



Why 13 Can Only Succeed to 11, or, The End Of Probability

Elie Ayache¹ of ITO33 recommends that Houston is informed of the situation immediately ...

The ground floor exchange

That derivatives *derive* from the underlying is just the reflection of the fact that their payoff, at maturity, is something dependent on the underlying, something that comes second to the underlying and can only exist if the underlying is given first. It says nothing about the episode of *derivation* of their present value as a function $V(S,t)$ of the sort that everyone has become familiar with ever since Black and Scholes derived their famous equation. Indeed, we require an additional *underlying* for derivative value to be derived in that second sense of derivation, and that is the assumption that the underlying process is given and that trading of the underlying is allowed at any one state of the world and any point of time.

I shall call this second underlying assumption the “ground,” or the basis, of derivative pricing theory. Notice that it involves a lot of additional structure, such as the fixity of states of the world and the knowledge of the probability distribution: a large allowance of metaphysics, really. This appears totally unwarranted when you realize that all we practically need in order to have derivative prices are derivative markets. As a matter of fact, derivative markets do not require



an underlying process to form a derivative price, or the prior knowledge of a probability distribution. They don't require any form of knowledge for that matter, and it is not even clear that the

formation (I will no longer say “derivation”) of derivative value should proceed in a sequence where states of the world and probability distributions are posited first and derivative value is obtained second. All that is needed is the capacity to trade the derivative and the underlying, as if on the same level, and there is no reason why derivative prices should not equally qualify as states of the world.

For this reason I shall call the “floor” the view according to which derivative prices and underlying prices are given, i.e. traded, on an equal footing. Whenever something trades, it trades on the floor; and whatever trades on the floor trades at a *valid* price, an undisputable (although not long ago negotiable) price that automatically becomes the reference price, or the fair price, or the *zero* price. (“Zero” in the sense that it has been leveled down to the market. Think that market prices provide the *zero* mark of a marked-to-market evaluation procedure.)

With the advent of derivatives, ground and floor enter into a relation both conflicting and complementary. Indeed, derivatives cannot just trade liberally on the floor. Their derivative nature imposes on them hierarchy and structure; hierarchy, because they ultimately depend on their underlying and become absolutely a function of it at maturity; and structure, because they have to verify non-arbitrage relations between one another. So the ground comes back into play and it grounds derivative prices on a pricing kernel, that is to say, it re-establishes the hierarchy and the structure by imposing the necessity of fixed states of the world and of the corresponding Arrow-Debreu prices as the building blocks of derivative valuation. Yet the ground, or derivative pricing theory, has no other purpose, ultimately, but the trading

of derivatives. (What else do we need a pricing tool for?) This means states of the world cannot be fixed, for if they were, some derivative would ultimately be perfectly replicable by some others, and therefore would not be allowed to trade on its own and have a market of its own. As a matter of fact, traders in practice keep turning the ground head down on the floor. They use their theoretical models in reverse, feeding them with traded derivative prices and inferring the underlying process that might instantly explain them, through calibration. It is as if the floor was always returned to as the ultimate ground, and the grounding power of the theory was used to re-construct and re-write a plausible theory or process rather than to produce derivative prices.

The market

Calibration is recalibration. The changing nature of the floor (what good would a market be if it did not change?) therefore imposes a perpetually moving ground. Not only is the underlying process always recalibrated, or rewritten (as if the derivatives were now in turn “writing” the underlying instead of being written on it), but the whole market dynamics, in a word, the whole market, now receives a broader and quite revolutionary redefinition. Indeed, I will no longer call “the market” the dynamics that was postulated at the start as our initial underlying stochastic process. The “market” will now be *the process of change of the ground, based on the change of the floor*. The market will be the recognition of the fact that the newly priced derivative trades on the floor and that, if it so trades and is validated by the floor, the real dynamics, the real market dynamics, will now be the dynamics of recalibration. Acknowledging a derivatives market is acknowledging both the fact that derivative pricing theory is needed for trading and the fact that derivative trading will devastate the theory and keep rewriting it. The market is located in neither one of the horns of this apparent dilemma, not in the ground as such (as safeguarded from the floor) and not in the floor as such (as uninformed by the ground). The market resides in the hinge.

