Securitization is Dead; Long Live Securitization

by

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I hope this thesis inspires those who are overwhelmed, exhausted, distracted, frustrated, or bored to continue learning, thinking, and writing. They are exhilarating processes.
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Opening Remarks

A Hoegaarden on the New York Stock Exchange

On October 15, 2009, approximately one year after the near-collapse of the U.S. financial system, the masters of the universe gathered for a beer at 11 Wall Street in the New York Stock Exchange. Traders, bankers, and hedge fund managers networked with journalists, academics, and policymakers under the vast archipelago packed with tickers, screens, and keyboards. The festivity marked the commencement of a two-day conference on “fixing finance.” Given that lending activities ground to a near-halt a year earlier, suffocating households and businesses from the credit needed for consumption and investment, and pushing the U.S. economy to the brink of a second Great Depression, the mood of the evening was remarkably light. Fortune smiled on the author and granted him the opportunity to attend this extraordinary event. The contentious author, a young man who has never executed a trade or published a paper or made a policy decision, clashed with the wits and genius of Timothy Geithner, the U.S. Treasury secretary, Larry Summers, Director of the National Economic Council, Robert Shiller, co-founder of the Case-Shiller U.S. housing index, and Elizabeth Warren, head of the TARP Congressional Oversight Panel.1 Beneath his arrogance and pride, the author was

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1 The author fielded these accomplished individuals many penetrating questions. For example, he asked Tim Geithner two queries. The first concerned his opinions on how the global current account imbalances that developed over the past decade between export-driven and consumption-fueled economies contributed to the financial crisis. The second question asked whether the U.S. Treasury secretary thought recent innovations in structured finance, from mortgage-backed securities to collateralized debt obligations, were a net positive for society. To watch the secretary’s replies to the author, see: http://buttonwood.economist.com/content/video
genuinely curious about profound questions concerning the origins and broader implications of the crisis.

What exactly happened during the 2007-09 financial crisis? How did recent financial innovations and market developments contribute to the crisis? Why did economic and financial theory fail to predict the events? Was the government successful at saving the credit markets? And how might the world be different moving forward from this systematic collapse in finance? Though the masters of the universe were quite insightful, they failed to elucidate clear answers. At that point, the author decided to seek his own explanations. Months after he embarked on this thesis, he arrived at enlightenment: securitization. Securitization – and its broader implications – is the key to understanding all the complexities of the recent crisis. It is the central anchor to this convoluted story.

**The Significance of this Mind-Numbingly Dull Process**

At first glance, securitization appears mind-numbingly dull and utterly perplexing. The process of bundling loans into tradable bonds entails examining credit ratings, coupon rates, risk-weightings, and other numbers that appear meaningless. Likewise, it can be baffling to fully grasp the complex, multi-link chain of intermediation from initial borrower to ultimate investor. However, the broader implications of securitization, the revolutionary new form of financial intermediation, are fascinating. Securitization redefined the link between savings and investments. By transforming traditionally illiquid, long-maturity assets into
tradable pieces of paper, securitization amplified the supply of credit and lowered its cost, substantially increasing lending activities. It financed household consumption binges at shopping malls, auto lots, and housing markets. It provided the capital necessary to sponsor enterprise, expand businesses, and acquire commercial real estate. From budget deficits to current account deficits, securitization financed America’s deficit spending. When it finally collapsed, the central bank and the federal government both scrambled to resuscitate it. This seemingly dull process was the engine of U.S. economic growth. Its demise after the financial crisis bodes poorly for the prospect of America’s consumption-fueled economic empire. Thus, even students wholeheartedly bored ought not to lightly dismiss the topic.

**Multidisciplinary Promiscuity**

Although plenty of research, new and developing, exhausts the topic of the recent financial crisis, this thesis is fresh in three ways: synthesis, scope, and style. In an age of academic specialization, this thesis is rather promiscuous, covering remarkable interdisciplinary breadth. It dabbles with equilibrium macroeconomics; it dines with the history of economic thought; it dances with public policy; and it flirts with econometrics.² Some critics may accuse the author to be a dilettante, a jack of all trades rather than a master of one. But often, a broad, multidisciplinary analysis drawing on all the social sciences is much more illuminating than a narrow, highly

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² The author extends his third chapter into a final term project for his econometrics class. He builds, tests, and destroys a time-series model to determine whether government intervention was a statistically significant factor in lower borrowing costs in the aftermath of the crisis.
specialized one.³ More important, this multidisciplinary approach is also far more interesting. Fortunately, the author’s undergraduate major, the College of Social Studies, is an interdisciplinary one that allows him to indulge in this widely-shunned promiscuity.

Another defining characteristic of this thesis is its writing style. Besides the second chapter, which builds a dynamic stochastic general equilibrium (an economy with changing preferences and uncertainty, in which a set of prices clears all markets) the writing style of this thesis is in stark contrast to the jargon-plagued, bland language of many economics papers. It is clear, engaging, and mostly jargon-free. Following the dictates of George Orwell, the author tries diligently to avoid vague prose, pretentious diction, and ugly language in favor of clarity, simplicity, and elegance.⁴ Although some topics require more thought to grasp, all topics can be broken down and understood. If articulated well, readers would not only understand the purpose of complex instruments like collateralized debt obligations and Arrow-Debreu state contingent claims, but also how they contributed to the crisis.

Drawing on his Wesleyan education, the author writes this work uniquely as a College of Social Studies thesis. He considers himself accomplished if the reader, regardless of specialty or interest, can read this work, understand, and articulate all the arguments and ideas presented.

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³ Indeed, one of the lessons of the crisis is that specialization substantially diluted the common sense of otherwise brilliant minds. Bankers and policymakers wholeheartedly relied on complex modeling without questioning underlying assumptions or drawing from other disciplines.
⁴ George Orwell, “Politics and the English Language” (1946).
Securitization

“It is a riddle, wrapped in a mystery, inside an enigma.” – Winston Churchill5

“Make everything as simple as possible, but not simpler.” – Albert Einstein6

It is quite remarkable that as recently as 2006, before the credit crunch, people could secure 30-year interest-only option adjustable-rate mortgages (financial jargon for mortgage loans with low teaser rates) to purchase homes they seemingly could ill-afford. Thrift institutions routinely lent to “subprime” borrowers: individuals without incomes, jobs, or assets. Investment banks then bought these risky loans, and bundled them together with other risky loans to create mortgage-backed securities, which delivered higher-than-expected returns given the level of risk. The largest credit rating agencies (Standard and Poor’s, Moody’s, and Fitch) rated most of these mortgage-backed securities AAA, the highest possible credit rating. In other words, these structured financial products were considered to be as safe investments as U.S. government bonds! Likewise, riskier, junior-tranche mortgage-backed securities were pooled with other asset-backed securities (bonds secured by non-mortgage debt such as credit card, student, and car loans) to create collateralized debt obligations with various risk-return tranches rated from AAA superior to CCC junk. Depending on their risk appetite, hedge funds, sovereign wealth funds, and other institutional investors parked their cash in these attractive, high yielding investments. For over half a decade, these financial innovations

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5 How Winston Churchill described Russia in a radio address in October 1939.
6 A quote Albert Einstein hung in his office at Princeton.
defined global investment, stimulating real GDP growth, enhancing asset liquidity, and promoting market efficiency.\textsuperscript{7}

The quantitative alchemists, with their advanced statistical analyses and complex mathematical models, truly created a black box that churned junk into gold. This financial alchemy was securitization, one of the many new innovations that revolutionized risk management. In order to explore the frictions in securitization (distorted incentives, flawed modeling, information asymmetry, etc.) and how it contributed to the 2007-09 financial meltdown, one must understand securitization, and the many financial instruments and institutions involved in this process. For example, one must distinguish a collateralized debt obligation (CDO) from a credit default swap (CDS). And one must grasp their economic underpinnings such as Arrow-Debreu state-contingent claims, the rational expectations hypothesis, the efficient markets hypothesis, and dynamic stochastic general equilibrium.

**Financial Black Boxes**

Many financial instruments appear more complex than they actually are. For example, credit default swaps – the infamous instrument that nearly dragged the

\textsuperscript{7} Liquidity is a characteristic of financial assets. Cash and cash-equivalents such as U.S. Treasury bills are the most liquid assets. People readily accept them as mediums of exchange, stores of value and units of account. Stocks are less liquid, and loans (or bonds), financial assets with a stream of interest payments until maturity, are very illiquid. Financial innovations enable less liquid assets to be commoditized and traded, thereby enhancing their liquidity.

Efficiency is a measure of the price-discovery procedure within the market. Through the price discovery procedure, buyers and sellers interact, negotiate, and exchange until they, in the aggregate, reach the market-clearing equilibrium price and quantity. By creating markets for hard-to-value assets like credit derivatives, financial innovations allow investors to constantly fail and succeed in discovering the “true value” of assets.
global financial system down a pitch-black precipice – are merely sophisticated insurance policies for bonds. They protect the swap buyer from the possible default of a specific security.\(^8\) Interest rate swaps (the most popular instrument in the derivatives market) are tools used by companies to swap uncertain, variable payments for known, fixed payments. They allow firms to hedge against future risk and volatility in their payment streams. For example, an American aluminum manufacturer would purchase interest rate swaps to protect itself from having to pay higher interest payments on its debt if the Federal Reserve raises the target Fed Funds rate.

The story of finance is a story of evolution. And like evolution, some agents evolve through periodic crises and shocks while others die. Most of today’s complex financial instruments were not inventions of “quants” in the twenty-first century, but of merchants in the Renaissance and even of farmers in ancient Mesopotamia.\(^9\) Commodity futures, for example, are agreements to trade an underlying good (e.g., grain, sugar, oil, metals, etc.) at a predetermined date and price. The buyer of the futures contract has the obligation to buy the underlying good on the maturity date at the negotiated price, while the seller of the futures contract must sell the underlying good on the maturity date at the set price. Before traders bought and

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\(^8\) Interestingly, according to derivatives legislation passed by Congress (the Commodities Futures Modernization Act of 2000), credit default swap buyers need not actually own the underlying bond, whose default they are protecting against. In other words, an investor who does not own the underlying bond can purchase a credit default swap on that bond. Financial institutions such as AIG and Lehman Brothers sold these CDS contracts under the assumption that the underlying securities would rarely default. “Naked” CDS buyers, who have no risk exposure to the underlying assets, purchased the contracts to speculate against those assets. Together, these were the reasons why the CDS market ballooned to a notional $45 trillion by 2007.

\(^9\) “Quants” is a term that characterizes mathematical wizards in finance.
sold commodity futures on the Chicago Mercantile Exchange to speculate on underlying price trends, farmers used agricultural futures to protect themselves from the risk of falling food prices when they brought their inventories to market. Before the farmer invested time, capital, and energy into growing grain and raising livestock, he could purchase commodity futures that guaranteed a minimum floor price for his produce. In other words, the farmer could write a derivatives contract to hedge his investment.

