I able to bracket out probability (and the intractability of the Black Swan in metaphysical time) and stand the problem on its “edge”.<sup>27</sup> on the context-changing feature of the Black Swan.

It remains to be shown how the derivatives market can *happen* at all. (Should the solution of the Black Swan problem be itself a Black Swan or be permanent? At any rate, we know it cannot be Platonic.)

I wish to argue that it happens by *necessity*. Not the material necessity of cause and effect but the very formal necessity which made us say of the Black Swan that it *can only happen*. In other words, I wish to deduce, or derive, the derivatives market itself by an argument from writing, not an argument from probability. (As the derivatives market is itself a trading/writing process, you can already guess what kind of bootstrapping I will be after.)

I wish to *write* the derivatives market, not to predict it. (And this, as I am in the business of writing Black Swans, as opposed to predicting them, will give you the hint that the derivatives market is itself a Black Swan, so improbable and yet so necessary. Maybe it is the Black Swan I am writing right now, and thus my argument for the necessity of the derivatives market will be *performative* and not just propositional.)

Recall that the Black Swan of all Black Swans is when we come to realize that our everyday language and our representational knowledge are non-contextual. From this, as you recall, we concluded that causality and even representation are not adapted to framing events of the meta-contextual kind. The quantum mechanical phenomenon is one such. The Black Swan is another. Our realizing that our ordinary, representational knowledge is non contextual and that a more general variety of knowledge is required is itself, of course, an event of the meta-contextual kind. It is an arresting event. Facing such a seizure, we could do two things. Either we elevate ourselves in the philosophy that extends beyond the duality of subject and object, beyond the representational view of “a world facing us”: a fundamental ontology where the only question worth articulating is the question of being from out of the finitude of being-

there and its being-in-the-world, a question which ultimately hinges on the question of why there are beings instead of nothing all (what Heidegger calls the fundamental question<sup>28</sup>). This is the philosophy leading ultimately to the *other beginning* and to *inceptual thought*: to the event of appropriation that is so singular that we don't know what to write next.<sup>29</sup> Or we attempt to enter into a *performative dealing* with the seizure; we try to put it to rest, to write it down like all the other Black Swans.

Note that Taleb too invokes representation at some point. Speaking of the opacity of knowledge and of the “invisibility of the generator of the world” (268), he condemns our tendency to first form theories and representations (the Platonic urge) and to proceed to reality second, when we should obviously travel the road in the opposite direction. However, it is clear that what Taleb has in mind here is a *given* representation. He remains at the object level. He is not questioning the fact that the world *may* be represented at all, or criticizing *representationalism* as a whole doctrine. That kind of criticism belongs to the meta-level and parallels the difference in levels I have already noted between Taleb and me, concerning both our uses of the term “context.” So Taleb is never really ascending to what, following Kant, I shall call a *critical* philosophy of the Black Swan (a philosophy which would understand the Black Swan as a *hinge* between our knowledge and the world, not as the world's black residue). He remains a realist, with his eyes set on the “generator of the world.” For the same reason, he could only envision a diatribe against his book under the plumage of *The White Swan* (171), in other words, from out of the same colouring context. He could not predict that somebody would exchange the context (against the probability) and write the Black Swan as a criticism of *The Black Swan*. (Isn't criticism the noblest form of exchange?)

An arresting event like the one we noted above keeps a distance with everything we know, and the only way to shelter this distance is to entrust it to capacity rather than provability and probability: to the capacity of writing. It all comes down, then, to writing the *über* context-changing event which speaks to us of the constitutive par-

taking of the contexts in everything we know, and correlatively, of the inscrutability of the context-changing event (the Black Swan) without the context that can only take place after it. The way to write such a *über* context-changing event cannot be to write it in a given context (this would be a performative contradiction), but to write it in line with itself and ourselves, to write it in line with the *change of contexts*, to write it by improvising the writing process that is not only context-changing (like the rest of writing processes) but *induces the context changes by the process of its own writing*. This is the definition of the derivatives market.

Amazingly, Taleb's discussion of representation occurs in the passage where he suggests that “we study the intense, uncharted, humbling uncertainty in the markets as a means to get insights about the nature of randomness” in the other sciences. So we both agree that the markets are the golden ladder to the Black Swan nest. However, Taleb reasons analogically, comparing the phenomenon of markets to the other phe-

## What's unacceptable is the discrepancy between inside writing and the simplicity of the outside sentence describing the event

nomena, whereas I wish to extract the writing thread from inside the market (and from the heart of the dynamic trader), in order to generally write, and ride, the Black Swan.