But then it won't just be the underlying as we know it that will get rewritten by the market. If derivative pricing were just an ordinary theory

Traders in practice keep turning the ground head down on the floor. They use their theoretical models in reverse

arguing from a theoretical model (for instance Brownian motion with constant volatility) to an observable consequence (the option price) and if the market were just an ordinary empirical reality in charge of submitting the theory to the trial of experimentation, then the next deviation of the observed option price from the prediction of the model would just be a case of ordinary falsification and would pose the ordinary problem of induction. The situation is here different in that (a) the *purpose* of the pricing tool and model and theory is to trade the derivative, (b) trading the derivative presupposes dynamics at variance with the initial dynamics: for instance, option trading presupposes that option prices will vary in their market independently of the underlying, contrary to the assumption of constant volatility² and (c) the market, where the derivative is immersed, is ultimately no different from the original market. (This is saying that the floor admits of no levels.)

It is the underlying lying *underneath* the underlying which will also get rewritten by this peculiar twist of the market, and by that I mean, not the underlying from which the derivatives derive, but the whole underlying metaphysics which enables the derivation of derivative value, the whole representational framework where we can proceed with the grounding science and claim: “If the underlying process is such, *then* the derivative price will be such.” The very logic of derivation, which is underlying the fact that derivatives derive from their underlying, is here questioned and rewritten.

Derivative and underlying

I will therefore call “underlying,” not just the underlying which the derivatives derive from, but the underlying metaphysics itself, even more generally *metaphysics* as the archetypical underlying thing, the thing that has always been

underlying, metaphysics *as ground*. And I will call “derivative,” not just the derivative which is written on the underlying and whose trading in effect keeps rewriting it, but the derivative as always already engaged in trading, the derivative *as market* whose possibility, we saw, is equivalent to the rewriting of the logic of derivation.

The problem of induction poses no threat to deductive logic or the ground that it is based on. At best, it shows empirical reality to be separate from it, and irreducible to it. It doesn't put into question the idea of underlying and derivation, or the hierarchy that they presuppose. Only when it is exposed and pulled back to the surface of the floor by the very thing that derives from it, namely by the derivatives *as market and floor*, can the idea of the underlying be shaken. Thus the market and the writing that is attached to it (the writing of derivatives and the trading of derivatives as rewriting) will have found a way both to say: “If the underlying price is S , then the derivative price shall be $V(S, \dots)$ ” (the derivation) and to say it for the *sole purpose* of the derivative ending up trading – which means that it shall leave the ground and return to the floor, that it shall overturn the hierarchy of the derivation.

To put it in even more original terms, I will say that the underlying has always been given first (its process has always been written first) and this is so by its very nature. The underlying is what *lies under* and for this reason it is laid down first. At the same time, the ground is also laid down first, and it is composed of two sides: the very nexus linking the underlying to what it is meant to underlie, or the underlying-derivative duality, and the representational framework which allows us to fix the underlying in mind (this is what “given” means), to pin it down in fixed states of the world, and later to say: “If the process of the underlying is such, then the value of the derivative will be such,” in a word, the very logic of deduction and derivation.

Probability is the best trick the ground has come up with to re-cover the floor; to try to reincorporate the derivative within the continuity of representation that it was meant to break

When the underlying is so fixed and so present (and by “underlying” I now mean both the underlying and the logic), and when the ground is so pervasive and so complete, the only thing that can be truly derivative is something that will therefore be cast away, something that will be sent off, away from the present of the underlying and the completeness of its space. It is something that will be deferred and differentiated, postponed and fractured, something that will only pay off in the *future* and in a *fraction* of space. Literally a derivative whose only reason for being *written* (where “written” means that it is not yet a claim laid out in the open, that it is encoded in writing only to be disclosed later, that it is not meant for the present of time or the integrality of space) is to pay off at a later time and not right now, to pay off conditionally and not absolutely:

$$V(S,T) = S - K \quad \text{if } S > K, V(S,T) = 0 \text{ otherwise.}$$

What I am trying to do here is give the notion of the derivative the most original reading that I can, by reaching all the way back to the meaning of “underlying” and finding, by way of consequence and derivation, what “derivative” shall mean. If “underlying” really means fullness of time (the present), fullness of space (the states of the world), and fullness of ground, then “derivative” shall mean: a later time, a lesser space, and, as we shall see, a shifting of the ground, a continuous displacement or drifting of the ground (*dérivée* also means “to drift,” in French), what we have called the floor, or the market. I will call this maximal reinterpretation of the derivative, its *original* interpretation.

