

**What is Past is Prologue:**  
The History of the Breakdown of Economic Models Before and During the  
2008 Financial Crisis

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Political Science and History Dual Honors Thesis  
University of Oregon  
April 25<sup>th</sup>, 2016

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**Introduction:**

The year 2008, like its predecessor 1929, has established itself in history as synonymous with financial crisis. By December 2008 Lehman Brothers had entered bankruptcy, Bear Sterns had been purchased by JP Morgan Chase, AIG had been taken over by the United States government, trillions of dollars in asset wealth had evaporated and Congress had authorized \$700 billion in Troubled Asset Relief Program (TARP) funds to bailout different parts of the U.S. financial system.<sup>1</sup> A debt-deflationary-derivatives crisis had swept away what had been labeled Alan Greenspan's "Great Moderation" and exposed the cascading weaknesses of the global financial system. What had caused the miscalculated risk-taking and undercapitalization at the core of the system? Part of the answer lies in the economic models adopted by policy makers and investment bankers and the actions they took licensed by the assumptions of these economic models. The result was a risk heavy, undercapitalized, financial system primed for crisis. The spark that ignited this unstable core lay in the pattern of lending. The amount of credit available to homeowners increased while lending standards were reduced in a myopic and ultimately counterproductive credit extension scheme. The result was a Housing Bubble that quickly turned into a derivatives boom of epic proportions.

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<sup>1</sup> As of March 2015, \$427 billion has been disbursed with an additional \$13 billion in additional disbursements expected. Over three quarters of the already disbursed amounts has been paid back to the Treasury. "Report on the Troubled Asset Relief Program-March 2015," The Congressional Budget Office, March 18, 2015, <https://www.cbo.gov/publication/50034>.

In such a complex system no single reason for the crisis has gained primacy; however many explanations have been put forth.<sup>2</sup> This paper seeks to better understand how the role of multiple models with different theoretical underpinnings interacted in shaping the behaviors of those most directly involved in the crisis. The focus here, in other words, is on the ideas and the theoretical models developed from such ideas that buttressed decision-making and influenced the actions of key financial market institutions and individuals. What were the intellectual roots that sanctioned the type of debt and risk incentivizing monetary policy practiced by Federal Reserve Chairman Alan Greenspan and his successor Ben Bernanke before and during the crisis? What were the dubious probabilistic and diversification assumptions of the specialized derivatives found in financial economics that oriented the investment behavior of both individual investors and financial institutions? This paper will address both sides of this issue, that of Federal Reserve policy and that of investment behavior, in an effort to grasp the rationale and motivations of their respective actions. In doing so, this paper seeks to demonstrate that different sections of the financial system did not go about the buying and selling of financial products in a vacuum. Feedback loops were (and continue to be) the norm, not the exception.

The paper has three sections. The first section deals with intellectual origins of Ben Bernanke's Federal Reserve, the Greenspan Put, and questions the causal direction

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<sup>2</sup> The literature on the 2008 crisis is becoming increasingly vast: for a systemic overview see Raghuram Rajan's *Fault Lines*, for a Wall Street-centric explanation see Michael Lewis's *The Big Short*, for a critique of Neo-liberalism and deregulation see Simon Johnson and James Kwak's *13 Bankers*, for an expansive cultural and corruption explanation see former Reagan White House Budget Director David Stockman's *The Great Deformation* and for an enlightening take on how the politics of finance can be viewed as a game of bank bargains see Charles Calomiris and Stephen Haber's *Fragile by Design*.

of debt-deflation. The second section examines the history of financial economics with respect to the Black-Scholes option pricing model, pseudo-diversification and collateral calls. The third section attempts to explain how these two forces coalesced in the years before 2008 and ultimately resulted in the type of breakdown in the financial system that occurred.

**Part 1: How Ben Bernanke's Fear of "Deflation" Institutionalized Itself Here: The Intellectual Origins of the Federal Reserve Policy Employed Before, During and After the 2008 Financial Crisis**

There are few other historical figures that better personify the institution and theories they represent than Ben Bernanke. As such, it is difficult to discern whether Ben Bernanke is the embodiment of Federal Reserve monetary policy or if Federal Reserve monetary policy has become the embodiment of Ben Bernanke. In order to better understand the relationship between Bernanke's actions and the economic theory buttressing his actions, a historical account of both his intellectual forefather and Federal Reserve predecessor must be considered. Enter Milton Friedman and Alan Greenspan. By tracing the intellectual and ideological similarities through the academic work and public speeches of these giants of economics, an astonishing degree of similarity in their views and policy prescriptions comes to light. Ben Bernanke and Milton Friedman's shared views necessitating the prevention of debt-deflationary spirals, such as the one that occurred in 2008 are of particular importance. The reasoning underpinning this preventative policy arose from a similar view of the cause of the Great Depression.

This exercise in intellectual history must be enhanced so as to also include the role Alan Greenspan played concerning his identification and promotion of the wealth effect as a policy tool. In 2008, Bernanke's own theoretical research and historical case study into the financial stability arising from the wealth effect mixed with Greenspan's ad hoc wealth effect policy. Connecting the academic works and actions of Bernanke's intellectual predecessors and himself reveals a remarkable amount of ideological consistency. In section 3, this consistency can then be cross-examined with historical data and competing economic theories, which cast doubt upon both the efficacy and explanatory power of monetarism. The result is to show how Bernanke was both focused and blinded by his monetary orthodoxy, which resulted in specific policy choices that may actually have created the very conditions he was trying to prevent.

Whereas George Kennan dubbed the First World War the seminal catastrophe of the 20<sup>th</sup> century,<sup>3</sup> in the field of economics, the seminal economic event of the 20<sup>th</sup> century was the Great Depression. The first and perhaps most influential intellectual outgrowth from this shock, in terms of the teaching of economics, was the rise of Keynesianism. Keynes determined the cause of the Great Depression to be the result of the economy reaching a non-optimal equilibrium driven by investors' animal spirits and depressed aggregate demand. Such an explanation implied an inherent flaw in free markets and to some degree the entire system of capitalism. This necessitated government counter cyclical policy to stimulate the economy to a preferred higher equilibrium. Naturally, such a policy suggestion and explanation were anathema to those with free market sympathies. The countervailing force to Keynes, largely in the United

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<sup>3</sup> George F. Kennan, *The Decline of Bismarck's European Order: France-Russian Relations 1875-1890* (Princeton: Princeton University Press, 1981), introduction.

States, coalesced around the doctrine of monetarism. The economic titan leading this counter-revolution in economics was Milton Friedman. The intellectual history of the 2008 Global Financial Crisis nominally begins with Friedman's explanation of the cause of the Great Depression 20 years after the event and 45 years before the Global Financial Crisis.

In 1963, Milton Friedman and Anna Schwartz published *A Monetary History of the United States: 1867-1960* and a corresponding article "Money and Business Cycles" in *The Review of Economics and Statistics*. Combined, these two publications laid the economic framework and historical justification for monetarism. "Money and Business Cycles" explicitly described the mechanism by which money was an active force in economics, while *A Monetary History of the United States* provided nearly 100 years of history to apply monetarist theory using historical data sets in natural experiments.

Monetarism is the economic theory that holds the expansion or contraction of the money supply is the main source of the contraction or expansion in business activity and output in the real economy. As Friedman and Schwartz more elegantly put it, "we have chose to concentrate on the part of [money and business cycles] that relates to monetary factors in economic fluctuation."<sup>4</sup> In 1963 such a concept was novel. In mainstream economics, the explanations of the Great Depression largely revolved around either structural or demand problems.<sup>5</sup> Money was assumed to be the passive variable, responding to other factors such as demand and structural changes. It was not the causal source of demand or structural change.

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<sup>4</sup> Milton Friedman and Anna J. Schwartz, "Money and Business Cycles," *The Review of Economics and Statistics* 45 (1963): 32.

<sup>5</sup> For a thorough examination of structural and demand problems, see Charles P. Kindleberger, *The World in Depression 1929-1939* (Los Angeles: University of California Press, 1986).

Throughout the first part of “Money and Business Cycles” Friedman and Schwartz attempt to demonstrate the correlation between money supply growth and economic expansion. Often they invoke their intellectual predecessor Irving Fisher. Fisher was one of the main contributors to the quantity theory of money, which postulates that inflation is a direct result of an increase in the money supply. Friedman and Schwartz adamantly agreed: “There is a one-to-one relation between monetary changes and changes in money income and prices. Changes in money income and prices have, in every case, been accompanied by a change in the rate of growth of the money stock.”<sup>6</sup> Another one of Fisher’s important contributions to economics was his debt-deflation thesis. Although it had many nuanced parts, the basic assumption, and, if you will, the punch line of Fisher’s theory, is that over-indebtedness would lead to defaults. Defaults would lead to bankruptcies, bankruptcies would induce a fire sale of assets and this would lead to deflated prices, undermining more businesses and resulting in more deflation. The result was an ongoing debt-deflation spiral. Fisher’s remedy for this vicious cycle was reflationary policy through central bank intervention.<sup>7</sup> Friedman’s own analysis, as will be explained further below, borrowed these insights, yet his focus drifted more toward fighting deflation by increasing the money supply than examining over-indebtedness. In Fisher’s debt-deflation thesis, this over-indebtedness was the proposed catalyzing factor in this process of deflation. Friedman and Schwartz frequently cited Fisher and it should come as no surprise that Friedman called Fisher, “the greatest

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<sup>6</sup> Friedman and Schwartz, “Money and Business,” 50.

<sup>7</sup> Irving Fisher, “The Debt-Deflation Theory of Great Depressions,” Federal Reserve Archival System for Economic Research (FRASER), <https://fraser.stlouisfed.org/docs/meltzer/fisdeb33.pdf>. 349.

economist the United States has ever produced.”<sup>8</sup> However, Fisher’s record does not remain unblemished. Days before the 1929 stock market crash, Irving Fisher muttered the now infamous phrase that, “Stock prices have reached what looks like a permanently high plateau.”<sup>9</sup>

Friedman and Schwartz took these insights from Fisher and enhanced Fisher’s theory with statistical and historical justification. They also clarified the mechanism by which an increase in the supply of money moves through the financial system. Before describing the technical details of the mechanism in “Money and Business Cycles,” Friedman and Schwartz provided a brief exposé of the 1929-1933 contraction. It was categorized along with other business downturns denoted as “Deep Depressions”. In this category of “Deep Depressions,” Friedman and Schwartz point to bank failures resulting from a decline of the money stock coupled with a decline in Federal Reserve credit as the source of the scramble for liquidity and the ensuing bank run. The scramble for liquidity refers to the actions of investors as they cycle out of less liquid assets such as commercial loans and into highly liquid assets such as cash or treasury bills. This, they claim, was further intensified by deflationary actions brought about by the Federal Reserve response to the British departure from the gold standard in September 1931.<sup>10</sup> Subsequently, deflationary actions courtesy of bank runs and the Federal Reserve caused a reduction in output. In Friedman and Schwartz’s explanation, money became an active force in economics. Their theoretical justification for this phenomenon is the core of monetarism.

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<sup>8</sup> Michael D. Bordo and Hugh Rockoff, “The Influence of Irving Fisher on Milton Friedman’s Monetary Economics,” Working Paper 17267 (National Bureau of Economic Research, 2011), <http://www.nber.org/papers/w17267.pdf> (accessed March 12, 2016), 7.

<sup>9</sup> John Kenneth Galbraith, *The Great Crash 1929* (Boston: Houghton Mifflin Company, 1972), 75.

<sup>10</sup> Friedman and Schwartz, “Money and Business,” 52.



Explicitly, their mechanism, that which makes money an active force in economics, is as follows: The Fed buys securities resulting in increased cash reserves for businesses. These businesses then turn their larger cash reserves into investments or they make loans or they store the cash in an investment or commercial bank. Banks then have access to additional funds (those deposited by the businesses) to make additional loans. These funds then make their way into various financial markets driving up financial asset prices. As financial prices are bid up in value, the demand for financial assets drops as a result of the price increase in the financial prices. This occurs relative to nonfinancial asset prices, which are then also driven up in value as the money chasing financial asset prices spills over into nonfinancial assets. The result is that “the price level of nonfinancial assets tends to raise wealth relative to income, and to make the direct acquisition of current services cheaper relative to the purchase of sources of services.”<sup>11</sup> Monetary stimulus from the central bank transverses the market (with some lag) into the purchase of goods and services through this complex mechanism reminiscent of Fishers debt-deflation thesis. However in this case, monetary expansion increases output. Of course, this mechanism works in both directions such that if the Fed instead decides to target the price level and sell securities, the stock of money will contract as it is pulled from the real economy. At least, theoretically that is.

Friedman and Schwartz’s model has had staying power and is still the standard by which undergraduate and graduate economic students are taught that central bank actions through the increasing or decreasing of the money supply can increase or decrease output and inflation. Such a feat in the economics profession is remarkable. Had it not been for the Global Financial Crisis and the revelation that many more forces are at work and

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<sup>11</sup> Ibid., 60-61.

many other sub-optimal outcomes resulting from such central bank actions are possible, the theory would be even more remarkable (more on this later). Nevertheless, it cannot be overstated that this theoretical transmission mechanism of money into the real economy and its influence on output is the crux upon which monetarist theory rests.

In *A Monetary History of The United States*, this mechanism is then put to the historical and statistical test. The policy prescription to prevent this mechanism working in reverse is explicitly put forth as well. Friedman and Schwartz point to the deflationary monetary forces unleashed by the failure of one fifth of American banks holding one tenth of the deposits in the United States during the Great Depression.<sup>12</sup> They divide the period of 1929 until 1933 into 4 distinct periods of different monetary dynamics, citing the only expansionary period from 1931 to 1932 as the only time during which output growth occurred in the initial economic contraction from 1929 to 1933. Before and after this period, they note the raising of the interest rate by the Federal Reserve, which they correlated with contractions in business output. Their conclusion of the cause of the monetary contraction, which they view as the active economic force operating in the business cycle is as follows:

The monetary collapse from 1929 to 1933 was not an inevitable consequence of what had gone before. It was a result of the policies followed during those years. As already noted, alternative policies that could have halted the monetary debacle were available throughout those years.<sup>13</sup>

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<sup>12</sup> Milton Friedman and Anna Jacobson Schwartz, *A Monetary History of the United States, 1867-1960* (Princeton: Princeton University Press, 1963), 299.

<sup>13</sup> *Ibid.*, 699.

For the monetarists, the Great Depression was no longer the result of demand or structural malinvestments;<sup>14</sup> instead it was the result of a technocratic error caused by Federal Reserve monetary policy. Not only did they conclude that more effective Federal Reserve leadership could have prevented the Great Depression, they also argued that future monetary policy could have the potential to cause or prevent future Great Depressions. Friedman and Schwartz even ventured a historical counterfactual that could have possibly, in their analysis, reduced the severity of the Great Depression to resemble a normal business contraction. Their protagonist capable of reflationism was found in the Federal Reserve Bank of New York's Governor Benjamin Strong. Strong had been the most prominent reflationist and powerful governor during the 1920s. He also acted in the capacity of international representative of the Federal Reserve System abroad in its dealing with British, French and German central banks. Friedman and Schwartz venture to suggest that had Strong not died in 1928 he could have prevented the Great Depression or at least greatly reduced its severity.<sup>15</sup> The legend of Strong's leadership and monetary foresight, whether founded or unfounded has persisted. In the 21<sup>st</sup> century, Strong has experienced a type of revival. Evidence of this and a perspective of the years before the Great Depression from a fairly strong (no pun intended), pro-monetarist perspective can be found in Liaquat Ahamed's *The Lords of Finance*.

Monetarism was met with mixed acceptance. The Chicago School, Friedman's University, was converted while Keynesians were less than convinced. Peter Temin even devoted a book, *Did Monetary Forces Cause the Great Depression?*, to argue against

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<sup>14</sup> A malinvestment is an Austrian economic term for capital mistakenly invested into a non-productive or non-investment recouping line of production. This 'malinvestment' then ultimately results in economic losses when the investment is shifted toward a more productive use or sold.

<sup>15</sup> Friedman and Schwartz, *A Monetary History*, 693.

Friedman's explanation. Hyman Minsky was skeptical as well, although his summary of monetarism is worth noting. "According to their view, the monetary event that calls the tune for economic activity [...] is a change in the rate of change in the supply of money."<sup>16</sup>

The most notable intellectual heir and avid proponent of Friedman and Schwartz's view was future Federal Reserve Chairman and Great Depression economic scholar Ben Bernanke. The number of references to Friedman and Schwartz's work in Bernanke's academic and professional life is numerous. Curiously, he often cites Temin's book as well, pointing to a consensus approach. However, the consensus leans heavily in favor of Friedman's explanation of the Great Depression because Bernanke usually invokes Temin's criticisms only to defend monetarist doctrine. Bernanke has written extensively about the Great Depression and about deflationary spirals. In the "Nonmonetary Effects of the Financial Crisis in the Propagation of the Great Depression," Bernanke freely and often cites Friedman. In fact, the article serves to adapt Friedman and Schwartz's monetarism so as to plug the holes poked by Temin. Temin's main critique was that the mechanism required to transfer monetary contraction to the real economy did not exist, instead the real economy caused the monetary contraction. The question was not of the correlation between declining economic activity and the money supply, but a question of directional causality. Bernanke, while defending Friedman and Schwartz's work, adds an additional mechanism by which financial crisis induced debt-deflation can prolong downturns. This mechanism is what he terms "Nonmonetary forces". The primary force of these nonmonetary forces is the weakening of the effectiveness of the financial sector

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<sup>16</sup> From a comment on the last page of: Friedman and Schwartz, "Money and Business," 64.

in credit intermediation.<sup>17</sup> Credit intermediation is economist-speak for the ability of banks to match savers' savings to properly vetted borrowers through the issuance of loans. The effectiveness of credit intermediation, Bernanke asserts, was weakened by a general loss of confidence in the system. In more economist-speak, banks changed their liquidity preference. Liquidity preference refers to the type of assets a bank holds. If banks desire to be more liquid because, for instance confidence in financial markets has weakened, banks, like individual investors, choose more liquid assets such as US treasury bills or cash.

Friedman and Schwartz, in *A Monetary History of the United States*, noted statistical evidence of this liquidity preference change.<sup>18</sup> In the theory of debt-deflation, a change in liquidity preferences results in a flight to safety via the purchase of more liquid assets. In turn, this undermines the solvency of those holding less liquid assets because those assets are now being sold at fire sale prices and it makes refinancing more difficult for the companies that have issued less liquid securities, thus leading to more defaults and thus, more deflation. Through the theorizing discussed above, complemented by his own Great Depression case study, Bernanke added a new tool to monetarist theory. The effect of monetary contraction was no longer bound only to monetary effects. Bernanke summarizes his new economic force in the following manner:

Economic institutions, rather than being a “veil,” can affect costs of transactions and thus market opportunities and allocations. Institutions that evolve and perform well in normal times may become counterproductive

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<sup>17</sup> Ben S. Bernanke, “Nonmonetary Effects of the Financial Crisis in the Propagation of the Great Depression,” *American Economic Association* 73 (1983): 257.

<sup>18</sup> A chart depicting widening credit spreads after the crash of the stock market indicating a flight to safety. See: Friedman and Schwartz, *Monetary History*, 304. 304 graph shows credit spreads widening after the crash of the stock market

during periods when exogenous shocks or *policy mistakes* drive the economy off course. The malfunctioning of financial institutions during the early 1930's exemplifies this point,<sup>19</sup> (emphasis the authors).

In economics, exogenous shocks refer to events or forces that are outside the explanatory power of the model. In the epistemology of historical knowledge, this cop out of exogeneity has been mitigated thanks to the introduction and teaching of feedback loops resulting from international events. Economics has not been so fortunate when dealing with exogeneity. To some degree, this is the result of the prohibitive mathematical complexity required to properly depict such feedback loops.

Bernanke continued his scholarship on the Great Depression using the idea of debt-deflation as the mechanism by which monetary forces affect the real economy. Debt-deflation remained his causal suspect in his explanation of the Great Depression. In "The Gold Standard, Deflation and Financial Crisis in the Great Depression: An International Comparison," with co-author Harold James, Bernanke continues to defend and fortify this point. "Deflation creates an environment of financial distress [...] this provides a means by which falling prices can have real effects."<sup>20</sup> In the article, Bernanke then expands his research about the 1930s deflation in the United States and extends it to the international monetary system. The conclusion being that deflation decidedly had the most important effect on real output. To Bernanke, deflation was no longer a monetary phenomenon; it was *the monetary phenomenon* that had to be prevented at all costs.

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<sup>19</sup> Bernanke, "Nonmonetary Effects," 275.

<sup>20</sup> Ben Bernanke and Harold James. "The Gold Standard, Deflation, and Financial Crisis in the Great Depression: An International Comparison." *Financial Markets and Financial Crises*, (1991): 34.

Deflation, in Bernanke's view, turned a normal late 1920s contraction into the Great Depression.

If the magnitude of the Friedman influence at this point is not already clear, it can be underscored further. In 2000, Bernanke published *Essays on the Great Depression*. In this 300-page book on the Great Depression, Milton Friedman is cited over 40 times to buttress Bernanke's arguments.<sup>21</sup> What were previously fairly hedged comments in Bernanke's writing concerning the cause of the Great Depression gave way to a concrete explanation. "I believe that there is now overwhelming evidence that the main factor depressing aggregate demand was a worldwide contraction in world money supplies. This monetary collapse was itself the result of a poorly managed and technically flawed international monetary system."<sup>22</sup> This conclusion differs only in prose from that of Friedman and Schwartz. Furthermore, deflation was now what Ben Bernanke checked for under his bed each night. It was his economic bogeyman, the monetary force that had to be stopped by any means at all costs. In due course, without many frictions, this view would carry over into his professional life at the Federal Reserve.

Ben Bernanke was appointed to the Federal Reserve Board of Governors in 2002, he resigned in 2005 to serve as the Chairman of the President's Council of Economic Advisors until he was appointed Federal Reserve Chairman in 2006. In 2002 Bernanke was able to toast his great intellectual influence and economist hero Milton Friedman on Friedman's ninetieth birthday. It is doubtful a kinder or more revealing speech in terms of Bernanke's utmost admiration for Friedman and Friedman's explanation of the cause of the Great Depression could have been given. "Among economics scholars, Friedman has

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<sup>21</sup> Ben S. Bernanke, *Essays on the Great Depression* (Princeton: Princeton University Press, 2000).

<sup>22</sup> *Ibid.*, viii.

no peer,” one of his (Friedman’s) economic contributions became, “the leading and most persuasive explanation of the worst economic disaster in American history, the onset of the Great Depression.”<sup>23</sup> In the speech, Bernanke also references Friedman and Schwartz’s protagonist Benjamin Strong in a call for strong and reflationist Federal Reserve leadership. Bernanke concludes the speech with “I would like to say to Milton and Anna: Regarding the Great Depression. You’re right, we did it. We’re very sorry. But thanks to you, we won’t do it again.”<sup>24</sup> Keeping in mind that this was a birthday speech to one of the greatest economists of the last century, and Bernanke’s personal hero, the implications of this speech, in regard to Bernanke’s central banking philosophy and policy prescriptions, are still rather revealing.

Two weeks later Bernanke gave a speech titled, “Deflation: Making Sure ‘It’ Doesn’t Happen Here,” earning him the nickname Helicopter Ben. In the speech he discusses “the danger of deflation,” which can be remedied by the *fortunate* technology of the United States government called a printing press. He even referenced Friedman’s theorized “helicopter drop” of money to prevent deflation, which Bernanke thought possible through a money-financed tax cut.<sup>25</sup> From that speech the nickname Helicopter Ben and its derivative, the Bernank-o-copter, were born. This nickname would be reinforced by his actions after the onset of the 2008 Global Financial Crisis. However, at this point in Bernanke’s academic and Federal Reserve career, to anyone remotely

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<sup>23</sup> Ben S. Bernanke, “Remarks by Governor Ben S. Bernanke At the Conference to Honor Milton Friedman, University of Chicago” (speech, Chicago, IL, November 8, 2002), <http://www.federalreserve.gov/boarddocs/Speeches/2002/20021108/default.htm>.