### A return to history

Thus the derivatives market is a return. It is the return to history after the seizure of the Black Swan of all Black Swans. Philosophy, understood as fundamental ontology, is the human science par excellence: the science that re-sites being-there at the centre of science and re-sites finitude at the centre of the infinitude of metaphysics. It leads to the thought of being-there as the site of the event of being, and to the thought of *Ereignis*<sup>30</sup> — the appropriating event or inception, the event without a context, the ultimate Black Swan which stands above all contexts.

The queen of human sciences leads to this

arrest. The market, or simply, history, is then the human science in charge of writing the morrow of this event. It is the putting back in writing, and in risk, of the flash of this ... “White Swan” (what is the color of “Black of Black”?). It is the return to what's most human in the human, to writing and to trading, which are at once the two human activities that truly have no end. When the contexts are all arrested at one end, what choice do you have, at the other, but to rejoin the perpetual negotiation between the promises that were once sent (the derivative payoffs), the contexts of their replication, and their freeing (*élargissement*) by the exchange?

Thus, the relation between the market and history is not accidental. The market is a way of writing history: the way to return to the string of contexts (not of events) after the *über*-contextual arrest.

The market is not a historical process; it is the very process of history. (One understands why it is a category mistake to apply probability to either.) From my treatment of the Black Swan in the process of trading/writing specific to the

market, it should become apparent how the treatment could be generalized to history. Just find the right writing/trading thread which may simply consist in ... writing. (I've always thought that, through writing, anything you fill in the blanks ends up being fulfilled and anything you wish and expect ends up coming true, as if by necessity. Malcolm Gladwell has written *Blink*. Nassim Taleb has written *The Black Swan*. I shall write *The Blank Swan*.)

### Writing inside the event

Writing is inside the event. What's unacceptable is the discrepancy between inside writing and the simplicity of the outside sentence describing the event. Fear is how we address the event ahead of time and how we have premonition of its happening. Fear is the true consequence of the Black Swan: its true predictive “consequence.”



The passenger behind me starts groaning with fear as soon as the plane encounters air turbulence. At times, his groaning sounds like female orgasm (and this inspires me the thought that imminent disaster also threatens women in transports). And yet his vocalizing bestows structure and depth on my own fear of flying which, until now, has been locked inside me like a black and damp body. He helps me penetrate into fear and articulate *expectations* in there. I almost wish the air turbulence occurs again for me to listen to him again.

Writing on board the plane enables me to dominate my fear, because, in writing, I lodge my mind in the unknown. I test a limit then I tell myself that I shouldn't let go of the limit, just yet.

Show me the script of Mohammed Atta! How did

he manage to create such an indescribable event?

I must write inside the event and try to describe its form, not its cause. Fear of the Black Swan is *groundless belief*. (The kind of belief you have on a plane?)

Probability is not compatible with inner life, even less so with "inner" survival. How can I accept the fact that my having survived this flight, after it made me tremble with fear at every jolt of the plane, is a matter of statistics?

I've always written inside the event. I have filled five pages of my notebook standing on the pit on October 19, 1987.

In a recent writing attempt, I have essayed the event of the market.<sup>31</sup> This is the event I've always wanted to *describe*. I have adapted the

metaphors of the *first beginning* (dynamic replication) and of the *other beginning* (the October 1987 market crash) from Heidegger's *Contributions*. Today, I have established the derivatives market by an argument from writing: by the putting in writing of the *über* Black Swan. This is the event I've always wanted to predict, or rather to *prescribe*. (This is the most unexpected writing event, the Black Swan of all conclusions.) For the record, my initial plan was to write the Black Swan, to trade it against the gift that I found most surprising in *The Black Swan*: the mention — not the use — of the derivatives market.

And what is *The Black Swan*? A book, of course. The book I have mentioned and I have used.

