

Global and Historical Perspectives on Invention & Innovation

Pharma Finance 2008 - Roma

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The distinction between *invention* and *innovation*¹ was discussed previously in a series of three articles published earlier:

[Part I: Concepts of Innovation, Invention Should Now Be Regarded Differently](#)

[Part II: Invention Needs to Be Left Free; Innovation Must Be Managed](#)

[Part III: Innovation vs. Invention: Accelerating Development](#)

Having spent the past few days in Rome, I've had the chance to reflect upon the rise and fall of empires, the invention/innovation concepts described in the above articles and the relation between these and the fate of nations.

Reading today's *New York Times* sober headlines (5/24/08) about teens unable to find a job ("[Toughest Summer Job This Year Is Finding One](#)") and Wall Street bankers pondering their irrelevancy ("[Wall Street Exodus: Fear, Panic and Anger](#)")², makes it seem a Prosecco sipping luxury to consider questions of invention vs. innovation.

It should be clear, however, that the central story of the rise and fall of nations – which certainly does impact us personally – more often than not invokes the ebb and flow of inventive people and innovative societies. While prominent commentators (such as Thomas Friedman in "[Imbalances of Power](#)")³ depressingly note the triple storm of *fiscal deficit*, *trade deficit* and *geopolitical deficit* traumatizing America from one shining sea of vanishing strip mall jobs to the opposite shining sea of imploding investment houses, these deficits are but signs and symptoms of a deeper disconnect underlying civilizational decline. Invention and innovation is the key to both understanding and solving such challenges.

I am writing at the tail end of the [Pharma Finance 2008](#) conference organized here in Rome by the regional authorities – mainly [Sviluppo \(Development\) Lazio](#), [Filas S.p.A](#) and the [Italian Institute for Foreign Trade](#). As with any business gathering, the 300 plus participants did the usual: sharing ideas and exchanging business cards. However, this was no ordinary conference along the lines of the usual rituals of industry extravaganzas, investment bank deal-making retreats or government-sponsored foreign direct investment plays. Pharma Finance 2008 was a very different affair. This special conference – I will explain its uniqueness further below – combined with a very personal opportunity to contemplate the ruins of an ancient Roman aqueduct just outside my hotel window here in the historic *Esquilino* district taught me some important and timeless lessons.

¹ This distinction has also been discussed by several authors including [Bill Buxton](#), [Lewis Branscomb](#) and [Philip Auerwald](#), [John Hagel](#) and [John Seely Brown](#), [Larry Dignan](#), [Michael Schrage](#) and others who mostly discuss this topic in the context of information technologies. The purpose of this article is to (1) apply some of these concepts to the life sciences and (2) present a global and historical perspective on the issue all in the context of the recent [Pharma Finance 2008 conference](#).

² These are both articles from today's *New York Times* (24 May 2008).

³ Also from today's *New York Times* (24 May 2008).

Invention vs. Innovation

Invention and innovation are concepts that are often incorrectly conglomerated and confused. Understanding the distinction will explain the unique importance of the Pharma Finance 2008 conference.

Invention refers to the discovery or creation of a new idea. It is usually the work of an individual. Invention is, by definition, *outside* of reality. Inventions deviate far enough from reality so as to mark the inventor as being, let us say, a little crazy. Insane genius is not an oxymoron.

Innovation refers to the combination of inventions and/or institution of processes around a core invention. Innovation is typically the work of groups – not individuals – since a variety of capabilities and resources are required. Innovation, by definition, takes invention *into* reality. Innovation makes what would have been considered slightly crazy into what is routine.⁴

An innovative product; no invention

A salient example is the IBM Personal Computer (PC) of 1981 - [named](#), as some may remember, *Time Magazine's* “[Man of the Year](#)” in 1982. The PC was devoid of *invention* yet it was most certainly one of the most revolutionary *innovations* of the 20th century.

