

An Ethical Analysis of Automation, Risk, and the Financial Crises of 2008

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ABSTRACT: *The unprecedented financial market volatility of 2008 has profound implications. While there is plenty of 'blame' to be shared, some key elements of the instability are relatively straightforward to identify. We contend that a fundamental, underlying cause is the cavalier approach taken to applied risk management, an approach that was only possible because of the use (and some would say abuse) of automation.*

This paper examines ethical issues associated with general behaviors leading to the market volatility of 2008. It then isolates some related ethical factors that can be singularly attributed to automation. While the effects of market automation cannot be realistically blamed for the overall market situation, automation certainly contributed to, and still contributes to market uncertainty. Some of this uncertainty is due not merely to automation, but to decisions made as risk management was automated. These findings are reinforced by research work employing Latent Semantic Analysis (LSA). The LSA results inform our analysis of the impact of questionable ethical behavior in the 2008 financial crisis, and suggest that closer attention to the ethics of financial automation will help achieve eventual market stability and prosperity.

The Current Situation

History demonstrates that hysteria is only optional in a bear market, as the market always recovers given enough time. With people's life savings at stake, however, the influence of panic cannot be brushed aside. The 2008 market conditions are unique in that they are far more volatile and seem to inspire the greatest fear-factor in the history of the modern market.[1] Moreover, because of extensive global networking and border-transcending fiscal interdependence, initial fluctuations in a single market resonate almost simultaneously world wide.[2] The degree to which automation plays a role in this phenomenon appears significant, although the extent of automation's role is likely impossible to quantify beyond the most general of assertions. While it is possible to build a working taxonomy of market related software offerings,[3] it is virtually impossible to assess the installed base much less the scope of networked interactivity among the finance programs operating across the globe. However, there is clearly an ethical imperative implicit in the growing influence of automation in market behavior. The ethical dimension of market automation is therefore worthy of serious study. It is first reasonable to separate some of the key ethical factors that do not relate to automation from the abundance of available information. In so doing, the ethical consequences of financial automation come more sharply into focus.

Ethics Take a Holiday

The 2008 volatility appears to have deep roots. The Government Sponsored Enterprises (GSE) Fanny Mae and Freddy Mac seem to have actively encouraged irrational lending practices as they celebrated a seemingly unending boom in the housing market. Buoyed by the lofty notion that everyone deserved to share in the American dream, and reinforced by explicit Federal decisions to relax or ignore market regulation, the mortgage industry embarked on a high risk journey. Fueled by a rare combination of optimistic exuberance and greed, easy loans became irresistible, even to those who clearly could not afford to pay the premiums. Those granting the loans did the most cursory checks as to the credit-worthiness of their recipients, thereby assuming astronomical

risk based on ever increasing home equity values. When the bubble burst, many hapless homeowners were stuck with mortgage terms that once looked attractive, but became intractable as home equity values plummeted, often below market value. As interest rates escalated, Adjustable Rate Mortgages (ARM) and other risk-laden instruments worsened the effect.

The mortgage bubble is not as large as many imagined. As of the second quarter of 2008, only 9.14% of mortgages showed signs of failure, leaving over 90% of Americans meeting their housing financial obligation relatively on time. [4] Moreover, 1/3 of the population had no mortgage burden at all. Were it not for the fact that the bad debt was repackaged, fractionalized and sold many times over across international markets, the problem would have been burdensome but far more manageable. The bad debt was not only sold and resold; it was also insured by Credit Default Swaps (CDS). Because of the CDS “backing,” the packages of mortgage debt that contained the poisoned pill of bad debts were traded as AAA rated financial instruments, a rating that masked the inherent risks. This led to a family of instruments of questionable value, which were virtually impossible to reverse engineer. These instruments were further guaranteed by intangible CDS derivatives that held no real intrinsic value of their own. The estimated face-value of the burgeoning CDS market is \$55 Trillion, [5] which equates to more than the world’s Gross Domestic Product. [6]