<sup>24</sup> Ibid.,

<sup>25</sup> Ben S. Bernanke, “Remarks by Governor Ben S. Bernanke Before the National Economists Club: Deflation: Making Sure ‘It’ Doesn’t Happen Here” (speech, Washington, DC, November 21, 2002), <http://www.federalreserve.gov/BOARDDOCS/Speeches/2002/20021121/default.htm>.



familiar with his works and speeches, there existed overwhelming evidence that Bernanke was determined to fight deflation in any form by any means at his disposal. This Federal Reserve Governor and later Federal Reserve Chairman had the financial system and by extension the banking system's solvency during times of stress under his watchful debt-deflation fearing eye, buttressed by his economic analysis and his debt-deflation prevention quest.

Aside from his deflation fighting reflationism, Bernanke is also known for his promotion of the wealth effect. The wealth effect is the economic phenomenon that occurs during a rising stock (or other type of financial asset) market. As the value of assets in nominal dollars increases, this induces consumers to spend more on goods and services as they either sell their assets to purchase real goods, save less of their income because their assets have increased in value or simply spend more because they perceive themselves as wealthier. Assets can include stocks, bonds or even nonfinancial assets such as houses. The concept of the wealth effect's origins can be found far back in economic intellectual history, yet the practice of promoting the wealth effect as Federal Reserve policy can be traced to Bernanke's predecessor Alan Greenspan's tenure at the fed. Greenspan's promotion of the wealth effect began as an ad hoc policy prescription to ease financial stress. However, the ad hoc nature of the Put did not dampen the wealth effect's ability to stimulate markets, which prior to 2008 (and arguably afterwards to a lesser degree) trickled through the market resulting in increased consumption in the real goods and services economy. This type of stock market focused policy was a marked departure from Paul Volcker's 16 percent interest rates in the early 1980s and William McChesney Martin's removing of the "proverbial punch bowl" once the party in the

markets got underway. The proverbial punch bowl refers to the access to cheap credit caused by low interest rates. The party refers to the boom resulting from the low interest rates, which is often likened to a party.<sup>26</sup>

Greenspan accomplished this wealth effect promotion through a lowering of interest rates at signs of financial stress, which allowed for a refinancing of debts outstanding at a lower rate. This was particularly beneficial for investment banks, hedge funds, or anyone in the market using borrowed funds to assume a wide array of rising market positions. Lowering interest payments also allows for more money to be made available to chase the existing assets in the markets. Lower interest rates usually raise all financial boats. In the finance community, Greenspan's lowering of interest rates during times of market stress became known as the Greenspan Put. The Greenspan Put first came into existence following the actions of Chairman Greenspan during the 1987 market crash. The 1987 crash was a severe and unprecedented 22.6 percent drop in the Dow Jones Industrial Average.<sup>27</sup> A put option is a type of derivative contract that allows the holder of the put the right, but not the obligation, to sell an asset at a predetermined strike price<sup>28</sup> until or on a predetermined option expiry date in the future. As such, the

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<sup>26</sup> William McChesney Martin was Dwight Eisenhower's Federal Reserve Chairman. Richard Nixon viewed his loss in the 1960 presidential election as partially a result of McChesney increasing rates before the election. It is unclear if the removal of the punch bowl refers to asset price inflation, goods and services inflation or both, but the effect of higher rates removes the punch bowl for consumers and investors alike. For the punch bowl quote see: William McChesney Martin Jr. "Address of Wm. McC. Martin, Jr. before the New York Group of the Investment Bankers Association of American," *Fed Reserve Archival System for Economic Research*, December 9, 2015, [https://fraser.stlouisfed.org/scribd/?item\\_id=7800&filepath=%2Fdocs%2Fhistorical%2Fmartin%2Fmartin55\\_1019.pdf#scribd-open](https://fraser.stlouisfed.org/scribd/?item_id=7800&filepath=%2Fdocs%2Fhistorical%2Fmartin%2Fmartin55_1019.pdf#scribd-open).

<sup>27</sup> Bob Woodward, *Maestro: Greenspan's Fed and the American Boom* (New York: Simon & Schuster, 2000), 37.

<sup>28</sup> A strike price is the agreed upon price at which an option can be exercised. For example, if an investor buys a put option for Amazon stock at a strike price of \$600, the

Greenspan Put refers to the lowering of interest rates after a market-stressing event. This lowering of interest rates acts to place upward pressure on falling asset prices because more money is made available to chase those assets. Thus, investors and other market participants are gifted by the Fed a lower bound at which they can, it is assumed, always sell their assets. If this lower bound is breached, Federal Reserve actions will kick in to stimulate the market. This stimulus will buoy the market and allow the sale of assets at a higher price. Technically speaking, the Greenspan Put is metaphorical, but the result is the same.

This Greenspan Put was introduced in 1987. Alan Greenspan, a student of Black Tuesday --better known as the stock market crash of 1929 widely regarded as the beginning of the Great Depression-- was immediately placed into a state of fear<sup>29</sup> following his receiving of the news of the 22.6 percent market sell off.<sup>30</sup> The fear expressed by Greenspan is notable because there is evidence that such fear permeates the financial and economic communities during times of distress. For instance, while Greenspan worried about a new Great Depression, Mark Rubinstein, a prominent financial economist in the field of option pricing and portfolio insurance<sup>31</sup> entered what

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option therefore gives the investor the right but not the obligation to sell Amazon stock at the strike price of \$600 dollars at some predetermined date in the future. The price of the put option itself is determined by the Black-Scholes formula whereas the investor chooses the strike price he or she would like to be able to exercise the option at.

<sup>29</sup> Perhaps this state of fear was actually a domain of fear in accordance to the behavioral economics of Daniel Kahneman's prospect theory.

<sup>30</sup> Woodward, *Maestro*, 37.

<sup>31</sup> Portfolio insurance is a type of financial product that can be added to an investor's portfolio. Portfolio insurance, as implemented by an investment advisor or a broker is designed to rebalance a portfolio when price changes occur. The idea is that the investor always wants to be in possession of the optimal portfolio (more on this in section two). Problems arise when feedback loops occur. The selling of multiple positions triggered by portfolio insurance has the potential to trigger the selling of multiple other positions with portfolio insurance and so on.

he describes as clinical depression. In an interview, he claims, “He could not rid himself of the fear that the weakening of the American markets could tempt the Soviet Union to a challenge to the United States akin to the one that had provoked the Cuban missile crisis, and nuclear war might ensue.”<sup>32</sup> For Rubinstein, one of the fathers of portfolio insurance, the crash felt very personal. The existence and widespread adoption of portfolio insurance in the market before and during the 1987 crash has often been cited as either one of the causes or one of the accelerators of the steep market drop. This likely weighed heavily upon him. While Rubinstein contemplated the end of the financial and real world, the trader Marty Schwartz went to his safe deposit box and removed his gold during the 1987 crash over fears of a bank run parallel to the 1930s.<sup>33</sup> How even those most aware of the assumptions of rationality (presumably economists and investors) can panic with such trepidation concerning a repeat of the Great Depression raises many questions about the assumptions of rational actors in financial markets in accordance with formal economic theory. It also raises many questions about the soundness of financial markets if the smartest guys in the room soon fear a complete collapse. Nevertheless, the Greenspan Put worked and the market regained its 1987 high by mid 1990.

Although the Federal Reserve’s mandate is to keep prices stable and promote full employment, the Greenspan Fed increasingly viewed the stock market as another key plank of policy and as a mechanism to achieve the Fed’s mandated goals. Contemplating a rise in rates in 1988 following the 1987 crash, Greenspan argued against a raise on the grounds that, “If we were to indicate that we were tightening, the shock to markets I think

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<sup>32</sup> Donald Mackenzie, *An Engine, Not a Camera: How Financial Models Shape Markets* (Cambridge: The MIT Press, 2006), 206.

<sup>33</sup> Ibid.

would break the stock market.”<sup>34</sup> The Greenspan Put became an effective tool in stabilizing short-term market fluctuations after a shock to confidence or bank solvency. In the 1990s, bad loans made in Latin American real estate resulted in a near bankruptcy of CitiBank (CitiBank later merged in the late 1990s to become Citigroup). Citibank required the infusion of \$5 billion worth of capital within six months in order to survive. Greenspan arranged an investment from a Saudi Arabian prince and then lowered interest rates. The idea was that the lower interest rate (the Greenspan Put) would make the bank more profitable and thus the bank could recapitalize itself with profits. Such a recapitalization scheme is similar to the plan Bernanke put forth to recapitalize AIG during the Global Financial Crisis.<sup>35</sup> Again in 1995, with the Mexican Peso crisis in full swing, Greenspan helped to negotiate a \$12.5 billion American loan to the Mexican government. The Federal Reserve and Treasury Department effectively assuaged the fear of the consequences of widespread Mexican defaults on dollar denominated debt obligations with an infusion of credit. They did far less to address the causes of such debt imbalances. George W. Bush, then governor of Texas, was a strong proponent of the bailout and stimulus because it protected the then thriving border economy.<sup>36</sup> These, and other incidences of Greenspan Puts can be found in Figures 1-3 in the appendix.

The use of the Greenspan Put continued. It was used in the aftermath of the East Asian Financial Crisis in the form of a ¼ percent cut in interest rates in conjunction with a Federal Reserve convened private bailout of Long Term Capital Management in late 1998.<sup>37</sup> A ¼ percent cut may seem negligible, but a ¼ percent interest rate cut on the

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<sup>34</sup> Woodward, *Maestro*, 49.

<sup>35</sup> *Ibid.*, 73.

<sup>36</sup> *Ibid.*, 138-144.

<sup>37</sup> *Ibid.*, 206.

trillion dollar US economy with many more trillions in loans and derivative contracts works out to a considerable reduction in interest payments as a whole. The freed funds, previously earmarked for interest payments, could then be redeployed as collateral for new loans. At the consumer level, freed-up funds from lower interest rates can be used to purchase real goods and services. The markets responded each time with a jump in stock indices and asset values. The Greenspan Put also entailed cheaper financing, which played a role in the increasing debt taken on by corporations and homeowners alike (Figures 6, 7, 9 & 10). Greenspan's only attempt at trying to restrain market asset price inflation occurred during his "irrational exuberance" speech, where he ever so gently implored market participants to consider their unfounded exuberance in bidding up stock prices during the tech bubble.<sup>38</sup> However, Greenspan hedged this comment by noting that a collapsing financial asset bubble might not "threaten to impair the real economy, its production, its jobs and price stability."<sup>39</sup> Being Greenspan, this comment too was hedged with the need for the Federal Reserve to not become complacent in examining, "the complexity of the interactions of asset markets and the economy."<sup>40</sup> Nevertheless, this attempt to place pressure on the bubble gave way to a de-facto bubble clean up policy as Greenspan concluded that one, even if he was the Federal Reserve Chairman, could not properly anticipate a bubble accurately because it would go against the assessment of

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<sup>38</sup> Better known colloquially as the Irrational Exuberance Speech: Alan Greenspan, "Remarks by Chairman Alan Greenspan At the Annual Dinner and Francis Boyer Lecture of The American Enterprise Institute for Public Policy Research: The Challenge of Central Banking in a Democratic Society" (speech, Washington, DC, December 5, 1996), <http://www.federalreserve.gov/boarddocs/speeches/1996/19961205.htm>.

<sup>39</sup> Ibid.

<sup>40</sup> Ibid.

millions of investors.<sup>41</sup> Such a view necessitated the use of the Greenspan Put once the bubbles popped and furthermore seems near identical to the then highly respected efficient market hypothesis theorized originally by Eugene Fama (more on this later). The result was that the bubble building in the tech stocks of the late 1990s would proceed without any pressure against it coming from the chief regulator and interest rate setter of the US financial system, the Federal Reserve. As the bubble popped and the 9/11 attacks tore a scar in lower Manhattan, the Federal Reserve dropped interest rates to near 1 percent by early 2004 (see Figure 1 or 2). The Greenspan Put was beefed up and in play. The question that remained was: what would happen once the policy trickled through the financial system? The answer would not be clear until 2008. Nevertheless, by 2002, the wealth effect induced by the Greenspan Put had enshrined itself as official Federal Reserve policy. It remained policy as Bernanke took the helm as Chairman in 2006. It seemed simple. Why would the Fed want to deflate asset prices if the wealth effect raised economic activity and popping bubbles could be easily cleaned up with the lowering of interest rates?

It is difficult to square Alan Greenspan's self proclaimed Objectivism with his consistent use of the Federal Reserve created Greenspan Put during market stress. How can a free market function freely or properly if every time it tries to liquidate a bad loan or investment, the Federal Reserve steps in with inflationary asset policy to change the level at which the market clears? Furthermore, if even the Federal Reserve Chairman cannot identify a nearly obvious bubble in tech stocks, how can he possibly know and set the correct interest rate? The interest rate is not trivial; it is the same interest rate that influences nearly every financial transaction. Using the same logic, should not the interest

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<sup>41</sup> Woodward, Maestro, 218.

rate be set by the market too? How can a handful of economists, regardless of their academic accomplishments, accurately administer the correct rate at which millions of borrowers and savers plan their economic lives?<sup>42</sup>

Regardless of this logical inconsistency, by 2002 the promotion of the wealth effect had become policy and the stock market was no longer irrational but instead, for Greenspan, the rises were attributable to the *very rational* result of increasing structural productivity growth. In turn, this productivity growth raised the expectation of higher corporate earnings, which would then be eventually transmitted back into the economy through equity dividends benefiting from the increased productivity growth.<sup>43</sup> As for the wealth effect, according to Greenspan, “Historical evidence suggests that perhaps three to four cents out of every additional dollar of stock market wealth eventually is reflected in increased consumer purchases.”<sup>44</sup> This suggestion equates that for each trillion-dollar increase in the market capitalization of the stock market, 30 to 40 billion dollars of that paper wealth will then find its way into the real economy --a considerable sum. Such an estimate does not even attempt to theorize the amount of wealth that could be extracted through home equity mortgages, nor does it consider the fact that the wealth effect can work in reverse at an even quicker pace than the speed by which the Tech Bubble and later Housing Bubble inflated. Those details would become clearer later.

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<sup>42</sup> The Keynesian counterargument is the Wicksellian Differential (see Kurt Wicksell’s “natural rate of interest”). Addressing the merits of this counterargument is beyond the scope of this paper.

<sup>43</sup> Alan Greenspan, “Testimony of Chairman Alan Greenspan, The Federal Reserve’s semiannual report on the economy and monetary policy, Before the Committee on Banking and Financial Services, U.S. House of Representatives” (speech, Washington, DC, February 17<sup>th</sup>, 2000), <http://www.federalreserve.gov/boarddocs/hh/2000/february/testimony.htm>.

<sup>44</sup> Ibid.



By now, it is well known that Bernanke not only implemented the Greenspan Put in the wake of the 2008 Global Financial Crisis, but he also greatly enlarged its economic and financial market stimulatory power, in his very own Bernanke Put. Bernanke's conceptions of the efficacy of the wealth effect are readily available in his writings and economic case studies, specifically those of the Great Depression. In essence, Bernanke took Greenspan's ad hoc put and formalized it as a component of the nonmonetary forces that affect financial markets during debt-deflationary periods. Bernanke likely became acquainted with the idea of the wealth effect while studying Friedman and Schwartz. In their description of the monetary mechanism that changes output in the real economy (discussed in detail above), they note that the rise in nonfinancial assets, as the dollar transverses the financial market from the central bank to a good or service, raises wealth relative to income, which ultimately leads to greater demand for current capital goods and services.<sup>45</sup> Whether he first came across it there or not, in "Bankruptcy, Liquidity and Recession," Bernanke notes that a household's expenditure depends on both income and wealth.<sup>46</sup> The concept of wealth as a driver of consumption and thus output is therefore a channel for deflationary forces to contract the real economy. This is noted in further detail in *Essays on The Great Depression*, "As the distress of the banks' borrowers increase, the banks' nominal claims are replaced by claims on real assets (for example, collateral); from that point, deflation squeezes the banks as well."<sup>47</sup>

This actually makes Bernanke's understanding of deflation more nuanced.

Deflation can occur not only in the prices of real goods but also in the prices of assets. As

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<sup>45</sup> Friedman and Schwartz, "Money and Business," 60-61.

<sup>46</sup> Ben S. Bernanke, "Bankruptcy, Liquidity and Recession," *American Economic Review* 71, no. 2 (1981).

<sup>47</sup> Bernanke, *Essays on the Great Depression*, 25.

such, to prevent asset deflation --keeping in mind that deflation in any form is Bernanke's ultimate economic bogeyman-- requires a policy akin to Greenspan's market levitating Put. Furthermore, the Greenspan Put could also repair confidence in the banking system. This realization endowed the Greenspan Put with an air of theoretical justification as dictated by Bernanke's study on the higher cost of credit intermediation after financial crisis. The initial ad hoc lowering of interest rates by Greenspan --caused by the fear of another Great Depression being unleashed in the 1987 crash-- culminated in the implementation of the Greenspan Put policy. However, in 2008 with Bernanke as chairman, this put also gained a solid grounding in economic theory, which was backed by Bernanke's own historical case study of the Great Depression. The reasoning for the Bernanke Put was economically and theoretically sound policy to Bernanke. There was no reason not to use it. Post facto rationalization of the Federal Reserve's action in the Global Financial Crisis further reinforces this view. In a 2010 *Washington Post* Op-Ed, Bernanke defended his actions, citing how easier financial conditions would promote economic growth, while lower rates would allow homeowners to refinance. Importantly, in terms of evidence for the Bernanke Put, he cites how, "higher stock prices will boost consumer wealth and help increase confidence, which can also spur spending." This was increasing stock price policy with the ultimate aim in mind that increased spending would lead to higher incomes and profits in what Bernanke dubbed "a virtuous circle" of economic expansion.<sup>48</sup>

Far less clear are Bernanke's policy prescriptions when it comes to slowing or halting asset bubbles. However, insight into this can be gleaned from Bernanke's

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<sup>48</sup> Ben S. Bernanke, "Aiding the Economy: What the Fed Did and Why." *The Washington Post*, November 5, 2010, [http://www.federalreserve.gov/newsevents/other/o\\_bernanke20101105a.htm](http://www.federalreserve.gov/newsevents/other/o_bernanke20101105a.htm).

examination of the cause of the Great Depression. He cites the Federal Reserve's desire to curb the U.S. stock market as one of the initial decisions that led to contractionary monetary policy throughout the world.<sup>49</sup> It is not unreasonable to conclude that he thought bubble clean up via the Bernanke Put was the best policy. Bernanke's actions support this hypothesis. At the very least, he would have been cautious about any attempts to pop a Housing Bubble because of his view that pricking the bubble with contractionary policy could result in a deflationary spiral.

This is a difficult position to defend wholeheartedly because there is substantial evidence that the Federal Reserve entirely missed the development of the Housing Bubble and the structural changes that had occurred on and off investment bank balance sheets. Both of these developments resulted in the accumulation of mountains of debt (Figures 6, 9 & 10). In 2007, on the other side of subprime mortgage-lending boom, but at the beginning of the derivatives crisis, Bernanke gave testimony before Congress addressing subprime worries. "At this junction, however, the impact on the broader economy and financial markets of the problems in the subprime market seems likely to be contained."<sup>50</sup> This is a slightly more pessimistic view than the one he espoused in 2005 to counter those claiming there was a Housing Bubble. Bernanke, in testimony to Congress's Joint Economic Committee, viewed housing price increases "[that] 'largely reflect strong economic fundamentals,' including growth in jobs, incomes and the number of new households."<sup>51</sup> In Michael Lewis's book *The Big Short*, Lewis estimates

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<sup>49</sup> Bernanke, *Essays on the Great Depression*, 276.

<sup>50</sup> Ben S. Bernanke, "Testimony: The economic outlook, Before the Joint Economic Committee, U.S. Congress" (speech, Washington, DC, March 28, 2007), <http://www.federalreserve.gov/newsevents/testimony/bernanke20070328a.htm>.

<sup>51</sup> Nell Henderson, "Bernanke: There's No Housing Bubble to Go Bust," *Washington Post*, October 27, 2005. online edition.

that Bernanke underestimated losses by about \$900 billion dollars as determined from Bernanke's \$100 billion dollar worst-case scenario assessment in 2007 versus the International Monetary Fund's assessment, which determined ex-post losses from subprime mortgages and derivatives to stand at \$1trillion.<sup>52</sup> This number does not reflect the resulting losses in currency, stock and bond markets as the subprime crisis spread contagion to the entire global financial system. In 2010, Greenspan reflected upon the performance of the Federal Reserve in the run up to the Global Financial Crisis, "We didn't forecast better than anyone else; we regulated banks that got in trouble like anyone else. Could we have done better? Yes, if we could forecast better. But we can't."<sup>53</sup> Such a conclusion lends itself toward promoting reactive Federal Reserve policy, the kind that Bernanke, once his US economic dashboard indicators flashed financial stress and deflation, was most familiar with. Such sobering assessment does also not bode well for future economic developments in a complex financial system such as ours, if the chief regulator of US financial markets cannot adequately forecast.

Although there is no evidence that any investor or investment bank did so intentionally, a fortune could have been made by betting on Bernanke not only bailing out the financial system with favorable loans and bailouts but also on Bernanke reducing financial stress through the utilization of an enhanced type of market put as justified by his academic research. In fact, such a bet, if quantifiable, would have been a much better

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<sup>52</sup> Michael Lewis, *The Big Short: Inside the Doomsday Machine* (New York: W. W. Norton and Company, 2010), 175-225.

<sup>53</sup> Quote from an interview recently published by the National Archive. The National Archives is in the process of releasing documents from the Financial Crisis Inquiry Commission. The index alone is over 1400 pages. It is important to note that this particular excerpt, the document itself (which is a Memorandum for the Record), has been paraphrased, see: Alan Greenspan, interview by Dixie Noonan, Greenspan Associates Conference Room, Washington, DC, March 31, 2010.

investment than betting on subprime Collateralized Debt Obligations (CDOs).<sup>54</sup> His responses to any type of financial stress could have easily been predicted by reading his work and speeches. The only question would have been the magnitude of his reflationary policies.

Utilizing this historical examination of the development of monetarism from Milton Friedman and Anna Schwartz to their intellectual heir Ben Bernanke, the intellectual underpinnings of monetarist doctrine and its role in Federal Reserve policy can be better accounted for. Identifying the Greenspan Put and the reasoning for it, while understanding how the Greenspan Put was synthesized and justified with Bernanke's research into nonmonetary forces as a causal element of the Great Depression, allows for a better understanding of the intellectual justification for Greenspan's actions before 2008 and for Bernanke's actions in the wake of the 2008 Global Financial Crisis. It is important to keep in mind that a specific type of economic ideology was the driver of Federal Reserve policy during this era.

## **Part 2: Financial Economic Theory is Released Into the Wilds of Wall Street**

Finance does not operate in a bubble and asset bubbles are not merely the result of irrational finance. The financial marketplace is a system of bankers, governmental regulators, investors and academia. This system is a nexus with feedback loops, conflict, and compromise. The actors involved have an expressed ability to learn and internalize the actions of other participants in the system. To understand how financial products went

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<sup>54</sup> CDOs are a type of complex financial product implicated in the 2008 crisis. CDOs pool assets such as commercial loans or mortgages, which are then divided into tranches based upon the riskiness of the specific underlying assets and sold to investors. As the 2000s progressed, CDOs became increasingly composed of subprime home loans.

from what retrospectively appears to be a quaint savings and loan intermediation system at the end of the Second World War into quant run multi-trillion dollar industry with 680 trillion dollars worth of nominal derivative contracts<sup>55</sup> and much more debt and equity “wealth”, these different institutions cannot be examined in a vacuum. *Ceteris Paribus* will have to be placed on hold for now. Attention must be paid to the effect of the rise of quantitative financial economics and its ability to influence both banking and government in buttressing assumptions and arguments toward different types of products, regulation and risk taking. Meanwhile, acute attention must be focused upon how financial theory shaped the realities within the markets themselves instead of merely explaining them.

Before an account of the mathematical formalization that would occur in economics and particularly in financial economics, it is important to note the particular political developments that would reshape the financial environment in which economic theories would be applied. The first, and most crucial development of the Great Depression/World War Two era was the entrenchment of the warfare-welfare state model. Despite some nascent framework laid following the Civil War and the First World War interwoven amongst smaller interventions into developing countries and economic programs for special interests groups, most notably farmers and railroads, the codifying of this bargain of state power became most prominent after the Second World War. And although the state has many functions, political dialogue of the parties shifted in a manner by which political deals could always be crafted resulting in a welfare-warfare procurement compromise. The quintessential example of this welfare-warfare state compromise was Lyndon Johnson’s Great Society and Vietnam War, later continued to

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<sup>55</sup> “Global OTC derivatives market: Table D5,” Bank of International Settlements, accessed March 16, 2015, [https://www.bis.org/statistics/d5\\_1.pdf](https://www.bis.org/statistics/d5_1.pdf).

some degree by Richard Nixon. The problem with and the chief characteristic of such programs, in relation to the US financial markets, are that they are enormously expensive. By 1971 this was the problem Richard Nixon faced trying to keep his economy in fifth gear in order to win the 1972 election. The problem for funding massive state projects within the Bretton Woods Monetary standard was that the dollar was supposed to be kept in check by a fixed gold ratio of \$35 to the ounce. The fixed currency regime was designed to stop competitive devaluations such as those that had plagued the international economy during the interwar years.