The IBM engineers sent off to secluded Boca Raton to [work their magic](#) were specifically instructed not to invent anything new but simply to take off-the-shelf components and bring to market whatever it was to be within 18 months.⁵

American Ascendency

The PC exerts its influence not only prosaically on everyday lives but also shapes the geopolitics of our era from Iraq and beyond. For example: we speak wistfully now of the extraordinary economic growth of the US in the late 1990's. The influential [work](#) of the Harvard economist Dale Jorgenson attributed much of that success to the “...acceleration of productivity growth, driven by information technology, [as] the most remarkable feature of the US growth resurgence.” Innovation was the major driver of this - what the Dutch economist Luc Soete [called](#) the - “historically unique ... pulling away of the leading technology country.”

This renewed US economic power – enabled by a remarkable spurt of desktop computing based innovation – has had profound implications since then. With this power

⁴ The inventor Dr. Fred McBagonluri provided me with a witty and apt analogy:

A man arrived at the hospital, where his wife just had a baby. As he walked in, he noticed the pediatric nurse cleaning the baby. He walked past his wife without saying anything to her. He congratulates the nurse for cleaning the baby. His wife is mad and raging. Why? Because the baby was her invention and the nurse was simply the innovator. Invention is an uncleaned baby; innovation is when that baby is cleaned up enough to make money!

⁵ The idea of taking off-the-shelf components and combining them also has tremendous potential for medical technologies. See, for example, the articles [Convergent Medical Technology: Part I - What is it?](#), [Convergent Medical Technology: Part II - Why is it important?](#) and [Patent Reform Act of 2007: Innovation, Implications and the American Inventor](#).

in hand, President Bush was able to write in the [preamble](#) to the well-known *US National Security Strategy* document of 2002:

“Today, the United States enjoys a position of unparalleled military strength and great economic and political influence.”

Powerful words indeed ... made possible – quite literally – by a Word processor on a PC. It is sobering to think how unaware the Bush strategy architects must have been of what is now a completely different economic situation marked by a triad of fiscal, trade and geopolitical deficits.

The Rise & Fall of the Roman Empire

The fall of the Roman Empire is perennially fascinating. Edward Gibbon’s [History of The Decline and Fall of the Roman Empire](#) and his thesis that Rome fell because of a loss of “civic virtue” was more or less required reading for generations of 19th century English Eton and Harrow school boys prepping for their day in the sun as leaders of a British empire upon which the sun never sets ... but eventually did.

There has been no shortage of theories to explain the fall of Rome. The still graceful half-ruin of my aqueduct neighbor beckons me to imagine less of the many insults dealt it - “death by a thousand cuts” – and more about the creativity that built it.⁶ This alternative explanatory perspective – looking at the *rise* rather than the *fall* – is substantiated by a simple appeal to the laws of thermodynamics – specifically the 2nd Law which mandates that in the absence of specific organizing forces, systems inexorably devolve into complete disorder. Maximum entropy is the technical term for this state.

Take a sugar cube, for example. There are only a few conditions of temperature and concentration that lead to the formation of homemade rock candy. There are zillions of reasons, however – a veritable [Avogadro’s number](#) to be precise – for a sugar crystal to dissolve and disappear. Since disorder is more probable than order, the factors driving an empire’s *rise* should more simply help to explain its *demise*.

Duodecim Tabulae and the jus Latii

Two unique “inventions” distinguished Rome from the multitude of other neighboring Latin villages during the 5th and 4th centuries BCE. The first invention – established around 450 BCE - was the written codification of Roman law – specifically the [Twelve Tables](#) (*Duodecim Tabulae*); a far reaching “bill of rights” for that time.