Baffled by the summations, equations, and Greek letters, many fail to understand the underlying logic behind modern financial instruments and how they evolved. Although the concept behind a 21st century credit default swap and an 18th century Scottish Ministers’ Widow Fund is the same, the former is often articulated in opaque mathematical language that has the potential to confuse rather than enlighten. The purpose of this section is to strip recent financial innovations of their mathematical obscurity and explore their underlying logic. A strong conceptual understanding can clarify why and how the credit markets froze during the turmoil.

**Blowing Bubbles**

The 2007-9 financial crisis had its roots in the U.S. housing market.10 Put simply, investors speculated heavily in housing assets: households purchased physical houses while portfolio managers purchased mortgage-related financial

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10 With the collapse of the U.S. housing market and the subsequent credit crunch, the summer of 2007 marks the beginning of the financial crisis. The author chooses the summer of 2009 as the end period because only then did credit markets thaw to pre-crisis levels. The strongest banks also repaid their government TARP capital during that period.
assets. According to the S&P Case-Shiller U.S. 10-city seasonally-adjusted composite index, the average value of homes increased 125% from 2000 to 2006. In other words, the average home price doubled in six years. In comparison, average home prices in the 10 cities increased only 37% in the thirteen years spanning from 1987 (the year the Case-Shiller index began) to 2000. Under the common assumption that house prices would rise forever, many home-buyers over-borrowed to expose themselves to these rapidly appreciating assets. Like all bubbles, price increases triggered additional price increases. There were two reasons for this self-reinforcing cycle. First, people held rational expectations. Similar to commodity price inflation, asset price inflation increases the magnitude of expected future price increases. As people witnessed upward trends year after year in the value of their homes (as well as their neighbors’ homes), they revised their forecasts upwards. These optimistic forecasts motivated real estate investments on the margin, placing upward pressure on current house prices and reinforcing expectations of future home price appreciation.

Second, strong demand for houses could only thrive in an environment of cheap credit. In the early 1980s, Paul Volcker, then chairman of the Federal Reserve, raised interest rates to double digits to combat inflation. This was extremely painful

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12 Ibid.
13 The rational expectations hypothesis does not make the heroic claim that people are perfectly rational, e.g., that households meticulously forecast future home price appreciation using mathematical rigor. Rather, it makes a much more plausible claim that people incorporate all relevant information in their decision-making.
for the U.S. economy and the U.S. entered its (then) deepest recession since the Great Depression. In particular, the housing market stagnated because financing a house became increasingly expensive. When inflation was tamed, however, nominal rates soon declined and remained low for years. Low interest rates reduce the cost of borrowing, enhancing the profitability of investments. Many argued that the drop in the Fed Funds rate from 6.5% to 1% by former Fed chairman Alan Greenspan after the collapse of the tech bubble in 2001 made credit excessively cheap, thereby encouraging investors to take on debt (leverage) to expose themselves to rapidly appreciating assets.

Concentrating the blame on Greenspan’s Federal Reserve, however, ignores the fact that the decline of interest rates was a global phenomenon. Indeed as a benchmark interest rate, a low target Fed Funds rate puts downward pressure on all other lending rates. But quantitative easing by itself could not have injected the US economy with so much cash. The “bond conundrum” proves this point. Even when the Federal Reserve began raising the target Fed Funds rate in mid 2003, the yield on ten year Treasury securities, another benchmark rate, hardly rose. As a matter of fact, at the zenith of monetary tightening in 2006, when Greenspan raised the target Fed Funds rate to 5.25%, the yield on a 10-year government bond fell 20 basis points over the same period, from 4.7% to 4.5%. This unusual and unexpected situation

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14 In 1982, the seasonally adjusted unemployment rate peaked 10.8%. In comparison, the seasonally adjusted unemployment rate released by the U.S. Bureau of Labor Statistics in November 2009 was 10.2%.
saw the yield curve for Treasury securities flatten and ultimately invert.\textsuperscript{15} What explains this bond conundrum? Why did credit become cheaper in the face of quantitative tightening?

**The Global Savings Glut**

Imbalances in the global economy became the source of excess liquidity. This global savings glut, as current Fed Chairman Ben Bernanke coined in a 2005 speech, overwhelmed domestic investment opportunities in emerging markets and instead flowed into developed country asset markets, in particular the U.S. housing market. The global savings glut had two principal drivers: the accumulation of Chinese foreign exchange reserves and the petrodollars accumulated by oil producing countries from record increases in the price of oil. Although these two phenomena operated independently of each other, they occurred simultaneously and quickly. The magnitude and the speed of their accumulation swamped the developed economies with excess cash, which was then channeled into housing.

China’s vast current account surplus was the primary driver of the global savings glut. Since the 1990s, China became increasingly reliant on net exports to stimulate growth. China’s trade surplus ballooned from less than 2% of GDP in the

\textsuperscript{15} The yield curve captures the rates on all Treasury securities ranging from 1 month to 30 years in maturity. With the full faith and credit of the U.S. government, a default on Treasury debt is highly unlikely. Treasury yields are therefore used as benchmark rates for short term, medium term, and long term lending. For example, companies issuing debt must pay a premium above the yield on comparable maturity Treasuries. This premium is the extra interest that a borrower must pay in order to compensate lenders for a perceived risk of default, and it is commonly denominated as the credit spread, or the spread over Treasuries. Interestingly, the yield curve is also an extremely prescient tool in forecasting economic recessions. Yield curve inversions have preceded each of the last seven recessions from 1960 to 2009.
early part of this decade to a whopping 11% in 2007, a remarkable position for a major emerging economy. Under a fully convertible currency, however, current account surpluses are not sustainable. David Hume highlighted this two centuries ago in his classic treatise, “On the Balance of Trade.”\(^{16}\) Without policy interventions, a nation’s balance of trade equilibrates or self-adjusts in the long run. For example, if a nation’s current account surplus becomes excessively large, its currency will appreciate due to the high demand for its goods (national goods and currency are complementary goods; as the demand for the former rises, the demand for the latter rises as well). The home-foreign exchange rate will decrease and the domestic interest rate will increase as a result of this currency appreciation, making the prices of its goods and the wages of its labor uncompetitive relative to other nations’. Demand for its exports will in the medium run diminish as a result of the currency appreciation. In the long run, its current account surplus will disappear and its currency will depreciate.

A non-fully convertible Chinese Renminbi (RMB) inhibited this naturally equilibrating mechanism. Under the Mundell-Fleming IS-LM model, central banks can choose only two of the three policy options: monetary independence, capital mobility or fixed exchange rates. Because China is an export dependant emerging economy with millions of workers entering the labor market annually, the Chinese government chose to adopt monetary independence under a pegged exchange rate regime. In other words, to keep the Renminbi from appreciating, and to keep its

\(^{16}\) David Hume, “On the Balance of Trade” (1742).
goods competitively priced, the Chinese central bank accumulated vast foreign exchange reserves: they sold Renminbi and purchased dollars. Over the first eight years of this decade, China’s foreign exchange reserves soared to $2 trillion USD. Likewise, other emerging economies responded similarly. After a string of financial crises in Latin America, Asia and Russia, emerging economies built up large foreign exchange reserves to shield their currencies from another round of debt mismatches and currency devaluations. South Korea, Taiwan and India, in particular, also saw significant run-ups in their own reserves. This global imbalance in current accounts widened the gap between savings and investments. In contrast to Lenin’s predictions, developed countries borrowed heavily from their developing country counterparts to fuel consumption and investment.\footnote{\textit{Imperialism as the Highest Stage of Capitalism} (1914), argued that the flow of capital is always from the developed to the developing: from America and Western Europe to Asia, Africa, and Latin America. With China’s economic ascent and the rise in petroleum prices, this trend was reversed by the turn of the century.} China, for example, invested heavily in U.S. government and agency securities with their dollar reserves. Thus, the U.S. economy was awash with cash even when Greenspan tightened the money supply by raising interest rates.

Vast petrodollar accumulations were the second source of cheap credit. This was a result of substantial increases in the price of oil. Oil prices skyrocketed from about $25 a barrel in 2000 to a peak of $147 a barrel in mid 2008. Oil exporting countries, most notably the Persian Gulf states, Venezuela, Nigeria, and Russia benefited from the high prices of oil, accumulating petrodollars. Oil exporters’ current account inflows exceeded $65 billion per month in recent years and an
aggregate total of over $2.5 trillion from 2001 to 2007.\textsuperscript{18} These petrodollars, in conjunction with Asian reserves, fueled the U.S. housing bubble.

This outflow of capital into developed economies directly refutes economic growth theory. According to the Solow growth model, capital ought to flow to the avenue with the greatest return, other things equal. With underdeveloped infrastructure, inadequate education, and flawed healthcare systems, savings from emerging economies should flow into their own domestic investments, where the returns to that capital are the greatest. Moreover, in the Solow growth model, capital-rich developed economies should export capital to developing economies, where the returns to investments are significantly higher.\textsuperscript{19} However, two obstacles inhibited this flow. First, the sheer magnitude and speed of capital accumulation overwhelmed efforts to allocate savings efficiently. These excess savings vastly exceeded domestic investments that promoted long-term growth. Instead, emerging economies invested in U.S. government and agency debt, which in turn made credit excessively cheap. The second constraint on capital absorption was political: governments of many commodity-exporting economies constrained the free flow of capital, labor and technology. For example, in Russia, foreign investment in oil and gas sectors was subject to government approval. In Middle Eastern countries such as the United Arab Emirates and Saudi Arabia, foreign direct investments were tightly

\textsuperscript{18} Source: Haver Analytics; Goldman Sachs Global Investment Research.

\textsuperscript{19} The marginal product of, or real return on, capital in capital-scarce, labor-abundant regions in Shenzhen, China, according to economic logic, should be great. New York, on the other hand, is a region rich with capital and should have a much lower real return on capital. Economic logic dictates that capital should flow from New York to Shenzhen.
restricted, if not banned. With strong global economic growth fuelling energy and commodities demand, the world should have seen significant investments designed to increase supply. These restrictive government policies, however, deterred energy, infrastructure, education, and other long-term growth investments.

**Securitization and the Revolution in Lending**

Securitization played an integral role in fueling the housing boom. It channeled the turn-of-the-millennium global savings glut that developed in the East Asian and the petroleum-exporting economies into U.S. residential real estate. And when the bubble finally burst in the summer of 2007, securitization transformed a local, sector-wide problem into an economy-wide, if not global, contagion.

The explosion in mortgage originations for credit-worthy borrowers (consumers with good credit histories and steady incomes) was not surprising given the fact that the U.S. economy was awash with liquidity from a prolonged period of monetary expansion and a global savings inflow. What was peculiar was the shifting composition of mortgage lending: the fact that increasing numbers of subprime borrowers (consumers with poor credit and employment histories) were able to take out large loans to purchase houses and other assets they could ill-afford. Banks more than tripled their total volume of subprime lending from 2001-

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20 Although U.S. housing was the central asset bubble, global housing also boomed. Especially in countries like Finland, Norway, Spain, and Australia, home price appreciation was driven by more than income growth.

21 A creditworthy borrower is one with a proven history of on-time debt repayment and a low level of current indebtedness.