At this point the plot thickens considerably concerning the interaction of the monetary policy of multiple advanced economies, the Federal Reserve Chairman Arthur Burns, Nixonian methods of persuasion, and the establishment of the petrodollar system. Unfortunately, these developments are outside the scope of this paper. Nevertheless, subject to inflationary pressure, President Nixon decided to end the gold window and effectively end the Bretton Woods monetary regime. Instead of dealing with inflationary pressure through tax increases or curtailing spending, the choice was to instead remove the obstacle to increased credit creation. President Nixon obtained the academic buttressing required to float the dollar courtesy of Milton Friedman. Friedman argued for the efficacy of floating exchange rates in the international monetary system in a paper sent to policy makers titled, "The Need for Futures Markets in Currencies."<sup>56</sup> This crossing from academia to policy making and this event in particular will have grander implications later in our story, while it adds credence to the view that financial markets must be studied as a system of institutions (including government, academia and investment banking) in order to be properly understood.

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<sup>56</sup> Mackenzie, *An Engine*, 147-148.

Regardless of how this development was arrived at politically, the result can easily be identified: continued inflation. The gold check within the system had been removed. Gold, despite the affection of many gold bugs, must be socially construed as money before it becomes money. It is not inherently or naturally money from its discovery; instead it became currency or the backing of currency as more and more people and governments demanded payment in gold until it became the metal backing the Pound Sterling in the early 19<sup>th</sup> century. More recently, it has become less prestigious as governments and individuals no longer demand it. This development too has been part of a social process and is subject to change contingent upon developments in the international monetary system. Within the Bretton Woods system, gold was used more as a mechanism than as a currency to ensure no country could devalue below agreed upon parameters. The system functioned fairly well until the system hegemon, the United States, decided to fight a land war in Southeast Asia and increase welfare expenditures without increasing taxes substantially.<sup>57</sup> Currently, it seems gold has been relegated to a second tier currency, where its chief characteristic is no longer its use as a mechanism to ensure stable exchange rates, but instead its potential propensity to hold value in the face of hyperinflation because of its scarcity. The financial adage, that gold holdings are a hedge against the stupidity of politicians (it is implied the politicians own a printing press and are not afraid to use it), perhaps still holds.

Conceptually, inflation as an economic topic is far more nuanced, varied and complex than is usually understood. Inflation looking at a single price of a single good is

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<sup>57</sup> Had the gold check remained in place due to Nixon or Congress cutting spending and/or raising taxes, a curious alternative scenario unfolds. Without the ability to print dollars, would the Reagan military build up or Global War on Terror; in addition to many different types of welfare programs have been possible?



fairly straightforward and easy to determine. Quite simply, inflation is a rise in prices resulting from a greater amount of money chasing the same amount of a good. Murray Rothbard offers perhaps the most revealing observation of inflation, once the number of goods measured increases beyond one good, “inflation does not and cannot increase all quantities proportionately, and this is its chief characteristic.”<sup>58</sup> When the monetary supply is expanded it is much like dropping a rubber ball from a tall building, one can never be sure where it will bounce. It can be averaged across the economy using an aggregated measure such as CPI, but CPI does not reflect the variance in price increases. CPI does not measure the structure of inflationary change in the economy. Measuring the inflation of asset prices is far more difficult due to the role of expectations in financial markets and remains far more controversial of a subject in orthodox economics. The inflation of asset prices usually results in bubbles, where deflationary pressures cause an often-quick decline in asset prices. Yet, what is the source of this inflation and then deflation? Because the purchasing of an asset is over a longer time horizon than a consumer good and overwhelmingly dependent upon the expectations of the investor, it seems there are multiple identifiable components, which can influence the pricing of assets away from their fundamentals. The most likely culprit of these, that is, the one that would carry a heavier weighting in a mathematical expression, seems to be the expected riskiness of an investment. After all, if a financial asset has no earnings today, it is acceptable if the earnings tomorrow offset the detrimental effects of no earnings today, but the future is uncertain and that makes such an expectation type of investment risky.

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<sup>58</sup> Murray N. Rothbard, *America's Great Depression* (Princeton: D. Van Nostrand Company Inc., 1963), 65.

In many ways regulation has similar characteristics to inflation. A policy maker or even an entire institution tasked with examining the effects of a certain policy, can never be 100 percent certain how the nexus of relationships, expectations and the ingenuity of market participants will respond to a new barrier or stipulation, no matter how well intentioned the policy might be. So, what exactly happens when regulation and inflation meet? Well, the outcome becomes increasingly difficult to predict. However, the historical record continually offers evidence of how well-intentioned solutions can result in even worse problems.

Regulation Q capped the interest that could be paid on demand deposits. As the bill for Vietnam and the Great Society came due, this proved to be a problematic regulation in an inflationary environment where the capped interest payments were fixed at a rate less than the rate of inflation. Thus, investors sought other types of investments that would actually return them money. Regulation Q was one of the four components of the Glass-Steagall Act passed in 1933 under the leadership of Senator Carter Glass. Glass identified that during seasons of low demand for agricultural financing, demand deposits from rural unit banks would be occasionally lent to securities dealers to finance dealer loans to those wishing to buy stocks on margin. Margin refers to the financing method of those buying stocks using borrowed money. Carter Glass believed that this had helped fuel the stock market speculation machine, which he was convinced, had played a major role in starting the Great Depression.<sup>59</sup> By 1980, Congress and the Carter Administration

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<sup>59</sup> While there is near certain evidence that margin debt acts like an accelerator of stock prices in both directions, there is no evidence of Glass's pet peeve of interest of time deposits carrying much burden for starting the Great Depression according to Calomiris and Haber: Charles W. Calomiris and Stephen H. Harber, *Fragile by Design: The Political Origins of Banking Crises and Scarce Credit* (Princeton: Princeton University Press, 2014), 191.

had passed the Depository Institutions Deregulation and Monetary Control Act, which phased out Regulation Q in an attempt to give Savings and Loan banks the ability to attract new depositors in order for the S&Ls to shore up their balance sheets. If the purpose of this act was to keep savings in S&Ls, the act came too late. In about 6 years, the amount of assets that fled S&L balance sheets into money market funds went from \$3 billion to \$230 billion by 1982.<sup>60</sup> The development of money markets funds can be traced back to the 1960s; however, as the inflationary pressures grew, more and more funds left the S&L balance sheets to find higher returns in equities, treasuries and commercial paper.<sup>61</sup> The identification of higher returns in equities is an economic concept known as the equity premium. The definition of the equity premium, which is technically considered a puzzle, is the phenomenon of equities returning on average 6 percent more than government bonds. An astute student of the corporation as an institution will remark that *of course* equities are riskier because in bankruptcy court, stockholders are the last in line to receive any remaining assets, while bondholders are the first. Furthermore, in finance and economics in general, risk requires reward. Indicative of the increase in mathematical complexity of financial economics, the equity premium for the linear algebra and auto regression aficionado, is the *obvious* result of the volatility in equity prices. Given, it is not impossible to square these definitions into one if default is deemed to be an extreme price movement. Nevertheless, these definitional differences prove enlightening into the thinking and modeling of the different economic theoretical approaches.

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<sup>60</sup> Simon Johnson and James Kwak, *13 Bankers: The Wall Street Takeover and the Next Financial Meltdown* (New York: Pantheon Books, 2010), 66-67.

<sup>61</sup> Calomiris and Harber, *Fragile by Design*, 196.

The result of the discovery of the equity premium by the retail investor versus the Regulation Q dis-incentives of capped interest rates on time deposits is clear. Investors fell in love with both the stock and the bond market, because of the increased returns, in ways not seen since the Great Depression. As pension and mutual funds grew in wealth, number of members and therefore political clout, more attention was paid to financial markets. Mutual and pension fund investors, due to their vast collective size and wealth demanded an end to the fixed commissions of stockbrokers. As larger stock buying and selling entities, these funds could gain better rates in a competitive environment due to their size. The same was true for the larger brokers, most notably Merrill Lynch, in terms of their ability to attract clientele. By May 1975, these calls for a competitive environment had reached the ear of the Securities and Exchange Commission and subsequently, the New York Stock Exchange was “obliged” by the SEC to end the fixed commissions.<sup>62</sup> The removal of the cartel-like structure of fixed rates, although favorable for the pension and mutual funds, exacted its pound of flesh from the investment banks and brokers. A similar dismantling of the cartel-like structures occurred as the Internet revolution allowed unprecedented access to stock quotes and stock analysis; the investment banks bottom lines were undermined once more. The result of both these developments was to hurt traditional sources of investment bank profits. In both cases, the banks responded by searching for new sources of revenue from new customers and through the use of new products. As the indebtedness of the western world and Japan increased in all sectors (Governmental, Corporate, Household), the banks did not have to look far for new customers. Nor did they have to search long for a new line of products,

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<sup>62</sup> Johnson and Kwak, *13 Bankers*, 65-66.

which would exponentially increase the types of assets and quantity of assets that could be financially engineered to earn unprecedented profits.

Financial economics has not always been the top or even a promising field for young prospective Ph.D. economists to enter. However, by the mid 1980s it was the field for those economists desiring to turn theory into practice and that practice into millions on Wall Street. Financial economics sprang forth during the mathematicization of economics, well underway by the end of the Second World War as a result of the increased pressure placed on academia to model the economy, harness and maximize the production power of the United States in the fight for the world. The process leading to this mathematicization of financial economics has much deeper historical roots than the ambitions of a handful of financial economists. Despite economics always having been assisted by mathematical and statistical evidence, the rigor and intensity of applied mathematics and statistics in economics grew at an increasing rate after the rise of new modeling techniques and wartime demands of the 1940s. Many of the men who would become foremost economists found themselves working in anti-aircraft fire control labs or as economic apparatchiks minimizing the cost of soldiers' rations. This paper does not seek to synthesize sixty plus years of financial economics. Instead, it seeks to highlight important assumptions and models that would affect each aspect of the financial system by the late twentieth and early twenty-first century.

To understand the long arc of the history of economic thought, it is proper to highlight economist Alfred Marshall, who formalized such economic topics as supply and demand curves and marginal utility. He best espouses the old view of the purpose of

mathematics in economics. In a 1901 letter to a friend and student of his, he explained his method of model formulation as a 6-step process:

- 1.) Use mathematics as a shorthand language rather than as an engine of inquiry;
- 2.) Keep to them till you have done;
- 3.) Translate into English;
- 4.) Then illustrate by examples that are important in real life;
- 5.) Burn the mathematics
- 6.) If you can't succeed in 4.) burn 3.)

This last I did often. <sup>63</sup>

In fact, many of the most prominent economists are more easily identifiable by their ideas in traditional social science mediums such as speeches or writings as opposed to rigorous mathematics. This is certainly the case with Adam Smith, John Maynard Keynes and even Friedman's voluminous yet statistically inclined *A Monetary History of the United States* and later television programs. Keynes's first international bestseller was *The Economic Consequences of the Peace*, which was accompanied only with statistical tables.<sup>64</sup> By the time Keynes published *The General Theory* in 1936, the equations were still sparse, but the Keynesian bombshell was heavy. In contrast to many of the classical economists who came before him, Keynes thought possible multiple equilibria, an invisible hand that failed to produce full employment and less than rational human

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<sup>63</sup> David Warsh, *Knowledge and the Wealth of Nation: A Story of Discovery* (New York: W. W. Norton, 2006), 77.

<sup>64</sup> John Maynard Keynes, *The Economic Consequences of the Peace* (USA, Digireads.com Publishing: 2011).

beings.<sup>65</sup> In terms of Keynes's *General Theory* in relation to the so called hard sciences of math, physics and biology, David Warsh, a journalist, offers an adept metaphor, "In fact, Keynes's macroeconomics probably has more in common with Sigmund Freud's psychoanalysis – a brilliant heuristic, a durable mental map of an otherwise mysterious terrain."<sup>66</sup>

It was not until Keynes's *General Theory* was mathematically formalized in 1937 by British economist and mathematician John Hicks<sup>67</sup> and later during the Second World War by American Lawrence Klein that the ascendancy of Keynesianism gained momentum. Klein had been a prominent model-builder during the Second World War using many of Keynes's "heuristic" devices to develop a macroeconomic model of the United States wartime economy.<sup>68</sup> Klein, undoubtedly brilliant in both Keynesian economics and mathematics, was somewhat of a complicated figure including a past membership in the Communist Party. The subject of his communist allegiance was brought before the House Un-American Activities Committee during the McCarthy era.<sup>69</sup> To economics, Klein brought with him a new worldview that differed from that of the older literary economists: "We saw the world as the solution to an equation set and we were aiming to build a model that worked."<sup>70</sup> As a student of M.I.T. professor Paul A. Samuelson –arguably the leading figure in mathematizing economics, a prominent

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<sup>65</sup> Keynes sold his general theory against his crafted straw-man argument of classical economics. In reality classical economics was far less uniform than Keynes would like it to appear. Warsh, *Knowledge*, 100.

<sup>66</sup> *Ibid.*, 105.

<sup>67</sup> *Ibid.*, 106. Also see Minsky: Hyman P. Minsky, *Stabilizing an Unstable Economy* (New Haven: Yale University Press, 1986), 130.

<sup>68</sup> *Ibid.*, 127.

<sup>69</sup> Glenn Rifkin, "Lawrence R. Klein, Economic Theorist, Dies at 93," *New York Times*, October 21, 2013, online edition.

<sup>70</sup> Warsh, *Knowledge*, 128

Keynesian and the champion of what would become the saltwater economists-- Klein was endowed with the mathematical formalism that was transforming the economics profession. Of political importance, the economic ideology of Keynesianism acted (and continues to act) as an economic license to intervene in markets.

The classical economists did not resign themselves to defeat with the widespread adoption of Keynes; instead they reinvented themselves as the neoclassical school and to some degree as monetarists, both centered at the University of Chicago. The Chicago school emphasizes perfectly competitive markets, perfect equilibrium, maximization problems and rational choice theory. Due to its proximity to Lake Michigan, the Chicago school became known as the Freshwater economists, while M.I.T economists and their Keynesian allies in California, due to their proximity to the Atlantic and Pacific Oceans became the saltwater economists. Simultaneously, monetarism, led by Friedman, engaged in deeper analysis of the money supply and monetary policy relying heavily upon statistical analysis. Eventually Friedman, in his magnum opus *A Monetary History of the United States*, would cast blame upon the Federal Reserve System for failing to stop debt-deflation during the late 1920s downturn, thus allowing for the development of the Great Depression. For Friedman, the Great Depression was not an inherent flaw of capitalism, but a technocratic error far removed from the explanation of Keynes. Friedman was much less involved in the mathematicization of finance than other members of both the salt and freshwater schools. However his impact upon monetary policy and his explanation of the Great Depression carried much weight in Federal Reserve monetary policy as discussed in the first section. Nevertheless, Friedman, through the use of statistical techniques learned at the National Bureau of Economic



Research (NBER) under the direction of Arthur Burns, and the rest of the Chicago school took up the new mathematical theories to enhance their economic school of thought as well.

The fresh and saltwater schools were not entirely antagonistic. The Cowles Commission, a foundation examining policy through statistical regression analysis, was located in Chicago before the commission moved to Yale. Before its departure, the commission employed many students versed in both schools of economic thought. Indicative of this spillover and crucial to the development of financial economics, Harry Markowitz, a PhD candidate, was set to defend his dissertation that endeavored to solve the problem of financial portfolio selection. Markowitz was less concerned with identifying the best actual financial portfolio than with formulating a theory that could be applied to such a task. Once it was published in the *Journal of Finance*, Markowitz's seminal article containing matrix algebra and a critical line algorithm contrasted quite sharply with the institutionally descriptive and applied economic algebra of what was orthodox finance at the time. During Markowitz's dissertation defense, a prominent member of his dissertation committee, Milton Friedman, concluded, "Well Harry, I've read your dissertation and I don't find any mistakes in the math, but this isn't a dissertation on economics and we can't give you a Ph.D. in economics for a dissertation that's not economics."<sup>71</sup>

In the end Markowitz got his Ph.D. and a few years later he was able to influence a young student by the name of William Sharpe. Sharpe sought to solve the problem Markowitz had set up: what was the optimal market portfolio? Initially, Sharpe's plan was to find the correlation between each security in a basket of securities. This proved to

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<sup>71</sup> Mackenzie, *An Engine*, 50.

be quite difficult as a basket of a thousand securities required calculating almost half a million correlations. Instead, Sharpe found that if he used a single security's correlation to the market as a whole, which he proxied via a stock index, then he only had to calculate each stock's correlation to the market. He chose the Greek letter beta as his measure of correlation.<sup>72</sup> Today stock betas are widely used in portfolio construction. A lower beta value is less volatile relative to the market and thus perceived as less risky, while higher betas are perceived as more volatile and therefore more risky. Using these betas, stock portfolios can be constructed to reflect the individual risk preference of the investor.

Nevertheless, Sharpe still lacked the answer to the optimal market portfolio question he set out to answer. He began to struggle with the assumptions he was building into the model. Sharpe assumed that all investors shared the same expectations about the return of each stock. Sharpe's optimality occurred when the portfolio could maximize returns subject to the investor's risk preference. The solution was the riskless rate of return. Furthermore, if the market was in equilibrium, this would imply that all the investors were holding the same portfolio. In reality, this constant adjusting would be quite costly due to brokerage fees and if all investors sold a stock at once, this would imply the price would go to zero resulting in adjustment (and more brokerage fees). Nevertheless, Sharpe desired to find a mathematical answer that was not subject to brokerage fee frictions. Therefore, mathematically, Sharpe attempted to solve for multiple optimal portfolios. This turned out to be an exceedingly difficult maximization/minimization problem. Using Markowitz's set up of the optimal portfolio selection problem and incorporating what he had learned from the construction of the

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<sup>72</sup> Ibid., 52-53.

stock beta, Sharpe reached the inescapable conclusion, premised on the assumptions above, that the entire market was the optimal portfolio. Attempting to solve this problem mathematically, the selection of the market as the optimal portfolio was the only solution that yielded a satisfactory answer.<sup>73</sup>

Sharpe was acutely aware of the simplistic assumptions of the model, yet he did not dismiss it out of hand. Sharpe defended his model using a methodology adapted from Friedman. When faced with criticism in the 1950s, Friedman had written that the assumptions of some of his models were defensible premised upon economic theory as “an engine to analyze, not a photographic reproduction of [the world].”<sup>74</sup> Sharpe used similar reasoning; “The proper test of a theory is not the realism of its assumptions, but the acceptability of its implications.”<sup>75</sup> Such reasoning is certainly defensible in the sense that models do not have to depict every aspect of the real world. However, if a model strays too far from the actual processes and/or mechanisms underway in a market, it may offer convincing returns that are perceived as true. That is, despite the engine of inquiry producing these results, the results arose from a process detached from economic processes actually at work. At the policy level, the resulting miscues from such models have the potential for disaster.

The creation and adoption of economic models is often rife with tension as well. In reference to model building, the term exogenous is used to explain a variable outside the model. Exogenous sets of variables are the ones the model chooses not to explain. The more the word exogenous is used in an economic model examining, for instance, stocks or business cycles, the less explanatory power the model has. Often this results in

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<sup>73</sup> Ibid., 51-57.

<sup>74</sup> Ibid., 11.

<sup>75</sup> Ibid., 55.

the model being broader instead of more specific. At an extreme, if every part of the model is an exogenous shock, the model does not describe the internal economic phenomenon at all.<sup>76</sup> Sharpe was aware that certain assumptions of his model were not realistic. Nevertheless, he still promoted it because it offered a better understanding of the economic phenomena he sought to describe. It would have passed the too many exogenous variables test laid out above, as well.

The development of the Efficient Market Hypothesis was one of, if not the, most important development in financial economics. It brought together divergent research when Eugene Fama officially formalized it in 1970. Fama was a University of Chicago student turned professor. The efficient market hypothesis is as follows: the stock, bond and other asset markets are efficient markets because the market instantaneously prices-in all available information. Because these assets are priced according to information about them, and the market processes all of this information efficiently, then markets must always be in equilibrium. Due to Fama studying and learning at the University of Chicago, this idea of efficiency being closely related to equilibrium is not surprising. The efficient market hypothesis entailed that any extra return would be the result of increasing the riskiness of an asset. Risk requires reward and in finance the reward is higher dividends or interest earnings. Furthermore, the efficient market hypothesis undermined the traditional financier and stock market enthusiast notions of technical or fundamental value analysis. If the market was efficient, then an investor could not beat the market in the long run and therefore his or her best move, after factoring in the cost of buying and

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<sup>76</sup> Strangely, in Keynesian and Neoclassical economics, many, if not all, of the economic phenomena that cause recessions are treated as shocks and thus are exogenous. In fact, Neoclassical models are built to only allow for recessions caused by exogenous shocks.

selling stocks, was to index investments to the market via an index fund such as the Dow Jones Industrial Average or S&P 500. Technical analysts, derided by the financial economists as chartists, determine their price predictions based upon moving averages and chart formations. Fundamental value investors examine the fundamentals of a stock, such as its assets, cash flow, the stocks relation to other companies producing a similar product and expected sales growth. Fundamental value investors never claim to know the actual intrinsic price of an asset, but they instead look for an intrinsic price they know to be wrong. For instance, if a company's stock capitalization is worth less than its total assets, the intrinsic price is wrong and the stock should be bought. If technical analysis conjures images of charts, then fundamental value investing should bring to mind the Oracle of Omaha, Warren Buffett.<sup>77</sup>

As had Friedman, Sharpe, and many other economists before him, Fama realized that the model he had created had different degrees of explanatory power based upon the characteristics of the market. There existed a weak, semi-strong and strong form of his model. The strong form entailed that all new information is instantly priced in and the market is most efficient, whereas in the weak form there is a great deal of information asymmetry that allows for latency arbitrage.<sup>78</sup> Therefore, the market was least efficient in this weak form.<sup>79</sup> These three forms relaxed the information assumption, but were not able to predict future price movements alone. Friedman would later warm to the efficient

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<sup>77</sup> Mackenzie, *An Engine*, 76.

<sup>78</sup> Latency arbitrage refers to a type of arbitrage (riskless profit making) made possible by information reaching different geographic points at different times. Historically, latency arbitrage was much easier due to information technology constraints. Contemporarily, latency arbitrage requires vastly expensive microwave towers and fiber optic cables and is now known as High Frequency Trading.

<sup>79</sup> Johnson and Kawk, *13 bankers*, 69.

market hypothesis and express something close to tepid approval of the theoretical concept:

You don't have to believe it. I don't believe it. We all know the market is not efficient in a descriptive sense. But that doesn't mean that the efficient market is not the best approximation if you don't have anything else to use. ... Warren Buffett proves that there's not an efficient market, and yet Warren Buffett is what makes the market efficient, and both statements are right. If the market were 100% efficient, nobody could make any money making it efficient, and then it wouldn't be efficient again. So in a way it's self-contradictory to suppose that there really is an efficient market.<sup>80</sup>

For better or for worse economic titans are human: this necessitates a framing of the timing of this quote. Friedman's answer was given in 2004 after the bursting of the Tech Bubble, which also managed to remove some air from the academic bubble of the efficient market hypothesis. Nevertheless, Friedman does offer some implicit insight into the ways in which the concept of efficiency does not stay within the realm of theory, but is actually a mechanism in practice, while he also defends the efficient market hypothesis as the best approximation. In a way, Friedman seems to view the property of efficiency as an action of market participants upon the market instead of as a descriptor of the market itself. In this sense, the market is made efficient by those buying and selling in the market instead of efficiency being an observable state of the market. It seems efficiency is an action by market participants, not a state of the world.

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<sup>80</sup> Justin Fox, "Milton Friedman on the Efficient Market Hypothesis," *By Justin Fox*, November 21, 2006, [http://byjustinfox.com/2006/11/21/milton\\_friedman/](http://byjustinfox.com/2006/11/21/milton_friedman/).

