Of Synthetic Capital

Outline of a Research Project

When one hears of a research project whose purpose is to construct a non-Euclidean history of finance, and which employs as its analytical instruments Klein's mathematics of group theory and Deleuze's philosophical renovation of the mathematical concept of difference, one is surely justified to request some additional preliminary elaboration.

A principal insight of the group theoretic approach to non-Euclidean geometry is its observation that the motions of geometric transformations can be arranged as a series of equivalence classes. These classes characterize a variety of behaviors of geometric figures when in motion from one to another place in space. Collectively, they comprise the total group of automorphisms.[1]

An equivalence class is defined by its domain of action and respective symmetry group: for instance, its domain of action might be a zero-curvatured Euclidean plane, whose geometric figures congruently transform into their image; in this case its symmetry group is either the rigid motions of isometries, or similarities, depending on the invariance requirements placed on the metrical properties of its figures. Or its domain of action might be a curved non-Euclidean space, whose geometric figures are capable of any variety of non-congruent transformations into their image, insofar as their motions are not rigid, and thus do not require a preservation of the original metrical properties of its figures. It is no overstatement to assert that the sticky ontological problematic of Euclid's parallel postulate is the historical leaping point for the 19th century geometer's wager that the gambit of congruence will collapse if the properties of geometric figures are not invariable in their course of transformation.[2] For if there are exceptions to the Euclidean theorem that parallel lines *always* hold, so too this compromises our conception of space as metrically-fixed, rigid, homogeneous, absolute. And if this conception of space is shown to be not so much always false as only sometimes true, we are left suspicious of the essentialist model of representation implied by its conservative invariance requirements.

Of course, already with the birth of finance we are greeted by the knowledge that economic objects do not always congruently transform into their image in the course of their exchange. For this reason, our non-Euclidean history of finance commences with the observation that in the earliest of debt-transactions, in the Paleolithic era, we see a loosening of the strict invariance requirements placed by classical forms of exchange on several important economic properties of the object –for example and most notably, the property of maturity (previously requiring immediate settlement), and a subsequent loosening on the volume of its image of value (in money)– at which point, the thought proceeds, if these previous invariance requirements on

[1] The reader who is uniformed of this mathematics is referred to two good introductions, found in I.M. Yaglom, *Geometric Transformations (Volumes I-III)*, Random House (1962) and H. Graham Flegg, *From Geometry to Topology*, The English Universities Press (1974).

[2] The locus classicus on the history of this confrontation is Roberto Bonola, *Non-Euclidean Geometry: A Critical and Historical Study of its Developments*, Dover Publications (1906). Among the more recent but capable histories are B.A. Rosenfeld, *A History of Non-Euclidean Geometry: Evolution of the Concept of Geometric Space*, Springer-Verlag (1976), and Jeremy Gray, *Ideas of Space: Euclidean, Non-Euclidean and Relativistic*, Clarendon Press (1989).

maturity and image of value can be loosened, while yet a symmetry has still been achieved and an exchange has occurred, why not the other invariance requirements placed on the properties of the object as well? The first observation of our project, then, which is a group-theoretic observation, is that if exchange is fundamentally the transformation of an economic object from one to another place in the space of exchange we call a market, we should be able to group different kinds of exchange into a series of equivalence classes; and in turn, these classes will describe the different behaviors of economic objects comprising the total group of automorphisms of exchange. For by adhering to the group-theoretic definition of an equivalence class as constitutive of a domain of action and symmetry group, we realize that the former is simply a market, putatively, which determines the invariance requirements imposed on of its symmetry group. And the further task of drawing conclusions from the non-Euclidean contribution to our project –namely, that *as* domains of action, markets constitute a continuum of economic spaces, but that those spaces need not be flat– is immediately revealed.

Now to be sure, in any act of exchange there is never a question of whether or not there is symmetry. In the first place, and economically-speaking, symmetry is simply an acknowledgement of commensurability or equivalence between the exchanged object and its image of value as price –and lacking this symmetry, no exchange will occur.[3] But we also know from group-theoretic contributions to other discursive, scientific, but extra-economic registers that there is much more to symmetry than this. How can the political economist fail to evaluate the suitability of application of these insights to our own register?

If we do, we will see that it is always a question of *how much* and *what kind* of symmetry marks any given equivalence class of exchange, and therefore a matter of determining what invariance requirements are placed by a domain of action on its respective symmetry group: we will realize that as invariance requirements are loosened the degree and kind of symmetry in a given class of exchange expands; and conversely, as the invariance requirements are tightened the degree and kind of symmetry of the class of exchange contracts. But it is also not the case that the economic properties of an economic object *determine* the symmetry contained therein; for in fact there *are no fixed* economic properties contained in and/or by any object, per se, since all economic properties of any object are only acquired *as* properties insofar as the object is in motion in a given domain of action; and we have already observed that the latter intrinsically defines the behavioral constraints, or invariance requirements, placed on the economic properties of the object, as it's transformed into its image of value as price –which is another way of saying that the mobile structure distributed as the space of the market determines its respective symmetry group.