22 According to the 2001 *Interagency Expanded Guidance for Subprime Lending Programs* subprime borrowers display a range of credit risk characteristics, including one or more of the following:
Many critics in hindsight accused banks of poor loan underwriting standards, predatory lending, and even fraud. These, however, were symptoms rather than the disease. The root of the increase in subprime lending was securitization.

Securitization packaged traditional on-balance sheet, held-to-maturity assets like loans into marketable assets. Securitization created the secondary market for mortgage, credit card, student, and auto loans. From Wall Street’s perspective, mortgages in themselves were bad investments. Mortgages were not tradable pieces of paper; they were not bonds. They were loans made by financial institutions that were never supposed to leave the institution’s books. John Doe’s four hundred thousand dollar mortgage with a nine percent fixed interest and a maturity of thirty years, secured by a nice three bedroom affair in Norwalk was too personal an investment for firms like Goldman Sachs, which dealt in larger aggregates. No trader or investor wanted to poke around Connecticut suburbs to determine whether John Doe was creditworthy. More important, mortgages suffered enormous risks: the risk of default, the risk of prepayment, and the risk of changes in interest rates. These risks deterred investors.

If, however, thousands of these home mortgages from geographically dispersed neighborhoods could be pooled together to back tradable instruments

- Two or more 30-day delinquencies in the last 12 months, or one or more 60-day delinquencies in the last 24 months;
- Judgment, foreclosure, repossession, or charge-off in the prior 24 months;
- Bankruptcy in the last 5 years;
- Relatively high probability of default reflected by a credit bureau risk score (FICO) of 660 or below
- Debt-to-income ratio of 50 percent or greater; or, otherwise limited ability to cover family living expenses after deducting total debt-service requirements from monthly income.

23 See table in Appendix 1.
paying an interest of ten percent until maturity, these risks would be diluted, if not eliminated. Traders and investors would trust statistics and buy into a pool of several thousand mortgage loans made by thrifts, of which only a small fraction should default given a normal distribution. Thus standardized, these pieces of paper could be sold to institutional investors such as Calpers, California’s largest pension fund for public employees, the Industrial and Commercial Bank of China, the government of Iceland, a tax-evading Russian oil tycoon in a yacht in the harbor of Monte Carlo, etc. – i.e., to anyone with money to invest. Through securitization these home mortgages became impersonal, tradable bonds.

Mortgage originations, or loans to homebuyers, soared as a result of increased securitization during the first half of the decade. From 1985 to 2000, mortgage originations (a flow) as a percentage of total mortgage debt outstanding (a stock) averaged 6.3%. From 2001 to 2006, that number increased to 10%.24 During those five years, the percentage of new loan originations that were considered subprime or Alt-A (the middle tier credit grade between prime conforming and subprime nonconforming) increased significantly from about 12% to almost 40%.25 Appendix 1 documents the origination of mortgages and the issuance of mortgage securities since 2001. Jumbo loans include loans to prime borrowers with an original principal balance larger than the conforming limits imposed by Congress.26 The Alt-A asset class involves loans to borrowers with good credit histories but include more

24 Source: Mortgage Bankers Association; Federal Reserve Board.
25 Source: Inside Mortgage Finance.
26 Although the Federal limit is $417,000, the cap now varies by metropolitan area (e.g., it is much higher in New York City and some suburbs).
aggressive underwriting than the conforming or jumbo classes (e.g., poor documentation of income and high leverage). Agency issuance includes bonds issued by the Government National Mortgage Association (GNMA), the Federal Home Loan Mortgage Corporation (FHLMC), and the Federal National Mortgage Association (FNMA) to prime borrowers conforming to tight underwriting standards.

There are two noticeable trends. The first is the increasing issuance of mortgage securities from all asset classes regardless of quality. Through securitization, mortgages were sliced into bonds and sold to investors. The second and more important trend is the growing dominance of non-agency loan origination and security issuance (i.e., subprime, Alt-A, and jumbo loans that did not conform to Fannie, Freddie and Ginnie loan criteria). In 2006, the total notional value of non-agency loan originations was $1.48 trillion, more than 45% larger than its agency counterpart. Similarly, in 2006 the gross notional value of non-agency bond issuance was $1.034 trillion, more than $100 billion larger than the total value of agency bond issuance.27

Before securitization, subprime loans were rare. Most loans were made to prime borrowers conforming to stringent underwriting standards.28 With loans as assets held-to-maturity on balance sheets, banks viewed subprime lending as very risky investments. Loan managers followed conservative lending practices. They

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27 Author’s calculations; see table in Appendix 1.
28 From the lender’s perspective, a ‘prime’ borrower is one with a combined loan-to-home value ratio below 80% (e.g., the loan taken out on a $300,000 house does not exceed $240,000), a FICO score above 650, a payment-to-income ratio below 40% (e.g., monthly mortgage payments do not exceed 40% of monthly net income), and sufficient income documentation.
frisked their customers aggressively before extending them a loan. However, through the process of securitization, local banks could bundle up these risky loans and sell them to Wall Street investment banks, who would then structure these pools of assets into residential mortgage-backed securities (RMBS), which are claims to cash flows from the underlying mortgages. In essence, securitization enabled banks to distribute risk across the financial system. If local banks kept the loans they made, they warehoused all the risk. This made individual banks quite vulnerable to sector-specific or regional downturns. Through securitization, however, institutions could share the risk of lending with others. It was the crowning achievement in risk management and modern finance.

The downside, however, was a new payoff structure that favored irresponsibility over due diligence. Without their “skin in the game” (i.e., with no incentives to follow prudent lending standards), mortgage originators were no longer confined to loaning to quality customers who could reasonably pay back their debt. Instead, mortgage lenders such as Countrywide and New Century loaned heavily to no income, no job, and no asset customers (so-called NINJA loans), generating revenue from origination fees and asset sales. Although predatory lending and borrowing may have played their roles, securitization, by altering the payoffs of making subprime loans, eroded lending standards.
Financial Alchemy

How did this black box work? How did investment banks like Bear Stearns and Lehman Brothers churn junk into gold? This was where the quantitative wizards stepped in and became financial engineers. Suppose that ten 30-year mortgages, each with a principal value of $100,000 are grouped together into a million-dollar pool. If the mortgage rate is 10%, then the first month’s payment for each loan would be $877.57, of which $833.33 is interest payment and $44.24 is principal repayment. The holder of this mortgage pool would receive a payment in the first month of $8775.70, the total payments of all ten mortgages in the pool. If one of the mortgages happens to be paid off in any month, the holder also receives that payment of principal. In future months, the pool will comprise fewer loans, and the interest and principal payments will be lower. The residential mortgage-backed security (RMBS) is the financial instrument that represents the future cash flow from this pool.

There are substantial risks to investing in this mortgage pool. The first is prepayment risk. Prepayment provides the borrower flexibility: if a borrower wants to move, he can sell his property, repay the mortgage, and get a new loan for a new home. Even if the borrower does not move, it may still be advantageous to prepay. Although it is unlikely an average person has or will use a few hundred thousand dollars sitting idle in his savings account to repay the remaining principal on his 30-year fixed mortgage twenty years ahead of time, the borrower may take out an additional mortgage, a junior liens mortgage, also known as a home equity line of
credit (HELOC). In an environment of cheap credit, lending institutions will offer borrowers junior liens mortgages, which are often used to repay first liens mortgages, the original loan. This is attractive for the consumer for two reasons. First, the mortgage rates in today’s environment may be substantially lower than the mortgage rate the borrower secured. If the mortgage rate fell below 10% in the example above, then it is perfectly rational for a borrower to refinance his original mortgage. Second, even if lending rates do not fall, home price appreciation builds homeowner equity. The borrower can use that additional equity to secure a junior liens loan or to refinance his original first liens mortgage. Suppose in the example above the borrower of $100,000 uses the sum to purchase a $100,000 one-bedroom apartment. If the home price appreciates 2% annually, then five years later the value of the apartment would be $110,408. Now, if the annual home price appreciation quintuples to 10% (a rate very plausible given the housing bubble doubled average house prices in 10 major U.S. cities from 2000-06), the value of that one-bedroom apartment five years later would be $161,051. With that additional $61,051 in homeowner equity, the borrower may secure additional debt at a lower rate.

This prepayment risk, however, is dreadful from an investment standpoint. Investors channel cash into investments with expected attractive returns over time. Suppose one borrower in the above example decides to prepay their mortgage, then the investor holding the pool of loans would see $877.57 less in each of the subsequent monthly cash flows. Moreover, with $100,000 now sitting idle, the
investor must find new investments with comparable monthly returns. If more borrowers prepay their original mortgages, the investor would be even worse off.

A second flaw deterring investors from this mortgage pool is interest rate risk. Each of the ten 30-year mortgages has a fixed rate of 10%. In other words, the investor would see a monthly return of $8775.70 from his investment. If 30-year mortgage rates (which adjust to benchmark long-term interest rates such as 30-year Treasury yields) decline in the future, then this mortgage pool would be an extremely attractive investment. Newly originated 30-year fixed mortgages would yield lower monthly returns after the interest rate decline. If, however, lenders or investors face an environment of increasing interest rates, the future cash flow of this mortgage pool would become less attractive relative to other investments. Banks and thrifts, institutions that traditionally issue short-term liabilities (their customers’ deposits) and hold long-term assets such as conventional fixed-rate mortgages suffer tremendously from interest rate risk if they keep mortgage pools on their balance sheet. For example, the sudden spike in interest rates in the 1980s (a consequence of Paul Volker’s Federal Reserve attempt to curb inflation) triggered the collapse of many thrift institutions. Without the ability to adjust fixed mortgage rates upwards, these lenders were generating less in revenue than they were giving out as interest on demand deposits. Interest rate risk was one cause of the savings and loans crisis in the 1980s.
Adjustable-rate mortgages are solutions to the interest-rate risk faced by traditional 30-year fixed mortgages. Adjustable-rate mortgages require the borrower to pay an interest rate that varies with some benchmark interest rate: London Interbank Offer Rate, prime rate, T-bill yields, etc. For example, the interest rate could be set at 2 percentage points above the current rate on 1-year Treasury bills and is adjusted bi-annually. Usually, the mortgage contract sets a cap on the maximum size of an interest rate change on each subsequent adjustment and over the life of the contract: period and lifetime caps. Nevertheless, the adjustable-rate mortgage shifts much of the costs of interest rate volatility from the lender to the borrower. This transfer of interest rate risk allows lenders to offer lower rates on adjustable-rate mortgages than on conventional fixed-rate mortgages. This can be a great inducement to borrowers during a period of high interest rates. As interest rates fall, however, conventional fixed-rate mortgages regain popularity.