In 2003, Warren Buffet called derivatives “financial Weapons of Mass Destruction.” [7] While some derivatives serve a useful purpose in moderation (some people think the Bible endorses a form of agricultural derivatives [8]), they appear to have become a massive and powerful hidden market force. The “Commodity Futures Modernization Act of 2000” [9] re-authorized derivatives in the modern market after they were banned subsequent to the Great Depression. Composed largely of intangible value, the sheer volume of derivatives, including hedge funds, looms over the tangible value of real assets, including stocks and bonds. The entire range of all types of derivatives are estimated to top \$350 Trillion in face value in 2006, and some say have reached a staggering face-value exceeding \$500 Trillion by 2008. [10] There are no centralized derivative clearing houses, no regulation of derivatives and, consequently, no required reporting mechanism for these instruments that often take the shape of nothing more than speculative bets. This has led some to equate the emergent derivatives market to a huge casino, [11] but with a faceless house that may not always win. Thus, when housing prices began to decline, the derivative backed mortgage instruments posed sufficient uncertainty to eventually cause world-wide governmental bailouts and globally frozen credit, devastating businesses, employees, consumers and investors. It is relevant to this paper that the creation, marketing and selling of these derivatives in their present ubiquitous form would not have been practical without automation.

Market Automation

The story of the 2008 meltdown harbors all manner of ethical transgressions, which while egregious in their own right, have no direct bearing on automated market mechanisms. Thus, it is difficult to “blame” the resultant problems solely on automation. In fact, The International Swaps and Derivatives Association (ISDA), the professional organization created to promote derivatives, calls for further automation in the world of Over the Counter (OTC) derivatives as a proactive means of reducing attendant OTC risk. [12]

According to at least one newspaper report, however, the use of automation is highly suspect. [13] Senior managers at investment houses commissioned so called “quants” or mathematical gurus, to build mathematical models of staggering proportion to characterize financial risk in instruments the houses were developing. Given that these were models, however, they could only approximate real-world behavior, behavior that is fraught with unquantifiable influences. As most

managers failed to understand the elegant mathematics underlying these models, they innocently or intentionally drove their own assumptions into the models, further skewing the potential outcomes in directions that were useful for selling the instruments, but ultimately ruinous for the economy as a whole. Thus, when it was the time to alert buyers to the dangers that emerged as conditions changed, the risk management programs failed to raise the alarm. Their thresholds were skewed towards the underlying false and overly bullish assumptions. An additional problem is that, many of the models incorporated standard distributions, distributions that have been widely criticized as inappropriate because they do not conform to the complexities of the market. [14] When a model depends on such distributions, deviations at the positive and negative edges of the standard bell curve are liable to take gigantic and unanticipated excursions when perturbed by unpredictable patterns. [15]

Most trading programs are mathematically biased to logically provide value to shareholders. When a quant, who creates and implements a model, focuses exclusively on short-term shareholder value, the social and economic consequences of the trades themselves may be completely ignored. This, in turn, can lead to actions that are, in retrospect, highly suspect ethically. [16] Because of the weak models implemented into automated risk management programs, alarms warning of impending danger failed to go off, presumed flat tails went asymptotic, and trades derived monetary value at the expense of unwitting world citizens. Moreover, this happens around the globe on a daily basis as networked markets feed upon one another in near real-time. Such automated market behaviors cannot help but fuel growing uncertainty and doubt, among people, and the automated and human reactions feed upon each other in a vicious cycle.

Ethical Considerations

We note here two interrelated, but distinct phenomena: first, quants created models that did not accurately reflect the true risk of financial instruments; second, a vast network of sellers and buyers of financial instruments distributed these instruments in a way that was swift and virtually impossible to track. The action of the quants is best viewed as “micro-ethics,” which analyzes the actions of individuals and small groups. The financial institutions that all too eagerly bought and sold the products badly labeled by the quants is best viewed using “macro-ethics,” which aims for a large picture that encompasses companies, governments and cultures. In both cases, the actors and their allies realized substantial personal gains; in both cases, there are all too obvious societal costs.