This potent ability to depersonalize legal relationships, that is to say, to separate them from the particulars of ethnic or family ties enabled the second, even more significant, invention: the unique Roman institution of the Latin Right (*jus Latii*). The Latin Right was a form of civic status in between that of full citizenship and non-citizenship (e.g. alien standing) which carried no legal rights. The Latin Right allowed Rome, in contrast its neighboring states, to productively assimilate foreigners. Likewise

⁶ To be clear, the argument here refers more specifically to the rise of the Roman Republic – relative to the other Latin city-states in the area which it gradually assimilated – resulting in the [conquest of Italy](#) and subsequent consolidation of Latium thus creating the framework by which the later Roman Empire emerged. These are the fundamental reasons for the Empire’s rise rather than the oft-quoted proximal reasons such as the political ambitions of Julius Caesar, the resulting civil wars and other military-political events.

visitors of all origins flowed into a sleepy village which was rapidly transformed into a cosmopolitan city. Rome became a powerful engine of innovation, tapping into individual inventions from all quarters of the known world, perfecting these and rapidly implementing them throughout the growing Republic.

Ancient Rome: An Engine for Innovation

The ancient Romans were not known for being a particularly inventive people. We may never know how much of the astounding variety of Roman innovation was natively developed or assimilated via foreign ferment. It is safe to say though that for what was once a minor city-state to rapidly acquire the trappings and capabilities of empire could only have been possible through substantial cross-fertilization with other cultures combined with systematic technological improvement. We know, for example, that the archetypical arch – which made possible the aqueduct still standing before me which, in turn, enabled the aqueous sustenance of large urban populations - was perfected from Etruscan influences. Likewise, glassblowing came from Syria, a variety of inventions were most definitely imported from the ancient Greeks and even Roman numerals were adapted from Etruscan predecessors. The Roman engineering corps (*praefectus fabrum*) was itself an innovation instituted to leverage advanced materials, water power and other inventions to build and sustain Roman military supremacy.

The stunning sophistication of Roman technology was highlighted by Prof. Hamlin Jennings of Northwestern University in a recent [Nanotech Today](#) interview “[The Nanostructure of Portland Cement - New Approaches to Studying an Old Material.](#)” Jennings discussed the remarkable properties of the Pantheon – a nearly 2,000 year old domed structure still standing in Rome. In building the Pantheon and its dome, Pozzolana cement – a revolutionary invention in its own right - was applied in a unique layered fashion by which the upper sections of the dome were constructed from successively less dense concrete. This innovation significantly reduced the Pantheon dome’s overall architectural stresses making possible its soaring grace.

Republican Rome and the early phase of the Empire was built on innovation. However, notwithstanding the proximal environmental forces that [Jared Diamond](#) and others ascribe to civilizational decline, it was the loss of creative forces and the shift to acquisitional conquest as a source of growth rather than material invention that led ultimately to the decline of Empire. And so, with the dissipation of innovative energies, empires - as do all things – ultimately (and sometimes rapidly) succumb to their thermodynamic endpoint - entropic death.

All roads ultimately lead to disorder; entropy, in the end, rules.

Pharma Finance 2008 and Italian “Malessere”

Reflecting upon Pharma Finance 2008, I have come to realize that this conference was designed to address a very peculiar and important problem for the Italian life sciences community: namely the frustration in transforming the extraordinary inventiveness of the Italian scientific enterprise into productive and effective innovation.

Indeed, it could be said that this problem pertains to Italy more generally – not just the biotechnology sector. *Invention without innovation* may be central to the deep “malessere,” or “malaise” felt by many Italians today. This feeling was well described by Ian Fisher’s [article](#) last December in the *New York Times* “[In a Funk, Italy Sings an Aria of](#)

[Disappointment.](#)” His observations received mostly affirmative recognition here in Italy. As Fisher writes:

“... these days, for all the outside adoration and all of its innate strengths, Italy seems not to love itself. The word here is “malessere,” or “malaise”; it implies a collective funk — economic, political and social — summed up in a recent poll: Italians, despite their claim to have mastered the art of living, say they are the least happy people in Western Europe.”