How do we know this? If we follow an insight drawn from a group-theoretic approach to geometric transformations, we will define and measure the degree of symmetry of any process –in our case, the activity of exchange– by the number of transformations in a given class that leaves one or more (economic) properties of the (economic) object invariant. Accordingly, we will see that a non-Euclidean history of finance provides just as much insight for a group theoretic approach to the ontology of finance as the latter does for the former –and the answer to our prior question herein follows: once we acknowledge that the behavior of economic objects is not necessarily restricted by rigid motions (i.e. as if visually analogizing economic objects as geometric figures, whose movement into its image always runs along parallel lines), we

[3] By this we mean that lacking the subjective perception of objectival commensurability, i.e. symmetry, no exchange of objects (whether hot dogs, junk bonds, interest-rate swaps, and so on) for images of objects (money) will take place.

immediately see that we need not –indeed, it is reifying, Platonic, materially-conservative, and naïve to– classify economic properties by their objects, as if such properties in objects were inherently contained therein. The non-Euclidean insight is that there are no necessary or essential economic properties endemic to exchanged objects, since all economic properties are only even represented in these objects as a conditional side-effect of their class of exchange. Our group theoretic methodology takes its cue from this deduction, and proceeds to classify economic transformations by their degree of symmetry, therein realizing that we ought not search-out a set of inherent properties common to all (economic) objects –whether we're investigating geometric cubes and spheres, or generic financial assets, like debt and equity– since their properties are not statically 'in-themselves', as such, but only adhere to their objects insofar as they are affected by a transformation –namely, the transformation of exchange, as the object is transformed into its image of value as price. Therefore, economic objects are only classified and classifiable as *kinds* of economic objects relative to the transformation of their economic properties in the course of their exchange, i.e. as determined by their domain of action and respective symmetry group.

The first wager of our project is, therefore, that by identifying the kind of symmetry marking any given economical object, we will observe the invariance requirements of its domain of action, which will allow for its grouping in its proper equivalence class of exchange, from among the total group of automorphisms of exchange. Hence, when combined with this wager, the objective that follows is the construction of a non-Euclidean history of finance whose group-theoretic approach defines the various equivalence classes of exchange.

A sketch of an answer to the obvious follow-up question of *"by what manner do we proceed to accomplish this objective?"* already convokes our second observation.

Natural studies on symmetry illustrate the process by which differentiated structures progressively emerge as any given dynamical system or object develops. There is a qualitative difference between the undifferentiated abyss of indetermination and those progressively-defined, increasingly-distinctive zones of concentration and established polarities of position that always actualize by way of symmetry-breaking events.[4] For example, we see modern neuroscience speak of the self-amplifying fluctuations in synaptic density from an initially undifferentiated and spatially disordered brain, productive of the broken symmetry that results in neurocentral organization. Microbiologists studying the aggregation of slime-mold stress the importance of symmetry-breaking and entrainment for the progressive actualization of a multicellular organism. Embryological research on egg-fertilization emphasizes the organizational work of cleavage patterns, transforming a highly symmetric ooze into differentiated tendons and muscles, blood, brain, and bones. Cosmologists model the expansion-to-cooling phase of our universe to gain insight into the symmetry-breaking bifurcations that allowed for the differentiation of our basic physical forces (at the extreme high temperatures precipitating the birth of our universe, the four forces were yet one). Even geologists studying hydrological patterns are delighted to observe pattern-generating asymmetries of river-formation, as the dynamical flow of water bifurcates, inscribing its sculptures into the face of our Earth.

What repetition threads through the multitude of differences of these phenomena? On the one hand, there is no shortage of corroborating evidence from the science of morphogenesis that the metrical structures of such systems differentiate through a cascade of symmetry-breaking

[4] J. Maynard Smith and G. Vida (eds.), *Organizational Constraints on the Dynamics of Evolution*, Manchester University Press (1990); F. Yates et al (eds.), *Self-Organizing Systems: The Emergence of Order*, Plenum Press (1987)

phase transitions –as if all itemized actuality is the result of emergence from yet some virtual and undifferentiated, nonmetricized, topological space. And yet, on the other hand, they all concede that the price paid for a structure of order is the loss of white symmetry, an accruement of the burden of rigidity, a diminution in genetic fungibility –as if, in turn, a kind of fee charged by Charon for safe passage from the virtual to the actual across the river of potentiality is a renunciation of primal pliability, and the only accepted currency broken symmetry herself.

From one angle, and provisionally, our history is a rather straightforward morphogenetic narrative of the progressive differentiation of our financial system along this familiar storyline of symmetry-breaking at the origin of metricized structure. For example:

(i) *Classical Exchange*. First, we locate the earliest-known instances of exchange belonging to the equivalence class we call classical exchange in the Stone Age, and trace its increasing activity through the city civilizations of the ancient Orient, the beginnings of the Mediterranean civilizations of the early Iron Age, the polis economies up through Alexander, on into the reign of Caesars, and the late classical period.[5] We observe that Marx is our thinker par excellence on classical exchange, and use his careful examination of the relation of the becoming-commodity of the (natural) object to its (synthetic) value-form in order to observe a peculiar quality to exchange already betrayed by classical objects.[6]

However, to be sure, there is nothing exclusively "classical" about classical exchange – even if we are content to regard it as the most blue-collar, pedestrian, ordinary, and oldest of the groups of exchange. So if we proceed to develop our history up to, but then quickly past, an observation of the still-incessant ubiquity of classical exchange today (e.g. at the farmers market, hot-dog stand, and yard sale), our reader will ultimately know why: classical exchange consists of a congruent transformation, which occurs by way of the rigid motions of isometries, and isometries are defined as the absolute non-variability of the properties of the object into its image of value as price in a flat economic space. That is to say, classical exchange is what we commonly expect *of* exchange when no one is there to watch what we expect *from* exchange: classical objects isometrically move to and fro in an economic space, but their economic properties are otherwise always invariant under their variable rigid motion. We therefore need not overly-labor to theoretically exposit what we always already expect we mean by "exchange" –other than to labor to explain *why* this expectation is perhaps in need of some theoretical exposition. For this reason we commence our history with an account of the concept and practice of the kind of exchange belonging to the equivalence class of classical exchange.