With the U.S. economy awash in credit and the ability to remove assets from balance sheets, banks pushed the boundaries on acceptable loan terms. The underwriting characteristics of loans in mortgage pools continued to deteriorate during the housing boom. More aggressive loan underwriting did not simply consist of offering a young couple in their early life-cycle stage of income a 30-year adjustable-rate mortgage (ARM) to purchase their first home. Appendix 2 shows that underwriting standards have declined across-the-board from 1999-2006. Banks not only extended more Alt-A and subprime loans, but they also required less rigorous income documentation. There are a few alarming trends in this industry data. First,
mortgages were taken out on increasingly less homeowner equity. This is reflected by the steady increase in the combined-loan-to-value (CLTV) ratio. Second, loans were increasingly used to finance speculative purchases and household consumption. The percentage of Alt-A loans used for first-time home purchases fluctuated greatly over the span of 7 years, dipping to 39.4% in 2003. More important, the mortgages in both Alt-A and subprime pools were increasingly junior liens, which are subordinate to original first liens loans in the event of a default. This data suggests that the average borrower became significantly more risky.

In addition to riskier borrowers, the mortgages originated were more complex. Banks originated a plethora of exotic loans to dicey, financially unsophisticated borrowers. Many of these products exhibited derivative-like features such as payment shocks. To guarantee lower permanent rates, banks offered jumbo mortgages amortized over 40 years: so-called 40-year fixed jumbos. To attract clients with poor credit histories, banks offered hybrid loans that held both adjustable-rate and fixed-rate characteristics. One popular loan was the 3/27 hybrid ARM, which offered low teaser rates for the first 3 years. After the initial period, the mortgage rate could reset at a different, higher rate. Even this 3/27 hybrid ARM was vanilla compared to the negatively amortizing 2/28 interest-only option ARM. Borrowers of this exotic loan made only interest payments the first 2 years while the principal of the loan grew over that time, hence, the negative amortization.
Why did investors channel their money into mortgage pools if they knew full well the substantial risks inherent in the underlying assets? The probability and magnitude of potential losses in the hypothetical 30-year fixed-rate mortgage pool pale in comparison to the credit risk in this real basket of non-conventional mortgages. If anything, risk-averse institutional investors should be deterred from these assets plagued characterized by a higher frequency of delinquent payments, home foreclosures, and loan defaults. Mortgages could be high-risk, high-return assets. They would appeal to investors if their risks could be mitigated without a large trade-off to returns.

The Golden Goose

Securitization guaranteed most investors steady cash flows regardless of whether homeowners prepay, refinance, or default on their loans, i.e., regardless of the quality of the loans. It reduced the prepayment, interest rate, and credit risks that plagued the underlying assets. Under a normal statistical distribution, the laws of probability state that only a small fraction of a geographically dispersed pool of loans should default. If that assumption is appropriate, then loans could be bundled together and structured into synthetic instruments. These synthetic instruments had various tranches that reflected varying levels of risk and return. The senior tranche was the safest, offering investors a low but steady stream of coupon payments. Credit rating agencies assigned their highest rating, AAA, to securities in the senior tranche. The subordinate mezzanine and equity first-loss tranches, in contrast, were very risky. They paralleled junk bonds in their risk-return nature: high variance in
returns along with a significant probability of default. Because of the subordinate debt structure, holders of senior tranche securities were paid first. After first tranche investors were paid in full, then payments flowed into the second tranche, and so on. The holders of securities in the equity first-loss tranche were paid last, if at all. They were compensated for the additional risk with the highest potential coupon payments, known as the excess spread. This excess spread was the first line of defense against losses. Securitization, in essence, was the transformation of information-sensitive, personal debt, into information-insensitive, standardized bonds.\textsuperscript{29} It perfectly distributed risk to those willing to bear it.

The process of buying pools of loans from mortgage originators and arranging them into various securities can be a very expensive and risky business. Unless the firm is a depository institution, with FDIC-insured checking and savings accounts to draw on, it may lack the necessary idle capital to purchase and bundle these large pools of underlying assets.\textsuperscript{30} Investment banks and other MBS issuers must finance these operations externally by tapping the capital markets. There are two ways to do this. The first is to borrow directly from investors through the issuance of corporate bonds. MBS arrangers, however, are weary about issuing

\textsuperscript{29} One should know that home mortgages are not the only assets that were securitized. Other asset classes include auto loans, credit card receivables, student loans, and even aircraft leases.

\textsuperscript{30} To give one example of the vast size of mortgage pools, New Century Financial (the second largest subprime lender from 2004-06, according to \textit{Inside Mortgage Finance} 2007) in the second quarter of 2006 originated a mortgage pool with an aggregate principal balance of $881 million, containing 3,949 subprime loans. GSAMP TRUST 2006-NC2, a bankruptcy-remote special purpose entity of Goldman Sachs eventually purchased the pool of loans to create residential mortgage-backed securities. One can search the SEC Edgar database at \url{http://www.sec.gov/edgar/searchedgar/companysearch.html} with the company name, GSAMP TRUST 2006-NC2, to explore the details of this transaction. The structure of the MBS issuance is available on ABS net via free registration at \url{www.absnet.net}. 
information-sensitive corporate bonds. Analysts rigorously examine financial institutions’ quarterly accounting statements to evaluate their portfolio of risks. The buying of risky assets such as non-conforming Alt-A, jumbo, and subprime mortgages will be reflected on the balance sheet. A high exposure to risky assets should increase the cost of capital, other things equal. Thus, firms that issue mortgage-backed securities have an incentive to hide these transactions by removing them from the balance sheet when possible. Likewise, if unhedged, a drastic decline in the value of the mortgage pools via an exogenous shock (e.g., a widespread depreciation in home values) would threaten the solvency of MBS issuers. A sudden write-down in asset values would force overleveraged, undercapitalized firms to rapidly deleverage by liquidating assets and increasing cash reserves. These two disincentives, a higher cost of capital and a greater risk of bankruptcy, deterred MBS arrangers from financing their securitization operations through the issuance of corporate debt.

Instead, the preferred method of financing securitization was the creation of a bankruptcy-remote trust: a special purpose entity (SPE) or vehicle (SPV). The key characteristic of special purpose entities is their inability by design to go bankrupt. In fact, SPEs are not actual firms: they have no physical location, and no independent managers or workers. SPEs are merely legal entities created by sponsoring firms to conduct off-balance sheet transactions. They suffer no regulatory oversight and are subject to different accounting standards. Enron used a variety of SPEs to hide losses and to boost earnings. MBS arrangers can use these off-balance sheet vehicles for
the sole purpose of structuring risky cash flows into riskless securities. The diagram in Appendix 3 depicts the transactions of a hypothetical SPE. The MBS arranger (an investment bank) creates and sponsors a bankruptcy-remote trust that will purchase pools of loans from mortgage originators. These purchases are funded by the underwriting and sale of asset-backed debt, i.e., the fees charged to investors for arranging the mortgage-backed security and any premium investors pay on the issued securities above par value. This was a lucrative business during the housing boom and various institutions from commercial to investment banks jumped on the securitization bandwagon. At the end of the day, sponsors can elect to transfer profits back onto their balance sheets. Alternatively, if the SPE records a net loss, sponsors are not legally obliged to record the red ink. The key point is that SPEs cannot go bankrupt.

This bankruptcy-remote master trust is an essential component of credit risk transfer; it protects all agents involved from the losses associated with potential defaults on underlying loans. The SPE protects the mortgage originator (local banks and thrifts) by purchasing the original loans. It reduces the credit risk the investor (hedge funds and asset managers) faces by structuring the cash flows into various tranches. And most important, it protects the sponsor (investment banks, commercial banks, and mono-line MBS issuers) from losses if the pools of underlying assets deteriorate in value. There is the possibility of a sponsor bailout if the SPE faces financial difficulty. Sponsors often offer credit provisions to their trusts, and reabsorb losses on their balance sheets to save their reputations. For example, Bear
Stearns, in an attempt to show strength during the subprime housing crisis in the summer of 2007, pledged $3.2 billion to one of its ailing mortgage trusts.\textsuperscript{31} Support in the event of financial distress, however, is implicit rather than legally mandated.

Special purpose entities “financially engineered” pools of risky subprime and Alt-A loans into attractive mortgage-backed securities that could be sold to potential investors. The table in Appendix 4 details the structure of a hypothetical MBS. The cash flows from the underlying assets are sliced into various tranches, each with different risks and returns. The lion’s share of the capital structure is senior AAA, accounting for 75% of the combined principal balance in the mortgage pool. The mezzanine tranches, AA to BBB, account for 23% of the split, while the most junior class, the equity tranche, accounts for the remaining 2%. In this example, the securities in the equity tranche carry a risk-weighting of 1250%, reflecting a significant probability of loss. When cash flows from underlying loan pools are healthy, the equity tranche pays an excess spread, the residual between the weighted average coupon from the mortgage loans and the weighted average coupon on debt securities issued by the trust. However, when underlying assets deteriorate, the equity tranche is the first line of defense for absorbing losses. If the equity tranche cannot fully absorb all the losses, losses spill over to the most junior class remaining, and so on. This subordinated capital structure protects investors of the most senior securities, regardless of the quality or type of underlying assets.

\textsuperscript{31} Numerous other sponsors also supported their off-balance sheet vehicles during the crisis. The Federal Reserve Bank of New York’s website contains a detailed timeline and description of these events. It can be accessed at \url{http://www.newyorkfed.org/research/global_economy/Crisis_Timeline.pdf}.  

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Because special purpose entities, by design, cannot go bankrupt, they are able to create and retain equity tranches. In other words, they are able to sell senior and mezzanine securities to investors, while at the same time absorb losses by retaining the equity tranche. The SPEs are in essence issuing less debt than the total value of the underlying assets. This innovation of over-collateralization is vital to shielding investors from credit risks.

A pool of junior tranche mortgage-backed securities can also be arranged into subordinated debt. Collateralized debt obligations (CDOs) are essentially “securitized” mortgage-backed securities: pools of loans that are securitized two times. The table in Appendix 5 details the capital structure of a hypothetical CDO, an almost-mirror image of a MBS. A normal statistical distribution of potential losses or value-at-risk still applies. However, because the underlying assets of a CDO, a pool of junior tranche mortgage-backed securities, are significantly riskier, the magnitude of the losses is greater, while the variance is smaller, i.e., the CDO’s loss-distribution bell curve is taller and more compressed. To offer the same credit protection to senior tranche investors, greater over-collateralization and subordination are necessary. The former is achieved by issuing and retaining more securities in the equity first-loss tranche. The latter is achieved by expanding the mezzanine and junior tranches relative to the senior tranche. A close examination of Appendices 4 and 5 will reveal this. Whereas the size of the most senior MBS tranche is 75%, the size of the most senior CDO tranche is 60%. In other words, the SPE must reduce the issuance of senior level debt by one-fifth in order to offer the same level of credit
protection. Likewise, the “first line of defense” equity tranche doubled from 2% to 5%. The securitization of riskier assets requires greater over-collateralization and subordination. Bankruptcy-remote SPEs can achieve both.