Probability

And now you can see how probability will come about in my original interpretation of the derivative. When the derivative is recognized to be everything that *derives* from the underlying, in the sense of drifting away in space and in time and literally *differing* from the present and from the fullness of states of the world, probability is created in order to pull back the derivative to the ground and make its value strictly derivative on the states of the underlying (literally by enforcing mathematical derivation); in other words, in order to assign to it a *present* value.

Probability is the best trick the ground has come up with to re-cover the floor; to try to reincorporate the derivative within the continuity of representation that it was meant to break. It is here to bring back into power the logic of the grounding and the foundation; to reinstate the logic of the derivation, which seems so very much adapted to the derivative.

When the derivative is meant to escape the presence, both in time and in full space, of the states of the world (through being deferred and only conditional), probability is ordered to bolt it back to the states of the world. As such, probability belongs in the grounding domain and is at one with the grounding character of the ground. Probability is the only way that the present (the present of the representational schema and of the fixed states of the world) can look into its other: into the future and contingency.

Writing, trading and presencing

All is well and probability will play this grounding role so long as the market is kept out of the picture. We saw that the underlying, in our

maximal sense of fixity of the present, fixity of the states of the world, and fixity of the logic of the derivation, could only generate, as *derivative*, the derivative in our maximal sense of the thing that keeps escaping the present and the unconditional. (For this reason, derivatives are said to be *written* on the underlying; for the reason that writing is what is not present but to be disclosed later, what is not full and selfsame but fractured and programmatic.)

Derivatives were *written* so they could be sent away. This is so by their derivative nature. They are contracts that would be opened and honored later. Promises the underlying sends over to itself in the after-present, in the afterlife. However derivatives were not sent in order to be dismissed; and they were not written for the sole pleasure of writing testaments. If writing derivatives were only a matter of naming a future date and naming conditions under which the underlying would pay off or not pay off, then nothing would be achieved. It would all remain an immaterial overlay, a mere play on words or just a re-coloring of the states of the world.

In fact the underlying, at about the same time that it produces the derivatives (as if with the back of the hand, as if they were only the fallout of what is so present and so full in the underlying), will have produced an emergency which has *now* to be addressed and attended to. For if representation (the present of the ground) produced derivatives only dismissively and derivatively, then indeed all it would have to do is assign probabilities to the future states of the world and compute derivative value as a mere static expectation. However derivatives were mainly written to be traded, and to be traded right now. What purpose would the industry have in distinguishing a certain future date and distinguishing a fraction of space other than lifting them from the indistinctiveness of their sending and seeing the difference that they make *today*?

Yet this presencing of the derivative is by definition different from the presencing accomplished by the ground. What I am saying is that derivatives, although they seem to derive so naturally and so dismissively from the underlying (for

they are just a fraction of its time and a fraction of its space; they are already all subsumed in the idea of presence to mind of the process of the underlying), although they seem to bring only a supplementary confirmation, as a matter of fact, a *derivative* confirmation, to the grounding power of the ground (for the grounding representation of states of the world and probability will then only play the episode of derivation of their value), are in fact destined to the floor.

Earlier I said that the purpose of derivative pricing theory (the ground) was to trade derivatives. Now I am going up one level. I am saying that the whole purpose of derivative writing (which a second ago seemed so residual, relative to the underlying) is to trade derivatives to begin with, and to trade them *right now*.

If the *written* is what escapes the grounding character of the underlying (both in the sense of the underlying process and the logic of derivation) then probability cannot be written. Even though it seems concerned with the future and with contingency, it cannot really deal with what escapes. It belongs to the ground and is harnessed to the representation of states of the world.

Derivatives *are* written; and if they are indeed written and distinguished and remarked in order to be presented, then they cannot be presented by probability. They can only be presented by this counterpart of writing which is trading. *Trading* as the rewriting of the underlying process of the underlying. Trading as the marking of the derivative to the floor. The *floor* as the ground of recalibration.

What is so original about the floor is that it makes the derivatives present. It doesn't make them present to mind or to representation like probability does, but present through the effectiveness of the exchange. On the other hand, the reason why derivatives were originally written is that they be traded and presented on the floor. Between the writing of derivatives and the rewriting of the floor there is, therefore, no gap and no time for representation. This is the *logic of the derivative* finally coming together. It has nothing to do with the logic of derivation as we saw it, or the brief passage of probability. *Probability has nothing to do with trading.*

The market as technology

The market begins with the derivatives. It resides neither in the ground (the underlying stochastic process) nor in the floor (the indistinctive trading of everything). It begins at the moment when the derivative, as lately priced by the theory and the logic of derivation, trades on the floor by virtue of this pricing and exchanges the floor for its ground. It begins at the moment when the derivative, as lately harnessed to the states of the world by probability, accomplishes its written destiny (the destiny of being written) and debases the ground by shaking the fixity of the states of the world. This is the *original* moment of the derivatives market, and the derivatives trader deals with the derivative at exactly this moment.