(ii) *Generic Finance*. Secondly, we then back up in order to retrace our ontological trajectory through an historical exposition of what we label generic finance –and once again, up through its near-universal contemporary prevalence. As we alluded to earlier, already in the first instance of generic finance one witnesses the loosening of the conservative invariance requirements placed by classical exchange on the image of the value of the object: we see this plot repeatedly played-out from the earliest interest-bearing loans of seed and cattle among the Indo-Germanic, Semito-Hamitic, and Sumerian peoples of the Paleolithic era, to the increasing use of interest-bearing inorganic moneys of the 4th century BCE;[7] from the religious origins of

[5] Fritz Heichelheim, *An Ancient Economic History: From the Paleolithic Age to the Migrations of the Germanic, Slavic, and Arabic Nations* (Volumes I-III), A.W.Sijthoff-Leyden (1957)

[6] Karl Marx, *Capital* (Vol. I), Random House, 1977 (esp. see chapters 1-3)

[7] A.H. Quiggin, *A Survey of Primitive Money*, Barnes & Noble (1949), John Chown, *A History of Money From AD 800*, Routledge (1994), Meir Kohn, "Medieval and Early Coinage and Its Problems", Working Paper 99-02 (Febr. 1999), Richard Grossman, *Unsettled Account: The Evolution of Banking in the Industrialized World Since 1800*, Princeton University Press (2010)

banking in ancient Babylon, and the "irregular deposits" of classical Greece, to Bagehot and Stigum's modern money market;[8] from the legal codification of debt-practices by Hammurabi, to the colorful history of usury through the Middle Ages and on up through the global banking regime under Basel III;[9] and then through the evolving differentiation of contemporary dark pools from out of the trading of stock of ordinary shares once sold below a Buttonwood tree, to now the commodization of generic debt concomitant with modern (cash) securitization and its so-called shadow banking sector.[10]

We trace the progressive development of generic financial objects in their various guises, and seek to emphasize that although the motions of congruence are to classical exchange what the motions of similarity are to generic finance, these two equivalence classes, otherwise distinct, share in common the same Euclidean economic space we have labeled (for Deleuzian reasons that are clarified below) *flat space*: their markets are populated by objects whose intensive corollary is *numerical multiplicities*; they are rigid, metricized, and sedentary objects whose transformations involve the actualization of *classical symmetry* on a zero-curvatured plane of exchange. That they *differ in kind* from the nomadic objects whose intensive corollary is *qualitative multiplicities* will become clear throughout the course of our exposition. For insofar as qualitative multiplicities increasingly populate our financial markets today; insofar as they are nonmetrical and topological, but economic and exchangeable nonetheless; insofar as their properties may warp and twist, fold-over and bend under their variable force of motion: for all of these reasons, qualitative multiplicities actualize a different kind of symmetry that we have properly labeled *synthetic symmetry*.

(iii) *Synthetic Finance*. Lastly, we then back up our chronology once more –albeit, and necessarily so, not nearly as far as when probing the equivalence classes of flat space– to observe the inaugural moment and subsequent zigzagging historical trajectory of the ontological differentiation of the equivalence class of synthetic finance. We earlier alluded that Marx already detected a kind of synthetic property to classical objects that lay latent but virtual in the representation of their value (in part (i) of our project we elaborate that Marx's conservative Euclidean commitments, best witnessed in his concept of fictitious capital, preempted any further investigation by him of this passing observation –no doubt for fear of catastrophically stumbling upon a casket of dynamite for his own labor theory of value!).[11] And so if the equivalence class of generic finance differentiates itself from classical exchange by simply dropping the

---

[8] Benjamin Bromberg, "The Origin of Banking: Religious Finance in Babylonia", *The Journal of Economic History* (May 1942), A.P. Usher, "The Origins of Banking: The Primitive Bank of Deposit, 1200-1600", *The Economic History Review* (Apr. 1934), and *The Early History of Deposit Banking in Mediterranean Europe*, Harvard Economic Studies (1943), William Westermann, "Warehousing and Trapezite Banking in Antiquity", *Journal of Economic and Business History* (1930), George Calhoun, "Risk in Sea Loans in Ancient Athens", *Journal of Economic and Business History* (1930), Walter Bagehot, *Lombard Street: A Description of the Money Market*, Scribner (1873), Marcia Stigum and Anthony Crescenzi, *Stigum's Money Market*, McGraw-Hill (2007).