## FOOTNOTES

1. Cf. Michel Bitbol, "La Mécanique Quantique Comme Théorie des Probabilités Généralisée," in: *Prévision et probabilités dans les sciences*, E. Klein & Y. Sacquin (eds.), (Paris: Editions Frontières, 1998).
2. See Grete Herman, *Les Fondements philosophiques de la mécanique quantique*, translated and with an introduction by Lena Soler (Paris: Librairie Philosophique J. Vrin, 1996).
3. See the closing of my previous column.
4. Numerals, either roman or Arabic, inside brackets refer to the pagination of *The Black Swan* in its first edition by Random House, New York, 2007.
5. Paulette Destouches-Février, *La Structure des théories physiques*, with a preface by Louis de Broglie (Paris: Presses Universitaires de France, 1951).
6. Cf. Elie Ayache, "L'événement du marché ou la nécessité de l'ascension méta-contextuelle", in *Théorie quantique et sciences humaines*, Michel Bitbol (ed.), Paris: Editions du CNRS, forthcoming.
7. Cf. Elie Ayache, "Why 13 Can Only Succeed to 11, or, the End of Probability," *Wilmott* July 2006: 30-38, and *Apollo 13*, the movie by director Ron Howard (1995), starring Tom Hanks as captain Jim Lovell and Ed Harris as flight director Gene Kranz.
8. See my previous column, "Elie Ayache, Author of the Black Swan." Pierre Menard is the twentieth-century French writer whom Borges has immortalized in the novel "Pierre Menard, Author of the *Quixote*."
9. Cf. Elie Ayache, "The Next Question Concerning Technology: Part I: The Significance of Dynamic Replication," *Wilmott* March 2007: 32-38.
10. Cf. Elie Ayache, "The Next Question Concerning Technology: Part II: A World Inverted," *Wilmott* May 2007: 42-48.

11. Cf. Martin Heidegger, *Being and Time*, Joan Stambaugh (trans.), (New York: State University of New York Press, 1996): 2-8, 302-303.
12. Martin Heidegger, *The Question Concerning Technology, and Other Essays*, Lovitt, W. (trans.), (Harper Perennial 1982): 12-13.
13. Cf. Jean-Philippe Bouchaud and Farhat Selmi, "Alternative Large Risks Hedging Strategies for Options," *Wilmott* March 2003: 64-67.
14. Taleb (171) and Karl Popper, *The Poverty of Historicism* (London: Routledge, 2002).
15. See Benoit Mandelbrot, *Fractales, Hasard et Finance*, (Paris: Flammarion, 1997): 81-82.
16. Cf. Benoit Mandelbrot, op. cit. p. 143.
17. Cf. Elie Ayache, Philippe Henrotte, Sonia Nassar and Xuewen Wang, "Can Anyone Solve the Smile Problem?" *Wilmott* January 2004: 78-96.
18. Cf. Elie Ayache, "The Next Question Concerning Technology: Part I: The Significance of Dynamic Replication," op. cit.
19. Cf. Jim Gatheral, *The Volatility Surface: A Practitioner's Guide*, (Hoboken, New Jersey: John Wiley & Sons, 2006).
20. That is, if we assume a Brownian component to our process. Even so, calibration can yield zero Brownian volatility and only jumps, in some extreme cases.
21. A "can only" which I analyze as occurring in *spacing* not in *timing*; it is due to the *distance* that the Black Swan keeps with probability, not to probability. The Black Swan is "spatially" — not "temporally" — distant from probability because, if this distance were to be interpreted in time, it would have to be interpreted both as a "before" (as in the Black Swan takes place *before* probability because it concerns the context relative to which probability has first to be defined) and as an "after" (as in:

- the Black Swan takes place *after* probability because it is the event of the market which is always *what happens next*, the event of the derivative's trading away from the context which was saturated by probability not long ago, and where the derivative was perfectly replicated not long ago).
22. See: Elie Ayache, "Why 13 Can Only Succeed to 11, or, the End of Probability," op. cit., for an account of the market as a "successive successful failure."
  23. Cf. Elie Ayache, "L'événement du marché ou la nécessité de l'ascension méta-contextuelle", op. cit.
  24. "Elie Ayache on Option Trading and Modeling," in Espen Haug, *Models on Models* (London: Wiley, 2007).
  25. This distinction, between true price discontinuity and discontinuity under the cover of illiquidity, was pointed out to me by Philippe Henrotte.
  26. Cf. Elie Ayache, "Why 13 Can Only Succeed to 11, or, the End of Probability," op. cit.
  27. Not unlike the Collector's coin in his zero-gravity space station.
  28. Cf. Martin Heidegger, *An Introduction to Metaphysics*, Gregory Fried and Richard Polt (trans.) (New Haven: Yale University Press, 2000).
  29. Cf. Martin Heidegger, *Contributions to Philosophy (From Enowning)*, Parvis Emad and Kenneth Maly (trans.), (Bloomington: Indiana University Press, 1999).
  30. Cf. Martin Heidegger, *Contributions to Philosophy (From Enowning)*, op. cit.
  31. Cf. Elie Ayache, "The Next Question Concerning Technology: Part I: The Significance of Dynamic Replication," op. cit. and Elie Ayache, "The Next Question Concerning Technology: Part II: A World Inverted," op. cit.