Buffet, in a debate with one of the efficient market economists, Michael Jensen, offered his two cents on the subject. Jensen equated Buffet's success to the last man of a multitude of coin flippers who had managed to flip heads every time. Buffet responded by questioning why the coin flippers had to be men and not orangutans. However, he dismissed Jensen by asking him why so many of the successful orangutans had come "from the same zoo."<sup>81</sup> The zoo referenced by Buffet was actually his former teacher and employer Benjamin Graham, who was something along the lines of the patron saint of fundamental value investing.<sup>82</sup>

Despite the dispute over the accuracy and applicability of the efficient market hypothesis, many financial economists, investors and regulators accepted the theoretical concept and thus, the problem now presented itself in a new form. If markets are efficient and the market itself is the optimal portfolio, what causes stock price movements?

The simple answer was new news, which would then be rapidly priced into the market, at least in theory, until equilibrium was reached nearly instantaneously depending on which form of the model financial markets actually were. News, the economists assumed, was by definition random and contingent upon there being no information asymmetries. Upon inspection of the daily change of prices in financial markets, there appeared to be a normal distribution of price movements. This meant that price movements followed a bell curve (Gaussian)<sup>83</sup> distribution. The news's effect on prices, thus, seemed to follow a normal probability distribution. However, upon closer inspection, financial markets were in fact much wilder than a normal probability

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<sup>81</sup> Mackenzie, *An Engine*, 78.

<sup>82</sup> *Ibid.*, 76.

<sup>83</sup> The Gaussian or the Gaussian function, is the function used to model the normal bell-curve.

distribution. This entailed the presence of fat tails in the distribution to account for more wild price movements. Retrospectively, Fama appears to have been more aware of these fat tails than many of his students or other financial economists:

If the population of price changes is strictly normal, on average for any stock...an observation more than five standard deviations from the mean should be observed about once every 7,000 years. In fact such observations seem to occur about once every three to four years.<sup>84</sup>

Fama would flatten his probability distribution to account for these tails the best he could.

However, there was an alternative to simply flattening and adjusting a normal probability distribution. Bubbling beneath the surface of the statistical establishment lay a far stranger and wilder type of statistical distribution. Donald Mackenzie refers to these as Benoit Mandelbrot's monsters. These monsters were the fractals<sup>85</sup> that Mandelbrot studied and popularized. They behaved probabilistically in strange, less conventional ways than the bell curve. The attraction of this type of probability distribution was that it naturally had fat tails and large price movements were more likely to beget large price movements. Such a property fit the historical empirical data of cotton and wheat prices where large price changes would beget larger price changes. They were monsters because they had an infinite variance, which undermined a century of statistical progress and could not be expressed formally aside from a couple of specific examples. Most

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<sup>84</sup> Roger Lowenstein, *When Genius Failed: The Rise and Fall of Long-Term Capital Management* (New York: Random House, 2011), 71.

<sup>85</sup> A fractal is a type of equation set pioneered by Mandelbrot to create wild randomness. Wild randomness does not conform to the shape of the bell curve. Mandelbrot's work on fractals was partially a result of his work on Levy distributions. Levy distributions are probability distributions with infinite variance.



detrimental for economics, infinite variance undermines the least squares analysis in econometrics, a centerpiece of mathematical economics since its adoption. Interestingly, Fama likely arrived at his appreciation of fat tails in financial markets from Mandelbrot after taking up the study of Levy distributions following Mandelbrot's visit to Chicago.<sup>86</sup>

In the end, the Levy distributions proved too difficult and too costly to the statistical and economic establishments to gain traction. While it is certainly debatable to what degree Paul Krugman is representative of the orthodox economic establishment, his remark that, "Economics understandably and inevitably follows the line of least mathematical resistance,"<sup>87</sup> seems particularly insightful into the reasoning for abandoning the slaying of Mandelbrot's monsters, despite their apparent benefit of fitting more closely to the empirical data.

Once the randomness type was decided upon, the probability distribution could be applied to simulate the future direction of price movements. To simulate the future, a random walk using Brownian motion was utilized. A random walk consists of a mathematical path broken into steps with the direction determined by a probability distribution function. The steps, contingent upon the probability distribution, are random. Brownian motion, a modeling concept adopted from physics, was applied to stock movements. Brownian motion is very similar to the random walk, but proves more useful in visualizing the price path of the asset. The typical metaphor for describing Brownian motion is the way cream spreads throughout a cup of coffee. The path of each cream molecule's trip through the coffee is random, yet the molecules distribute themselves in a fashion that resembles a standard probability distribution; they have the shape of the bell

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<sup>86</sup> Mackenzie, *An Engine*, 106-113.

<sup>87</sup> Warsh, *Knowledge*, 59.

curve.<sup>88</sup> The tails, the cream in this metaphor, that reach the sides of the coffee cup (assuming the cream is poured directly in the middle of the cup), are thin.

In contrast to Friedman's tepid approval, Paul Samuelson, the other, if less well known by the public, titan of the era was a major proponent of the efficient market hypothesis. For the economics discipline, Samuelson's support was crucial. Samuelson's influence in shaping the teaching of young economists from the 1950s onwards was immense. This influence is perhaps best exemplified by the near universal acceptance of Samuelson's textbook, *Foundations of Economic Analysis*, in the college classroom. Samuelson worked to settle a dispute between the randomness focused statisticians and the older economists. Certain economists felt the idea of all economic actions being the result of chance was undermining the economic profession by relegating successful economic activity to luck. He managed to settle this dispute by using his stature to help those formalizing this "chance" into the efficient market hypothesis.<sup>89</sup> This chance was then imbedded, with Samuelson's help in the random walk and Brownian motion as applied to the efficient market hypothesis and as mentioned above.

Against the efficient market hypothesis are the behavioral economists who doubt the rational actor assumption. Robert Shiller, a saltwater economist and Keynesian in ideological persuasion, is one of the most prominent of the behavioral economists. Shiller was a student of Charles P. Kindleberger. Kindleberger spent his academic career attempting to understand the mechanics of financial crises. He was a literary lion of the older economic breed, tackling international monetary issues, the Great Depression and *Manias, Panics and Crashes*. Shiller continued in his tradition of attempting to inoculate

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<sup>88</sup> Lowenstein, *When Genius Failed*, 66.

<sup>89</sup> Mackenzie, *An Engine*, 64.

readers from irrational behavior by identifying the characteristics of irrational exuberance in the building of asset bubbles. Shiller attempts this by providing an explanation of each phenomenon that leads to irrational exuberance.

Although vastly different from the Keynesian behavioral economists, there in fact exists an entire school of economics that objected to the mathematical financial economics discussed above, citing the unrealistic assumptions that were buttressed upon calculus, linear algebra and statistical analysis, instead of deductive reasoning. These economists are the Austrians. Indicative of this view are Murray Rothbard's remarks on the nature of historical statistics: "Suffice it to say here that statistics can prove nothing because they reflect the operation of numerous causal forces."<sup>90</sup> Although it is beyond the scope of this paper to attempt to understand how the Austrians were relegated to the fringes of economic thought --likely due to their slow and incomplete adoption of advanced mathematical techniques and their libertarian bent that offers few proactive policy prescriptions to politicians, or both-- the Austrians working in finance are most likely to be fundamental value investors, not the new breed of financial economists. Furthermore, the Austrians have remained effectively outside the efficient market hypothesis and the new financial strategies arising from it. However, in the later examination of the Housing Bubble financial products, their business cycle theories and focus on the phenomenon of credit extension as the source of booms and busts may potentially carry more weight.

Regardless of economic school, the efficient market hypothesis had a lasting effect. For those in the market, the introduction of the efficient market hypothesis moved the goal posts of effective asset management. A fund manager, to a degree, no longer had

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<sup>90</sup> Rothbard, *America's Great Depression*, 81.

to keep consistent returns and stable wealth; he or she simply had to beat the market. The investment banking community internalized the financial economic doctrine. If the market was the result of random price movements, the best one could do was to beat the random movements. Therefore, no matter how severe the losses, all a “good” fund manager had to do in order to be absolved of claims of incompetence was to beat the market.<sup>91</sup> If the entire market was the culmination of all known information about financial assets, how could one blame a single manager for losses if the losses were not as bad the market as a whole?

These developments in financial economics paved the way for more complex financial instruments. A quick recap and listing of the assumptions may prove beneficial to understanding the more complex financial instruments. First, a problem was devised to solve for the optimal market portfolio. In the setting up of this problem, an assumption was made that all investors have the same risk preferences, expectations and thus the same aggregated optimal portfolio. Next, came the identification of the optimal market portfolio as the entire market, subsequently making an index fund the best investment. From this identification and in accordance with the formal theory that the market is the optimal portfolio, came the logical deduction that the market must therefore be efficient because information is priced in nearly instantaneously. Instantaneous processing of information is required in order to place the market in an assumed state of equilibrium. It was also theorized that there are different strength forms of this efficient market hypothesis. Importantly, it was also assumed that information is inherently random in nature. This assumption was formalized and modeled with the use of Brownian motion or a random walk process. Due to the mathematical constraints, a standard probability

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<sup>91</sup> Mackenzie, *An Engine*, 86.

distribution was chosen over a Levy distribution in order to describe the randomness of the Brownian motion, albeit the evidence of fat tails was noted.

This brings us to the Black Scholes formula, which incorporates the assumptions and models discussed above, and is used to apply these models to financial derivatives as opposed to their initial home in the stock market. The Black Scholes formula is a formula used to price financial options. It does this primarily through discounting the future and comparing the price of the stock with the strike price of the option at maturity. The only free parameter in Black Scholes is the volatility parameter. There are two main types of volatility that can be utilized to calculate the price of an option. The first is implied volatility. Implied volatility refers to how the market is currently expecting the volatility of the option to be over the length of the option contract based upon the price of the option as it is being traded in the market. Implied volatility is the volatility currently *implied* by market prices. The second type of volatility is historical volatility. Historical volatility is calculated using data on the history of the underlying asset's volatility. It is important to note that the past volatility of an asset does not necessarily predict the future volatility of an asset --as many unsuccessful option traders have discovered. When attempting to model future stock price movements, the Black Scholes formula incorporates the assumptions underlying the efficient market hypothesis. It uses a normal distribution to capture the "randomness" of price movements. Because distributions of price movements in markets often have fat tails (of varying types), the accuracy of the model can prove increasingly problematic the fatter the tail. Perhaps this normal distribution is actually the other (although unrealized) free parameter in the model. If the correct distribution of stock prices in the future can be predicted, using for instance a

Levy distribution, then Black Scholes could potentially be modified in order to offer more accurate option pricing. Empirical data demonstrates the presence of fat tails. Figure 11 in the appendix demonstrates the presence of fat tails in the S&P 500 over the last twenty years. Individual stocks are subject to this phenomenon as well. For example, the price movements of Deutsche Bank Stock (Figure 12) display the presence of fat tail with two of these price movements greater than six and a half standard deviations from the mean. Such large deviations from the mean only occur according the bell curve twice in 34 million years. Problematically, when the type of price movements is sliced thinner, Deutsche Bank stock loses the appearance of the bell curve altogether and begins to display wild randomness (Figure 13), this entails discontinuity, which is problematic for integration. Interestingly, the timing of large price movement deviations --the fat tails-- are not equally distributed throughout the twenty years of observation. Fat tails are clustered around other fat tails as Figures 14 and 15 depict.

In spite of existence of fat tails and wild randomness, Black Scholes was soon adopted as the mathematical framework for pricing a multitude of derivatives. The normal distribution, best symbolized by a bell curve, and historical volatility (or implied), best summarized as an educated hypothesis about the future based upon the past (or current market sentiment), were to be baked into the cake of nearly every derivative pricing model. This Black Scholes adaptation was subject to breakdown if volatilities were chosen improperly or at times, the markets moved in ways that did not resemble a normal distribution. However, Black Scholes did offer the generally perceived ability to estimate derivative prices accurately in a scientific and formalized method able to predict future prices. This allowed for rapid adoptions of derivatives.

The first derivative crisis that caused a systemic threat to the global financial system was the Long Term Capital Management (LTCM) crisis. Due to generous rescue terms facilitated by the Fed, their true potential for disaster was overlooked and the derivative market grew at an almost exponential rate. The derivative market came back into public consciousness during the 2008 Global Financial Crisis as subprime mortgage derivatives turned toxic and burned holes in bank balance sheets. To fully understand the complexities of the derivatives markets, the discussion of three particularly notable developments is necessary to understand how derivatives interacted with other parts of the financial system once they were let loose from their theoretical playgrounds and into the wilds of Wall Street.

First, with the introduction of derivatives, the nature of the self-fulfilling prophecy<sup>92</sup> and the process of defaulting upon debt obligations changed. Borrowing Michael Lewis's title from *The Big Short: Inside the Doomsday Machine*, the means by which self-fulfilling prophecies resulting in default occurs in the derivatives markets is through what could aptly be termed the mechanism of derivative doom. Once triggered, this mechanism of derivative doom can result in a spiral of credit rating downgrades and collateral calls ultimately resulting in bankruptcy. In technical terms, as default of a counterparty becomes more likely, that is, the counterparty's solvency is explicitly called into question, the counterparty has its credit rating downgraded by its lenders via credit rating agencies. This elicits further collateral calls because a counterparty with a lower credit rating thus necessitates more collateral as dictated by risk models and contractual agreements contingent upon the specific type of the derivative and other borrowed market

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<sup>92</sup> A self-fulfilling prophecy is a prediction that causes behavior that turns the prophecy into reality. Initially false, the self-fulfilling prophecy is a powerful force in markets and is subject to feedback loops that make the prophecy reality.

positions the counterparty holds. To meet these continued collateral calls, more positions have to be sold, lower prices ensue from this fire sale, and this pushes all those involved in the market with debt obligations to edge closer toward illiquidity and/or insolvency. This weakens balance sheets and necessitates more collateral calls. What threatened the system in 1998 and blew it up in 2008 was not outright default; it was actually the threat turned fear of default that initiated the mechanism of derivative doom. The mechanism of derivative doom is a series of cascading collateral calls that steers market forces downward. Envision a house of cards where the weakest card is required to hand more of itself over to its lenders. Once the mechanism of derivative doom begins, it is either stopped through heavy handed government intervention via bailouts and credit extension or until prices drop low enough to justify asset buying stability. Unfortunately, the first means of stopping this mechanism entails increased moral hazard and the issuing of a license for risk taking leading to a larger future risk in derivatives, while the second may occur after the destruction of most the financial system if the amount of derivatives outstanding is particularly large. Through this mechanism, the self-fulfilling prophecy is able to mix with the structural framework of derivative transactions. This is not your grandfather's self-fulfilling prophecy; instead the mechanism of doom is the self-fulfilling prophecy of the modern, highly leveraged, derivative heavy, globalized financial market system. Due to the notional value of these derivative contracts being multiple times world GDP, the speed by which this mechanism can bring down even the most illustrious banking institutions is uncanny.

The triggering of this mechanism occurred during both the LTCM crisis and during the 2008 Global Financial Crisis. For example, at LTCM, many of Long-Term's



positions consisted of convergence bets on the interest spreads of two separate assets. During the summer of 1998 and throughout the rest of the year these spreads widened. Due to the fact that many of these spreads were leveraged with debt to increase their return, which made LTCM highly leveraged, every time a spread widened or an asset moved in a direction against an LTCM trade, this required the posting of additional collateral to wherever LTCM had borrowed money to assume the convergence bet. A trade such as this necessitates leverage because the returns on this type of trade are usually only a few basis points.<sup>93</sup> Without leverage, many convergence bets would not be worth the effort it takes to implement them. By the beginning of September 1998, LTCM had lost 45 percent of its capital since the beginning of the year and was leveraged 55 to 1, *not including its derivative positions*.<sup>94</sup> The smallest price movement, or a de-facto credit downgrade resulting from their lenders requiring additional collateral, could sink the fund. Bear Sterns, LTCM's main lender, required \$500 million in capital in their account otherwise Bear would refuse to continue clearing LTCM trades, an action that would push LTCM into bankruptcy. As LTCM approached this level due to continued losses (reasons for this will be explained below) Bear was able to exact concessions, such as access to LTCM trading books and financial trading secrets.<sup>95</sup> The losses kept coming and eventually the firm was rescued by private loans bequeathed under the direction of the Fed and wound down. Although it may seem counterintuitive, Bear in fact may have actually had an interest in raising LTCM's collateral requirements. Due to the illiquid nature of the types of obscure financial derivatives that LTCM traded, Bear had

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<sup>93</sup> One basis point is equal to 1/100<sup>th</sup> of 1 percent. For example, 150 basis points equates to an interest rate of 1.5 percent.

<sup>94</sup> Lowenstein, *When Genius Failed*, 159.

<sup>95</sup> *Ibid.*, 169.

considerable power in pricing the position of the derivatives (this is similar to how only a handful of banks had the ability and the authority to price Credit Derivative Swaps during the 2008 crisis). Bear, and other investment banks, could “mark against” LTCM in an attempt to squeeze as much collateral out of LTCM before it went bankrupt.<sup>96</sup> Of course, by doing so, it increased the likelihood LTCM would go bankrupt and at minimum it exacerbated LTCM’s spiral into insolvency. If Bear really believed LTCM would go bankrupt, regardless of the realities on the ground, it could take actions against LTCM that would ensure bankruptcy. If taken, these actions would work to set in motion the mechanism of derivative doom.

This mechanism is only the legal structure for the contract payments part of the financial system. It is more the result of the precedents of the legal system than the rise of financial economics. However, with this mechanism of derivative doom now accounted for, the interactions of financial economics on this structure can now better be examined. One method of adding kindling to this flammable mechanism is through misunderstanding how to apply diversification. Typically diversification, as it is taught in business schools, requires the mitigation of risk through the purchase of assets across multiple economic sectors, geographic locations and asset classes. The idea is to diversify assets on the assumption that asset prices reflect the fundamentals of different economic assets. The problem is that this is only half of the diversification puzzle (or solution). Invoking Adam Smith’s desire to identify underlying mechanisms,<sup>97</sup> this type of diversification misses a highly significant factor: the market participants actually doing the buying and selling of assets to complete the diversification. If all those in the

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<sup>96</sup> Mackenzie, *An Engine*, 235.

<sup>97</sup> Warsh, *Knowledge*, 30-36.

marketplace diversify fundamental risk in the same manner, in the process they fail to diversify market participant risk and increase the correlation of prices.

As such, imagine a market with nine possible positions (assets 1-9) and 3 different economic sectors (Cars (C), Wheat (W), Phones (P)) with possible positions distributed evenly. If there are three market participants (LTCM, JP Morgan, Lehman Brothers) that can learn and imitate<sup>98</sup> each other, then an example attempt at diversification shows that diversification may actually cause the opposite. For instance, positing LTCM as the best financial player, LTCM has decided that the car industry will see the most growth and buys positions in the 3 types of car industry based assets (C-1, C-2, C-3), financing these positions with funds borrowed from JP Morgan. LTCM decides to diversify by buying only 2 positions of assets deriving their value from Wheat (W-1, W-2), which has traditionally been more stable. JP Morgan then sees LTCM doing these trades and copies them by doing a couple fewer trades total than LTCM, while Lehman follows with the smallest number of trades. In this example, the car industry growth proves to be based upon the extension of subprime auto loans and subsequently auto loan defaults flood the market with cheap used cars. This hurts car sales driving down the value of all car industry assets. LTCM has the largest position and tries to unwind slowly so as to not depress their position further and so as to not trigger the required posting of additional collateral on their borrowed funds. Meanwhile, JP Morgan, followed by Lehman cut their losses by dumping their C-1, C-2 and C-3 assets, while they unwind their diversification trade (W-1, W-2) to cover immediate losses inflicted by the bust car industry. LTCM's portfolio has now taken a double hit as its supposedly stable investment drops in price

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<sup>98</sup> Mackenzie, a sociologist, has documented imitation in markets. Mackenzie, *An Engine*, 225.

because it was initially imitated and then liquidated before LTCM could reduce its larger position. Due to wheat assets (W-1 and W-2) being perceived as stable, this destabilized their prices as they were dumped to cover riskier positions losses. The presumed hedge against risk failed, because it was not truly diversified. Although, it is important to note that diversification as a theoretical concept and an asset allocation tool is still intact. This is because any of the market participants could have diversified more thoroughly using asset W-3 or the phone sector. Instead, in this example, they copied each other's trades and failed to diversify market participant risk.

Now imagine this in a large enough diversified market. Although disparate asset classes are correctly identified with a low correlation, if all market participants pile into the same trades and diversify with the same trades, everything becomes correlated because everyone is holding similar portfolios. There is no hedge, only some hedges better than others. In fact, this may be another unintended consequence of increased bank concentration. A shrinking number of market participants undermine efforts at diversification because the market trends toward oligopoly. After all, the financial opposite of diversification is correlation. Furthermore, if a large enough portfolio position is assumed in a single asset or asset class, any trade to liquidate will become large enough to move the market. In what can only be described as a financial Mexican standoff, any attempts to sell will result in the need to post more collateral to lenders, while any decision not to sell still requires raising money to post as collateral for losses already incurred. There is no effective way to reduce this tension unless markets begin to rise or outside capital can be found. This was the case with many of LTCM's trades, which were in the predicament where liquidating the trade would entail large losses due to the

illiquidity of bespoke (newly created and made to order) derivative markets.<sup>99</sup> For instance, had LTCM attempted to sell some of their derivative swap positions it would flood the market and render their remaining swaps worth (even) less. Furthermore, the financial models themselves modeled conditions that were assumed to be continuous. Markets would behave discontinuously if large positions were liquidated, because the price would free fall. This would ruin previous modeling while making future modeling more difficult.<sup>100</sup>

The pseudo-diversification scenario is along the lines of what happened with first LTCM and then again in the 2008 Global Financial Crisis. The reasoning for this failed diversification may be more sociological in nature, although the economic reasoning to do so remained buttressed by the idea of the optimal portfolio component of financial economy theory. Donald Mackenzie asserts that the primary reason for LTCM's failure was imitation by other market participants simply attempting to replicate LTCM's trades. These other participants held smaller positions and sold first, while LTCM was bogged down with larger market positions it could not liquidate as quickly.<sup>101</sup> As price movements quickened because more market participants liquidated in favor of safer assets, this caused tail price movements in all markets. Price movements became correlated in all markets, sinking LTCM. The rapid increase in correlation was stark. LTCM predicted its correlation amongst asset classes to be 0.1, but by September 1998 it was near 0.7.<sup>102</sup> Unrelated to derivative diversification, yet still a curious outcome, despite being the apex of sophistication among financial economists, the partners of

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<sup>99</sup> Lowenstein, *When Genius Failed*, 169.

<sup>100</sup> *Ibid.*, 69.

<sup>101</sup> Mackenzie, *An Engine* 225

<sup>102</sup> *Ibid.*, 233.

LTCM lost \$1.9 billion with LTCM's failure.<sup>103</sup> The partners had not even managed to diversify their individual wealth amongst different institutions. Once these adverse price movements increased, across all asset classes, the doomsday mechanism was engaged and the chance of waiting out the market storm was reduced to single digits.

If the fat tail price movements arrive at the same time as pseudo-diversification, all subject to a highly leveraged mechanism of derivative doom, the results for the market are disastrous. This is what happened in 2008. Note again: Fat tail price movements are the events that occur in the tails of the bell curve. Also known as tail risk, these extreme events, according to the bell curve are not supposed to happen frequently in markets. However, the higher the correlation of assets and the riskier the underlying asset is, the more likely these price movements are to occur.

As LTCM was faced with cross asset class correlation, the fat tails began to strike real fear into the LTCM founders. Markets were supposed to behave in a manner more akin to the standard probability distribution. By the middle of 1998, they were face to face with the fat tails. Lowenstein notes, "The professors had ignored the truism-of which they were well aware --that in markets, the tails are fat."<sup>104</sup> This was difficult to accept for a bunch, which were inclined to believe in worldly normal randomness. They thought they were being, "front-run" by other firms that had discovered their portfolio.<sup>105</sup> In the end, the market fat tails won and LTCM lost \$4.6 billion. Fearing a collapse of the financial system, LTCM was orderly liquidated and bailed out with loans issued by a consortium of banks under the guidance of the Federal Reserve. The financial economics theorized over a period of 40 years had failed to accurately understand the feedback loops

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<sup>103</sup> Lowenstein, *When Genius Failed*, 219.