[9] Roger Orsingher, *Banks of the World*, Walker and Co. (1967), Jacques Le Goff, "The User and Purgatory", in *The Dawn of Medieval Banking*, Center for Medieval and Renaissance Studies, Yale University Press, (1979), Raymond De Roover, *Money, Banking and Credit in Medieval Bruges: Italian Merchant Bankers, Lombards, and Money Changers, A Study in the Origins of Banking*, The Medieval Academy of America (1948), and *The Rise and Decline of the Medici Banks*, Harvard University Press (1963).

[10] E. Victor Morgan and W.A. Thomas, *The London Stock Exchange: Its History and Functions*, St. Martin's Press (1962), Vinod Kothari, *Securitization: The Financial Instrument of the Future*, Wiley, 2007, K. Evans, "Bank Run Risk in Shadows", *Wall Street Journal*, Nov. 5th 2011, Masters and Grant, "Shadow Boxes", *Financial Times*, Febr. 3rd 2011, Masters, "Shadow Banking Sector Hits New Peak", *Financial Times*, October 28th 2011.

[11] Karl Marx, *Capital* (Vol. 3), Penguin Books (1981), especially see ch. 29.

congruency requirements for an isometric object, in order to allow for a similarity transformation, through which the image of value of the object as price can now shrink or grow, it is not an inconceivable move to loosen the invariance requirements on other properties of an object yet further still: this signals the birth into actuality of the synthetic object.

Now, it is both difficult and in some respect superfluous to attempt to *historically* pinpoint the first synthetic object. However, our history knows and speaks of Aristotle's report of Thales' brief but lucrative occupation with options contracts on olive presses (no doubt his material rejoinder to the haughty merchants who mocked his philosophical pursuits);[12] we take note of the Dojima rice futures exchange of the late shogunate period, and other early instances of both OTC and organized derivatives trading up through the 1973 founding of the CBOE, and subsequent rapid proliferation of modern standardized derivatives exchanges;[13] we can observe that already in the traditional intermediating function of the parallel loan the latent origin of the modern day swaps contract;[14] we even retreat to the medieval innovation of the "dry exchange" to observe the historical trajectory of the synthetically structured debt-note (e.g. credit-linked notes, etc.).[15] And this does not even begin to exhaust the subplots we relay in our history of synthetic finance.

So big picture, from this angle, the plot of our story isn't difficult to discern: from an undifferentiated and topological economic space financial objects arrive into actuality –they make, unmake, remake, and incessantly refine themselves; they progressively expand their extension in the world with the development of markets, pricing models, indices and other modes of metricization; they increasingly differentiate themselves *from themselves* in the process of becoming diverse and other (e.g. the medieval bill of exchange divides into itself and then the dry exchange as well; the parallel loan becomes itself and now the interest rate swap as well, which then splits yet into varieties of swaps (currency, compounding, equity, indexed-principle, etc.) with trillions of dollars in notional value; vanilla options become increasingly exotic; the CLO becomes the CDO, which becomes the synthetic CDO, and then develops standardized indices; and so on). In short, our narrative chronicles the many phase transitions from the difference of virtuality by way of repetition into the diversity of actuality by way of differentiation.

How then could we possibly fail to notice that our history of the actualization of finance speaks a dialect of the language by which the science of morphogenesis dictates to us its logic? Is our history not, in fact, another version of the common tale of the differentiation of material relations and metrical structures, of bifurcations and symmetry-breaking from out of that virtual white abyss of intensive, nonmetricized, topological space?

---

[12] Aristotle, *The Politics*, University of Chicago Press, 1984, 1259al

[13] Mark D. West, "Private Ordering at the World's First Futures Exchange", *Michigan Law Review* (Aug. 2000), "CBOE History" http://www.cboe.com/aboutcboe/History.aspx, Peter Bernstein, *Capital Ideas: The Improbable Origins of Modern Wall* Street, The Free Press (1992), and *Against the Gods: The Remarkable Story of* Risk, John Wiley & Sons (1996), Alfred Steinherr, *Derivatives: The Wild Beast of Finance*, John Wiley & Sons (1998), Perry Mehrling, *Fischer Black and the Revolutionary Idea of Finance*, John Wiley & Sons (2005).

[14] John C. Hull, *Options, Futures, and Other Derivatives*, Prentice-Hall (2009), Perry Mehrling, *The New Lombard Street*, Princeton University (2011) esp. ch.4.

[15] Raymond De Roover, *L'evolution de la letter de change (XIVe-XVIIIe siècles)*, S.E.V.P.E.N. (1953), and *Business, Banking, and Economic Thought in Late Medieval and Early Modern Europe* (ed. Julius Kirshner), The University of Chicago Press (1974), Janet Tavakoli, *Structured Finance & Collateralized Debt Obligations: New Developments in Cash and Synthetic Securitization*, Wiley (2008), Vinod Kothari, *Credit Derivatives and Structured Credit Trading*, Wiley (2009).

The answer to this question in the end may be "yes". However, we must be careful about what precisely such an affirmative reply denotes. For if we say that our provisional objective is an historical elaboration of the progressive differentiation of our financial system, we must immediately recall that our wager is to twist a non-Euclidean history through a group-theoretic approach. Here, then, in the course of attending to our book, our reader will become increasingly aware that if its angle of perspective appears to have suddenly shifted beneath the story of morphogenesis, it can only be because our narrative hook *that differentiation necessarily and always involves symmetry-breaking* proved both an unreliable assertion, and profoundly undertheorized from the very start. The line of thought that follows provides us with a rather counterintuitive observation, and is the second observation of our project.