The [article](#) goes on further about the usual topics of economic hardship and political brittleness. But these – like the traumas now afflicting America – are simply symptoms of a deeper problem.

Disappointment typically arises from a mismatch between reality and expectations. Italians know they should be doing better but when their gains do not match their talents, these can be perceived as losses. For Americans, “malessere” may soon arise from the increasing elusiveness of the American dream – and worse still its transmogrification into a nightmare of stranded SUVs languishing among suburban albatross McMansions abandoned with each mortgage readjustment.

Modern Italy: Inventive but not Innovative?

Since the Renaissance (which, by the way, was invented here – Florence to be exact), Italy has been an extraordinarily inventive nation; Italians are among the most original and creative people on this planet. As is well appreciated, “Made in Italy” is a mark of quality and style. More significantly “Invented in Italy” could well be the moniker for much of what we take for granted in our modern world. Radio communication (Guglielmo Marconi), the atom bomb (Enrico Fermi), double-entry bookkeeping (Luca Pacioli), opera and many more remarkable yet now routine ideas were invented by Italians.

Indeed, Italians have not uncommonly been described by their fellow Europeans as being “slightly crazy” in deference to the very Italian ability to think just a bit differently than others. The invention of a New World is what only an Italian such Christopher Columbus could do.

This uniquely Italian problem – invention without innovation – has two major consequences: economic stagnation and psychic disappointment. It has also given rise to the significant emigration of inventive talent out of Italy. There is a reason why Marconi, for example, went to England; Fermi went to the US⁷ and Columbus reached America via Ferdinand and Isabella of Spain.

There is profound irony, then, in realizing that a Roman heritage marked by a high degree of innovation (with invention provided by foreign assimilation) being replaced by a modern Italy with its nearly limitless culture of invention (but not necessarily innovation).⁸

⁷ On December 2nd, 1942, Arthur Compton, director of the “Metallurgical Laboratory” at the University of Chicago [telephoned](#) James B. Conant, President of Harvard University with the news “The Italian Navigator has just landed in the New World.” That cryptic message was meant to indicate that controlled and sustained nuclear fission – under the direction of Enrico Fermi – had been achieved. This was a critical first step towards the development of the atomic bomb.

⁸ These are generalizations and not meant, of course, to imply that innovation is absolutely non-existent in modern Italy. The statement should to be interpreted in terms of a comparative analysis over time (e.g.

Pharma Finance 2008: Fostering Innovation Partnerships

Pharma Finance 2008 was arranged not necessarily to showcase Italian ingenuity and invention – of which there is plenty – but more to foster the partnerships and collaborations necessary for innovation. Government sponsored business gatherings are often premised by: “look at our great stuff ... now give us funding.” Here in Rome the goal was more imaginatively along the lines of “we have great ingenuity here ... how can we work together to make it happen?”

The conference was also about opening up local entrepreneurs to the possibilities of partnership. A senior conference organizer told me:

“Italians are very proud of their discoveries. It is very personal for them and they hold their ideas quite close to their heart. Such an attitude can make it difficult to form the necessary collaborations – for example giving up majority control to a venture capitalist – or other partnerships that are necessary for success.”

Another conference official summed it up pithily when he noted that:

“In Italy it is not impossible to have someone like a Michelangelo or even several Michelangelos. But, how do you innovate around or commercialize something so precious? That is the challenge.”

Scrambler Therapy: An Example of Cross-Border Innovation

Prof. Giuseppe Marineo of the “Tor Vergata” University in Rome was frustrated. Marineo had invented a new approach to treating visceral pain – the sort of intractable, deep neuropathic pain that arises, for example, from abdominal cancers. His frustration stemmed from an inability to bring this revolutionary technology, which he called “scrambler therapy” to market.

“Scrambler therapy,”⁹ instead of using conventional pharmacological pain-killers or interventional surgery such as neurolysis, uses externally applied electromagnetic signals to confuse endogenous pain pathways into transmitting a signal of “non-pain” rather than “pain” to the brain. This represents a biophysical approach to treatment rather than a chemical (medical) or mechanical (surgical) one.