If states of the world were fixed and probability distributions were known, some derivative would be redundant with the existing stock (of derivatives) and there would be no point in writ-

This is trusting the ground so blindly that, from prices that are so in the market (as if prices were in the market to hold), we believe we can imply the future distribution (as if the future could be deduced)

ing-trading-it. Markets were created in order that such derivatives might always be traded-written. This is so despite the fixed representation, or ground, which grounds their value and lays down the underlying hierarchy. The very idea of a market is the idea of this “despite.” In its very *being* (anagram of “begin”), the market stands opposed to representation. It is what derives from, what derives off, representation. When all has been done and said about representation, even its end (the logic of derivation and probability), what more can be said is the market. The market starts after the end of representation. It is the end that can start. If being and thinking are to be related at all, I would like to say of the market: “*It is not what you think.*”

The market is forward-looking. In it perhaps lies the definition of the future (and not in the metaphysics of time which is a heritage of representation and the presence of the ground). The market is trusted because of the future, not because of the so-called “market consensus” and “equilibrium theory” which are just backward computations based on the fixity of states of the world, that is to say, on the past. The floor is the realm of validity because it is the realm of the tradable. The tradable is what can be exchanged and parted company with. Tradability is the capacity *not to hold* (something); typically, not to hold any statement to be true. This is a very strange kind of validity indeed, based on the exchange and non-coincidence rather than identity and presence.

The market doesn't *know* the future. From derivative prices, it is indeed tempting to invert the pricing model and infer the probability dis-

tribution “the market is implying.” But this is even worse than the foundation. This is the exact contrary of exchanging the ground for the floor (which, like we saw, was the defining moment of the market). This is trusting the ground so blindly that, from prices that *are so* in the market (as if prices *were* in the market to hold), we believe we can imply the *future* distribution (as if the future could be deduced). Between the two modalities that are remotest from presence, the market and the future, we try to build a bridge all cast in presence and representation and – what's even worse – we try to walk it inverted!

The market is the *technology of the future*. It is what makes the future *work*, and work today. It does so because it trades derivatives (non full

and non present, literally written) and because it trades them today. This trading capacity of the market (always a reason why the floor should ultimately replace the ground) is rooted in tradability. Tradability is the opposite of foundation and re-presentation and ground control. It is essentially an exchange and, as such, it twists free the locality of time and space (which is another name for their measurability, another facet of their representation and presence to mind).

As technology, the market *replaces* the future, or rather, its replaces its knowledge. When we think of the future, we automatically think of its knowledge. (What could the future be, other than something we do not *know*?) The market proposes a way of thinking of the future that is no longer mediated by knowledge. Since thinking of the future is thinking of its knowledge, it is more accurate to say that the market proposes another way of dealing with the future, which is to *deal* with it right now, in a derivatives exchange.

The market doesn't know the future, or think the future, or re-present it. The market re-places

Technology is neither located in the dead goal nor in the sum total of components because it is, first of all, a reflexive sight

the future, that is to say, it relocates the future in the present day, only not in the presence of the ground or the presence of representation or economical forecast. Rather – and here, in essence, lies the *exchange* – future and derivative trade on the floor and the only business the market has in trading derivatives is to *then* go ahead and trade derivatives. (Its business is not to get absorbed in knowledge or to infer probability distributions.)

Above all, the recourse to technology *replaces* my problem. Or rather, it re-lifts the problem and relieves it (*relève*). The market as representable process and states of the world, derivative pricing as probability calculation and present value, and statistical inference as knowledge of the future extracted from derivatives markets, or worse, from the past, all these received ideas break down

in my philosophy because of the breakdown of their common denominator: representation. I end up with two broken modalities, the market and the future, that I need to patch up *outside representation*. When I say: “The market is the technology of the future,” this not only short-cuts the problem and reassembles it, but it lifts the problem up and sublimates it through the novelty that is contained in the word “technology.”