Klein's Erlangen program formalized the consequence of the group-theoretic notion we discussed above –namely, that because any geometry is an equivalence class, and is therefore defined by its domain of action and symmetry group, the study of geometry is definable as the study of invariance under different kinds of motions.[16] Klein's groundbreaking insight, discussed below, was drawn from his realization that if a subgeometry of a given geometry is merely a collection of invariants grouped together as a subclass of the larger class of transformations, it follows that all theorems of the geometry of the subclass of transformations are already contained within, and continue to be valid theorems of, the geometry of the larger class of transformations. Klein began classifying Euclidean and non-Euclidean transformations (projective, affine, hyperbolic, etc.) according to this group-theoretic methodology, and found that projective geometry –as the larger class of transformations, richer in itemized elements, and hence comprising a larger symmetry group– is actually more fundamental than Euclidean geometry, since it concerns itself with qualitative and descriptive geometric properties that determine the formation of the standard, rigid, Euclidean geometric figures, without needing to make any recourse to the traditional metrics of Euclidean geometry. Moreover, Klein's treatment of the Cayley metric illustrated that all metrics of Euclidean geometry were actually *derivable* from projective geometry, and that therefore Euclidean transformations, its space and figures, proved to be merely a special case (in a hierarchical ordering) of the non-Euclidean geometries. Hitherto the widespread expectation had prevailed that Euclidean geometry comprised the universal class of transformations, while the non-Euclidean geometries were at best mere exceptions, at worst pure fictions; now it turned out that the former was a derivative of the latter!

Let us then observe. On the one hand, the application of Klein's group-theoretic insight to our own ontology of finance reveals that classical exchange contains fewer symmetries than generic finance, which in turn contains fewer symmetries than synthetic finance –not, of course, in the quantitative sense, for all three equivalence classes contain infinitely many exchange-transactions, but in the qualitative sense (i.e. as in a difference *in kind*), such that the first class is already contained in the second, and the first and second classes are already contained in the third. On the other hand, when we apply this same group-theoretic insight to the expectation of symmetry-breaking attached by the science of morphogenesis to the dynamics of differentiation, we will also see that if one class of exchange is a part of another, progressively determined class of exchange, we know that the smaller class of exchange is a more metricized but less fungible

[16] Felix Klein, "A Comparative Review of Recent Researches in Geometry: Programme of Entering the Philosophical Faculty and the Senate of the University of Erlangen in 1872" (July 1893). Also see I.M. Yaglom, *Felix Klein and Sophus Lie: Evolution of the Idea of Symmetry in the Nineteenth Century*, Birkhauser (1988), and Hans Wussing, *The Genesis of the Abstract Group Concept: A Contribution to the History of the Origin of Abstract Group Theory*, MIT Press (1984).

differentiated subclass of the less metricized but more fungible larger class of exchange: when a system, object, or class of transformations suddenly distinguishes a part of itself from itself to now become its other, we see and say that its symmetry "breaks", and this resulting state now forms a subclass of the symmetry group of the prior and overall larger class.[17] However, if symmetry-breaking truly is a material change to an equivalence class of transformations –i.e. from a larger and less differentiated system, to now a more differentiated smaller system, from a less metrical whole to a more metrical part of the whole, from the fungibility, pliant richness, and brilliance of white symmetry to the increase in rigidity and variety of colors infusing manifest actuality– we are struck here by a peculiar observation. For while a simple *linear history of finance* would appear to readily follow a standard *chronological* sequence of progressive differentiation, our *non-Euclidean history* reveals the unfolding movement of *ontological* expansion that yet results in an acquisition of increased symmetry. That is to say, when we compress our non-Euclidean materialist history of finance through a group-theoretic approach to the science of morphogenesis, we paradoxically observe as a bare fact the coming-into-being of what can only be called *the regressive differentiation of capital in its synthetic-systemic incarnation*.

Our second observation, then, which is an additional conclusion made available by tugging the insights of our first observation deeper into that of our wager, is that it is not the case that the progressive expansion of derivatives trading and general growth of synthetic financial markets signals some radical departure from a supposedly more "organic" logic of capital, which would otherwise consist of the generic exchange of non-synthetic and apparently "underlying" financial "referents". And it is not the case that the progressive expansion of generic finance, which preceded the derivatives revolution, signals some unnatural flight from the "more real" or (if one prefers the invocation of moral overtones) "true" exchange of classical exchange. Rather, because in both cases the latter proves to be a mere subclass of the former, we realize that the progressive differentiation of a system of synthetic finance is no twisted perversion from the so-called "normal" ontological development of our financial system, but from the very beginning –i.e. from the very first act of classical exchange– is already embedded within it as an organic condition of possibility. Albeit, and quite remarkably, *beneath the historical and ostensibly linear progressive differentiation of finance we are witnessing the ontological regressive differentiation of capital*. From an originally more metricized, geometrically-homogeneous, and flat economical space populated by rigid objects, we are now *regressing forward* towards a less metricized, more fungible, and topological economical space populated by synthetic objects. Indeed, our non-Euclidean history reveals that from a system of exchange initially founded on classical symmetry, we are now observing the differentiation of a system increasingly founded on synthetic symmetry, and that these two symmetries differ in kind. Moreover, a group-theoretic approach to this non-Euclidean history surprisingly reveals that the latter is at the heart of the former –from the synthetic we derive the referent, for the derivative is the now locus of the generic; what we previously regarded as the copy of a model in fact turns out to be the model itself –for in the unbounded movement of finance capital, with its incessant proliferation of objects of degraded likeness, we reach a point at which everything flips over into its opposite, the object switches over into its image, the image is set free of its object, and now becomes an image without likeness.