Having written before on bioelectromagnetic therapies “[Bioelectromagnetic Therapies: Science Fiction or Reality?](#)” the potential of such revolutionary approaches to medicine is not surprising. Invention can be crazy but rarely is it insane.

Prof. Marineo’s frustration – “malessere” if you will – was not to last long. During last year’s Pharma Finance 2007 conference the goal of bringing Italian invention to market was, in fact, amply realized. At that time, Leonardo Zangani (of the [Zangani Investor Community](#)) introduced Prof. Marineo and his work to John Nano, Chairman of [Competitive Technologies, Inc.](#) (CTT.AMEX) – a technology holding company based in the US CTT took up the technique forming a partnership with [GEOMC](#) – a South Korean

modern Italy as compared to ancient Rome) and over societies (Italy as compared to other nations that might be considered to be more innovative).

⁹ “[Untreatable Pain Resulting from Abdominal Cancer: New Hope from Biophysics?](#)” *Journal of the Pancreas*, 4(1): 1-10, 2003. Click [here](#) for a video interview (in Italian) with Prof. Marineo and another video [here](#) (also in Italian) demonstrating an early version of the device.

radio and television manufacturing company for the device's fabrication. The Hong Kong-based company [Lee's Pharmaceutical Holdings Ltd.](#) was further enlisted to help with its Asian distribution.

The successful trans-national marriage of Prof. Marineo's invention with industrial production and worldwide distribution embodied true innovation – a direct result of Pharma Finance 2007. The hope is that Pharma Finance 2008 will do the same.

America: Land of Immigrants?

The United States is a nation of immigrants and like ancient Rome it has derived nearly all of its inventive creativity from new ideas and cultures outside its borders. America, however, is now consumed by anti-immigration rhetoric and enforcement. Consider a recent *New York Times* report "[Italian's Detention Illustrates Dangers Foreign Visitors Face](#)" describing the travails of an Italian tourist Domenico Salerno – the son of a wealthy contractor – who was detained in a Virginia jail for more than 10 days. He was locked up, as the *New York Times* [describes](#) it "without charges or legal recourse while Ms. Cooper [his American girlfriend], her parents and their well-connected neighbors tried everything to get him out." This criminalization of immigration – not the only such example – portends a tragic societal shift that may substantially accelerate America's decline more than any combination of its fiscal, trade or geopolitical deficits.¹⁰

Mr. Salerno – apart from any real or perceived immigration violation – was not a criminal. It is also unclear whether such draconian enforcement would prevent terrorism as it has been well documented that the 9/11 conspirators had no known criminal records and apparently complied with then-standing immigration requirements. Ironically, it also should be noted that the ancient Roman Latin Right was not infrequently accorded to foreigners who were otherwise undesirables in their own lands. Indeed, a grateful and energetic peoples helped drive the Roman innovation engine still impacting our lives today.

Immigration was also essential to America's scientific and technological ascendancy in the wake of World War II. Legions of talented émigrés escaping war-torn Europe and specifically Nazi persecution were eagerly accepted by the US. During the succeeding Cold War, the eventual US victory over the Soviet Union was not necessarily an obvious conclusion. Without these formidable immigrant talents the outcome could very well have been different.

America and Invention

To be sure, invention and innovation cannot in separation drive economic growth and progress. Invention and innovation work together. Balancing these two is the

¹⁰ In reading today's *New York Times*, another article "[270 Illegal Immigrants Sent to Prison in Federal Push](#)" stood out – more concerning than the teenage [unemployment](#) or I-banker [redundancy](#) reports noted above. The article writes:

"In temporary courtrooms at a fairgrounds here [in Iowa], 270 illegal [mostly Guatemalan] immigrants were sentenced this week to five months in prison for working at a meatpacking plant with false documents."