The micro-ethics of the quants and their immediate supervisors turns on the professional requirement to not deceive. Note that professionals are not always required to be transparent to the public; there are many professions (lawyers and doctors are notable examples), that require confidentiality. But confidentiality is not deception. If the quants and their supervisors knowingly skewed the risk assessments towards marketing and away from reality, then they were not acting ethically as professionals. The same conclusion could be reached using several different ethical analysis techniques. For example, a deontological argument would emphasize that imbedding deception in the models was an abdication of a professional duty; a utilitarian analysis would focus on the harm that resulted from the deception.

A slightly more involved ethical analysis is required if the quants and their supervisors did not realize that their predictive models were unrealistic. If their mistakes were honest, then the analysis would have to explore if the mistake was unavoidable, or a result of negligence or willful ignorance. Many ethicists (though not all) would excuse the quants and their supervisors from ethical blame if it was due to circumstances or events that a professional using due diligence

could not have reasonably predicted. At the time of this writing, there is insufficient detail available to the public for us to make a final judgment about this issue of “did they realize what they were doing?” However, the models were shown to be completely unrealistic, and there were many critics who warned of impending problems. Furthermore, the people who developed and sold these financial instruments profited handsomely from these actions. These known facts suggest that the unrealistic models resulted at least in part from ethical lapses.

Although a micro-ethics analysis may find fault with the quants and their supervisors, a macro-ethics analysis would look at the broader picture. A macro-ethics issue is the power that was given to the quants and their employers by the commercial and governmental structures in place at the time they made their models. If the quants and their supervisors (and the companies that hired them) were in a position to both determine the risks and sell the instruments, then the system placed them in a position with inherent conflicts of interest. If no regulations or disinterested third parties had effective oversight in the risk assessment and the selling of these instruments, then the system (and the corporations and governments that established that system) also bear some ethical responsibility for the consequences. Were these problems foreseeable by regulators and legislators? At least some commentators think they were foreseeable, even obvious, if someone had been paying attention. [17]

The micro- and macro- ethical analyses are distinct, but inter-related. The system may have put the quants and their supervisors into a difficult position, but that does not remove the quants’ or the supervisors’ professional responsibilities. The quants and their supervisors might have acted more responsibly, and thereby avoided the financial disaster; but that does not absolve those who created a system that placed people in a difficult (and tempting) conflict of interest situation.

Amid the aura of deregulation fostered by Dr. Greenspan and other powerful figures in the 1980’s and 1990’s, [18] the Commodity Futures Modernization Act of 2000 kindled the real firestorm. This legislation went so far as pre-empting states from enacting anti-gaming legislation against derivatives. [19] Given these factors, one could argue that the macro-ethic atmosphere was super-charged with “go” cues that obliterated observable ethical boundaries at the micro-ethical level. This is not to say that Government was blameless and that the risks were unforeseeable with appropriately deep analysis. Rather, it suggests that the larger marco-ethical culture set the stage for a multitude of micro-ethical faults to appear as acceptable behavior. If so, one could argue that the recent systemic market volatility, fueled by unraveling derivatives, was borne of a systemic breakdown of enlightened ethical leadership at all levels. Even Greenspan has recently acknowledged that he made a mistake in assuming that banks’ self interest would be sufficient to avoid the disaster that eventually occurred after deregulation. [20]

Much as Intellectual Property (IP) rights and copyright issues must be re-examined as a result of pervasive automation, [21] the automation of markets should also received new scrutiny. It may well be the case that the ascent of global market automation fueled unprecedented speculation while masking a very real requirement to deal with the outdated laws and regulations to accommodate the emergent near real-time global interdependent financial networks. In this sense, there remains a critical need for ethical leaders to step forward in the financial industry.