[17] Herman Weyl, *Symmetry*, Princeton University Press (1952), Joe Rosen, *Symmetry in Science: An Introduction to the General Theory*, Springer-Verlag (1995).

This obviously raises some questions of considerable exigency. How should we proceed?

It will be evident from our earlier observations that by concerning ourselves with equivalence classes of transformations *qua* symmetries of exchange, we are attempting to think the economic properties of a constitutive process, rather than the constitutive properties of economic objects, and that therefore the theoretical tools familiar to political economy will prove impotent to the task at hand: their diamond-wheel was fit for cutting through sedentary objects, but our entities are nomadic motions; the site of their work-space was homogenous and flat, while ours is heterogeneous and of constant-curvature; the hardware of their craft was designed for problems of classical symmetry, but the substance of our analysis is a synthetic symmetry whose materiality is different in kind. We cannot use the tools of a methodology calibrated to analyze properties-as-essences of economic objects when we are attempting to think the dynamical drama of the multiplicities which give rise to these objects to begin. A second wager is thus required to complete our project herein: namely, we will bet on the quality of craftsmanship of Deleuze as our toolmaker *par excellence* for work in this register. Our third objective, then – which is a twofold objective folded into this wager– is the following.

First, we must be capable of thinking markets and the economic objects that populate them as *multiplicities*, in which the extensive properties represented in such markets and objects arrive into actuality by way of –but in the process conceal, or cover-over– their intensive dynamics. That thinking entities as multiplicities is different from thinking objects as essences, and that this is demanded by the agenda of our program will by now be clear: we are attempting to theorize the dynamical distribution *of* space of the property of the synthetic, rather than the sedentary distribution *in* space of rigid objects. And to be sure, in finance there is no object of physical identity, no representation in some pre-existing space: there is a multiplicity as a pure dynamism, which creates a corresponding economic space; there are internal differences which dramatize the multiplicity before any economic properties are represented in an object; and it is precisely these differences which we are attempting to think. So if we assert that by "domain of action" we understand a *market*, by "market" we understand a *multiplicity*, and by "multiplicity" we understand *that which structures the space of possible motions of economic objects*, our reader should know our purpose.

On the one hand, we understand this terminological move as a preliminary methodological exercise to exploit the conceptual resources of non-Euclidean geometry and the mathematics of group theory for the purposes inaugurating a new method of political economy. We have acknowledged that the two elements of a domain of action and symmetry group constitute an equivalence class; and we recognize that insofar as domains of action define the invariance requirements on properties of objects in their course of motion, the task of determining the distributions of variable structures to that space of motion is of the utmost importance –not simply for purposes of classifying a transformation under its proper symmetry group (as if setting-up as our final objective the accomplishment of some banal, academic exercise), but *because* in turn we then understand what any economic object is capable and incapable of doing when in motion in a given space of exchange. In this respect, it is difficult to overestimate the methodological importance of our simple assertion that markets are multiplicities, and therefore *as multiplicities* are immaterial entities that are immanent to material processes; that markets distribute the space in which economic objects are transformed into their image of value as price; that markets actualize a moving horizon of unbounded structure, whose analysis can account for the genesis of economic objects and their constitutive, extensive, mobile

set of properties. Can we confidently purport to know the intrinsic limitations and latent capacities of our economic objects and institutions without knowing the manner by which their force of motion is predicated on the distribution of structure to their space? We think not.

On the other hand, and relatedly, we understand ourselves to be commencing an enterprise of importing insights derived from Deleuze's philosophical transformation of mathematical concepts –including those from group theory, calculus, differential geometry, and topology– into our own non-Euclidean approach to studying the ontology of finance. And certainly there is no notion from the Deleuzian toolbox more profound than that of *the virtual structure of a multiplicity*. Now, its well-known that Riemann's technical concept of a manifold greatly influenced the 19th century geometer's reconceptionalization of space that we have alluded to above (i.e this aforementioned epistemic shift in mathematics and physics from an axiomatically-defined and ambient Euclidean space, bestowing all encompassed subspaces with their metrics, to now a heterogeneous set of spaces for which certain Euclidean properties only incidentally hold as a particular and locally-metricized instance of a more general, nonmetricized, topological space).[18] Equally well-documented is the extent to which Einstein and other 20th century field theorists, who had carefully read Riemann, incorporate his conception of space to aid their revolution in physics.[19] And of course, none will hesitate to acknowledge that the pricing models of contemporary quantitative finance, whose proliferation immediately precedes and then coincides with the derivatives revolution in finance, are built with a mathematical architecture first designed for physics –itself the field of study in which the insights of the Riemannian revision of the parallel coordinate concept, and subsequent radical reconceptualization of space, was first deployed.[20] To be clear, our project situates our field of inquiry within this tradition, even while we acknowledge that unlike mathematics and physics, (political) economics has hitherto suffered from being insufficiently curious of its own ontology. We will both emphasize why we credit Deleuze for reworking the manifold into the theoretically more robust concept of a multiplicity (first in his book on Bergson, two years later more thoroughly in his magnum opus, *Différence et Repetition*, and in subsequent guises, albeit less rigorously, in his work with Guattari), and yet add that it is difficult to overstate the magnitude of the epistemological consequences of our methodological premise over any fidelity to a thinker, as such. The fact is, the 19th century geometer's theoretical conception of space as a number manifold (multiplicity) severed the study of so-called "objective" physical space from the study of mathematical spaces, and therein ontologically distinguished a space of physics from a space of geometry. Our project is prepared to further itemize this distinction, by distinguishing these