Juliet Stumpf – an immigration law professor at Lewis & Clark Law School – [commented](#) on the inauspicious action as being "... a startling intensification of the criminalization of immigration law."

essential – one may say existential – challenge which only the most successful societies resolve.

Among the two, invention is the more difficult to cultivate as it requires a culture of freedom, a respect for new ideas and an ability to tolerate a certain degree of “craziness.” Innovation on the other hand can (and should be) managed and hence a process that may be actively developed.¹¹

Clearly, Italy already has substantial innate inventiveness. In this regard, then, Italy – despite its perceived failings – possesses a tremendous advantage over other nations. In the absence of such indigenous creativity, it is extraordinarily difficult to create an inventive society as this is a function of deep-seated cultural mores¹². Indeed, the only remedy to rapidly correct an invention deficit is to encourage selective immigration.

Education, of course, has always been regarded as a powerful and long-term mechanism for increasing a nation’s inventiveness. Education does have its limits. Invention requires a certain ability to think unconventionally; overly proscriptive educational systems can certainly suppress individual inventiveness. It should be noted that Leonardo *da* Vinci – an Italian and arguably history’s most inventive individual – had virtually no formal education; he was also known to have expressed a deep contempt for formalized learning.

Another problem for America is its high cost of education. Students encumbered by oppressive loans have not the liberty, literally, to be inventive. Education without freedom – true freedom – only serves to stifle invention.

Is the U.S. inventive enough?¹³

While Italy may be struggling with an innovation deficit, America may very well be facing an invention deficit. Five factors come to mind:

- Constraints on immigration (watch, for example the internet TV [interview](#) with Dr. Norbert Riedel – Chief Scientific Officer of Baxter International),
- the regimentation of American education via the “[No Child Left Behind](#)” law,
- a manufacturing sector increasingly crowded out by a [service-based](#) (and non-goods producing) economy that is fast approaching 80% of the US gross domestic product (GDP),
- a foreshortened investment cycle driven by the necessary expectations of increasingly powerful private equity firms and hedge funds, and
- the exaltation of mediocrity and ignorance¹⁴ that spans resurgent American social and political movements that embrace the *status quo* rather than change.¹⁵

¹¹ As described further in the 2nd article ([Part II: Invention Needs to Be Left Free; Innovation Must Be Managed](#)) in the previously described three-part series.

¹² It is important to note that I am not at all referring to one people being more “intelligent” than another. Inventiveness – while typically a result of individual work – results more from cultural attitudes than necessarily innate abilities. One could say it is an epigenetic rather than genetic factor.

¹³ See the work of the *Task Force on the Future of American Innovation* (<http://www.futureofinnovation.org/>) whose recommendations – namely to increase government research funding – while important but somewhat different from the one’s discussed in this article.

Each of these factors alone and certainly all in combination may make it increasingly difficult for America to invent new ideas. The last point, while admittedly somewhat broad in scope, is particularly concerning. The injection of political ideology into scientific discovery is bound to be fraught with unintended consequences.

For example, the Marxist-Leninist ideological [rejection](#) of cybernetics caused the Soviet Union – despite its tremendous sophistication in mathematics and engineering – to substantially lag behind the US in terms of advanced information technology and computer software capabilities. Because of the relatively primitive state of Soviet software capabilities, President Reagan’s 1983 [Strategic Defense Initiative](#) proposal – the space-based anti-missile program colloquially called “Star Wars” – profoundly frightened the Soviet leadership. They acutely realized that such an initiative relied heavily on strengths in artificial intelligence and other complex software technologies¹⁶ that the Soviets, at least that time, could not match.¹⁷ By analogy, the ideologically driven prohibition against embryonic stem cell research here in the US¹⁸ may very well result in similar unintended and insalubrious consequences.