This financial wizardry transformed risky, volatile, and personalized cash flows into safe, steady, and standardized mortgage-backed securities that outperformed their corporate counterparts. Through the process of securitization, the various risks associated with investing in pools of loans were reduced, if not eliminated. The credit rating agencies, the unbiased third-party observers of securitization deals, reassured investors about the safety of structured debt by offering their highest ratings to senior-level securities. The table in Appendix 6 summarizes the deal structure of GSAMP Trust 2006-NC1, a Goldman Sachs special purpose entity that purchased a pool of subprime loans originated by New Century in the second half of 2005.32 There are two noticeable trends. First, both credit rating agencies assigned their highest ratings to senior securities (A-1 to A-3) even though the underlying assets were high-risk subprime ones. This was possible because of the 1.01% of over-collateralization (reflected by the size of the X tranche) and the 18.08% subordination level (reflected by the combined size of the junior tranches). Equally interesting is the attractiveness of securitized debt relative to other similarly-rated corporate bonds. In GSAMP Trust 2006-NC1, the senior and mezzanine coupon rates float with the London Interbank Borrowing Rate (LIBOR).

32 The prospectus of this deal can be found on the SEC webpage (http://www.sec.gov/edgar/searchedgar/companysearch.html) under the name “GSAMP Trust 2006-NC1.” The specific details of the deal are available on ABS Net (www.absnet.net) under the same name. Registration is required, but free, to access the information.
The last column on the table can be interpreted as the additional return on securities in each tranche compared to similarly-rated corporate debt. Thus, securitization not only distributed credit risk, but it also squeezed additional returns out of investments. This attracted risk-averse institutional investors such as endowments and pension funds. The table in Appendix 7 highlights the types of investors in collateralized debt obligations. Although risk-taking investment banks and hedge funds purchased two-thirds of all securitized debt issued, increasing numbers of risk-averse institutions invested in CDOs and MBSs.

**Avarice Trumps Logic**

This high-return, low-risk characteristic of securitized debt violates one fundamental premise of portfolio theory: risks and returns should be inversely correlated. The key implication of the capital asset pricing model is that excess returns are negatively correlated to the covariance of the return. In other words, investors require no additional premium if returns are risk-free. If senior-rated mortgage backed securities are indeed riskless, then their superior yield should be

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33 For a primer on portfolio theory or CAPM, see Bodie, Kane and Marcus Investments (6th ed.), pp. 282-92.

34 In a dynamic stochastic general equilibrium, individuals maximize their lifetime utility by smoothing consumption over time. We will sacrifice consumption (by saving) when the marginal utility of an additional unit of consumption is low, i.e., when we have already consumed a lot. On the other hand, we will borrow to consume more when the marginal utility of an additional unit of consumption is high, i.e., when we have consumed only a little. This explains our desire to hold assets that exhibit a negative covariance with our income. In other words, we desire “safe” assets that pay when macroeconomic conditions such as employment and income deteriorate. The marginal utility of an additional unit of consumption is higher during those distressed times than during boom times. Consumption smoothing is the reason why utility-maximizing individuals demand a premium when holding assets whose returns are positively correlated with macroeconomic conditions. The strength of the positive covariance between asset returns and economic trends dictates the size of the excess premium.
short-lived. However, the fact that the market consistently demanded a higher yield for structured products than for similarly-rated corporate bonds provides a clue to the potential for higher risk. This conclusion, however, comes with the benefit of hindsight.

Securitization fundamentally altered the way individuals and institutions accessed credit. For the consumer, it created the secondary market for mortgages and loans, especially risky ones. By 2006, 75% of subprime and 92% of Alt-A loans originated were bundled and structured into asset-backed securities. Less creditworthy borrowers could now finance homes, cars, and other goods and services they could not previously afford. The extension of credit to minorities and the poor pushed by the government-sponsored entities Fannie Mae and Freddie Mac widened home ownership to historic levels. One unintended consequence, however, was a substantial erosion in lending standards.

For institutions, securitization revolutionized the means of raising short-term capital. Commercial banks, savings institutions, and credit unions were the traditional suppliers of credit in the United States. They supplied credit to firms through conventional loans. But their roles were increasingly supplanted by non-depository institutions in the overnight funds market. This overnight funds market – also known as the “shadow banking system” or the overnight repo (repurchase agreement) market – became the dominant method of raising temporary capital.

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35 See table in Appendix 1.
Investment banks, hedge funds, and non-depository financial institutions entered the repo market to finance short-term liabilities such as asset purchases, leveraged trading positions, and employee payrolls. They secured funds from other firms by pledging collateral. In other words, cash-strapped borrowers entered into a repurchase agreement with cash-full lenders by “loaning” collateral with the intention of repurchasing it shortly. The lender entered the repo transaction completely hedged. The borrower paid an interest on the short-term loan above the yield on risk-free Treasury bills. And in the event that the promised payments or deliveries did not materialize, the lender kept the collateral, mitigating its credit risk.

There were two questions for the lender in the “reverse repo”: what type of collateral to accept and how much of it to demand? Although lenders accepted risky assets such as mortgage-backed securities, they preferred liquid assets that were easily tradable, such as T-bills. If the pledged collateral deteriorated in value by becoming less liquid or more risky, lenders demanded a margin call by requiring additional collateral. Lenders also imposed haircuts to protect themselves from loss contingencies. A haircut is the percentage difference between the market value of the pledged collateral and the amount of funds lent. For example, a haircut of 5% meant that a firm could borrow 95 cents on each dollar of pledged collateral. The simultaneous increase in haircuts and margin after the collapse of the housing market initiated a repo run similar to traditional bank runs. Lenders demanded safer and greater collateral or refused to rollover (renew) overnight loans. Systemic panic in the repo market triggered the downfall of blue-chip MBS issuers such as Bear
Stearns and Lehman Brothers. The funding of long-term asset positions in mortgage-related products through the use of temporary repo liabilities created a maturity mismatch that only exacerbated the panic.

**The Rise of Shadow Banking**

Some economists argue that the growth in repo financing was an unintended consequence of pervasive securitization. The need to raise large funds quickly and cheaply grew from the need of MBS arrangers to purchase expensive pools of mortgage loans. Indeed most MBS arrangers financed their asset purchases through repo. Likewise, the excess supply of overnight funds lent between financial institutions could also be attributed to securitization. Senior securitized debt satiated the demand for collateral in the repo market. Collateral placed limits on how much firms could borrow in the repo market. Lenders demanded collateral worth an equal value to the loan. For example, a one-hundred million dollar asset is needed to secure a one-hundred million dollar repo loan. Before the collapse of housing, senior-tranche mortgage-backed securities, with their steady coupon payments, little probability of default, and AAA credit ratings, were perceived virtually as riskless, liquid instruments comparable to other cash-like assets such as Treasury bills. Lenders therefore willingly accepted senior securitized debt as collateral in repo agreements. Often they reused or “spent” that collateral in other transactions. They pervasively rehypothecated the collateral in their own repo

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37 Gorton, p. 29.
agreements and trade, increasing the interconnectedness of the entire financial system.\textsuperscript{38} For example, Lehman used Bear Stearns’ collateral to clear a trade with Goldman Sachs.

The rise in securitization paralleled the growth in shadow banking. In 1996, primary dealers financed less than $2 trillion of fixed income securities using repo. By 2008, that number increased three-fold in nominal terms to $6 trillion.\textsuperscript{39} Although more support is needed to strengthen the causal link between securitization and repo, it is clear that securitization, along with increased competition from nonbanks and decreased regulation, contributed increasing dependence on repo by creating the demand for short-term funds, and a steady supply of supposedly riskless assets that could be pledged as collateral.

\textbf{The Derivatives Boom}

Like the repo market, securitization also triggered a boom in the derivatives market. Investors used derivatives, agreements between two counterparties bestowing certain financial rights and responsibilities, to hedge their increasing exposure to housing assets. Many agreements were extremely customized, tailored to specific risks. Known as over-the-counter (OTC) derivatives, they were not cleared by a central counterparty or traded on an exchange. Instead they were personal agreements between two counterparties that were opaque to both market investors and government regulators. “Vanilla” interest rate contracts have historically

\begin{footnotesize}

\textsuperscript{38} The term rehypothecate is a technical verb meaning to post a counterparty’s collateral as collateral for your own transactions.

\textsuperscript{39} Ibid.

\end{footnotesize}
dominated the derivatives market, encompassing about 70% of all amounts outstanding. However, by the summer of 2007, when cracks in the housing bubble first appeared, credit default swaps (CDS) were rapidly issued and traded. In June 2007, the CDS market exceeded $42.5 trillion. One year later it grew to $57.4 trillion, a whopping twenty-fold increase since 2000. In essence, these complex, exotic instruments were insurance contracts between protection buyers and sellers, covering the default of a specific bond. The buyer paid an upfront amount and yearly premiums to the protection seller to cover any loss on the face amount of the referenced bond.

Credit default swaps quickly won the hearts of MBS investors. Investors were now able to chase assets with high returns and lay off the attendant credit risks at low costs. Credit default swaps added another layer of protection to the debt subordination and over-collateralization provided by MBS issuers. Bankers loved it too as they were able to lucratively sell insurance on assets that showed little to no risk of potential default. During the housing boom, when delinquent payments and foreclosures were low, institutions such as AIG and Bear Stearns issued billions of dollars of CDS contracts. Their insufficient capital to execute those commitments ultimately led to their demise. Indeed, many firms jumped on this profit bandwagon, insuring supposedly risk-less senior tranche asset-backed debt.

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Again, securitization fueled the demand for financial derivatives, especially for credit default swaps. One plausible counterfactual is the statement that CDS contracts could not have ballooned like they did had the insurable assets (asset-backed debt) remained limited. One could also argue that effective regulation of derivatives may have constrained the market as well. A causal link between CDO and CDS is difficult to prove. Nevertheless, the two phenomena are highly correlated. The rise and fall of credit default swaps mirrored the zenith and nadir of securitization. When securitization halted after the collapse of Lehman, the CDS market shrank dramatically.

Securitization was designed to distribute risk to those able and willing to bear it. Through the process, risky loans were purchased from original lenders and placed in bankruptcy-remote master trusts. The special purpose vehicles of MBS issuers subordinated and over-collateralized the cash flows to create inverted-pyramid-like debt structures. Senior tranche investors were shielded by junior tranche investors. And other financial institutions shared the credit risk by selling over-the-counter credit default swaps.

**Key Frictions in Securitization**

Key frictions, however, developed in this complex process involving various agents with different (perhaps even conflicting) interests. Securitization started with the mortgage borrower who was relatively financially unsophisticated. Less aware of all the available financial options and less able to grasp the complexities of the loan
terms, the borrower may have lacked the information needed to make borrowing decisions in accordance with his best interests. This asymmetric information between the borrower and originator led to the possibility of predatory lending, which can be defined as welfare-reducing extensions of credit.

Such information asymmetry also plagued the next link in the chain between the mortgage originator and the MBS arranger. The first responsibility of the arranger was to conduct due diligence on the originator. This review included financial statements, underwriting guidelines, and discussions with senior management. The originator, however, had an information advantage over the arranger with regard to the quality of the borrower: the local thrift, unlike the Wall Street investment bank, knew full well the credit histories and true incomes of the borrowers. An originator could have the incentive to collaborate with a borrower to make significant misrepresentations on the loan documentation. Indeed, there exist many stories of loan officers who lent on stated income and stated assets, which meant borrowers did not have to provide paycheck stubs and W-2 forms, as they had in the past. Some originators even inflated the incomes on loan applications simply to originate the loan and book fees.41 The incentives to prudent lending were significantly weakened by the sale of traditional held-to-maturity assets.