Space technology

To my mind, the space program is the *prolegomenon* to any future technology. I do not believe its goal is to go to the Moon, the actual dead celestial body, but to attain the following sentence in our language: “Man has walked on the Moon.” Therefore I will no longer worry about the prize that the astronauts bring back from the Moon, the collection of stones, the records of astronomical or selenological observations, etc., but only what the implications should be, in our lexicon and our grammar, literally in our *agora*, for the walk on the Moon to be possible. In a word, I worry what it *means*, and what

this involves, to walk on the Moon.

“To walk on the Moon” is a very simple sentence. For quite a long time, it was even just a metaphor. When I say the purpose of the whole Apollo program was to produce that sentence, I do not mean to discount the complexity of the underlying technology. On the contrary, I make the final payoff as lapidary and symbolic as possible (you can simply represent it with an arrow pointing in space towards a sphere) in order to polarize the technological field towards the simplicity of its purpose, in order, really, that each tiny detail and procedure and protocol of the flight mission, that each individual component of the rocket, of the Command Module, the Service Module and the Lunar Module, be directed towards the historic intention of man,

and that we may say: “It takes nothing short of all this for man to go to the Moon.”

Technology doesn't take place in outer space. It doesn't reside on the far planet that the spaceship has orbited, or upon the extraterrestrial surface the astronauts have walked. It is not summed up by its goal, even when the goal is achieved. It does not reduce to the technological means either, to the sum total of circuits and modules and components that have landed man on the Moon, no matter how complex they may be. Neither by the picture of Neil Armstrong's footprint in the lunar dust, nor by inspection of Saturn V and all the equipment it freights into space, are we, therefore, offered the sight of technology.

The rocket is sent into space to attain the states of the world it is destined to, at the scheduled time. It is launched and gone and is no longer here. If everything goes according to plan, it will eventually reach its target. In this sense, the rocket is derivative and it passes. Even though the completion of the mission still lies ahead, the rocket is past history. Its combustion phases, its burns and final jettison – its whole trajectory is a settled matter. It is not alive with technology. It is a sending, something that goes according to plan. Likewise, the footprint on the surface of the Moon is an inscription, a postcard man sends over to his descendants. It is the trace of him walking on the Moon, a derivative payoff finally attained. It is not vibrant with technology.

Technology is neither located in the dead goal nor in the sum total of components because it is, first of all, a reflexive sight. The technological question is the question that looks back at itself and wonders: “Every such detail of the Apollo program is needed in order to land on the Moon; it takes nothing short of all this to land on the Moon!”

Mission control

The stage of technological representation (the stage where technology can play itself to itself, where it literally presents itself to itself, or in short, *re-presents* itself) is Mission Control Center. It is located back on Earth; it is a large dealing room, an *agora*, a market-place, full of controls and buttons and speakers and microphones and

filled with people, competent users of the language. Every component of the spaceship, every phase of the flight, is here reflected in a multitude of checklists and cross-checklists. Every detail has got its monitor, every sequence of activities its Go-NoGo criteria and decisions. Here technology keeps questioning itself, monitoring itself, and replying to itself.

The spacecraft may have taken nine years to design and build, and the astronauts may be traveling through space to the Moon, but it is really in Mission Control Center that technology is staged and represented. Ground control is its stage director. It speaks the language of technology, as technology is made live and vibrant through the series of casts and returns that is characteristic of control. As far as the living language is concerned, we do not care what words the astronauts may be speaking right now in their space capsule, or what endless notes the engineers, who have designed the spacecraft, may have logged in their logbooks. For all we care, the whole Apollo 11 mission may as well be staged, and Neil Armstrong setting foot on the Moon actually filmed in a studio back in Houston. All we really care about is that the following sentence: “Man has walked on the Moon,” become part of our language and, to really trust so, that we actually witness the vast network of coded terms, procedures and checklists that make this sentence possible. This much action is taking place in Mission Control Center. It really displays the meaning of the sentence. It shows how complex this sentence is.

For this reason, I don't think that man really intended to fly to the Moon. With Apollo 11, he really set out on a journey into his own knowledge. The more distinguished and unmistakable the target (the *Moon* for God's sake!) the broader the stage where knowledge is first decomposed and then reassembled, the more enticing the breakdown of knowledge into routines and sub-routines and procedures and protocols and simulations and criteria, and the more rewarding the fact that it all comes back together every time mission control *re-presents* the technology and confirms everything is going according to plan.