It also becomes nearly impossible for inventive people to apply their talents, find work and survive. In America, not matching a computer-driven resume scanning system or being inconveniently overly inventive to one’s employers can be a fate worse than having a felony conviction on one’s record. Leonardo *da Vinci* would likely have been unemployed and homeless had he lived in America today. This is unfortunate since the US, more than ever before, needs a modern-day *da Vinci* to provide creative solutions to its crippling addiction to foreign oil.

Innovation without Invention and its Consequences

Despite the growing invention deficit, innovation is actually quite strong here in the US. In fact, one of Wall Street’s most recent innovations substantiates the profound problems that emerge from a system of innovation *without* invention.

[Mortgage-backed securitization](#) (MBS) was created – foisted, if you will, on a world eager for higher returns – as a means of expanding home ownership. Not necessarily a bad thing but without the requisite supporting economic fundamentals this has become, above all, the essence of the current credit crisis.

The mortgage-backed securitization innovation (and its problems) was multi-fold: an appeal to global [greed](#), the [opacification](#) of risk, the [arbitrage](#) of discrete credit ratings and again the leveraging of information technology capable of crunching voluminous masses of numbers regardless of whether they made any sense. In this case, innovation

¹⁴ See, for example, Susan Jacoby’s recent book [The Age of American Unreason](#) which was featured in a *New York Times* article [“Dumb and Dumber: Are Americans Hostile to Knowledge?”](#) commenting more generally the decline of American intellectual culture. See also another Op-Ed piece by Jacoby: [“Best is the New Worst.”](#)

¹⁵ This statement should not be construed as a generalized indictment against conservatives. David Brooks in his commentary [“The Conservative Revival”](#) writes convincingly about thoughtful conservative movements that are able to, and indeed, thrive under conditions of change.

¹⁶ See: [“Software Seen As Obstacle In Developing 'Star Wars'”](#) which points out that the software requirements represent probably the critical component to the success of any such system.

¹⁷ Russian software engineers have since – now unfettered by Marxist restrictions – proven themselves extremely capable so the Soviet weakness did not reflect some fatal lack of talent in this area.

¹⁸ See: [“Stem Cell Research Is Slowed by Restrictions, Scientists Say.”](#)

occurred in the *absence* of invention. True improvements in building design, safety features, energy efficiency or aesthetics did not underlie the increase in home prices. As is well known, real estate price appreciation was sustained largely as a result of speculative froth (Bernanke's "irrational exuberance" *redux*) enabled by complex (and "innovative") financial reengineering.

Consider another innovation: the [SUV](#) where nothing new was created but rather market value (now crashing) was built around combining several "innovations". These include:

- refashioning trucks as personal vehicles,
- a sophisticated marketing pitch appealing to the emotional sense that "bigger is better,"
- inexpensive gasoline enabled by artificially low crude oil prices during the late 1980's,¹⁹
- leveraging a suburban culture made possible by a *lack* of inventive approaches to high-speed rail, light rail or other transportation projects.²⁰

As a final example, I can relate my recent experience as a judge for a business plan competition at a leading American business school.²¹ Among the several excellent plans that were presented I saw nothing - again nothing - that was particularly inventive. Proposing a new social networking site, or yet another "fast casual" restaurant concept or an e-mail data-mining capability does little, in my estimation, to create new economic value. Unmanaged innovation can have rather surprising – and not so salutary – consequences. More on this shortly.

Pharma Finance 2008: Building upon Invention

Pharma Finance 2008 highlighted some truly inventive approaches to important human problems. Prof. Marineo presented yet another idea – [Entropy Variation System Delta](#) (Delta-S). The Delta-S technology utilizes organized electromagnetic fields to deliver information to biological systems in order to create desired therapeutic results. In this way a diseased tissue may be systematically coaxed by external influences to undergo a proper repair process much like the miracle of a developing fetus under the influence of growth factor gradients in tissues and calcium gradients within cells.²² Current

¹⁹ Low oil prices in the mid-to-late 1980's (e.g. the 1986 crude oil price [collapse](#)) and then largely propagated through the 1990's were driven by geopolitical considerations, namely as a primary means of burying (to use a phrase borrowed from Khrushchev) the Soviet Union. In this regard, it is quite disturbing to see President Bush's recent [inability](#) to convince the Saudis to increase their production as it speaks to a profound geopolitical weakness of the United States which despite pundit's concerns about the rise of Japan was clearly not the case back in 1986.