41 This American Life episode 355, The Giant Pool of Money, provides an amusing yet insightful analysis of the mortgage crisis. In the radio broadcast, the host interviews a loan officer who recounts stories of aggressive loan underwriting.
The last key friction that emerged from securitization was a principal-agent problem between investors and their asset managers. Asset managers in investment banks, hedge funds, and money market funds invested in mortgage-backed securities. They held a fiduciary responsibility to the underlying shareholders and investors who provide the funding. Asset managers were employed by investors to formulate investment strategies, conduct due diligence on potential investments, and find the best price for trades. Investors, like borrowers, were typically financially unsophisticated, unable to fully grasp the best investment strategies. Credit rating agencies helped relieve this information asymmetry by grading various securities. These grades, however, did not make clear the additional risk inherent in structured debt. Although AAA mortgage backed securities shared similar risk characteristics with AAA corporate bonds, they guaranteed additional returns (which in hindsight are indicative of the greater inherent risk). This was a problem because asset manager performance was evaluated relative to peers or relative to a benchmark index. Asset managers had an incentive to reach for yield by purchasing structured debt issues with the same credit rating but higher coupons as corporate debt issues. The asset manager’s struggle to generate higher returns than peers or benchmark indices conflicted with their fiduciary responsibilities of prudent investment. Gripped by a collective euphoria, an irrational exuberance, asset managers over-leveraged and over-exposed themselves to structured securities.

42 The diagram in Appendix 8 details all the key players and frictions in securitization. For a comprehensive analysis on these frictions see Ashcraft and Schuermann (2008).
The author hopes this chapter sheds light on the many intricacies and complexities of the black box known as securitization. Understanding these fundamentals is crucial to exploring greater empirical and theoretical analyses. The next chapter will explore theories on the business cycle. The key question the author asks in that chapter is whether securitization, the revolutionary new method of lending, exaggerates or dampens the business cycle. The third chapter will explore how securitization froze during the crisis. It will also analyze how the Federal Reserve and U.S. Treasury attempted to reinvigorate securitization. In that chapter, the author questions the success of government intervention. Did government resuscitate lending? The ultimate paradox the author wishes to explore is this: securitization must die, and yet securitization must live. Securitization was at the center of the financial crisis. Yet policymakers must reinvigorate the securitization markets in order to restore the flow of credit.
Booms and Busts

Much has been written about panics and manias, much more than with the most outstretched intellect we are able to follow or conceive; but one thing is certain, that at particular times a great deal of stupid people have a great deal of stupid money... At intervals, from causes which are not to the present purpose, the money of these people – the blind capital, as we call it, of the country – is particularly large and craving; it seeks for someone to devour it, and there is a “plethora”; it finds someone, and there is “speculation”; it is devoured, and there is “panic.”

– Walter Bagehot 43

The securitization market was the epicenter of the 2007-09 financial shock. The meltdown in securitization, caused by the poor performance of highly-rated debt securities, led to the collapse of major institutions from blue-chip investment banks (Lehman Brothers) to international insurance companies (AIG), and from once-mighty car companies (General Motors Acceptance Corporation) to government regulatory agencies (the Office of Thrift Supervision). Financial institutions had to reabsorb off-balance sheet assets; backstop lines of credit were triggered; healthy lenders demanded additional collateral; shadow lenders refused to renew overnight loans; and banks could no longer securitize assets, increasing the pressure on balance sheets.

More important, the abrupt halt to securitization tightened credit in the real economy. Contrary to popular rhetoric, financial intermediaries play an important role in the economic circular flow. They connect savings and investments by providing the farmer and the manufacturer the capital necessary for enterprise.

With increasing pressure on balance sheets (i.e., diminishing asset and equity values), banks tightened lending standards, cutting off credit to households, small businesses, students, and homebuyers. Money, as the philosopher David Hume articulated over three-hundred years ago, is the oil that renders the motion of capitalism’s wheels more smooth and easy. In the long run, it is merely a veil that connects goods and people. However, because of price and wage rigidities, money in the short run has real effects on economic output. Without credit provided by financial intermediaries, the circular flow breaks down: households cannot finance consumption and businesses cannot fund investments. This, in essence, was the story of the “Great Recession.”

According to the New Classical school of thought, the salt-water macroeconomic paradigm that governed the great minds of financiers and central bankers for a quarter-century, history should have been a counter-factual. A collapse in credit and output from a systemic crisis was an otherworldly event absent in models grounded in mathematical rigor and numerical precision. And though the assumption that all agents act as perfect inter-temporal utility-maximizers is heroic, theories such as the rational expectations hypothesis, the random walk hypothesis, the consumption-capital asset pricing model, and the

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44 David Hume, “Of Money” (1752).
45 The New Classical school of economists taught in American universities mostly located near freshwater lakes. The most illustrious economists in this school include Milton Friedman, Robert Lucas, Edward Prescott, and Robert Barro. The New Classical school clashed with the New Keynesian school of economists, who were ironically mainly located in universities near saltwater bodies. Economists like Paul Samuelson, Paul Krugman, Brad DeLong, and Robert Solow represented the New Keynesian school. The two schools’ debates over theory and policy often turned nasty, reinforcing the notion that economics is a dismal science. Nobel prizes were awarded to individuals from both camps.
efficient markets hypothesis were perceived to be accurate reflections of economic reality during the “Great Moderation.” Central bankers relied as heavily on these models to determine macroeconomic policy as traders did to assess trading strategies. Moreover, financial innovations were viewed as dampening mechanisms, firewalls that curbed the spread of potential contagion. Through securitization, the risks inherent in lending (credit, liquidity and interest rate risk) could be perfectly allocated to investors willing and able to bear it. Through state-contingent claims known as derivatives and insurance contracts, all idiosyncratic risks could (in theory) be hedged. These theories and models, however, ultimately proved inconsistent with reality. Indeed, the hypothetical markets described in dynamic stochastic general equilibrium stood in sharp contrast to real markets gripped by instability and irrationality.

Likewise, the New Keynesian, fresh-water paradigm also deserves blame for contributing to and exacerbating the financial crisis. Markets are embedded in institutional frameworks and public policies. Whereas the boys from Chicago would roll over in their graves to condemn this, New Keynesians in the Ivy Towers of Cambridge preached active government mitigation of short-term fluctuations. Through timely, targeted and temporary monetary and fiscal policies, Big Brother could (in theory) smooth the business cycle and stabilize output, price levels and

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46 From about 1987 to 2008, the U.S. economy suffered no extreme recessions: the 1991 recession and the post tech-bubble recession of 2002 were both mild in the loss of output and employment. Alan Greenspan, who presided over the majority of the two decades as Federal Reserve Chairman, explicitly catered monetary policy to sustain growth. Many economists call this era the “Great Moderation.”
employment. Central banks could also act as a lender of last resort, thawing credit markets when they freeze. One interpretation of the crisis, however, holds government directly accountable for the crisis. The active engineering of the economy via an extensive period of short-term interest rates by Alan Greenspan’s Federal Reserve fueled cheap money; an ardent public policy initiative of expanding home ownership (especially to the lower-socioeconomic strata) accelerated the increase in house prices; the pioneering of securitization by government-sponsored mortgage entities Fannie, Freddie and Ginnie encouraged loan-to-distribute business models; and the rescue of systemically significant banks only reinforced the problem of moral hazard. Government may not have been Bellerophon, the slayer of financial chimera, but rather its creator.

Although both paradigms embrace heroic assumptions and make flawed conclusions, their insights are pivotal to understanding why the credit markets (and, in particular, securitization) imploded during the turmoil. Moreover, using insights from both the New Classical and the New Keynesian frameworks, one can assess the success of U.S. Treasury and Federal Reserve policies in reinvigorating credit, the lifeblood of modern finance capitalism.

By chapter’s end, the author hopes to show that a housing bust in and of itself is not sufficient to spread a contagion that infects all sectors of the economy. Yes, a substantial portion of consumer net wealth is linked to homes, and a collapse in home prices would inevitably curb household consumption. But the American
consumer is resilient. It was the collapse in credit and the scramble to deleverage that cataclysmically shocked output and employment. National declines in house prices punctuated an equilibrium built on borrowed money. Securitization promoted cheap financing during the era of the Great Moderation. It globalized consumption and investment by structuring and distributing risk. Although idiosyncratic risk may have been mitigated, aggregate or systemic risk accumulated. Most important, by slicing assets into securities that could be pledged as collateral, securitization pushed the economy towards debt finance. With excess collateral at hand, financial institutions became increasingly dependent on borrowed money. It encouraged shadow banking and deterred reliance on traditional banks. This raised leverage ratios, increased vulnerability, and amplified risk.

Yet at the same time, securitization fueled economic growth by reducing the cost of credit. Its collapse triggered extraordinary measures by the Federal Reserve to act beyond its responsibilities of price stability and full employment. The ultimate dilemma lies in the fact that securitization is generally a social good that finances real things in the economy: healthy enterprise, student loans and first-time home purchases. However, left to its devices, it encourages excessive speculation and risk-taking. It is both a disease and a cure to economic growth.

In order to understand how securitization amplifies turmoil, one must grasp what constitutes crises and equilibria. This chapter articulates and assesses both New Classical and New Keynesian models of the business cycle. The goal of the
chapter is not to detail the events of the 2007-09 recession, but instead to provide explanatory power for why markets tend towards or veer away from equilibrium. It challenges the prevailing assumptions of policymakers and financiers. It synthesizes ideas from both the New Classicals and the New Keynesians. It draws on the widely ignored studies of disequilibria by Hyman Minsky, Charles Kindleberger and Irving Fisher. In the end, the author hopes to anchor discussions on the business cycle with the role securitization played in modern financial capitalism.

The Wisdom of the Ancients

Although the markets it analyzed were less global and less dependent on finance, the Classical doctrine still offers important insights on economic fluctuations. Many laissez-faire advocates refer to Adam Smith’s renowned idea of the invisible hand to support their claim that markets tend toward equilibrium without exogenous aid. In addition, attempts to engineer the economy through fiscal, monetary and protectionist policies will only inhibit socially optimal productions and allocations of goods and resources. Few actually reflect on Smith’s eloquent words to explore why an invisible hand may exist. Moreover, they ponder very little at the specific details of socially optimal equilibrium in various markets.