Apollo 11 (11, for short) is the perfect example of technology being embarked on its own

sightseeing tour. Everything here seems under (ground) control. Each detail that is embarked on the mission is directed towards its end. Every detail here counts, as the job of mission control is to constantly remind us that, indeed, it takes all this to go to the Moon.

Technology is made present by the “re” of reminding and re-presenting – the “re” of return and reflexivity. The circuits of return and reflexivity are visible in Mission Control Center and nowhere else. The mission to the Moon is above all a reflexive voyage. For this reason, it is essential that the astronauts be brought back home. However this is not the main goal. (In the 1960s, some articles used to debate the issue whether astronauts should not volunteer to remain and die on the Moon and save us the technological cost of the return to Earth.³) As long as the goal remains to go to the Moon, every single detail counts inasmuch as it points to the Moon and is part of the embarked technology. Ground control can look back at itself and re-present all the possibilities and the states of the world that are smoothly unfolding. An essential part of its control is stochastic control. Probability here plays its normal role; it belongs to the ground. By constantly making corrections and by forecasting a million ways that things can deviate from their assigned states, yet won't deviate thanks to the re-adjusting power of control, ground control expresses itself and re-affirms its mastery.

13

11 is thus the symbol of ground control and representation. It is the repository of probability and presence in the sense of re-presentation, the illustration of the “re” of return in the good sense of repetition and rehearsal and simulation.

However the circuits of technology and ground control, as visible in the *agora* of Mission Control Center, will have also produced a *floor*. 13 will succeed to 11, and the return of the astronauts will be its main theme. A different kind of return, though: not a return in the good sense of repetition and representation, not a return as piggyback on the initial sending and initial expectation, not the handsome return that technology expects from the states of the world it has itself charted and the probability it has assigned.

To pose the problem of the return *as such*, that is, *as unprecedented by the ground*, you need of course to leave the ground first, but you need second to leave the grounding power of the ground, to forego the return in the weak and derivative sense demanded by control, to cancel the technology and the very vehicle of your outward journey. In a word, you need to “lose the Moon” like the astronauts of Apollo 13.

Yet you remain inside your vehicle. The arrow is broken and the circuits not long ago full with the intentionality of the mission are shut down. You remain inside a disoriented technology, where every piece is mute and almost mysterious. Yet every detail now counts, but in a different way. It no longer counts as an indispensable piece of the overriding mission to go to the Moon, but as an individual, almost individualistic, piece of the overhaul that will follow. “I want you guys to find every engineer who designed every switch, every circuit, every transistor and every light bulb that is up there,” orders Gene Kranz, the flight director, to the staff of mission control right after the incident. “Then I want to talk to the guy in the assembly line who actually built the thing.”⁴

What will follow is a complete revision of plans and a remapping of the technology. “I want you all to forget the flight plan,” says Gene Kranz. “From this moment on, we are improvising a new mission.” By this time, the control room has become a real market-place where operators speak their mind and converse outside pre-established protocol. The only state now is the state of technology as *presently* and massively and almost mysteriously available to the astronauts of Apollo 13 (“massive” in the mineralogical sense of “not being visibly crystalline,” or the geological sense of “having no structural divisions”⁵) or, which comes down to the same, the state of effervescence of the floor, down in Mission Control Center. Hardly does this qualify as a neat “state of the world.”

My point is that the floor, once again, has overtaken the ground. And probability, or representation of states of the world, can be of no help. 13 is the explosion of the nice probabilistic set-up of 11. Design, control, and technological intention have been overcome by a massive and

unforeseen actuality.

I am not really interested in how unpredictable the event was. I am interested in the course of events that will follow the collapse of the states of the world. Once again, it will all take place on the floor, down in the control room.

To try to reconstruct in thought the chain of events that supposedly led to the accident (the explosion of oxygen tank #2), you can read the NASA mission report⁶, if you wish. This is analyzed in three phases.

● **Initiation:** “The evidence points strongly to an electrical short circuit with arcing as the initiating event.”

● **Propagation:** “There is enough electrical power in the tank to cause ignition in the event of an arcing short circuit in defective wire ... There are materials within the tank that can, if ignited in the presence of supercritical oxygen, react chemically with the oxygen in the heat-producing chemical reactions ... Combustion caused the pressure and temperature increases recorded in oxygen tank #2 ...”

● **Loss of Oxygen Tank #2 System Integrity:** “Combustion within the pressure vessel ultimately led to localized heating and failure at the pressure vessel closure ... Release of the oxygen then began to rapidly pressurize the oxygen shelf space of Bay 4. If the hole formed in the pressure vessel were large enough and formed rapidly enough, the escaping oxygen alone would be adequate to blow off the Bay 4 panel ...”