[18] It is difficult to overstate Riemann's importance for the 19th century's geometer's substitution of a Cartesian-coordinated geometry, which was founded on an absolute conception of 3-dimensional (Euclidean) space, with an intrinsic geometry of surfaces in n-dimensional space. Moreover, it's worth observing, as we will below, that just as Riemann distinguished physical space (*Raum*) from the mathematical space of a geometric manifold (*Mannigfaltigkeit*), we distinguish these two spaces from the economical space of a *market qua multiplicity*.

[19] Einstein was unambiguous that his insights derived from Riemann. See Albert Einstein, "Notes on the Origin of the General Theory of Relativity", in *Einstein's Essays in Science*, Dover Publications, 2009; also Herman Weyl, *Space-Time-Matter*, Dover Publications, 1922. More recently, see Tian Yu Cao, *Conceptual Development of Twentieth-Century Field Theories*, Cambridge University Press, 1997 pg. 373 ('Riemann rejected the notion that the metric structure of space was fixed and inherently independent of the physical phenomena for which it served as a background. On the contrary, he asserted that space… acquired a definite form only through the material content filling it and determining its metric relations…. [M]ore than 60 years later, Einstein took Riemann's empirical conception of geometry using it as an important justification for his general theory of relativity.')

[20] Emanuel Derman, *My Life as a Quant: Reflections on Physics and Finance*, John Wiley & Sons (2004). Also see Kirill Illinski, *Physics of Finance: Gauge Modelling in Non-Equilibrium Pricing*, John Wiley & Sons (2001).

two concepts from that of a third –namely, economic spaces, or domains of action, which distribute the structure to space for motions of properties of economic objects. We call these spaces *markets*, insofar as all three spaces (of physics, geometry, economics) are multiplicities; and multiplicities in any modality are n-dimensional and mobile centers of virtual structure, giving birth to actuality in form of property and object alike. Moreover, if the register of the virtual truly is that which distributes those differential relations structuring the particularities of metricization, and which in turn realize themselves in actuality, by probing the virtuality of our financial system we can then trace its development back to where its logic sets up camp.

Secondly, we realize that our ontology of finance must be conceptually equipped to directly investigate the economic register of synthetic finance. Here too Deleuze will prove helpful. Already in his first book of philosophy, we see Deleuze oppose the concepts of difference and repetition to similitude and generality, and immediately impute to the former the property of the synthetic. Now, if we notice that Deleuze makes this association precisely to break 'the four iron collars of representation' (the principles of identity, resemblance, opposition, analogy) mediating the illusion of an 'empty form of difference', or 'invariable form of variation'; and if we are immediately struck by the fact that this same suspect concept of representation is operational in the classical symmetry of flat space equivalence classes, it is no mere coincidence for our project: isometric motions *are* an invariable form of variation, classical exchange *is* an empty form of difference, congruence transformations *are* instances of false movement through generality, and these false movements *do* consist of rigid motions along parallel lines, whereby everything remains the same in their course of exchange. Conversely, we will also see that just as repetition persists as a difference without concept, so too the synthetic object is a material entity without matter. Just as repetition both disguises itself in the act of constituting itself, and yet constitutes itself precisely insofar as it disguises itself,[21] so too with the synthetic object there is no essence of content to be abstracted from the disguise of its mask – indeed, the ontological status of the synthetic object is such that 'everything is already masked and disguised', it's very essence is simulacra, virtuality, pure difference in itself. It is merely a matter for us to know what this material development signals, what this signal means for the future of our financial system, and how we are to maneuver therein.

Of course, the mere coincidence that Deleuze was laboring on a deep philosophy of the property of the synthetic, which we now encounter in the modality of financial derivatives and synthetically-structured debt, *is not in and of itself* our good fortune –since, absent the truth of the univocity of Being, or absent Deleuze's recognition of the truth of the univocity of Being, we would either lack the necessary dexterity to wield our tools, or else the tools, as built by Deleuze, would prove unfit in our hands. Indeed, were it not but for the univocity of Being, we would see no reason to believe that the same Being infuses finance and philosophy alike –or to say the same thing, there would be no reason to believe that the synthetic *is* difference *as* repetition in both registers, and so by probing the indeterminate register of synthetic finance we can trace the logic of our financial system back to where it sets up camp. However, *Difference and Repetition* both theorizes *and* illustrates in practical form how the univocity of Being *always repeats* itself in *different* guises: whether in philosophy (Plato), biophysics (embryology), psychoanalysis (Freud), mathematics (the calculus), and so on; *Difference and Repetition* illustrates that the actuality of Being's manifestation may differ, but its *virtuality* and intensive dynamics are repeated over and again. Our good fortune here bathes in the truth that, as Deleuze says,

[21] *Difference and Repetition* pg. 17

'[although] these modalities are not the same…Being is the same for all of these modalities';[22] and our wager therefore encounters no immediate resistance to proceed –and in theory, at least, we are permitted to deploy these Deleuzian conceptual tools, which are specifically designed to handle the property of the synthetic, in the service of our analysis of the ontology of a system increasingly grounded in synthetic finance.