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47 The oft-cited quote is in Adam Smith’s The Wealth of Nations (1776), Book 1, chapter 4, section 2: “Every individual necessarily labors to render the annual revenue of society as great as he can. He generally indeed neither intends to promote the public interest, nor knows how much he is promoting it... He intends only his own gain, and he is in this, as in many other cases, led by an invisible hand to promote an end which was no part of his intention... By pursuing his own self-interest he frequently promotes that of society more effectually than when he really intends to promote it. I have never known much good done by those who trade for the public good.”
The invisible hand Smith described is society’s collective reaction to changes in relative prices and wages. Smith, alongside his contemporaries David Ricardo, Thomas Malthus, Jean Baptiste Say, and John Stuart Mill (the classical economists) articulated the beauty of the price mechanism in an exchange economy. Using the labor theory of value, they suggested that fluctuations in the relative prices of goods and labor induce changes in consumer and firm behavior. For example, rapid home price appreciation will encourage speculating investors to enter the market. At the same time, they deter budget-constrained homebuyers and encourage new home construction. In contrast, drastic home price depreciation will deter speculators, discourage new home construction, and attract marginal buyers. Aggregate reactions to changes in relative prices equilibrate the supply and demand of any commodity, especially labor. Gluts, over-production and over-investment in goods, services and labor may prevail but are temporary. In the long run, there will be a set of prices to clear the economy: i.e., prices will adjust such that supply meets demand in all markets.

Although Smith, Ricardo and company first articulated the elegant price mechanism, they did not support their ideas with mathematical rigor. It was the neoclassical economists during the late nineteenth century (in particular Leon Walras) who built the modern framework of economics. The Neoclassicals supplanted the labor theory of value with the marginal theory of value: the value in

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48 Leon Walras, W. Stanley Jevons and Karl Menger led the neoclassical revolution by each introducing independently the marginal theory of value.
exchange of any good is not determined by the quantity of labor input (as Ricardo thought) but is instead determined by the incremental unit of utility added upon consumption. The preferences (or utility functions) of individuals are unique and endogenously determined. They are constrained by time and resources. Although the way in which each individual spends his budget to maximize his utility given his preferences is unique, the collective act is universal. Thus, an exchange economy can be modeled using a representative utility-maximizing agent and a set of relative prices. When relative prices fluctuate, the agent adjusts his behavior such that the marginal cost and benefit of consumption and leisure equate. Marginal cost-benefit analysis becomes the ultimate framework of economics.

The key market to apply marginal cost-benefit analysis is the labor market. Each worker derives utility from two sources: consumption and leisure. The individual trade-off between consumption and leisure is less relevant than the fact that trade-offs exist. Other things equal, because people enjoy variety, the marginal value of each additional increment of consumption or leisure diminishes. Furthermore, each worker is constrained by two things: time and budget. Given any unit of time, an individual must split that unit of time between working (in order to consume) and not working (to enjoy leisure). Each worker’s simplified budget is the mathematical identity that the market value of his total expenditures cannot exceed the market value of his total income. In other words, workers cannot spend more

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49 In mathematical jargon, so long as indifference curves are convex among two normal goods, then the intricacies of individual preferences are irrelevant.
than what they make. Thus, the market trade-off or opportunity cost between the two sources of utility, consumption and leisure, is the worker’s real wage. The optimal, utility-maximizing behavior for all workers is to match individual trade-offs between consumption and leisure with the market trade-offs between consumption and leisure. In other words, the marginal benefits of consumption and leisure must equal their marginal costs.

The key implication of the marginal framework is that the optimal utility-maximizing choice between consumption and wages adjusts according to changes in the relative price of consumption and leisure. This relative price is measured as a ratio of nominal wages over nominal prices, i.e., the real wage. Thus as the real wage increases, the opportunity cost of leisure also increases. Workers will increasingly substitute leisure for consumption as real wages rise. In contrast, if real wages fall, the marginal benefits of working fall, and thus workers will supply less labor. From this perspective, unemployment is a product of agency. This mode of analysis can be applied to all markets from labor to land. Firms also employ marginal analysis to determine labor demand. Firms will hire until the marginal product of labor (which is derived from their production function) equals the real wage. In conjunction, the decisions of both workers (who supply labor) and firms (who demand labor) in response to fluctuations in the real wage (the relative price of leisure) clear the labor market. Gluts, or deviations from a labor market equilibrium
where labor supply and demand are equal, are transitory and isolated. As a mathematical identity, there exists a set of prices to clear all markets. Thus the invisible hand that Smith describes is merely our collective response to fluctuations in relative prices. A proactive government is unnecessary for spontaneous order; stable output, employment and prices reign in the long run.

The Wisdom of the Infants

General equilibrium, envisioned by the Classical and built by the Neoclassical, generally described the state of the economy. Marginal analysis and optimal responses to changes in relative prices define homo economicus. After the Second World War, a new wave of “freshwater” economists added another layer to homo economicus: rational expectations. Expectations about the future are crucial to economic decisions made by households, firms and organizations. Economic agents not only attempt to maximize present utility, but also future utility. Likewise, inter-temporal optimization also applies to firms. Expectations of an uncertain future are dynamic rather than static: changes in the anticipation of future incomes, profits and conditions affect today’s decision-making. Forward-looking economic agents are believed to exploit all available information without making systematic mistakes. Expectations are formed by constantly updating and reinterpreting this information. Unlike the prevailing theory of static or adaptive expectations, the

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51 In chapter two of The General Theory of Employment, Interest, and Money (1936), John Maynard Keynes explicates in great detail the postulates of the classical theory.
52 The author is indebted to Bill Craighead, visiting economics professor at Wesleyan, for his understanding of the rigorous material in this section. The author borrows liberally from the notes in Craighead’s equilibrium macroeconomics class to build the following models.
rational expectations hypothesis emphasizes the difficulty of systematically fooling actors.

The influence of the rational expectations hypothesis (REH) cannot be overstated. 53 Rational expectations dominated the minds of not only policymakers and academics, but also bankers and coaches.54 In response to futile inflationary policies that attempted to push unemployment below its “natural rate,” Milton Friedman and Robert Lucas destroyed the macroeconomic trade-off between unemployment and inflation.55 The Phillips Curve, which captures that trade-off, is a central pillar of the Keynesian wage-price relation, or aggregate supply curve: sticky prices and wages, i.e., nominal rigidities, make the aggregate supply curve upward-sloping. If, however, workers and firms hold rational expectations, then the Keynesian aggregate supply curve, which is sloped, becomes perfectly inelastic (vertical) – as the Classicals assumed. Prices and wages are no longer very sticky, and their rate of change can adjust upon anticipation of future inflation or deflation. Attempts to stimulate aggregate demand through deficit spending or money

54 Head coaches often use the rational expectations paradigm to calibrate game strategies in professional sports. For example in basketball, a team may have great success in shooting three-pointers during the first half. Under adaptive expectations, the head coach will ask his team to re-invigorate their perimeter offense in the second half: the past will repeat itself unless the present appears convincingly exceptional. However, under rational expectations, the coach will ask his team to attack the basket. He anticipates the opposing coach’s response to the three-point success in the first half is stronger perimeter defense. This leads to a penetrable interior.
creation would not stimulate output. Rather, they would only place inflationary pressure on prices and wages.

There are two broader macroeconomic implications of rational expectations: the neutrality of money and the futility of intervention. Money is once again a neutral variable connecting goods and people. In the short run prices and wages may be sticky, however, because of rational expectations their rate of change can rapidly change. More important, forward-looking behavior can nullify the gains from deficit government spending and expansionary monetary policy. For example, today’s inflationary policies raise the inflation expectations of economic agents. Speculators would flee from investing in bonds, lenders would demand higher mortgage rates, and workers would renegotiate their wage contracts in reaction to greater inflation expectations. Expansionary policies may not achieve their original goal of stimulating aggregate demand but instead crowd out private investment and raise borrowing costs. One central lesson of the rational expectations hypothesis is that people cannot be fooled systematically. This implies that policymaking is significantly harder. Attempts to mitigate short-term fluctuations in output, employment and inflation can be costly and are often ineffective. Rational expectations hypothesis revolutionized discourse in the public, private and academic spheres. It validated the belief of spontaneous order and became a central pillar of many other models.
With the twin assumptions of rational expectations and representative agents, economic models can prove with numerical precision that all markets will clear, other things equal. Taking prices as given, agents can maximize their expected utility by equating their marginal utility of consumption across different goods and different time periods. For example, in a simple deterministic endowment two-period model (a two-period economy in which the consumer receives a known fixed income in each period), the consumer’s problem is:

$$\max_{(c_1, c_2)} U(c_1, c_2) \text{ such that } c_1 + \frac{c_2}{1 + r} = y_1 + \frac{y_2}{1 + r}.$$ 

In other words, the consumer desires to maximize period one and period two consumption given his preferences and under the constraint that total two-period consumption cannot exceed total two-period income. The unconstrained Lagrangian problem is:

$$L = U(c_1, c_2) + \lambda \left[ y_1 + \frac{y_2}{1 + r} - c_1 - \frac{c_2}{1 + r} \right].$$

If we assume the principle of additive separability (that lifetime utility can be written as the sum of instantaneous utility in each time period), then the two-period utility function can be written as:

$$U(c_1, c_2) = u(c_1) + \beta u(c_2),$$

where $u(c)$ is the instantaneous utility function and $\beta$ is the discount factor, which is never greater than one. The Euler equation governing optimal behavior is:
\[ u'(c_t) = \beta(1+r)u'(c_{t+1}) \]

In a more complex stochastic two-period problem where the uncertainty of future income is introduced, the optimal behavior of equating expected marginal utilities of consuming various goods across different time periods still holds. The expected value of any random variable is the sum of each possible outcome weighted by its respective probability:

\[ E(x) = \sum_{s=1}^{n} \pi(s)x(s) \text{ where } \sum_{1}^{n} \pi(s) = 1. \]

Thus, the unconstrained Lagrangian problem for optimal behavior given uncertain period two income is:

\[ L = \sum_{s} \pi(s) \left[ u(c_s) + \beta(c_{s+1}) + \lambda(s) \left( y_s + \frac{y_{s+1}}{1+r} - c_s - c_{s+1} \right) \right]. \]

By taking first order conditions with respect to consumption in every state, one can see that optimal behavior does not change given uncertainty:

\[ u'(c_s) = \beta(1+r)E[u'(c_{s+1})]. \]

That is, in a stochastic environment, the Euler equation holds in expectation. In other words, a person’s rational expectation of second state consumption will dictate savings and consumption decisions in the first state, which would then influence actual or realized consumption in the second state.

\[^{56} \text{For a primer on equilibrium analysis see F.C. Bagliano and G. Bertola, Models for Dynamic Macroeconomics (2004).}\]
The greatest achievement of these innovative models is that they can prove mathematically that there is a set of prices to clear all markets regardless of the number of consumers, commodities, endowments, time periods, and states of the world.\textsuperscript{57} Dynamic stochastic general equilibrium captivated the minds of economists, financiers and policymakers. Although many questioned its twin assumptions of representative agents and rational expectations, few doubted its conclusions. Derivative securities, the permanent income hypothesis, Ricardian equivalence, the random walk hypothesis, and consumption-capital asset pricing models were all products of dynamic stochastic general equilibrium.