<sup>104</sup> *Ibid.*, 173

<sup>105</sup> *Ibid.*

and sociological forces at work in the market. The wilds of Wall Street, including extreme price movements, the effects of pseudo-diversification and imitation, had triumphed over the clean academic rigor of modern economics. However, for those involved in financial economics, and other market participants hoping to get in on a slice of the profits from complex derivatives, LTCM did not instill a sense of apprehension.<sup>106</sup> Instead, it instilled a grand sense of opportunity.

### **Part 3: The Federal Reserve's License to Take Risks Meets the Economists' License to Undercapitalize: A Housing Bubble and a Global Financial Crisis Ensur**

The stage was set. Financial economics had come of age in the late 1990s and the failure of theory in practice was written off by the investment banking community as smart bets gone wrong. The Federal Reserve had continually stepped in with accommodative monetary policy via the Greenspan Put and lower interest rates at signs of financial stress. The “Great Moderation” was in full swing. Following the bursting of the dot-com bubble and the September 11<sup>th</sup> attacks, the Greenspan Put was utilized and the federal funds rate was set at 1 percent. Few additional factors were required to spark a new bubble.

The spark of the 2008 crisis stemmed from inadequate mortgage underwriting and lending, which was exacerbated by underestimating risk, correlation and the propensity for extreme price movements. The eventual problems of unidentified correlation resulting from pseudo-diversification differed only in details during the Housing Bubble, as the primary financial instruments were pseudo-diversified by geographic location instead of

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<sup>106</sup> Lowenstein, in his 2010 afterward of *When Genius Failed* (237-243), makes a similar case regarding the lessons left unlearned following the LTCM crisis and their relation to the 2008 Global Financial Crisis.

by asset class. The outright risk of relaxing underwriting standards in mortgages lending requires little explanation. Issuing mortgages to individuals with bad credit, and potentially no income or assets, is a risky decision. When the only potential homeowners have for paying off their mortgages is to bet on home price appreciation, those are risky mortgages. These conceptions of risk are not new and require no mathematical nuance or complicated financial engineering.

The rapid increase in the issuance of subprime mortgages is, however, a bit more complicated, but subprime mortgage machine's origins can be broken down into only a handful of moving parts. One notable summary of the rise of this type of lending and credit extension program can be gleaned from Greenspan critic and now head of the Indian Central Bank Raghuram Rajan. He likens contemporary US middle class and special interest group subsidized credit policies to the US government simply saying, "Let them eat credit."<sup>107</sup> Broadly speaking, this is an apt summary, however there are a few more details pertinent to the intricacies of the financial system. The first has to do with the interaction between activist groups, the US Department of Housing and Urban Development (HUD) and the banking industry. During the Clinton administration, activist groups demanded easier credit access in poor urban areas, while HUD was tasked with increasing home ownership in poor communities. Simultaneously, investment banks and commercial banks desired mergers and acquisitions in order to become megabanks and capitalize on the perceived new economies of scale. These new economies of scale were opened up by financial deregulation in the 1980s and culminated in 1999 with the Gramm-Leach-Bliley Act, which repealed the provisions of the Glass-Steagall Act

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<sup>107</sup> Raghuram G. Rajan, *Fault Lines: How Hidden Fractures Still Threaten the World Economy* (Princeton: Princeton University Press, 2010), 21-45.



prohibiting investment and commercial bank combination. However, mergers still had to be approved by the Federal Reserve Board. The chances for a merger being successful were greatly improved if the bank in question was displaying “good citizenship.” Legally this was codified in the Community Reinvestment Act (CRA), which had been passed in 1977 in response to claims by the urban poor of lending discrimination.<sup>108</sup> Fast-forward to the late 1990s and banks were doing all they could to inflate their CRA ratings through the co-opting of special interest groups devoted to helping the urban poor. For instance, Fleet-BankBoston paid travel expenses of community activists to testify on the banks behalf.<sup>109</sup> Meanwhile, the community organization ACORN wrangled a \$760 million commitment from the Bank of New York to invest in low income housing and small business lending.<sup>110</sup>

Eventually this coalition expanded to include Government Sponsored Enterprises (GSEs) Freddie Mae and Fannie Mac. The Clinton Administration pressed these GSEs to lend more and to lower income groups. George Bush doubled down on this policy in order to promote his homeownership society. By 2004, this included the issuance of no-doc mortgages. A no-doc mortgage requires no documentation of income. Mortgage originators such as Countrywide Financial found an entirely new source of demand for subprime mortgages. To sweeten the deal, there was no risk to mortgage originators if the government was guaranteeing purchases of these mortgages. This entire system was reinforced through political donations where the top recipients from 1989-2008 included Chris Dodd, Barack Obama, John Kerry, Hillary Clinton, Richard Shelby and John

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<sup>108</sup> Calomiris and Harber, *Fragile by Design*, 216-217.

<sup>109</sup> *Ibid.*, 219.

<sup>110</sup> *Ibid.*, 221.

Boehner.<sup>111</sup> This was an admirable project: however the means to achieve it resulted in a serious distortion of credit markets. The HUD-Bank-GSE coalition opened a door that was non-excludable. Lowering the underwriting standards for mortgages applied to all groups.

Although GSEs would not end up issuing the majority of subprime mortgages, their lowering of underwriting standards served as the impetus that set in motion the lowering of underwriting standards for all groups.<sup>112</sup> The fact that GSEs did not issue the most subprime mortgages does not absolve them of their role in sparking the Global Financial Crisis. The fact that the investment banks ended up holding a far larger quantity of deeper subprime mortgages should not be surprising because for financial institutions to gain access to this market they had to enter by originating mortgages below the rates offered by the GSEs or to applicants with lower qualifications. This may explain why the GSEs lost significantly less in terms of total subprime and per capita subprime losses. On the other hand, the borrowers sustained significant losses. The resulting decline in housing prices wiped out what little savings and equity a subprime borrower had. The political coalition determined to fight poverty and increase homeownership not only failed, but also managed to make things worse. The papering over of problems with credit failed to address structural and fundamental causes of poverty such as joblessness, reduced economic opportunity, indebtedness and an educational system lacking in many areas --apparently including personal finance classes. Homeownership would have proved much more stable had the home been financed by a solid paycheck instead of

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<sup>111</sup> Lindsay Renick Mayer, "Update: Fannie Mae and Freddie Mac Invest in Lawmakers," OpenSecrets.org, accessed March 16<sup>th</sup>, 2016, <https://www.opensecrets.org/news/2008/09/update-fannie-mae-and-freddie/>

<sup>112</sup> Calomiris and Harber, *Fragile by Design*, 246-255.

financial products betting housing prices would rise or the taxpayer would pick up the bill at some indeterminate time in the future.

Regardless of intricacies of the sausage making process required to create this myopic government credit extension scheme and regardless of the eventual toxic sausage that was made, the key contribution of these GSEs was that they relaxed the underwriting standards for everyone, which then fueled the boom in multiple types of financial derivatives. As these products eventually trickled into Wall Street, subject to a different set of specific developments, each one was in no small way the result of a political coalition attempting to achieve its goals through extending credit and obfuscating the ultimate price when the bill would come due. These sub-market mortgage-lending rates backed by an implicit government guarantee then met Alan Greenspan's Put in the aftermath of the tech bubble. The result was historically unprecedentedly low interest rates to buy or refinance a home.

The spurious assumption that these types of loans were adequately diversified played a key role in their destruction. In the construction of a subprime CDO, mortgages from around the United States would be chosen in an attempt to diversify risk. The idea was that the regional economies of the United States could not all face a decline in real estate prices at the same time. On the surface this was relatively sound reasoning. The problem was that in reality the entire country was experiencing a rapid increase in the issuance of subprime loans. Furthermore, these subprime loans came with a teaser rate attached to them. Teaser rates are common in home and auto purchases. They allowed the borrower to pay a miniscule interest rate for a predetermined number of months until the rate normalizes at a drastically higher rate once the teaser rate expires. If left unpaid

because the subprime borrower had cash flow problems to begin with, soon the amount of principal of the loan could grow to be vastly greater than the actual value of the home (or auto). This potentially could have occurred even before house prices began to drop. Ideally, for the mortgage originators, the borrower would then refinance and the mortgage originator would get another series of fees in exchange for giving the borrower another couple of months of teaser level interest rates. A quintessential example is as follows:

Want to borrow \$1,000,000 for just \$25 a month? Quicken Loans has now introduced an interest only adjustable rate mortgage that gives the borrower six months with both zero payments and a 0.03% interest rate, [...for] the home buyer with the short term cash flow problem.<sup>113</sup>

These deals were taking place across the county. It did not matter if the CDO was composed of loans from New York, Florida, Texas and California, because all the subprime loans were premised on ephemeral teaser rates and little to no payments in the first couple months. This was pseudo-diversification that presumably<sup>114</sup> managed to go unnoticed by those closest to the CDOs. Those that did notice the stilts of debt that increasing home prices and all the assets derived from those home price increases were

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<sup>113</sup> For a contemporary example of these teaser rate deals, simply turn on the radio and one does not have to wait long for a subprime auto loan financing commercial to come on the radio. For Quicken Loan advertisement see: Lewis, *The Big Short*, 55.

<sup>114</sup> There is much disagreement about just how unaware those closest to the CDOs were. It seems those selling the CDOs were acutely aware of the profit margins from CDO sales. These profits may have blinded them to the actual details of what they were creating and selling. It may have not, but to examine the evidence of a banking conspiracy to defraud investors is beyond the scope of this paper. This paper is concerned with the economic models behind the crisis and how those models shaped markets, actions and policy.

built upon along with the fundamental unsoundness of the global financial system have since been immortalized by Lewis as the “Big Shorters.”

There existed roughly two types of these shorters. First there existed the intrinsic value investors that saw beyond all of the misleading financial product language and CNBC stock ticker cheerleading. They crunched the numbers, they did their homework and they ventured an educated guess on there being a Housing Bubble. To categorize the composition of this group is difficult, but speculatively, they tended to be intrinsic value investors or Austrians economically speaking.<sup>115</sup> Their researched investment decisions proved correct and they made a killing. They used Credit Default Swaps to short the housing market. However, it is important to understand that the CDS instrument was their tool to be bearish, not necessarily central to their investing strategy. A Credit Default Swap is a type of financial product originally designed to be used as an insurance policy against bond defaults. Notably, an investor is not required to own the bond the investor desires to buy insurance on. This allows CDSs to be used as a tool to short financial assets such as CDOs (more on CDSs on page 74).

The second type of shorter is perhaps far more intriguing in relation to the discussion of the dubious financial economic probability assumptions discussed above. This second type of shorter sought out derivatives, such as CDSs, priced using the Black-Scholes formula because they found the pricing model to be flawed. This type-two shorter bet against the bell curve wherever they thought its assumptions of price movements most flawed. As fortune had it for these type-two shorters, one such area of

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<sup>115</sup> Michael Burry of Scion Capital is arguably an intrinsic value investor. Kyle Bass of Hayman Capital is an outspoken libertarian-Austrian economist as is Mark Spitznagel of Universa Investments. To attempt to categorize Steve Eisman of FrontPoint Partners (one of the protagonists of Lewis’s book) is beyond the scope of this paper.

egregious risk mispricing *just happened to be* the housing market. This was the case for Cornwall Capital, the “garage band hedge fund”<sup>116</sup> from Berkeley California. They searched for mispriced potential accidents waiting to happen. In practice, Cornwall first came across this flaw in modern finance when they bought a specific type of call option called LEAPS<sup>117</sup> on Capital One stock. Capital One became embroiled in a lawsuit over fraud and its stock price became stuck in a purgatory like price band pending the outcome of the lawsuit. The stock would either tank if Capital One lost the case or it would rise as it returned to its pre-lawsuit level. The Black-Scholes formula is inappropriate for discontinuous jumps in the market and predicts small price movements to be more likely than large ones. Cornwall Capital did their homework concerning which way the lawsuit would likely turn out, bought \$26,000 in LEAPS and once the lawsuit was dismissed and the stock price departed its uncertain stock price purgatory trading range, the LEAPS became worth \$526,000.<sup>118</sup> Cautiously, Cornwall Capital continued their highly unusual, yet highly profitable investing strategy. From the information available, what also set Cornwall apart from the type-one shorters was that they bet against the AAA credit rated CDOs because they thought all the CDOs susceptible to large price movements. To them, the credit ratings did not matter because all the CDOs were susceptible to default after only a 7 percent loss.<sup>119</sup> Because the cost of a CDS on a CDO with rating of AAA was around 50 basis points as opposed to 200 basis points on BBB rated CDOs, Cornwall was able to buy more CDSs relative to the other shorters on a dollar per dollar basis. Both

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<sup>116</sup> Lewis, *The Big Short*, 122.

<sup>117</sup> Remember, call options are the right, but not the obligation to purchase a stock at a determined strike price in the future. LEAPS (Long-term Equity Anticipation Security) are a type of call option.

<sup>118</sup> Lewis, *The Big Short*, 114.

<sup>119</sup> *Ibid.*, 129.

were the bargain of the bubble, but Cornwall had a considerably better bargain. For the banks and other issuers of CDS on mortgage CDOs, Cornwall became part of the bulldozer they were picking up nickels in front of.

Interestingly, one of the other investors in the type-two shorter groups may in fact be the father of this type of investing strategy. Twenty years before air began to escape from the Housing Bubble, Nassim Taleb was making similar bets on extreme price movements in options markets. His theories were overwhelmingly vindicated on Black Monday, 1987<sup>120</sup> when the Dow Jones Industrial Average fell 22.6 percent in a single trading day. It was the same day that pioneering financial economist Mark Rubenstein along with many other market participants entered clinical depression. Black Monday was the harbinger of the Greenspan Put. On Black Monday, Taleb made enough money to quit options trading and has since embarked upon an intellectual and academic journey to better understand, the application of fractals, wild randomness, and the risk and opportunities such randomness presents. Taleb is outspoken and does not mince words. He refers to the bell curve as the Great Intellectual Fraud (GIF) because it ignores large deviations and Taleb has far less flattering words for Myron Scholes, Alan Greenspan and Ben Bernanke.<sup>121</sup> Taleb has coined his extreme events theory as the Black Swan Theory and his book by the same name is dedicated to Benoit Mandelbrot.

On the regulatory and economic side there existed skeptics of the soundness of the financial system as well. During the late years of the Clinton Administration, before the LTCM debacle, Brooksley Born, Chair of the Commodity Futures Trading Commission began to raise red flags over the potential for fraud in the derivatives

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<sup>120</sup> Nassim Nicholas Taleb, *The Black Swan: The Impact of the Highly Improbable* (New York: Random House, 2007), 18-21.

<sup>121</sup> *Ibid.*, xxiv.

market. Born, a lawyer by trade, clashed with the Greenspan Fed and the Larry Summers Treasury over attempts to regulate derivatives. She ultimately lost the battle and the derivatives markets continued their climb into the stratosphere. Johnson and Kwak in *13 Bankers*, continually use Born's attempts to regulate and search for fraud<sup>122</sup> in the derivatives market as a foil to the policy approach actually taken.<sup>123</sup> Although Born could have potentially reduced the amount and type of the derivatives in play by 2007, it is unclear if this would have served to remedy the deeper crisis causes of excessive risk taking and undercapitalization, but her actions could have certainly had some crisis mitigating effects. On the economic side, Raghuram Rajan (cited frequently in this paper) is representative of the economic skeptics. Rajan's insights before, during and after the financial crisis have been particularly prescient including his "let them eat credit,"<sup>124</sup> and "license for risk taking"<sup>125</sup> observations.

Nevertheless, for the vast majority of market participants (including the Federal Reserve), there were no serious objections or questions raised about home prices across the country rising in unison. It was only once home prices started declining in unison, that it became apparent that the entire booming housing market was correlated. This wreaked havoc with risk models that were presumably diversified. That is, they were pseudo-diversified. CDOs all became correlated as prices declined and worst yet, they all

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<sup>122</sup> The dual developments of fraud and inadequate credit rating agency diligence are beyond the scope of this paper, albeit they certainly played an important role in the severity of the crisis at the personal level. For analysis of these activities see the works of Lewis, Stockman and Johnson and Kwak. Flawed probabilistic assumptions and misunderstanding complex financial derivatives (even if explained properly) are not, however, technically fraudulent behaviors. *Intentionally* bamboozling ratings agencies, investors and borrowers alike for financial gain, however, is considered fraudulent behavior.

<sup>123</sup> Johnson and Kwak, *13 Bankers*, 8-9, 103.

<sup>124</sup> Rajan, *Fault Lines*, 21-45.

<sup>125</sup> *Ibid.*, 15.



moved toward zero. As underestimated potential losses multiplied, particularly for those who had bought CDOs on credit or had issued CDSs, this necessitated liquidating other assets to meet collateral calls. Ideally, had the risk of these CDOs been more apparent, more capital could have been held to offset potential losses. Assuming diversification due to geographical location while overlooking the actual details of what was in part causing the rise in home prices (teaser rates and risky credit extension) is pseudo-diversification at its worst.

During the housing crisis, Bear Stearns, Lehman Brothers, Morgan Stanley and many other investment banks faced this dawning of reality. The supposedly riskless subprime CDOs were revealed to be full of actual risk as loans defaulted in droves across the country. They were revealed to be highly risky mortgages induced by teaser rates and overzealous mortgage originators with no skin in the game. The degree of correlation within a CDO was just as extreme as the dropping prices of the market. The tail risk had revealed itself. Bear Stearns' liquidity drained first and it was sold to JP Morgan as the first casualty of the crisis. Lehman Brothers fell next followed a few days later by AIG, which was taken over by the United States government. In total, Morgan Stanley lost 9.2 billion dollars from bets on subprime mortgage CDOs. Faced with explaining these losses, Morgan Stanley CEO John Mack blamed tail risk, "It's just simple as that. Those are big fat tail risks that caught us hard, right. That's what happened."<sup>126</sup>

Even former Fed Chairman Greenspan, looking back on the 2008 Global Financial Crisis, notes the incidence of these fat tails as the force capable of undermining the entire system.

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<sup>126</sup> Lewis, *The Big Short*, 218.

“ Yes [the system underpriced risk], throughout the system. You determine under-pricing by how much capital is needed to guard against tail events. [...] I think it was universally under-pricing risk across all asset categories. [...] If Bear Stearns had been required to hold more capital, it would not have failed.”<sup>127</sup>

The movement of prices in markets was not and continues to not follow a standard normal distribution. Using models derived from the standard normal distribution many work in the short run, but eventually these risk models are useless in the face of tail risk, just as was the case in the LTCM crisis and overwhelmingly in 2008. If derivatives contracts are made by an undercapitalized financial institution and the institution’s derivative risk and volatility are improperly measured using a standard normal distribution based model and pseudo-diversification, then the institutions making the derivative bets are essentially, “picking up nickels in front of bulldozers.”<sup>128</sup>

A division of AIG, known as AIG Financial Products (AIGFP), was doing just that. Faced with extremely fat tails, the most clear cut example of this mechanism of derivative doom’s potential for turning the fear of bankruptcy into actual bankruptcy unfolded at AIG in 2008. A division of AIG, AIG Financial Products, had issued Credit Default Swaps (CDSs) on subprime mortgage Collateralized Debt Obligations (CDOs). A CDS is essentially an insurance policy against a bond defaulting. However an investor can buy CDS on any bond. Explicitly, the investor does not have to own the bond he or she is buying CDS on. The models used to determine CDS prices are based upon the

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<sup>127</sup> Quote from an interview recently published by the national archives releasing documents of the Financial Crisis Inquiry Commission. See: Alan Greenspan, interview by Dixie Noonan, Greenspan Associates Conference Room, Washington, DC, March 31, 2010.

<sup>128</sup> Lowenstein, *When Genius Failed*, 102.

Black Scholes formula and upon the assumptions underpinning Black Scholes including the notorious bell curve price movement probability assumption. The Credit Default Swap originated at J.P. Morgan, with its original purpose being to change the means to mitigate risk. Traditionally, if a bank thought a bond was risky it would not issue it. This proved problematic if the bank wanted to avoid alienating a longstanding or important client. The solution was to still issue the bond, but to take out an insurance policy on it, where the insurance policy cost a few basis points each month, quarter or whatever the contract stipulated.<sup>129</sup> There was no stipulation, however, on CDSs requiring the purchaser of the CDS to actually own the bond the CDS was covering. Soon the CDS was re-imagined as a synthetic short.<sup>130</sup> For a couple of basis points a month, contingent upon how risky the underlying bond was, an investor or investment bank could short any bond on the market where he or she could find a willing counterparty to take on the risk of default in exchange for a couple of basis points a month. Yet, it is important to remember that default by definition is an extreme price movement, a tail event, and as such was modeled using the Black Scholes assumption that price movements followed a standard normal distribution. If this modeling assumption proved erroneous, mispricing could occur. It was as if an investor decided that his neighbor's house would catch on fire, not randomly, but perhaps because there was a forest fire next to the house unnoticed

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<sup>129</sup> Lewis, *The Big Short*, 32.

<sup>130</sup> The CDS was also re-imagined as an income-producing asset that could be *bundled into a CDO*. This type of opaque financial product consisted of the basis points paid by holders of CDS and of other types of debt obligations, many of which were subprime mortgages. These “innovative” CDOs were known as synthetic CDOs and were particularly susceptible to small downward price movements in home prices. Investors in the CDO were responsible for paying out CDS claims if defaults occurred in the subprime housing market. More risky yet, defaults had the potential to cut into the CDO from two directions because aside from paying CDS claims, defaults could also undermine the other portion of the synthetic CDO, which, at the time, was likely to be bundles of subprime mortgages. If this seems rather circular, that is because it was.

by the insurance company. Noticing this, the investor could then buy an insurance policy on his neighbors almost-burning house. Yet, the CDS would be priced as if the home was in a safe, fire-free neighborhood. By 2008, as subprime mortgage defaults returned a cascade of tail risk (as will be discussed further below), AIG was faced with serious solvency concerns.

These solvency concerns began the mechanism of derivative doom. The legal structure put in place to address the posting of collateral in relation to AIG, AIG's counterparties and AIG's CDS products is revealing:

The CDS contracts "carried substantial liquidity risks for AIG" because they required AIG to post cash collateral in three circumstances: (1) a default in a covered CDO; (2) a decline in the CDOs' market value; (3) a downgrade of an individual CDO tranche; or (4) a rating downgrade for AIG itself. If AIG's credit rating declined, AIG would be forced to post billions of dollars in collateral due to the terms of its CDS contracts.

(Noting that "[e]ventually the credit rating agencies [got] concerned about AIG's liquidity" which led to more liquidity problems and then the run on AIG).<sup>131</sup>

In August of 2008, the credit agencies were considering downgrading AIG's credit rating. This news leaked out. By the Friday before the week Lehman Brother collapsed, the mechanism of derivative doom was engulfing AIG. AIG predicted it needed an additional \$18 billion in liquidity on Saturday, which it increased to \$45 billion on Sunday and again on Monday to \$75 billion.<sup>132</sup> The gig was up. AIG was ultimately given two loans

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<sup>131</sup> Starr International Company, Inc. v. United States, 11 U.S. 779C (2015).

<sup>132</sup> Ibid.

by the Federal Reserve before it was taken over at the end of September. Once engaged, the mechanism of derivative doom could not be stopped. The momentum resulting from credit downgrades (real or perceived) coupled with increased required collateral posting requirements doomed AIG to bankruptcy. The derivatives market does not work well in reverse; the collateral requirements can sink even the largest and most prestigious of firms. Had AIG not issued mispriced CDSs on subprime CDOs the result may have been different for the company.

It is clear that investment banks, non-bank financial institutions and high-powered investors internalized the models, theory, justifications and ideas of financial economists, with retrospectively disastrous results. However, the interaction of these two groups interacted with others as well, including the Federal Reserve and other sections of the United States Government. This begs the question, why were these lessons not learned in 1998 when LTCM almost brought about a derivatives market meltdown similar to 2008? The answer to this question requires a look at the entire financial system.