Perhaps the recent literature can be viewed as prescriptive to this end. The next section of this paper presents a nearly subliminal mandate as drawn from applied lexical analysis against a number of relevant documents.

Latent Semantic Analysis Findings

For confirmatory evidence of the importance of automation in the current financial meltdown, a Latent Semantic Analysis (LSA) [22] was performed against eighty-eight fairly substantial documents reflecting diverse points of view regarding the current economic situation. These documents were selected and balanced ranging from highly regarded conservative financial authors to the rants of Year 2000 self-styled survivalists and economic conspiracy theorists, with most viewpoints falling between these two extremes. In our opinion, lax regulation, mortgage speculation and the flood of derivative products all contributed directly to, the subsequent meltdown. We contend that automation played a significant, but yet to be quantified, role in the unwinding of the markets. To guide the semantic analysis, therefore, the collection of eighty-eight documents was subdivided into three topically relevant domains, embracing documents with central themes involving ethics, derivatives or automation. A fourth domain for all eighty-eight documents taken together was also generated. This domain served as an aggregate cross-check against unions of the three topical domains.

The LSA process breaks documents in a topically bounded domain into tokens after excluding commonly occurring connecting words such as conjunctions, articles and prepositions and other words whose presence adds no value to the real association between tokens. These tokens are stemmed to eliminate plurals, gerund forms, tenses and other extensions. This stemming process yields the essence of the “word”, normalized without any added letters. (For example, “automation,” “automating,” and “automate” will all end of being mapped to the same semantic core idea represented by “automat.” The resulting stemmed tokens are then evaluated on a document by document basis and across all documents for significant associations. Appropriate mathematical weighting is applied across the resulting matrices to accommodate for variations in relative document size and other factors that could unduly skew the distribution. [23]

Once subjected to initial LSA tokenization and weighted affinity organization, each domain was influenced by the same set of selected context phrases. These phrases were “ethics”, “computer”, “quant,” “finance”, “wall street”, “derivative” and a mega phrase containing all the proceeding words. These context phrases served to build seven smaller sub-domains or “small-worlds” within each of the four major domains. The resultant contextual hubs and selected topical modifiers were then cross referenced across both the four major domains and the twenty-eight contextually generated sub-domains.

In most all cases, the tokens “deriv”, “market” “risk”, “manag” and “global” came up among, if not the most, highly significant hubs in the majority of the domains, sub domains and combinations thereof. This means that these stemmed tokens represented exceedingly strong affinities to all other tokens in the four major domains. In essence, they may be considered major hub tokens.

The tokens “deriv”, “market” and “risk” occupied the top three slots ranked by the number of direct associations to other tokens in the automation and derivative domains. The same tokens still fell among the top 15 attractors in the ethics domain which contained some documents aimed at computer ethics exclusive of market influences. Most significantly, these hub tokens also appeared with equally high frequencies in all the context influenced sub-domains. This also correlated well with the results of the all inclusive domain, whose aggregate associations, as expected, were far richer in their affinity counts, but nonetheless still similarly associated. In fact, the tokens “derive”, “market” and “risk” also occupied the top affinity slots in the all inclusive domain. The same terms also appeared as highly significant when the three domains were normalized for percentage of the total and cross referenced. These results represented repeatable

numerically weighted associations without regard to the “meaning” humans are prone to assign to the underlying words. Interestingly, the phrase “risk-manag” appeared frequently among the n-grams or “phrases” generated for each domain. These findings strongly suggest that the consensus of eighty-eight diversely oriented authors is that “derivative market risk” “management” on a “global” scale is a central concern.