Then a paragraph, entitled “Understanding the problem,” follows in the report. It begins thus: “In the period immediately following the Caution and Warning Alarm for Main Bus B under-voltage, and the associated “bang” reported by the crew, the cause of the difficulty and the degree of its seriousness were not apparent.”

Notice the euphemistic vocabulary of the report: “loss of system integrity,” “localized heating,” “would be adequate,” “the difficulty.” It is as if 11 technology was struggling with the terms that have long been adapted to describing its familiar states of the world and foreseeable scenarios (the technological terms that have always been an integral part of the numerous checklists and simulations) to try to push them out of place,

What arrests me here is the fact of the technology itself, technology as unmoved and uninformed by design, the sheer assembly of parts and wires and circuits and thrusters and tanks and canisters as it hangs there in outer space, waiting

and was not succeeding in doing so, or in a word, in calling an explosion an “explosion.”

As a matter of fact, for a lapse of several minutes, ground control was convinced the incident was only an instrumentation problem. “In the Mission Control Center, writes Kranz⁷, you can't see, smell, or touch a crisis except through the telemetry and the crew's voice reports.” At that point, instrumentation was showing a quadruple failure on board the spacecraft, so to the eyes of the ground controllers this had got to be a failure of instrumentation! In fact the simple explanation was that an explosion had simultaneously caused the failure of the corresponding organs. “Nothing remotely like this had ever happened in simulation,” writes Gene Kranz. “Everything we knew about our spacecraft, all that we had learned about the design, precluded the kind of massive failures we were seeing.” The NASA mission report continues: “Controllers asked the crew to re-power instrumentation in oxygen tank #2. When this was done, and it was realized that oxygen tank #2 had failed, the extreme seriousness of the situation became clear.”

Gene Kranz

So much for the causal explanation and the state of minds of the protagonists before and after the fact. Like I said, I am not interested in the knowledge of probabilities, or the knowledge that the astronauts or the ground controllers may have had, before the incident, of the *design* of the spacecraft and of what it can and cannot preclude. What arrests me here is the *fact* of the

technology itself, technology as unmoved and uninformed by design, the sheer assembly of parts and wires and circuits and thrusters and tanks and canisters as it hangs there in outer space, waiting. I speak of an “explosion of probability,” not only because the explosion of the oxygen tank instantly collapsed to null all the projected states of the mission and its control, but because the explosion, in a sense, also multiplied the states of the world.

So let us forget about design and projection for a while. Let us consider the spacecraft and the state of the technology as stripped of design. What fascinates me is that the same combination of parts and wires and circuits (the spacecraft) can, when it is rid of the element of design, be the cradle of the explosion, and that it can, when it is *also* rid of the element of design, be the cause of salvation. The turning point of 13 (when the ground turns into the floor) is when the Lunar Module, which was designed to land on the Moon (not to bring the astronauts back to Earth) becomes their lifeboat and return ticket. This is the moment when Gene Kranz, who a while ago was able to write that all he had learned about the design of the spacecraft precluded this massive failure, erupts: “I don't care what anything was *designed* to do. I care what it *can* do!” My question: Where does that leave the states of the world and probability?

The one and same massive actuality which had overwhelmed design and control and probability will now be the ground (or shall I say “the floor”?) of the strategy to bring the crew back

home. There is a *capacity*, in technology, which exceeds design and cannot be accounted for in terms of possibility or the corresponding array of states of the world. In the market, we recognized this capacity as tradability: the capacity not to hold something. In Kranz's case, we can say it is the capacity not to hold something for what it was designed for. From the moment Kranz engages technology in *this* capacity (which is almost contrary to previous design, and even the idea of design), he turns into a dynamic trader. "It was never tried before; we've never even simulated it!" exclaims one of the flight controllers. Why, indeed, would anyone want to simulate a flight back to Earth, powered by the LEM? What would be the point of *simulating* it beforehand? Proving how this can be done? And to what purpose? This is different from doing it in actuality for the *purpose* of bringing the astronauts back home.

By "dynamic trader" I do not mean the trader who rebalances his hedges according to plan, in the manner provided by his stochastic control solution. I mean the *floor* trader who faces the dynamics of recalibration which, by definition, cannot be accounted for by probability.