²⁰ See Paul Krugman's piece "[Stranded in Suburbia](#)." While Krugman emphasizes the development of fuel-efficient cars, he also points out (not at all the only one to comment as such) on the appalling lack of urban public transit options.

²¹ Out of respect for the school and the participants this shall remain nameless.

²² For a more direct (if somewhat abstruse) [summary](#) of Prof. Marineo's idea:

"... the basic Delta-S system is composed of a sophisticated dedicated parallel architecture computer controlled by an expert system which has the task of constructing, instant by instant, the energy forms required in order to achieve a high selectivity vis-à-vis the desired biological target, to evaluate the safety parameters, by means of suitable electromagnetic fields in a feedback loop with the biological system being treated (self-guidance) in order to introduce the energy required with a suitable

applications of this revolutionary technology are being developed, for example, to treat liver cirrhosis.

Economic Growth and Anti-Entropy

Prof. Marineo's "Delta-S: Entropy Variation System" was only one of several Italian inventions showcased here at Pharma Finance 2008. The reason it is mentioned here, even more than its unusual creativity, is that it specifically relates to the main theme of this article which can be summed up in one phrase:

Value is created by invention converted into reality by innovation.

Modern US style capitalism is predicated on a very simple concept: the supremacy of free-markets. But herein lays a profound logical and practical fallacy.²³ The supply-and-demand clearing paradigm of free-markets is based, in practical terms, on the mathematics of market *equilibrium*. At the same time the core principle of capitalist success is predicated on the expectation of continual growth which, by definition, implies an ongoing state of *non-equilibrium*.

Equilibrium – characterized by a state of maximum entropy – leads inexorably towards dissipation and disorder. *If* and only *if*²⁴ valuable information enters into the growing system can successful enterprises be created and sustained. This valuable information – the anti-entropy factor - is nothing other than invention.

Non-equilibrium systems, such as life itself, are characterized by sustained growth and increasing degrees of order. The success of a capitalist system, then, relies in fostering invention (via freedom) and enabling innovation (via management). Freedom applies to invention; management applies to innovation.

The distinction between invention and innovation can now be seen to be a categorically essential difference. Confusing the two and thus misappropriating freedom and management between these can lead to very undesirable consequences. Excessive management of immigration or education stifles invention. Unmitigated freedom of innovation leads to monstrosities such as mortgage backed securitization and SUVs.

This is why, in my estimation, Pharma Finance 2008 was such an exciting conference; indeed, an exciting concept speaking more generally. The concept that Italy's extraordinary ingenuity benefits from active management of its innovation.

Value is created by free invention converted into reality by managed innovation.

That, I believe, is what Pharma Finance 2008, here in Rome, was all about. The Italians, evidently, are not so crazy after all.

information content so as to achieve the desired biocompatibility within the process with which it is desired to interact."

²³ It should be noted that the critique described here is *not* at all the same as the classical Marxist critique of capitalism which emphasizes the historically determined conflict between capitalist growth and social stability. Nor is this critique the same as the [Club of Rome](#) concerns regarding sustainability and the "[limits to growth](#)." The paradox noted in this article points out that successful capitalist enterprises are required to simultaneously straddle both equilibrium and non-equilibrium status. This is obviously – from both a mathematical and practical sense – a highly problematic situation which, as is briefly argued here, can be resolved in a sustained manner only through the continual input of inventive ideas.

²⁴ The term "if and only if" is meant to be interpreted in its strict Boolean logic sense.