By late 2007, the United States had a Chairman of the Federal Reserve who had spent a great deal of his academic life theorizing and modeling deflation and the effect of debt-deflation caused financial crises upon output. He had spent nearly his entire academic and professional life championing monetary expansion, stopping deflation and the promotion of confidence in financial markets through a policy similar to the Greenspan Put. With Bernanke at the helm, it is difficult to imagine an outcome different than the \$3.5 trillion in quantitative easing (the distinction between this and helicopter money is tenuous), the \$700 billion infusion of cash from the Troubled Asset Relief Program (TARP), interest rates pegged to the lower zero bound and the takeover of AIG

to funnel backdoor bailouts to the entire global financial system.<sup>133</sup> The only question by late 2007 should have been one inquiring as to the magnitude of the policy action resulting from Bernanke's desire to re-inflate the entire world economy discounted by the tools at his disposal, legal issues and political pressures. If the Friedman-Fisher-Bernanke monetarist explanation of the Great Depression is correct, then Helicopter Ben was the man for the job. But, was Friedman right? Had monetary forces caused the Great Depression? Was Bernanke able to prevent the next Great Depression? And what caused the start of deflationary forces in the first place?

The misfiring risk and diversification models discussed above provide a sector specific explanation. On the macroeconomic front, let us begin with the question that sheds light upon both the deflation and wealth effect turned bubble questions. What starts the initial wave of debt-deflation as theorized originally by Fisher? Is it a contraction in the money supply as argued by Friedman and Schwartz and seized upon by Bernanke? Is a contracting money supply the ultimate economic force to be avoided in order to prevent debt-deflation induced financial crisis and depression? It is important to remember that Irving Fisher notes, "disturbances and new opportunities to invest," can "sometimes conspire to lead to a great volume of over-indebtedness; this, in turn, leads to attempts to liquidate; these, in turn, lead to falling prices."<sup>134</sup> Fisher's solution is reflation; what remains unclear is how the events leading up to the policy prescription of reflation affects the need for reflation. Drawing upon Fisher's original work, perhaps the better method to fight deflation is to fight over-indebtedness. After all, over-indebtedness, or at minimum a rapid increase in the accumulation of debt, preceded both the Great Depression and the

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<sup>133</sup> *Starr International Company, Inc. v. United States*, 11 U.S. 779C (2015).

<sup>134</sup> Fischer, "Debt Deflation," 349.

Global Financial Crisis as evident from the graphs below (Figures 4, 5, 6, 7, 9 & 10). Friedman, Schwartz, and later Bernanke may have been too focused on a symptom resulting from over-indebtedness instead of the actual cause of debt-deflation. Observing only a money supply and the consumer price index that are becoming increasingly difficult to accurately calculate, the Federal Reserve's dashboard indicator for inflation, may have focused Bernanke (and Greenspan before him) on the primarily *observable* monetary variable, making them both blind to the deeper cause of deflation and the behavior of inflation in asset prices. Over-indebtedness resulting from excessive credit extension is an important concept because it may first lead to overproduction, which causes falling prices, or asset bubbles as the price of assets is bid up in rapid succession. Eventually, the overproduction causes businesses with weaker balance sheets to fail whereas an asset bubble eventually crests and results in a negative wealth effect. This was the case in asset markets in the run up to the Great Depression as the stock market increased until it eventually crashed under its own ridiculously optimistic valuations on Black Tuesday. During the late 1920s, in the goods market, American and world agriculture suffered from oversupply. As Charles P. Kindleberger's *World in Depression 1929-1939* shows, in the late 1920s American and world agriculture suffered from chronic oversupply.<sup>135</sup> It is difficult to view this as a natural market outcome because American farmers were producing record surplus due to government credit extension programs, while foreign demand was financed with American loans as well. There is much evidence that from the depths of the First World War, until the global trade and currency wars that essentially brought international trade to a halt in 1933, the United

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<sup>135</sup> Specifically see chapter 4: Charles P. Kindleberger, *The World in Depression 1929-1939* (Los Angeles: University of California Press, 1986), 70-94.

States was running an unprecedented public export scheme built upon credit extension to suppliers and demanders alike.<sup>136</sup>

Under these speciously auspicious conditions, colloquially known as the roaring twenties, debt-deflation acted as a market force acting to correct imbalances. The market attempted to clear or re-price bad loans from outrageous values into more plausibly reasonable values. It is likely in such conditions that the sooner there is a return to sounder economic fundamental moorings, the less damage that will be wrought in the processes. However, it should be noted, there exists a stark recessionary effect if this process increases with too much alacrity, as it arguably did in the 1920s and the late 2000s. If the debt is piled too high, the downturn and recession can potentially cause reverse bubble-like conditions resulting in prices that are depressed below any feasible intrinsic value.<sup>137</sup> It seems the magnitude of contraction is directly correlated with the quality and quantity of the debts issued. Given that finance is essential in a capitalist system and debt financing can be very beneficial if used responsibly and the riskiness of the credit properly priced, debt increases can diverge from the trend line and result in over-indebtedness. This valuable idea of over-indebtedness, courtesy of Fisher, is likely the primal causal force of deflation. The changes in the money supply are simply the easily identifiable symptom of this over-indebtedness beginning to liquidate. If debt levels are low, monetary contractions theoretically should have a greater effect in goods

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<sup>136</sup> Adam Tooze, *The Deluge: The Great War, America and the Remaking of the Global Order, 1916-1931* (New York: Viking, 2014), 329.

<sup>137</sup> Intrinsic value and fundamental value or derivations of these two terms are rather vague descriptors, but are used often. By definition intrinsic is natural and innate, whereas fundamental is core. From a financial market perspective the concept of intrinsic value arises from Benjamin Graham and David L. Dodd's *Security Analysis*. The first edition was published in 1934 and in many ways has become the Old Testament of value investing. These two terms endeavor to understand a financial asset's true worth: its true value. How to arrive at the conclusion of true value is easier said than done.



and labor market prices. They should not be the cause of debt-deflation turned financial crisis such as what happened in the late 1920s during a time of unprecedented indebtedness or in the Global Financial Crisis, the recent iteration of over-indebtedness. Instead, unbeknownst to the Chairman of the Federal Reserve fixated upon fighting deflation, the over-indebtedness caused a greater amount of debt-deflation, not vice versa.

Before 2008, monetarism was usually associated with low inflation in goods and services, while Greenspan's tenure at the Federal Reserve was known as the Great Moderation. The Great Moderation, in part a moniker designed to distance the 1990s and early 2000s from the stagflationary 1970s, was coined to describe the stable growth, low inflation economy. Adding in two asset bubbles, and the greatest economic contraction since the Great Depression certainly casts a great deal of doubt over just how great this supposed moderation was. That said, it is important to reexamine the mechanism the Federal Reserve uses to gain a better historical understanding of the behavior of the economy. How does asset mispricing occur with respect to Friedman and Schwartz's mechanism that transmits monetary forces? What are the effects in the asset and goods and services markets respectively and how does this influence over-indebtedness?

The lack of expected goods and services inflation during the supposed Great Moderation has been explained by numerous theories, yet no answer has proven sufficient. This requires a reconsideration of the monetary mechanism that Friedman and Schwartz describe. Perhaps they failed to notice an avenue by which money can take on two not yet described routes in its chase of assets and goods and services. These scenarios will be explored to determine how the infusion of money resulting from the Greenspan or Bernanke Put acts in regard to the Fed's economic dashboard indicators. The Fed's

dashboard indicators are partially the result of those dictated to the Fed by congress in the Humphrey-Hawkins Full Employment Act including stable prices and full employment and partially the result of indicators required by monetarist theory including prices and the money supply. This is important to understand because these are not raw measurements. These measurements are determined and taken in part by theory just as the adjustments to policy from those measurements are determined by theory. Particularly revealing are the indicators not included in the Fed's dashboard because the missing indicators cannot influence policy.

The first possible outcome of loose monetary policy is the zombie corporation deflationary effect. As the Federal Reserve lowers interest rates through the purchase of treasuries (and after 2008 all eligible assets under Quantitative Easing) it in effect injects cash into financial markets. The Fed may do this because the Fed fears deflation --this point should be clear by now-- or the Fed fears the start of negative wealth effect resulting from financial stress. To avert these sub optimal outcomes, the Federal Reserve lowers interest rates or quantitatively eases. Lower rates entail lower yields on assets. Yield hungry investors readjust their portfolios to gain higher yields on assets. This requires taking on excess risk. There is little choice, but to accept risk if higher yields are demanded by pension fund goals, investing goals or simply at the direction your boss. This eases credit conditions for all firms, even the marginal (risky) ones. Corporations then issue more debt or refinance in order to take advantage of these credit conditions. This allows greater production. More supply causes prices to drop. The Federal Reserve observes lower prices and fears deflation or a negative wealth effect resulting from bankruptcies. The process repeats itself as the Fed eases further.

The strategy pursued by business in this environment becomes either concentration resulting in monopoly as the business takes advantage of lower rates to buy other companies through financially engineered leveraged buyouts and the like or the business employs the strategy of operating below the price of production and above the price required to avert bankruptcy by simply hoping for higher prices. Hope for higher prices may prove effective day-to-day, shovels of hope and confidence may even be a means to convince bondholders or stockholders to not pressure bankruptcy or rationalization, but hope is an entirely inadequate long-term strategy. 2015 oil and commodity producers are perhaps the best example of this strategy being employed. However, it remains too early to offer definitive judgment on this example.

The second, and perhaps more likely outcome of debt-deflation-prevention policy through the infusion of money into financial markets is the bidding up of asset prices. In this scenario, money infused into the market by the Federal Reserve does not make it into the goods and services economy other than through the wealth effect (likely in the magnitudes cited previously by Greenspan). There is no economic reason why a dollar has to trickle through the financial system into the goods and services economy. A dollar does not discriminate on any basis other than to earn the highest possible expected benefit for its owner. For institutional investors or the investment bank community, much of the time this dollar will be put to work investing or speculating (with the difference of these two terms being largely a subjective matter). The increased money supply, once placed in financial markets, can stay there as banks or firms engage in speculation and directional market bets with the use of derivatives or simply the buying of stocks. The increased value of stocks can work as additional collateral to borrow more money and buy more

stocks. Nonfinancial corporations can even buy back stocks with debt to enact a myopic increase in stock prices. They likely have a set of reasons to do this, including the fact that their compensation is usually based upon stock performance. The average investor can get in on the action too, as lower rates equate to cheaper financing for buying stocks or bonds with debt (on margin). In many cases monetary policy can act as a sledgehammer, not a scalpel. Initially increasing asset values can cause unintended feedback loops potentially resulting in asset bubbles. The result of debt-deflation prevention policy in a scenario such as the one discussed above will be greater asset prices and a net gain for economic output as the wealth effect increase. This gain will come with greater indebtedness and market risk. The presence of these factors raises the likelihood of future debt-deflation from defaults and price corrections once the risk is properly measured. Neither of these scenarios will register the appropriate flashing red lights on the Fed's dashboard indicators because neither will appear as inflation in the goods and services market.

Despite formal financial theory's assumptions of rational actors and an efficient market (thus, leaving little room for inflated asset prices), recent experience suggests otherwise. In fact, it seems inflation manifests itself in markets either through inflating expectations about future returns, therefore justifying a low dividend today in anticipation of a higher than normal return tomorrow or through the systemic mispricing of risk. The risk is mispriced in the sense that it is underpriced. Theoretically, such a proposition seems plausible to the extent that the return on an asset is reduced. Such a reduction only reduces the riskless rate of interest that is a component of the return. Inflated asset prices do not minimize actual risk; instead they just paper over it.

It is unclear if the Federal Reserve has considered these two possible scenarios in which the means to fight debt-deflation actually increase the chances of debt-deflation occurring, although historical evidence of the tech bubble and Housing Bubble may support this view. The behavioral economist, and efficient market critic, Robert Shiller concludes that supportive monetary policy was one of the many factors in the recent housing and tech bubbles.<sup>138</sup> Although Shiller does not explicitly mention low interest rates and the Greenspan Put, there is little doubt that these qualify as supportive monetary policy. This view is further supported by the fact that the Housing Bubble arose in the mortgage market, which is traditionally particularly sensitive to interest rate changes. And it seems it was particularly sensitive to Greenspan lowering the interest rate to below 2 percent in the early 2000s (see Figures 1 & 2). However, Federal Reserve easing takes place in the securities markets. It is likely many of these funds eventually chased home prices as investors freshly burned from a tech bubble searched for presumably safer assets. This sentiment is captured in *Irrational Exuberance*, “Real estate is safer. At least you own the property [Authors Note: not outright if the property is mortgaged or you take a home equity loan] with stocks, if you lose, you have nothing.”<sup>139</sup> The history of economic bubbles is multi-causal and often the result of many historical contingencies. Nevertheless, one of the least common denominators in bubble creation is the Federal Reserve’s overly accommodative monetary policy. The correlation is not exact due to lags in the transmission of policy, but the causation is there (see Figures 9 & 10).

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<sup>138</sup> Robert J. Shiller, *Irrational Exuberance* (Princeton: Princeton University Press, 2015), 62.

<sup>139</sup> Arguably, if your house is underwater, you have less than nothing. That is, besides the psychological feeling of home ownership. *Ibid.*, 96.

Federal Reserve Policy, despite its sincere best intentions to avoid debt-deflation and financial crisis, has through a specific series of mishaps and intellectual developments by economic giants, instead worked to create the conditions potentially ripe for debt-deflation. This is the same debt-deflation it has tried to prevent.

Focused on the change in the state of the money supply in an attempt to vanquish deflation before it could cause debt-deflation, Ben Bernanke and the Federal Reserve were blind to the risks of asset inflation and debt accumulation, which had in part been unleashed by the Greenspan Fed. By focusing on primarily monetary and price statistics, these statistics acted as a veil over the precarious debt levels and risks in the economy, which are likely the most primal sources of debt-deflation. Bernanke's policy prescriptions, combining Friedman and Schwartz's promotion of reflationist policy and the Greenspan's Put, which Bernanke enhanced through TARP, and QE, were used to stop this deflation brought about by liquidating market forces. Left unchecked, these liquidating forces would have resulted in a debt-deflation spiral in financial markets. Unfortunately, this deflation prevention policy has likely increased debt levels, made the market more complacent about risk taking and may even have increased the intensity of future deflationary forces once precarious asset price levels and debt levels are reassessed. This is how deflation happened here and why, if policy is not changed, it is likely to happen again.

In order to produce a complex financial meltdown caused by nuanced economic models replete with moral hazard, the United States and the rest of the world first had to build a complex financial system driven by nuanced economic models replete with moral hazard. Greenspan's belief in the efficient market hypothesis mixed with his ad hoc

Greenspan Put had allowed for a situation in which bubbles would be blown because they could be cleaned up. It does not seem this strategy worked particularly well because the tech bubble clean-up managed to help create the conditions in which another bubble was increasingly likely. The form the bubble took in the early 2000s was the Housing Bubble. Rajan puts it more bluntly, “Alan Greenspan, effectively told the markets in 2002 that the Fed would not intervene to burst asset-price bubbles but would intervene to ease the way to a new expansion if the markets imploded. If ever financial markets needed a license to go overboard, this was it.”<sup>140</sup> Such a policy inherently rebalanced the moral hazard in the system. Banks that did not take on leverage to their legal limit while failing to make the same risky bets as the rest of the system would not have the opportunity to be bailed out by the Greenspan Put and thus were less competitive. This changed the calculus. Before the Greenspan Put, conservative banks, defined as banks that kept their financial powder dry from reckless bets, would benefit in a crisis as their distressed competitors went on sale. Instead the opposite result was achieved under the guise of short-term stability during Greenspan’s tenure. In fact, this short-term stability courtesy of the Greenspan Put has undermined long-term stability.

The risk taking that occurred in financial markets prior to the crisis took the shape it did because of ascendancy of financial products based upon financial economic theory, such as Black Scholes option pricing and the idea that prices can be modeled with a standard normal distribution. The Black Scholes model gave investment banks the license to undercapitalize because the formula underestimated the incidence of extreme price movement possibilities under the false guise of the bell curve assumption. When products using these types of theories broke down during the LTCM crisis, instead of surveying

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<sup>140</sup> Rajan, *Fault Lines*, 15.

the damage and wondering what possibly went so wrong, the investment banking community found a Federal Reserve more than willing to bail out the derivatives markets. A time of analytical reflection upon the accuracy of derivative pricing and risk models during crisis was papered over by the Greenspan Put. The problems arising from the mechanism of derivatives doom and pseudo-diversification were overlooked as well. Accordingly, the system doubled, if not tripled, down on its derivative bets.

In the run up to 2008, a bipartisan credit extension scheme managed to undermine underwriting practices across the United States. The issuance of mortgages, particularly subprime mortgages, soared causing a boom in housing prices that begat more mortgage origination. The fuse had been lit. Using the type of derivative pricing and derivative risk models pioneered by financial economists, these subprime mortgages were sliced, diced and integrated into whatever bespoke financial product that was desired. During this period, the Federal Reserve was either unconcerned by or unaware of these developments, further figuring that any potential stresses in the market could be papered over with a Greenspan Put. Under the chairmanship of Ben Bernanke, a scholar of the Great Depression, the Fed was deeply concerned with preventing debt-deflation in the United States. Failing to grasp that over-indebtedness may be the root cause of debt-deflation, not simply a deflating money supply, Bernanke, like Greenspan before him, kept rates low leading to increased over-indebtedness, particularly in the mortgage market.

By 2007, the amount of credit being extended had peaked. Even teaser rates employed to attract deep subprime borrowers were failing to move prices in an upward trajectory. Price declines lead to price declines. Pseudo-diversification revealed itself to



be correlation, while prices moved in the tails. Tail movements sunk the derivatives and the risk models. Soon institutions such as Bear Sterns, Lehman Brothers and AIG were being subject to the mechanism of derivative doom, just as LTCM had been less than a decade earlier. The system nearly imploded as the true value of many of these complex derivatives approached zero.

Helicopter Ben was aghast. Deflation was happening here. As such, Bernanke undertook the most ambitious bailout, market put and monetary expansion the United States had ever seen. He even unleashed helicopter money, known more formally as quantitative easing, into financial markets. To his credit, this prevented the financial system from going deeper into the debt-deflation spiral. The problem is that the reflationist cure may be more dangerous than the deflationary disease. If what is past is prologue, the global financial system can expect these dual licenses, one for undercapitalization and one for risk taking, to be present at the epicenter of the next financial crisis.

### **Epilogue: Eight Years After the Global Financial Crisis**

Presently many questions about the soundness of the global financial system and the models discussed above remain. Did Bernanke prevent the next Great Depression or did he kick the can on writing off huge quantities of accumulated debt? What can be observed is that he seems to effectively have postponed, like Greenspan before him, the day of reckoning and reflection on the robustness and accuracy of derivative pricing models. In 2008, the derivatives were bailed out just like the rest of the financial system. If every time a system that should have been fixed is bailed out, why should it

fundamentally change? It is here that the history of Bernanke's intellectual development may turn from triumph to tragedy. The world economy and the system of bankers, investors, economists and governmental regulators that it is composed of, is far more complex than the setting of the rate of change of a rate of change. The economy is not a mathematical model that can be calibrated with all externalities and outputs accounted for. However, it is not entirely unpredictable or even random. It can be adequately modeled and perhaps even understood, but it is difficult to believe that it can be properly managed.

The bubble we may now find ourselves in is a result of the actions designed to clean up the Housing Bubble, which was partially caused by the actions designed to clean up the Tech Bubble. Both bubble clean-ups were designed to halt a painful debt write down and a deflationary goods and services price process. If this proves to be true, it seems the possible bubble we now find ourselves in is unprecedented in size, scope and complexity. Bonds are returning real returns barely above zero. Any bout of inflation or default will cause massive losses likely triggering collateral calls that may engage the mechanism of derivative doom. The situation in Europe is even more absurd. The Italian banking system is very unhealthy with large ratios of nonperforming loans. Despite this, Italian bonds are trading only a couple of basis points higher than German Bunds (i.e. German Treasuries). To make matters worse, Italian bonds and other southern European sovereign bonds are considered top tier capital according to the Basel III banking accords. Deutsche Bank's gross derivative exposure is estimated at around \$50 trillion dollars.<sup>141</sup> That amount is multiple times the size of Germany's annual GDP. At the

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<sup>141</sup> "Global OTC derivatives market: Table D5," Bank of International Settlements, accessed March 16, 2015, [https://www.bis.org/statistics/d5\\_1.pdf](https://www.bis.org/statistics/d5_1.pdf).

global level, it remains unclear how the rapid adoption of high frequency trading will affect the frequency of extreme price movements, derivatives and the mechanism of derivative doom.

In the United States, massive bailouts, near zero percent interest rates for 80 plus months and trillions of dollars in quantitative easing have caused a plethora of unintended consequences that remain to be fully understood. I am not in the position to bring in the intricacies of the oil market to this epilogue, but research into the effect of low interest rates on oil production between 2008 and the resulting 2015 bust may offer the best case study of the debt-deflationary zombie corporation discussed above. It is possible that low interest rates also result in an increase in mergers and acquisitions in addition to stock buybacks while undermining insurance and pension funds, which are forced to readjust their portfolios with riskier assets in order to meet investing benchmarks.

Perhaps the longest lasting consequence from these asset-levitating policies in developed economies will be the resulting redistribution of wealth as asset prices approach new heights. Thomas Piketty, a prominent economist researching inequality, cites the market as a mechanism capable of increasing inequality: “a booming stock market contributes both to the rise of top incomes (in particular via capital gains, which were very large both in the 1920s and in the 2000s) and to the rise of financial fragility.”<sup>142</sup> This increase in inequality is not trivial as Figures 16 & 17, taken from Piketty, depict. Each time there is a stock boom (or bubble if you prefer) an increase in the share of income going to the top percent of earners is observed. Also note that in Figures 16 & 17,

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<sup>142</sup> Thomas Piketty and Emmanuel Saez, “Top Incomes and the Great Recession: Recent Evolutions and Policy Implications,” 13<sup>th</sup> Jacques Polak Annual Research Conference, November 8-9, 2012, <http://www.imf.org/external/np/res/seminars/2012/arc/pdf/PS.pdf>.

the ex-capital gains line counts stock options and other market based sources of income as part of wages. This entails that the magnitude of gains accumulating to the top one percent of earners from wealth effect policy is likely greater than the chart depicts. After all, when the Fed unleashed QE, the primary beneficiary of higher asset prices turned out to be those with assets and usually those with assets are much better off socioeconomically than those without assets. The sledgehammer of monetary policy broke both ways. Not only did it increase the gap between rich and poor, but it also changed social expectations as the increased assets prices placed homeownership and financial security further out of reach of those most burned by the crisis. Quantitative easing benefitted those *already holding* assets the most. However, the findings of my research contradict and undermine Piketty's main point. Piketty attempted to show that capitalism naturally resulted in income inequality as the growth rate of wealth outpaced the rate of economic growth. He crafted his argument based upon a wide array of historical data. This paper predicts increased income inequality as the consequence of myopic deflation-preventative monetary interventions by the Federal Reserve. These market-centric policies levitated asset prices and failed to trickle through the financial system and accrue to those it was presumably intended to benefit. The contrasts between what is discussed above and Piketty are quite sharp even if the conclusion may prove similar. The Federal Reserve market put policy is comparable to socialism for asset owners, where gains are privatized and the United States government, the taxpayers, socialize the losses. Such a policy rearranges the incentives of market participants. A discussion of the causes of inequality has been largely outside the scope of this paper and I doubt the inequality resulting from quantitative easing and the Greenspan turned

Bernanke Put is by design. However, I do not doubt the phenomenon's existence and its eventual economic and social consequences, of which, the election of 2016 may be the first.

This brings us to the counter-point most often used by the proponents of ultra-loose monetary policy: where is the inflation? It certainly is not in goods and services market, but it is possible that the inflation the Federal Reserve is looking for is in the asset markets (home prices in select cities, stocks and bonds). This is not a hypothesis that can be easily or satisfactorily tested without data on future returns. Yet, there is no reason that increasing the money supply has to trickle through the financial system to goods and services. In fact, with the returns that can be earned on financially engineered products (using a bell curve granting a license to undercapitalize) so large, why should more than a couple percent ever trickle out? The quantitatively infused money that has failed to trickle out is now likely chasing increasingly hard to find yield in the financial markets. Unfortunately, unlike price inflation, a permanently high price plateau is unlikely because of the way asset prices inflate, which is heavily dependent on future expectations and particularly dependent upon the measured risk of the investment. Once risk (or expectations of risk) rears its head, price movements will ensue to re-price risky bonds more in line with reality and economic fundamentals. This will cause losses all else equal.