As ethics was an important area of concern for this research effort, a number of lesser context tokens were drawn from the ethics associations for purposes of correlation across the other domains. These context tokens were grouped by three eight to twelve word clusters. One cluster, closely related to ethically related concepts, used tokens found to exist under the ethics domain such as “polici” “rights” and “law”. The second cluster associated with computer science tokens within the ethics domain, using tokens such as “research”, “environment” and “privaci”. The third cluster associated with the market and used ethics derived tokens such as “quant”, “hedg” and “stock”. The ethics cluster concepts showed up selectively in all domains, but tended to show an exceeding low correlation with concepts dealing exclusively with automation and derivatives. Interestingly, the ethics based clusters dealing with computer science and market factors either ranked highly or had no presence in the automation and derivative domains. These results suggest that while ethics derived concepts ranked highly in the overall and ethics domains, they were not as significant influences in either the automation or derivative domains when viewed as standalone domains. While it is dangerous to conclude that these two domains are devoid of legitimate ethical concerns, it is a reasonable conclusion that such concepts were not significant factors among the selected documents. This is likely to be the case with larger, but untested, sample sizes, which could potentially confirm the suspected thesis that ethics are not a strong consideration in either financial market automation or the derivative market. However, the lexical analysis could also accurately reflect an attitude among people discussion automation that there work is “technical” and therefore ethics is not relevant. Such an attitude is not unheard of among computing professionals. For example, a recent article by Stieib claims that “competent creation,” not any responsibility for the public good, should be at the core of any professional ethics for computing professionals. [24] Others argue that the public good is at the heart of any professional ethic. [25]

Conclusion

While it is an overstatement to claim that automation was the sole culprit, it is not an overstatement to acknowledge that automation was a key enabling technology in the financial crises of 2008. Without automation, it is unlikely that this sequence of events would have occurred. [26]

When we consider “automation,” we are referring to the large amount of Information Technology (IT) required to turn the wheels of the financial markets. The IT intelligence (or lack thereof) is embodied in the software algorithms, and those algorithms can be adaptive, modifying trading decisions without hands-on human decision making. These algorithms can be deployed for many different motives, from purely malicious to completely ethical.

The results of our latent semantic analysis work suggest that there were many people who where “in on the game” that led to the financial crises of 2008. The genesis of this crisis was not the mischief of a few players. But even though there were many winners leading up to the meltdown, now it is clear that the losers greatly outnumber the winners.

That leads to is a difficult question: if IT was an integral part of this problem, how many other problems can it foster of even greater concern? IT is supposed to be a great enabler of positive

social and economic good; but does it also hold the potential to be the great disabler? We are continually fed information about cyber-terrorism and the insecurity of networks; could a cyber-pandemic lead to an even large disaster than the financial meltdown of 2008? We can't be sure, but it certainly gives us pause.