The market, I said, stands opposed to representation. It is a succession of failures of control and representation, due to the very usage of the technology and the very application of derivative models to trading. This endogenous trait led me to uplift the whole problem and to call the market the "technology of the future." To make use of this superior technology, no longer based on ground and representation but on the floor, the dynamic trader has to be immersed in his market; he has to be a performer, not a distant observer or a controller. He himself becomes part of the process of creation of states of the world, or even its trigger, as in Kranz's case.

Gene Kranz is an anti-Black Swan trader. When unexpected events hit him from outside (events not even accountable in the representational framework underlying probability), he responds from the inside, with equally unexpected solutions, which are equally foreign to design. As obstacles keep emerging, distracting the astronauts from their safe return (oxygen tank explosion, shortage of power, CO₂ build-up in the cabin), he does not respond with corrections

in the old-fashioned style of 11 technology and control. Using the same available technology, but flipped on the 13 side, he on the contrary turns every obstacle into an occasion to create new states of the world, and then to apply to them a 100 per cent probability of success: "Failure is not an option."

At the very beginning of the incident, when pressed by the president of the United States to quote him the odds that the astronauts would return safely, Gene Kranz significantly answers: "We're not losing the crew." When asked again, he answers again: "We are not losing those men." I don't think Kranz refuses to give a quote. He simply can't. From where he stands – and he stands right in the middle of the floor, right in the middle of the technology which he uses performatively, not representationally – there is simply no meaning to probability. Kranz does not *know* the odds, because he has no idea what states of the world he will have to invent next, out of the mute assembly of technological components waiting out there in space or similarly around him on the floor of ground control, in order to address the next problem.

He doesn't know the odds, yet he is not "uncertain" of the future outcome. And we cannot say that he is "certain," either. As a matter of fact, his answer gives no hint of knowledge, or even of the future. It expresses a present, actual, massive, state: "We *are not* losing the crew." the only state of the Kranz's world. When asked again, he *repeats* it.

Successful failure

There are, therefore, two cases where one cannot assign a probability number meaningfully: essential uncertainty, where the probability distribution cannot be known due to the inherent limitation of our finite knowledge, and what I like to call, following Kranz, "essential actuality," where the probability distribution cannot be known due to the complete takeover of epistemology by performativity. Both are cases of failure of knowledge. However the second is a *successful failure*, the very name the Apollo 13 mission was dubbed.

As recalibration is the heart of derivative technology and essentially the failure of the given model, I like to think of derivative trading

as a series of successful failures. As both ground and floor are needed, it is a series of 11s followed by 13s. 13 can only succeed to 11, for it is the flip side of the same technology: capacity as opposed to design, performativity as opposed to representation. And from there, it can only succeed.

If 11 is the end of technology and probability (i.e. their goal by design), then 13, the market, can only succeed to the end. It is the end that can start. It starts, because it is unconceivable anyway, under the *logic of the derivative*, that the states of the world should be embarked, once and for all, in a closed ship and a round trip mission, in a representation that would close itself off in its own reflexivity and control.

FOOTNOTES

[1] ITO33 SA, 36 rue Lacépède, 75005 Paris, France, e-mail: numbersix@ito33.com

[2] This is quite a general observation, even though my statement seems specific to Black-Scholes. Indeed, any advanced stochastic volatility / jump-diffusion "smile model" admits of a certain number of theoretical parameters (volatility of volatility, correlation between volatility and underlying, intensity and size of jumps, etc.) that can be calibrated against a certain number of liquid derivative instruments, and then it imposes the price of the more exotic, or less liquid, derivative instrument by way of dynamic replication using the liquid ones. This contradicts the fact that the exotic derivative stands to be traded on its own (why would it be invented if it was redundant with the existing instruments?) independently of its "underlyings" (the liquid instruments that replicate it in the given smile model).

[3] *Paris Match*, April 3rd 1966.

[4] *Apollo 13* (the movie), starring Tom Hanks, Kevin Bacon, Bill Paxton, Gary Sinise and Ed Harris, directed by Ron Howard, based on the book *Lost Moon* by Jim Lovell, captain of Apollo 13, Universal Studios 1995.

[5] *Oxford English Dictionary*.

[6] *Apollo 13, The NASA Mission Reports*, compiled from the NASA archives and edited by Robert Godwin, Apogee Books 2000.

[7] Gene Kranz, *Failure Is Not An Option, Mission Control from Mercury to Apollo 13 and Beyond*, Berkley Books, New York 2000.