The patient that is the United States and the global financial system almost melted down the last time it caught a serious case of the derivatives induced cold. By understanding how the complex relationships among market participants, driven by behavior buttressed by nuanced financial economic theory, shape market outcomes, then

a strange conclusion reveals itself. If what is past is prologue, then not only does the US financial system potentially remain in a precarious state of Bernanke Put and mispriced risk, but the policies designed to stabilize and secure the economy have actually continued to undermined the stability and function of the financial system.

By fighting debt-deflation repeatedly from its least dangerous form at the onset of the 21<sup>st</sup> century, it has now been made considerably more dangerous due to increased debt and asset levels. Stilts of debt have kept economies papered over the deteriorating economic fundamentals (such as productivity growth, demographics, and global competitiveness) beneath them. Furthermore, with rates near zero, it will be difficult to get another effective Federal Reserve market put at this point. Certain stocks, bonds, home prices, student loans, auto loans and other unobserved financial products may soon have their mispriced riskiness metastasize into default and begin (or accelerate) a reverse wealth effect. If this scenario occurs as it did in 1929 and 2008, it is unclear what Federal Reserve policy will take shape in response to this development, but negative interest rates and helicopter money may not be far off. The commitment to damn the unintended consequence torpedoes and prevent debt-deflation by levitating asset prices no matter the costs seems sincere. The question that remains is if it will work.

**Appendix Figures:**

Figure 1. Total Value of United States Stock Markets and the Interest Rate.

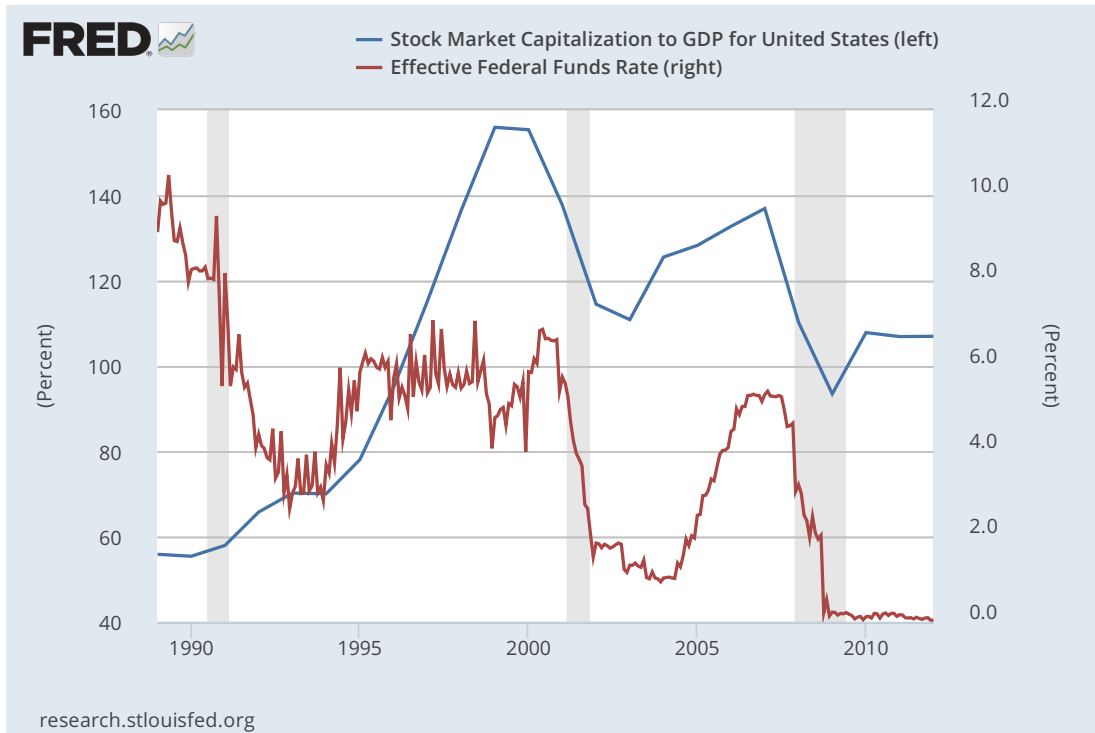


Figure 2. The Financial Stress Index and the Interest Rate.

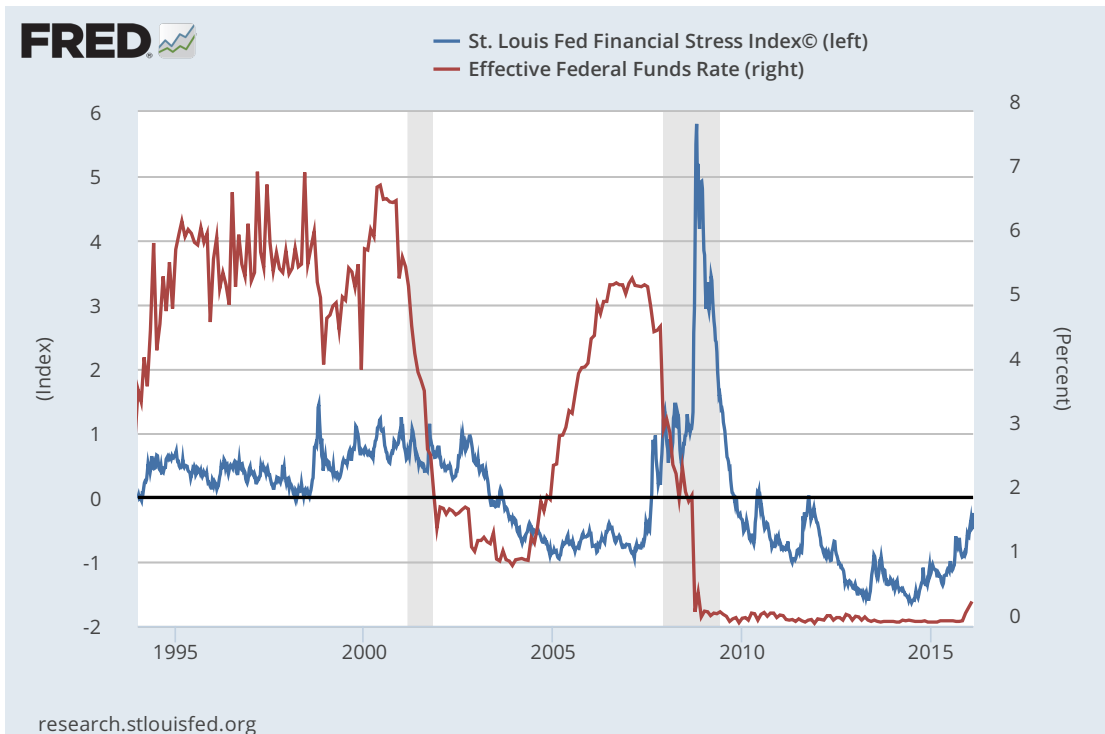


Figure 3. Interest Rates and Investment Grade Credit Spreads. Investment Grade Credit Spreads, which represent the difference between “safe” government bonds and less safe investment grade bonds. They are used as a proxy of financial stress because during times of stress, the spreads widen.

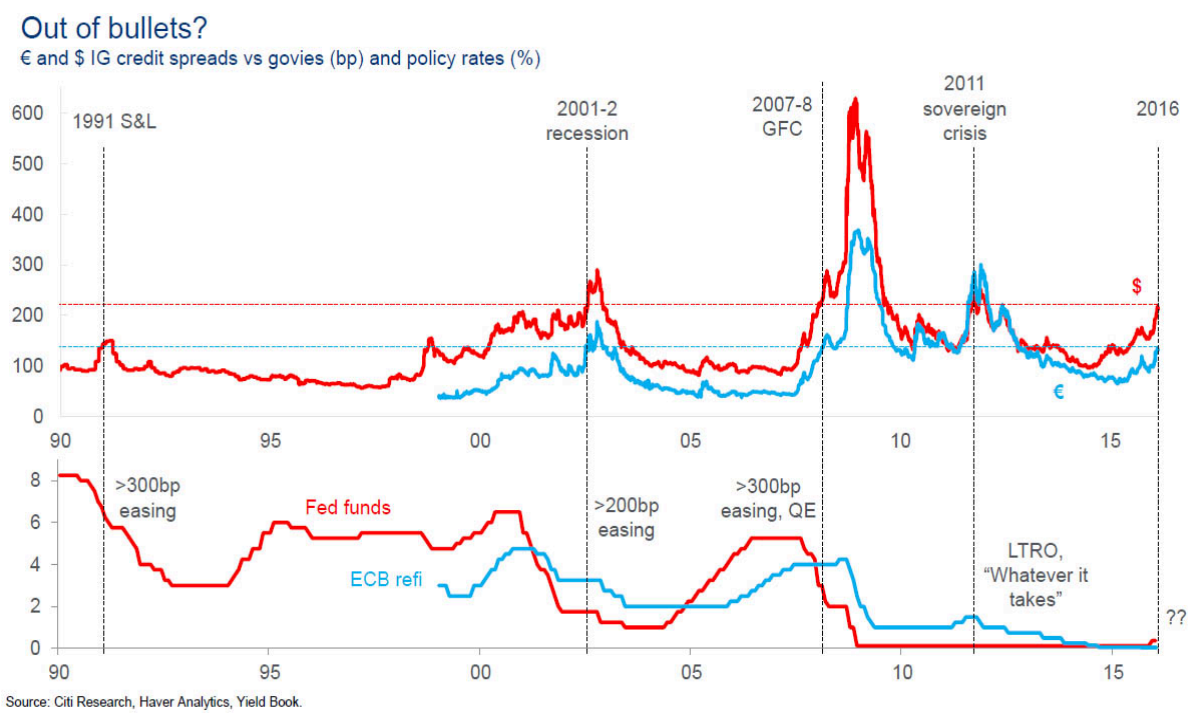


Figure 4. US Private Debt to GDP Ratio.

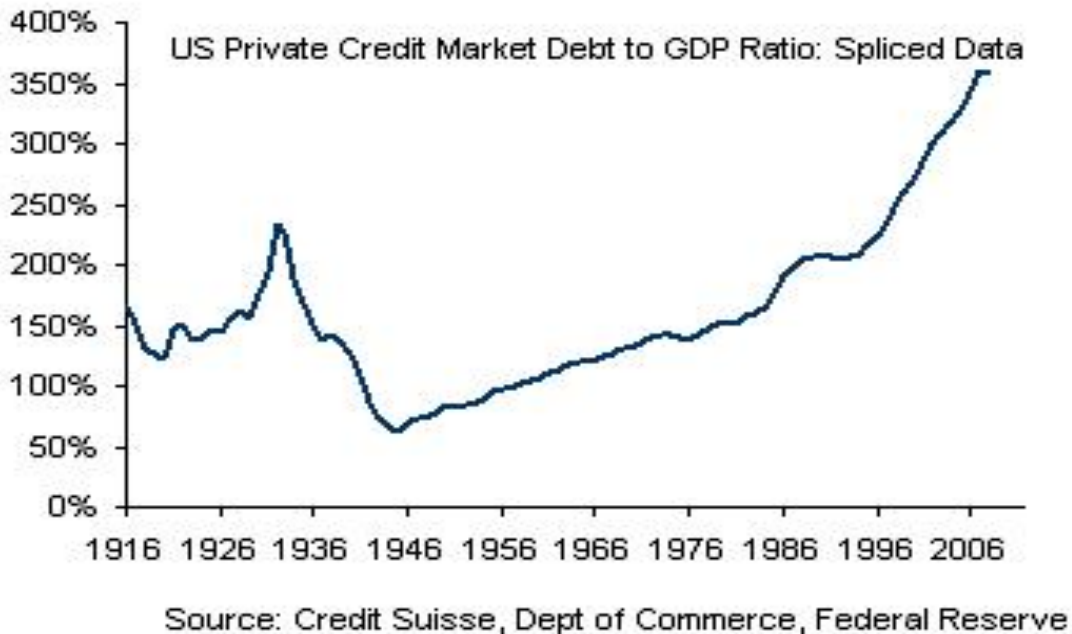




Figure 5. Real Estate Loans at National and State-Chartered Commercial Banks, 1900-1938.<sup>143</sup>

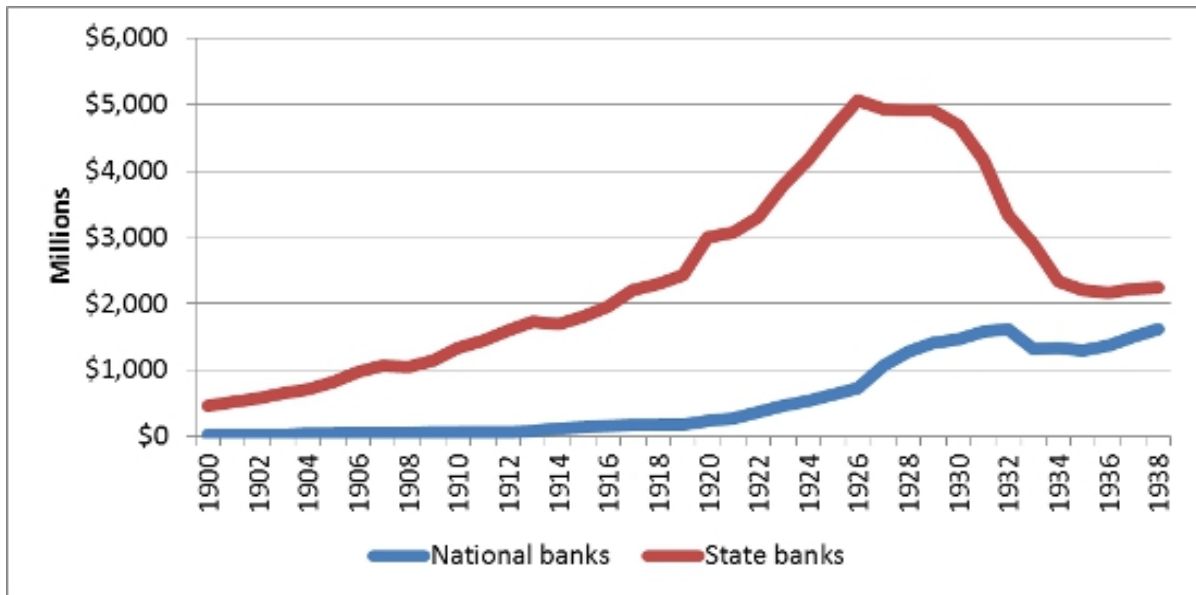
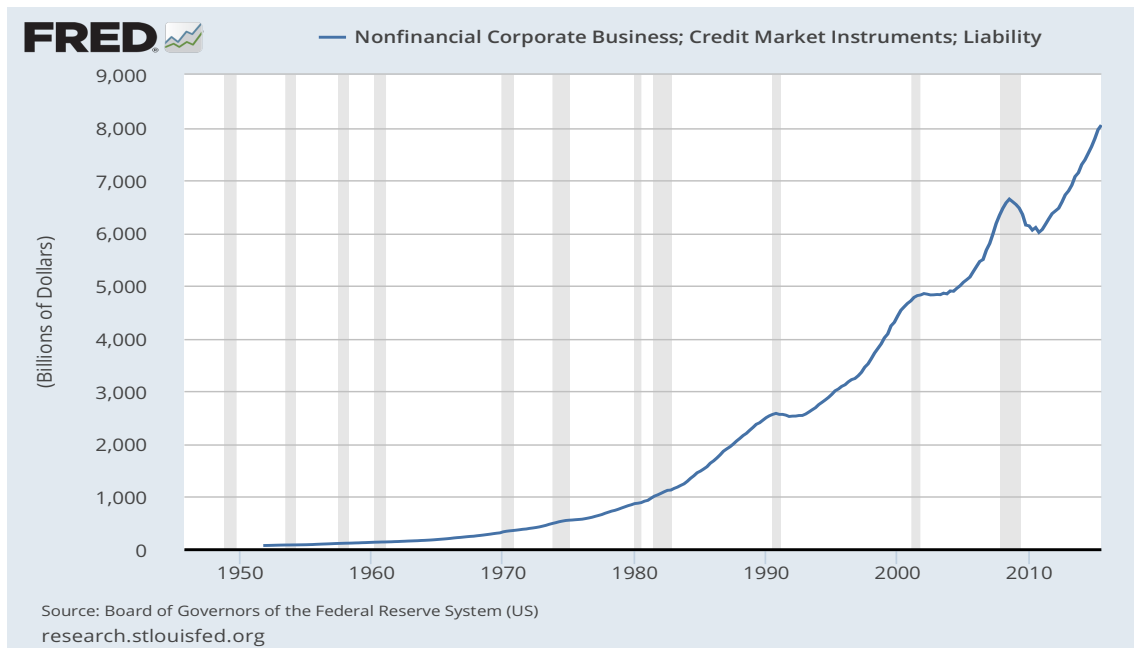


Figure 6. US Corporate Debt since 1945.



<sup>143</sup> Natacha Postel-Vinay, “The experience of the U.S. Great Depression suggests parallels between 1920s mortgage lending and the recent financial crisis,” London School of Economics, Working Paper, <http://blogs.lse.ac.uk/usappblog/2014/07/18/the-experience-of-the-u-s-great-depression-suggests-parallels-between-1920s-mortgage-lending-and-the-recent-financial-crisis/>.

Figure 7. US Housing Prices Since 1990.

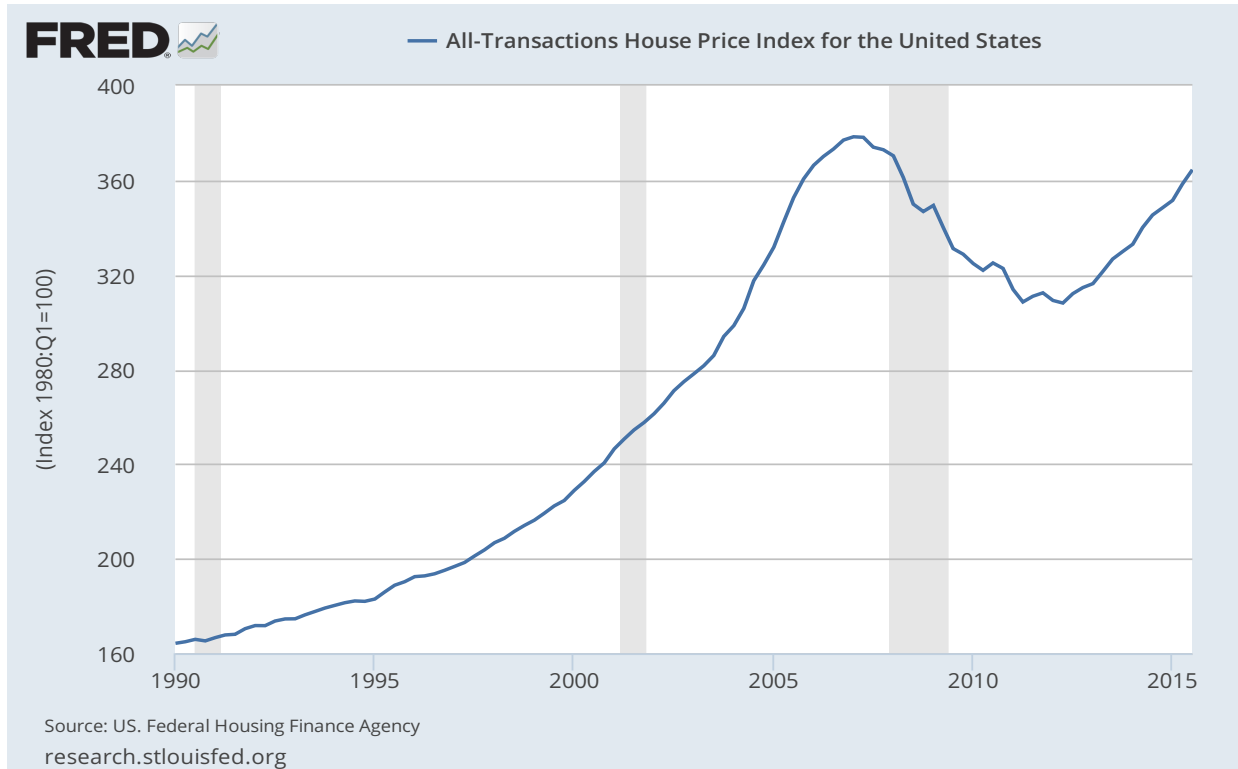
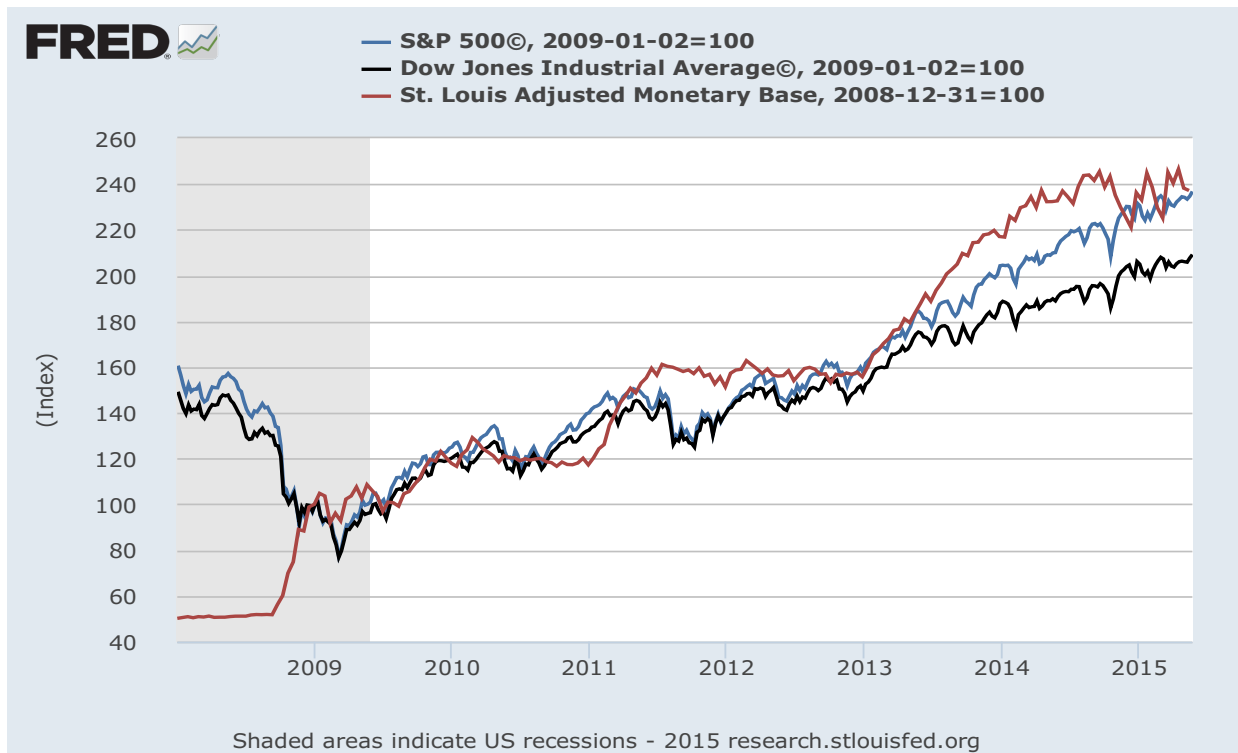


Figure 8. The Money Supply Quantitatively Eases the Stock Market Higher.