References

- [1] Rosenwald, Michael. The Financial Lobe: Coping with Panic and Fear in Markets, *washingtonpost.com* (September 29, 2008), <http://www.washingtonpost.com/wp-dyn/content/discussion/2008/09/24/DI2008092401851.html>, accessed October 29, 2008.
- [2] Castels, Manuel, *The Information Age, Economy, Society and Culture, Volume I: Rise of the Network Society*, Second Edition, Blackwell Publishing (2000), pp 77-215
- [3] Hurlburt, George. A Taxonomy of Market Automation Initiative Areas. Compiled from *bobsguide.com*, <http://www.bobsguide.com/>, accessed October 28, 2008.
- [4] Hagerty, James R. and Simon, Ruth, Housing Pain Gauge: Nearly 1 in 6 Owners "Under Water," *Wall Street Journal*, *online.wsj.com* (October 8, 2008), <http://online.wsj.com/article/SB122341352084512611.html?mod=relevancy>, accessed October 29, 2008.
- [5] ISDA, International Swaps and Derivatives Association, <http://www.isda.org/statistics/recent.html#2008mid>, accessed October 29, 2008.
- [6] Wikipedia. Credit Default Swap., http://en.wikipedia.org/wiki/Credit_default_swap, accessed October 29, 2008
- [7] Buffet, Warren. Berkshire Hathaway Inc. Annual Report 2002, To the Shareholders of Berkshire Hathaway Inc., *Berkshirehathaway.com*, <http://www.berkshirehathaway.com/letters/2002pdf.pdf>, accessed October, 29, 2008
- [8] The Bible, King James Version. Genesis 41:33-36.
- [9] Rep Ewing, Thomas W. [IL-15] et al. H.R.5660: Commodity Futures Modernization Act of 2000: To reauthorize and amend the Commodity Exchange Act to promote legal certainty, enhance competition, and reduce systemic risk in markets for futures and over-the-counter derivatives, and for other purposes. *Thomas.ooc.gov*, <http://thomas.loc.gov/cgi-bin/bdquery/z?d106:h.r.05660>, accessed October 27, 2008
- [10] ISDA op. cit.
- [11] Capra, Fritjof, *Hidden Connections: A Science for Sustainable Living*, Random House (2002), pp 138-141.
- [12] International Swaps and Derivatives Association (ISDA). ISDA Outlines Strategic Vision for Transforming Operational Processing of OTC Derivatives Marketplace, *isda.Org* (December 10, 2003), <http://Www.Isda.Org/Press/Press2003index.Html>, Accessed October 28, 2008
- [13] Hansell, Saul. Bits: Business, Innovation, Technology, Society: How Wall Street Lied to Its Computers, *The New York Times*, *nytimes.com* (September 18, 2008), <http://bits.blogs.nytimes.com/2008/09/18/how-wall-streets-quants-lied-to-their-computers/?scp=1&sq=How%20Wall%20Street%20Lied%20to%20Its%20Computers&st=cse>, accessed October 29, 2008.
- [14] Taleb, Nassim Nicholas, *The Black Swan: The Impact of the Highly Improbable*. Random House (2007).
- [15] Crovitz, L. Gordon, Information Age: The 1% Panic, *The Wall Street Journal*, (October 13, 2008), <http://online.wsj.com/article/SB122385689217827341.html>, accessed October 29, 2008.
- [16] Capra, op. cit, pp 142-149
- [17] Kurtz, Howard. Media notes: The press, a few dollars short. *The Washington Post*, *washingtonpost.com* (October 6, 2008), <http://www.washingtonpost.com/wp-dyn/content/article/2008/10/06/AR2008100600620.html>, accessed October 26, 2008.

- [18] Faiola, Anthony, Nakashima, Ellen and and Drew Jill, Economy Watch: THE CRASH: Risk and Regulation” What Went Wrong: How did the world's markets come to the brink of collapse? Some say regulators failed. Others claim deregulation left them handcuffed. Who's right? Both are. This is the story of how Washington didn't catch up to Wall Street. *The Washington Post*, (October 15, 2008), <http://www.washingtonpost.com/wp-dyn/content/article/2008/10/14/AR2008101403343.html>, accessed October 29, 2008.
- [19] Rep. Ewing, op-cit, p232
- [20] Associated Press. Greenspan admits “mistake” that helped crisis. (October 23, 2008), <http://www.msnbc.msn.com/id/27335454/>, accessed November 1, 2008.
- [21] Benkler, Yochai. *The Wealth of Networks: How Social Production Transforms Markets and Freedom*, Yale University Press, 2006, pp 133-176
- [22] Landauer, Thomas K., McNamara, Danielle S, Dennis, Simon and Kintoch Walter. *Handbook of Latent Semantic Analysis*, Lawrence Erlbaum Associates, 2007
- [23] Landauer, et al, op. cit, pp 35-56
- [24] 24) Stieb, James A. A critique of positive responsibility in computing. *Science and Engineering Ethics*, Vol. 14, No. 2 (June 2008) 219-233.
- [25] Miller, Keith W. Critiquing a critique. *Science and Engineering Ethics*, Vol. 14, No. 2 (June 2008), 245-249.
- [26] Edsall, Thomas. Man Versus machine, http://www.huffingtonpost.com/2008/11/02/man-versus-machine_n_140115.html, November 2, 2008.