The second half of our third objective, then, is to follow Deleuze's cue of thinking the synthetic. This must consist of attempting to think the qualitative multiplicity of synthetic finance, in order to understand how we might better situate ourselves to maneuver within the regressive ontological movement of capitalism towards its actualization as a system grounded in synthetic symmetry.[23] Our non-Euclidean history demonstrates that the progressive differentiation of our financial system harkens the reign of the synthetic. However, again: the reign of the synthetic –in and of what can this possibly consist, if not the emerging annihilation of any meaningful distinction between an original and its copy? How should we understand this, if not as an increasing nonsensicality of assertions of the primacy of a model over its image, of referent over derivative, of the concrete over its simulacrum? Are we not now forced to confront this monstrous fact of '[a] copy of an infinity of copies which allow neither original nor origin to subsist?'[24] Has not the synthetic now acquired an identity unto itself, whereby that identity is an image without likeness? And so is it not also the case that that the synthetic now paradoxically straddles both its prior virtual register, as well as increasingly also the register of actuality? For if it is truly the case that the synthetic has stripped from the generic financial object its rank as model and referent, has it not also swallowed up and destroyed any solid ground upon which would stand a distinction between an original and its derived, between things and their simulacra? If so, we must agree with Deleuze that the reign of the synthetic 'makes us party to a universal ungrounding' –to which we will add that the exigency of our project is reinforced *a fortiori*.

And so we are struck here by a third observation, which is our final observation to be outlined herein.

If the combined effect of the first and second observations of our group-theoretic approach to our non-Euclidean history of finance is the clarification that to grasp the ontological significance of the progressive differentiation of synthetic finance is to grasp that financial derivatives now increasingly act as basins of attraction for the behavior of generic objects, and so paradoxically from synthetic symmetry the objectival commensurability of classical symmetry is operationalized (rather than the other way around), it is also the case that for those persons attentive to the performative impact of the differentiation of synthetic finance, in some respect this observation is unremarkable (Indeed, this aforementioned truth may surprise a (Euclidean)

[22] *Difference and Repetition* pg. 36

[23] Deleuze is philosophically regarding group theory's non-Euclidean and expansion of the concept of symmetry, when he says: 'A distinction is drawn between arithmetic symmetry, which refers back to a scale of whole or fractional coefficients, and geometric symmetry, based on proportions of irrational ratios; a static symmetry which is cubic or hexagonal, and a dynamic symmetry which is pentagonal and appears in a spiral line or in a geometrically progressing pulsation –in short, in a living and mortal evolution. Now, the second of these is the heart of the first.' *Difference and Repetition* pg. 20. Just as Klein realized that projective metrics are more general than Euclidean metrics, so too do we realize that synthetic properties are more general than classical and generic financial properties. However, it is also the case that both Klein's and our own observation here are but particular instances of the raw philosophical truth Deleuze observes about these two kinds of symmetry –namely, that the 'second [symmetry] is at the heart of the first.'

[24] *Difference and Repetition* pg. 67

political economist, but it is a commonplace premise for a Wall Street trader, a quantitative analyst, or a historian of finance today –ironically, it is the former who knows to ask interesting questions about a material reality that fails to exist, while the latter fails to ask interesting questions about a material reality that is known as it exists). However, we will also see that this simple truth is not without its own enigma. For if, following Deleuze and dynamical systems theory, we consign the peculiar qualitative multiplicities that populate our financial system to the realm of the virtual, we are quickly reminded that derivatives *qua* synthetic financial objects are not merely *virtual* –if indeed the term still retains its strict philosophical denotation[25]– but are of course simultaneously *actual* and *indeterminate* as well. Perhaps the true exigency, then, is to address both *what becomes of* and *what can become of* economic materiality when the virtual –as the intensive and nonmetricized topological structure for potentiality –is refracted through itself, and now dumped-out into actuality, while yet unmistakably preserving some semblance of its prior (non-actualized) virtuality (And here, then, it seems that the ontology of synthetic finance has already begun to materially develop beyond the philosophy of Deleuze)?

To probe this query is perhaps yet to investigate the latent or at least hitherto unexploited material capacities of synthetic finance in an age of the oppositional determination of finance over the other economic industries (e.g. manufacturing, real estate, etc.), and hence this is a future question for our study of synthetic capital.

Benjamin James Lozano
December, 2011
blozano@ucsc.edu

[25] Henri Bergson, *Time and Free Will: An Essay on the Immediate Data of Consciousness*, Dover Publications (1913); *Matter and Memory*, Zone Books (1991); Gilles Deleuze, *Bergsonism*, Zone Books (1988)