Figures 9 & 10. The Interest Rate, Debt Levels and Asset Price Inflation

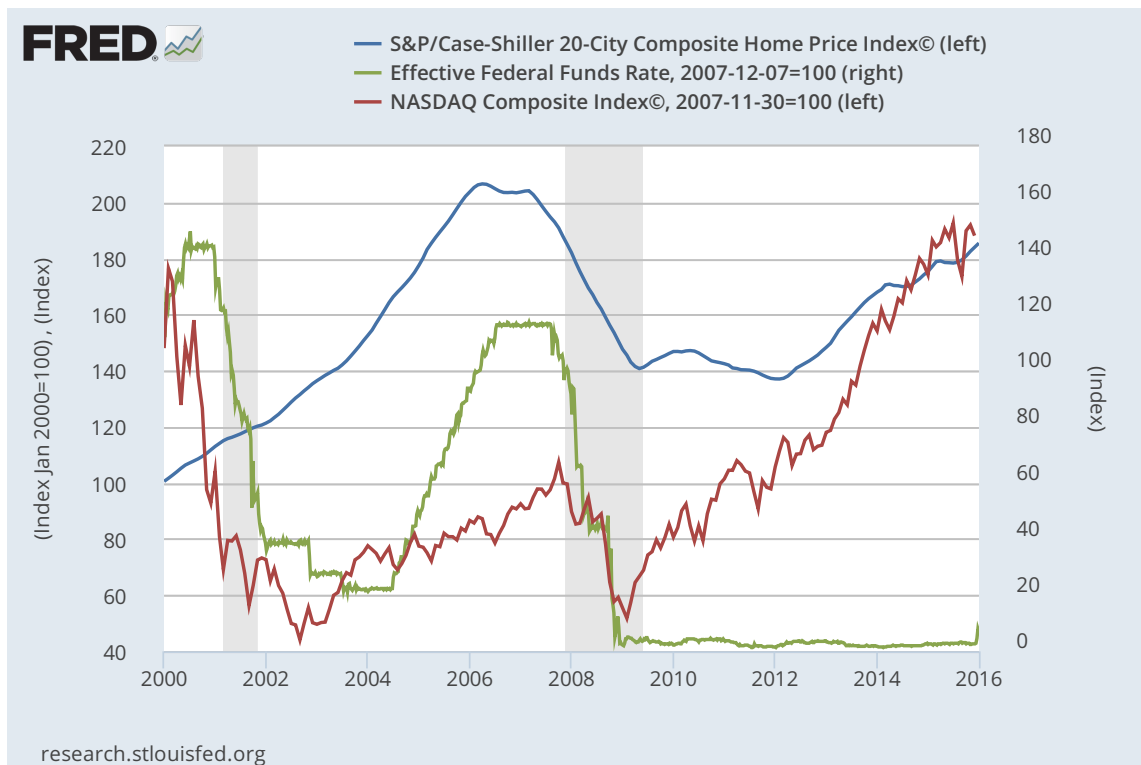
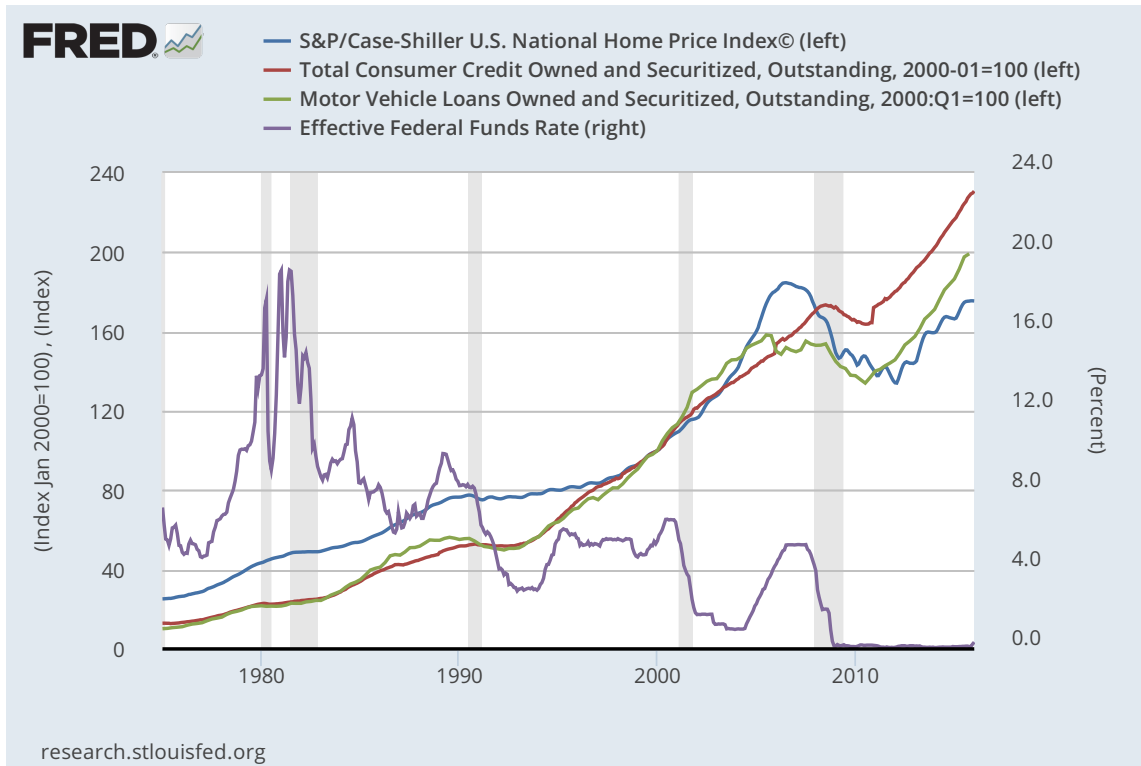


Figure 11.

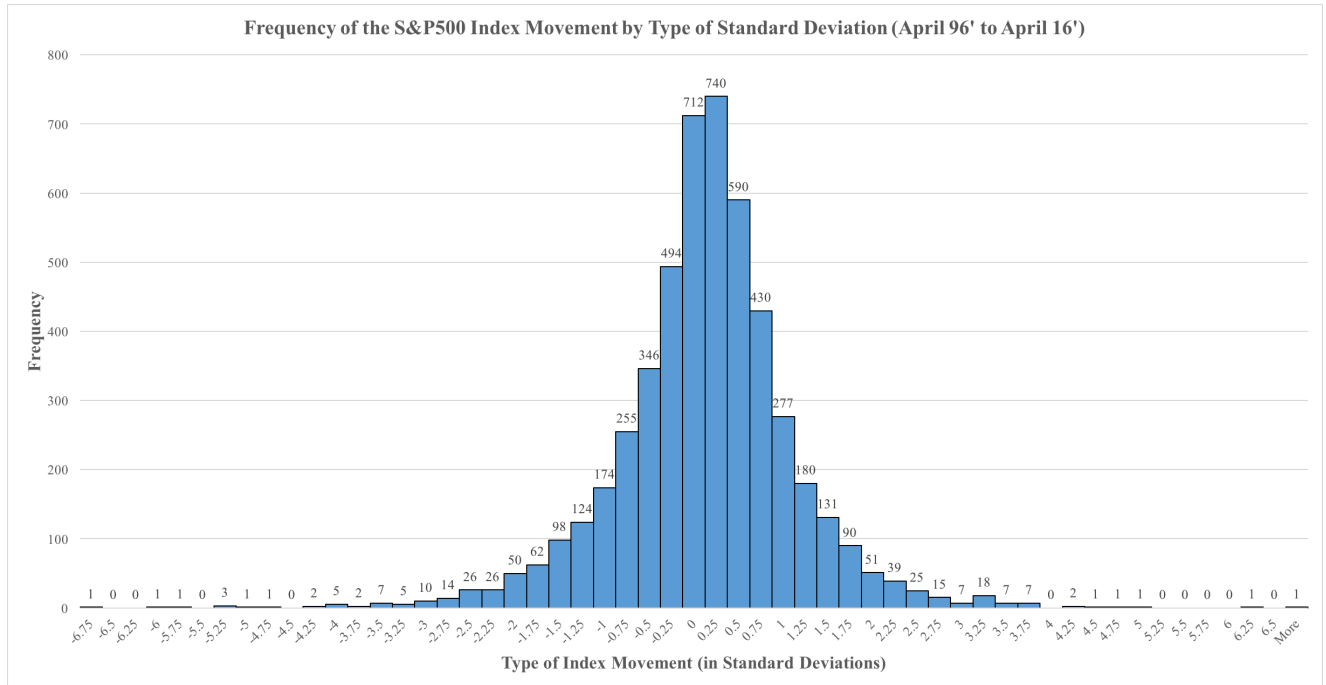


Figure 12.

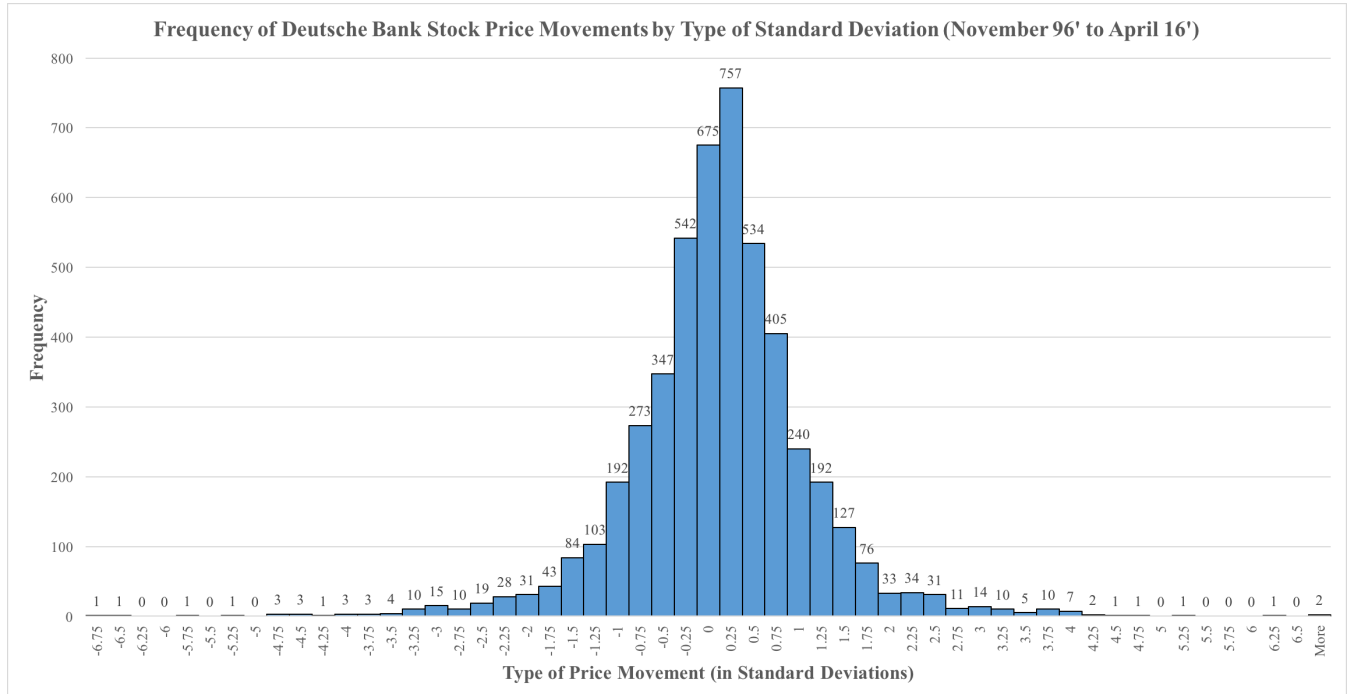


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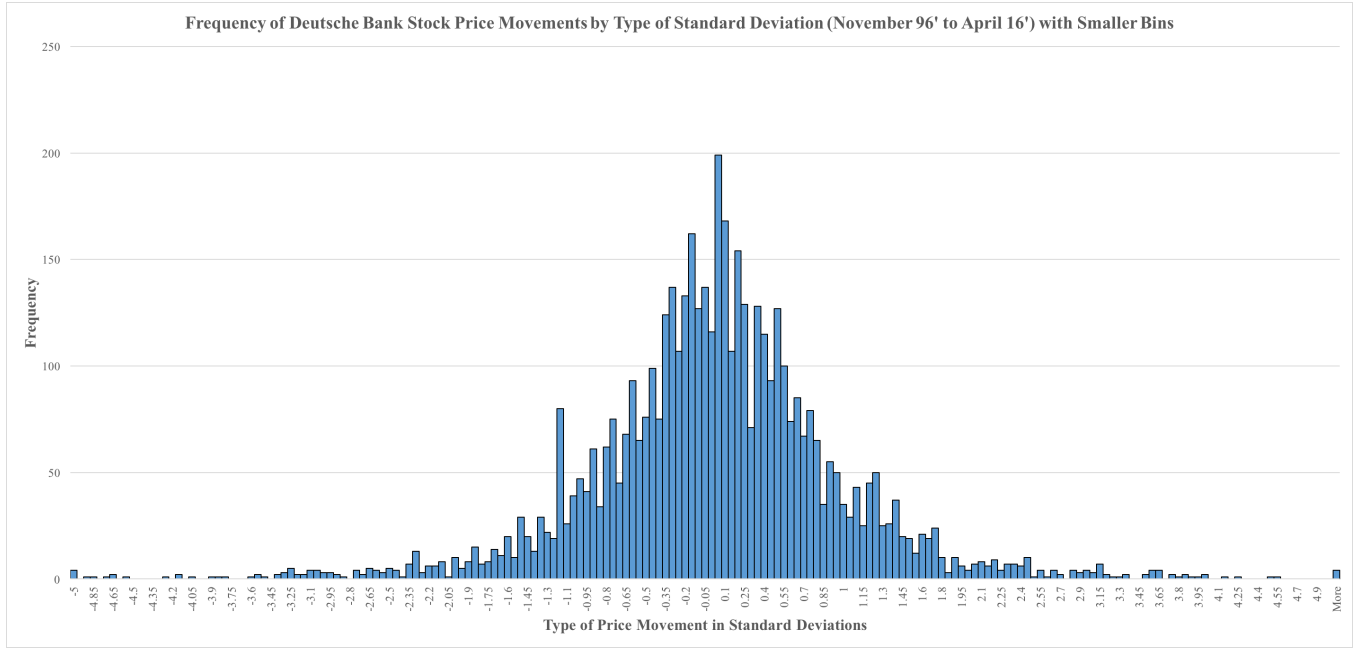


Figure 14.

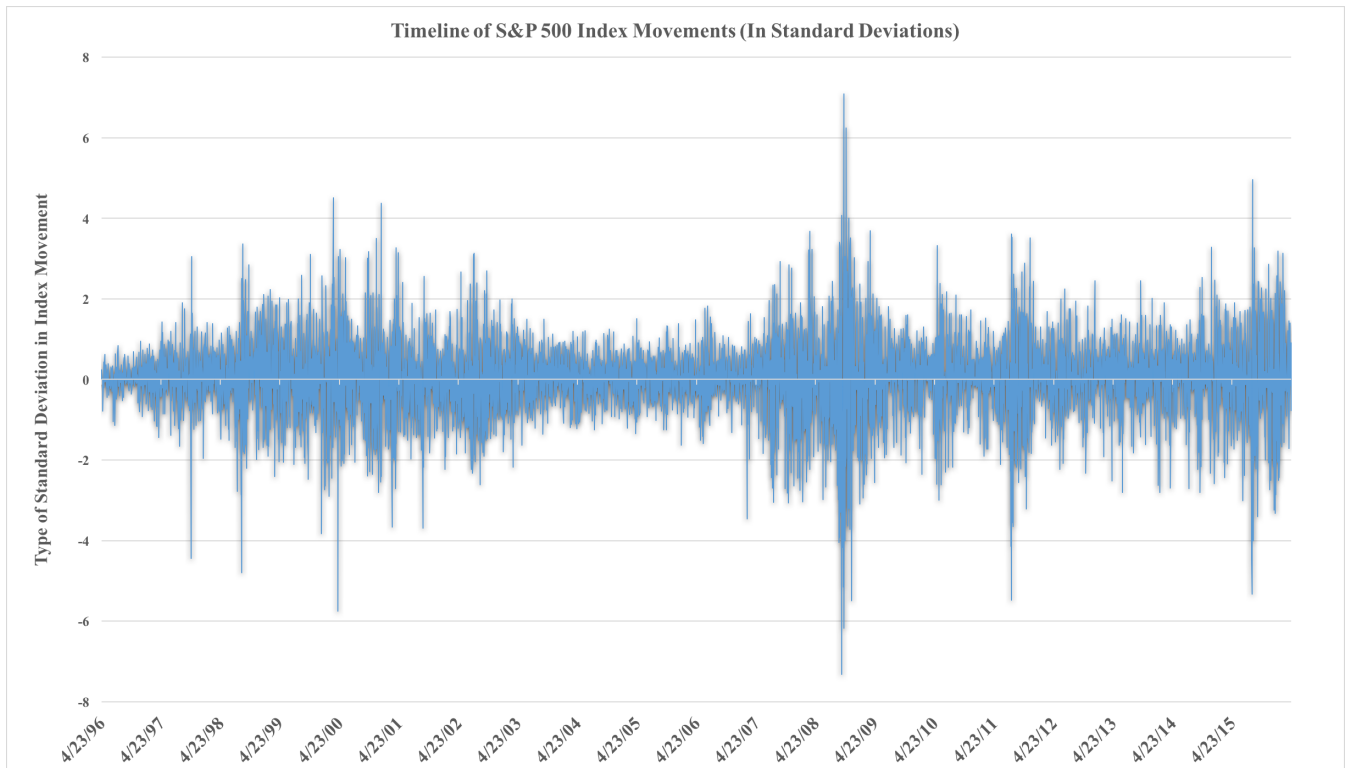


Figure 15.

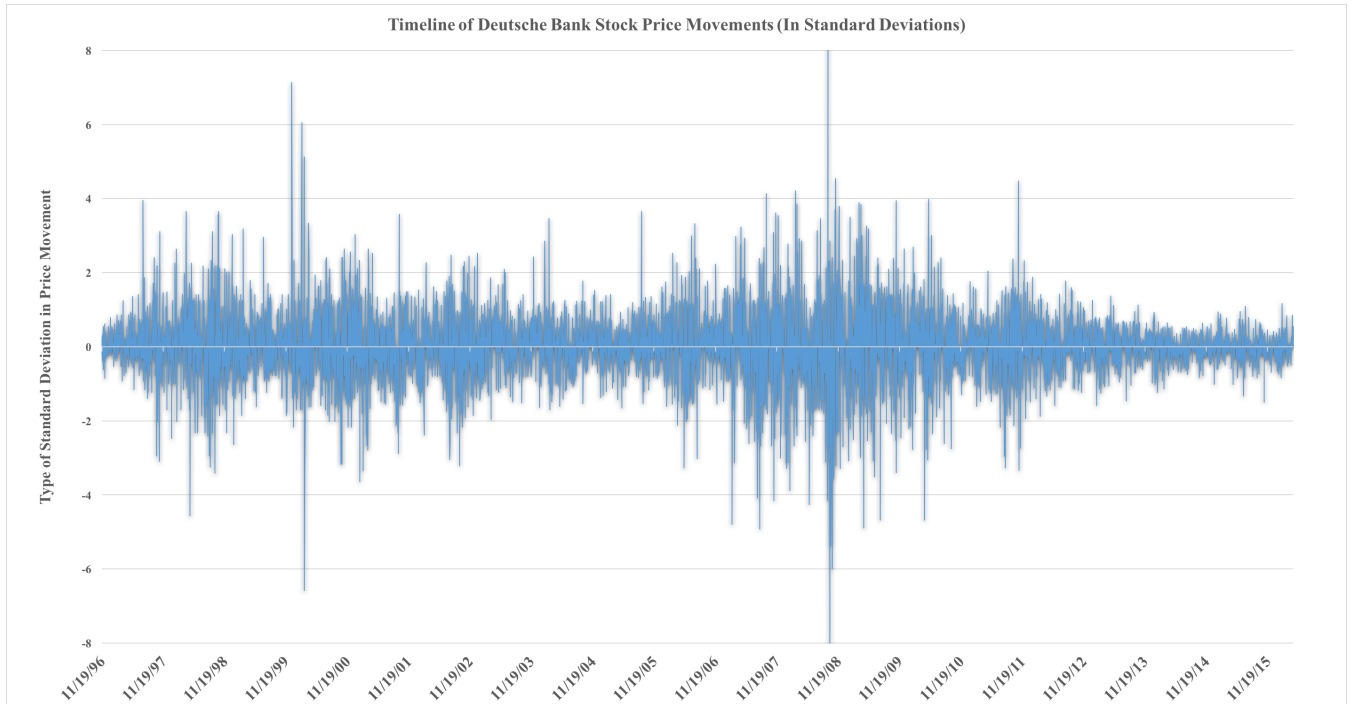
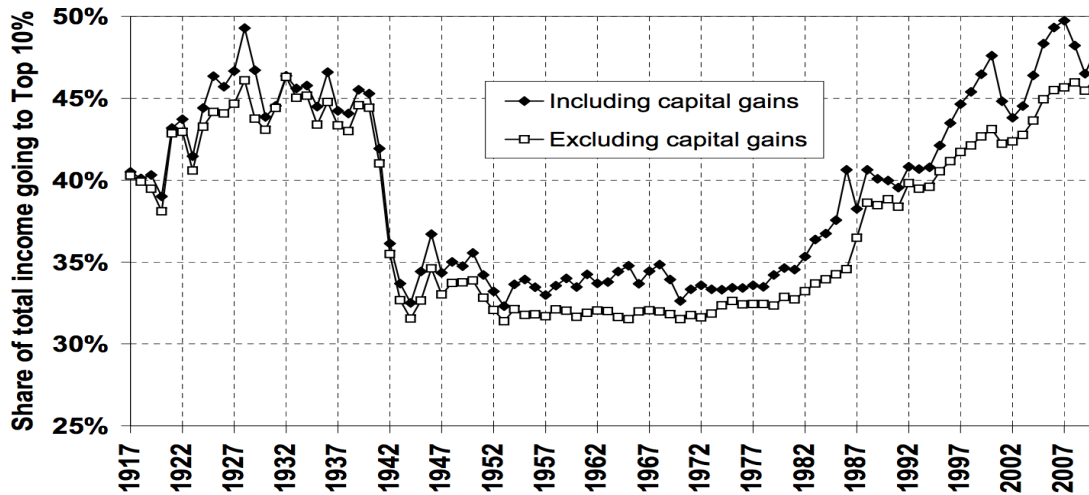


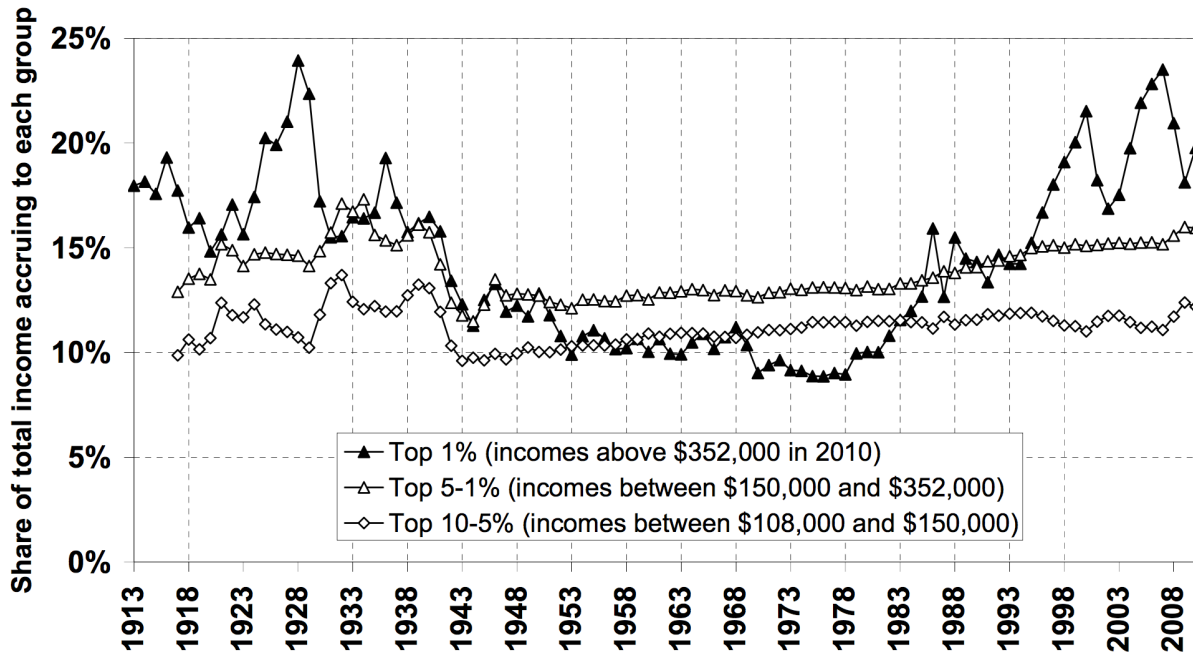
Figure 16.



**FIGURE 1B**  
The Top Decile Income Share in the United States, 1917-2010

Source: Piketty and Saez (2003), series updated to 2010.  
Income is defined as market income including realized capital gains (excludes government transfers).

Figure 17.



**FIGURE 1C**

Decomposing the Top Decile US Income Share into 3 Groups, 1913-2010

Source: Piketty and Saez (2003), series updated to 2010.

Income is defined as market income including capital gains (excludes all government transfers).