In a stochastic environment, agents can reduce uncertainty and share risk by using derivative contracts. Risk aversion is an implication of the principle of diminishing marginal utility. If agents face risk associated with uncertainty about the future state of the world before that state is realized, they should be willing to pay to reduce uncertainty about their future welfare. Generally, utility-maximizing behavior implies that agents will attempt to smooth their consumption across states, just as they should over time. That is, they would take advantage of opportunities to insure themselves against risk. In a general equilibrium, two parties are necessary to execute this contract: a buyer and a seller. The deal would reflect payment transfers from seller to buyer if a contingent state is realized and payment receipts from buyer to seller if all other states are realized. Thus, state-contingent

\textsuperscript{57} Kenneth Arrow and Gerard Debreu offer the best explanation of dynamic stochastic general equilibrium. See Gerard Debreu, \textit{Theory of Value} (1959).
claims such as insurance contracts or credit default swaps allow buyers and sellers to share idiosyncratic risk in various states. This state-contingent claim is also known as an Arrow-Debreu security, a contract that pays one unit if a particular state is realized, zero otherwise. More important, any risky financial asset can be thought of as a bundle of state-contingent claims. A portfolio of Arrow-Debreu securities can therefore replicate the payoff of any financial asset. In theory, with “enough” securities uncertainty can be bought to a manageable level and all idiosyncratic risks can be mitigated. This line of reasoning can be used against regulating or limiting complex, customized, over-the-counter derivatives. In reality, however, there are never “enough” securities because markets will forever remain incomplete due to an infinite possibility of states of the world.

Dynamic stochastic general equilibrium models can also prove the futility of expansionary government policies in stimulating aggregate demand. Lump sum payment transfers via tax cuts or stimulus checks were Keynesians solutions to economic downturns. Even if consumers and businesses only spend a portion of these transitory transfers, the aggregate expenditures, through the multiplier effect, will still increase. The permanent income hypothesis developed by Milton Friedman, however, questions the effectiveness of these measures. The consumer’s lifetime objective function is to maximize the present discounted value of all utility derived from consumption:

$$\sum_{t=1}^{T} \beta^{t-1} u(C_t)$$
where $\beta$ is the discount factor for each period’s consumption. He is constrained by a lifetime budget constraint of:

$$\max \sum_{t=1}^{T} \beta^{t-1} u(C_t) \text{s.t.} \sum_{t=1}^{T} \left( \frac{1}{1+r} \right)^t C_t = A_t + \sum_{t=1}^{T} \left( \frac{1}{1+r} \right)^t Y_t.$$  

In other words, lifetime consumption cannot exceed initial endowments plus lifetime income. By taking first order conditions with respect to consumption and doing some algebra, the permanent income hypothesis becomes clear:

$$C_t = rA_t + r \sum_{t=1}^{T} \left( \frac{1}{1+r} \right)^t Y_t.$$  

For any period of a consumer’s life, consumption is based on total lifetime resources, assets compounded by interest plus the sum of each period’s discounted. Suppose the government sends the consumer a one-time stimulus check with a value $\varepsilon$, the new consumption level (after taking the first order condition and doing some algebra) will be

$$C' = C + \frac{r}{1+r} \varepsilon.$$  

In other words, a transitory income shock of $\varepsilon$ raises consumption by only $\frac{r}{1+r} \varepsilon$. In Keynesian language, the marginal propensity to consume from a transitory change in income is $\frac{r}{1+r}$, which is quite small for reasonable values of $r$. The effect of a permanent increase $\varepsilon$ in income of all periods, however, is:
\[ C' = C + r \sum_{i=0}^{\infty} \frac{1}{(1 + r)^{i+1}} e^i, \]

and this consumption equation reduces to:

\[ C' = C + e. \]

In other words, the effects of a permanent change in income are much more substantial. A permanent income change increases consumption by the same amount, i.e., the marginal propensity to consume from permanent changes in income is one.

Another proof that government engineering of short-term fluctuations only distorts markets is the concept of Ricardian equivalence. Representative agents with forward-looking rational expectations can expect that governments cannot run a Ponzi scheme by accumulating permanent fiscal deficits. Over an infinite time horizon, budgets return neutral: government expenditures must equal tax revenue. Robert Barro’s principle of Ricardian equivalence proves this. The government’s budget constraint at any period \( t \) is:

\[ G_t + rB_t = T_t + B_{t+1} - B_t. \]

In other words, government spending and interest payments cannot exceed taxes collected and new bond issuance (the budget deficit). Assuming no initial debt\(^{58}\) \((B_t = 0)\) the value of outstanding bonds for any time period \( s \) is:

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\(^{58}\) The assumption of no initial debt is grossly heroic: most governments have outstanding public debt. However, for mathematical ease this assumption is made.
The equation states that the value of outstanding bonds is the sum of all previous deficits with interest. Because the government cannot run a permanent deficit (also known as a Ponzi scheme) in an infinite time horizon, the value of outstanding bonds or budget deficits in that infinite time horizon is zero. Thus, the present discounted value of government spending is equal to only the present discounted value of taxes:

\[ B_{t+1} = \sum_{t=1}^{\infty} (1+r)^{-t} (G_t - T_t) \]

The addition of taxes affects the household budget constraint in a straightforward manner: the household can consume and save out of its disposable, after-tax income. The after-tax lifetime budget constraint is therefore:

\[ \sum_{t=1}^{T} \left( \frac{1}{1+r} \right)^t C_t = A_i + \sum_{t=1}^{T} \left( \frac{1}{1+r} \right)^t Y_t - \sum_{t=1}^{T} \left( \frac{1}{1+r} \right)^t T_t \]

or:

\[ \sum_{t=1}^{T} \left( \frac{1}{1+r} \right)^t C_t = A_i + \sum_{t=1}^{T} \left( \frac{1}{1+r} \right)^t Y_t - \sum_{t=1}^{T} \left( \frac{1}{1+r} \right)^t G_t \]

In other words, what matters in household decisions about consumption is total government spending, regardless of how or when it is paid for. Tax finance and bond finance of government spending equally curb household lifetime consumption, hence the term Ricardian equivalence.
In a stochastic environment, when future income is uncertain, only unanticipated changes in expected future income alter current consumption patterns. This is in essence Robert Hall’s random walk hypothesis. The Euler equation for inter-temporal consumption optimization holds in expectation:

\[ u'(c_t) = \beta(1+r)E[u'(c_{t+1})]. \]

The lifetime budget constraint is your initial endowment plus the present discounted value of your lifetime income:

\[ E_t \sum_{t=1}^{T} \left( \frac{1}{1+r} \right)^t C_t = A_t + E_t \sum_{t=1}^{T} \left( \frac{1}{1+r} \right)^t Y_t. \]

Future income is uncertain today. However, by knowing today’s income, one can forecast tomorrow’s income. The Euler equation implies that the difference between actual marginal utility and expected marginal utility is an expectational error, \( \eta \), where \( u'(C_{t+1}) - E_t u'(C_{t+1}) = \eta_{t+1} \). Under rational expectations, however, people learn from their mistakes and do not systematically err. This implies that over a lifetime horizon \( E_t \eta_{t+1} = 0 \). In other words, because we learn from past errors, today’s expectation of tomorrow’s mistakes is 0. By taking the difference between optimal future and present consumption and doing some complex algebra, one can show that:

\[ C_{s+1} - C_s = r(E_{s+1} - E_s) \sum_{j=0}^{\infty} \frac{1}{(1+r)^{s+j}} Y_{s+j}. \]
In other words, the difference in future and current consumption is the change in your future and present expectation of future income. Thus, changes in consumption should be completely unpredictable.

The random walk hypothesis is often applied to financial assets. Similar to changes in consumption patterns, movements in asset prices can be unpredictable. Markets, like the individuals that make them, are forward-looking. The prices of today’s assets should reflect all expectations and foresight of a stochastic future. They should rise on good news and fall on bad ones. As the chances of good news and bad news are presumed to be equal in an infinite time horizon, future price fluctuations after a round of good news should be no different from future price movements after a round of bad news. In statistical jargon, this means that price movements exhibit no serial correlation. Thus, analogous to the roulette table, where asset prices will land tomorrow is completely unpredictable, i.e., prices and returns follow a random walk. This random walk characteristic implies that fluctuations are genuinely forward-looking, completely uncorrelated with past movements.

If the returns on assets are uncertain, then expectations of asset returns once again play an integral role in the pricing of those assets. The stochastic Euler equation becomes:

\[ u'(c_t) = \beta E_t[(1+r_{t+1})u'(c_{t+1})], \]
where $1 + r_{t+1}$ is the return on a risky asset from time $t$ to $t+1$. Notice that because the asset return is uncertain, the expectations operator does not go through like a basic two-period Euler equation. Because the marginal utility of current consumption is known at period $t$, the Euler equation can be arranged as:

$$1 = E_t \left[ (1 + r_{t+1}) \beta \frac{u'(C_{t+1})}{u'(C_t)} \right],$$

where the discounted ratio of marginal utilities $\beta \frac{u'(C_{t+1})}{u'(C_t)}$ is defined as the stochastic discount factor $M_{t+1}$. Using the statistical identity that if $x$ and $y$ are random variables then $E(xy) = E(x)E(y) + Cov(x,y)$, we can figure out the relation between returns and the weighted ratio of marginal utilities or the stochastic discount factor. For a safe asset with a certain return $r^f$, the covariance (or co-movement) of $1 + r^f$ and $M_{t+1}$ is zero. This implies that the risk-free rate of return satisfies the relation:

$$1 + r^f = \frac{1}{M_{t+1}}.$$ 

In other words, the risk free rate of return is positively correlated with the ratio of marginal utilities or the stochastic discount factor. A high stochastic discount factor means future marginal utility of consumption is high. An additional unit of consumption is highly valued only when consumption is low. The optimal safe asset for a utility-maximizing risk-averse consumer is one that pays off during times of trouble, when consumption is low and the marginal utility of another unit of
consumption is high. Risk-free assets such as Treasury securities exhibit this “safe” behavior and thus consumers do not demand a risk premium to hold them. Because risky assets do not exhibit this “safe” behavior, consumers expect an attractive risk premium when holding them. Thus, the following relation can be constructed:

\[ E_t(r^i_{t+1} - r^f_{t+1}) = -(1 + r^f_{t+1}) \operatorname{Cov}(1 + r^i_{t+1}, M_{t+1}) \]

where the expected risk premium of holding risky assets is equal to the negative covariance of risky returns and the stochastic discount factor. One must understand the stochastic discount factor, \( M_{t+1} \), in order to understand why there is a negative sign before the right-hand equation. The stochastic discount factor is the discounted ratio of inter-temporal marginal utilities: the marginal utility of tomorrow’s consumption over the marginal utility of today’s consumption scaled by a discount factor reflecting one’s degree of myopia. Expected premiums for holding risky assets are negatively related to the covariance of the return on risky assets and the stochastic discount factor. In other words, the more returns move with fluctuations in the stochastic discount factor, the weaker our demand for an excess premium for holding risky assets. This reflects an innate desire to hold assets that pay off when the marginal utility of an additional unit of consumption is high (when our stochastic discount factor is high). With some algebra, the above equation can be simplified to relate expected risk premiums to consumption:

\[ E_t(r^i_{t+1} - r^f_{t+1}) = \gamma \operatorname{Cov}(r^i_{t+1}, g^c_{t+1}) \]
In other words, the expected premium of risky assets over riskless assets (such as U.S. Treasury securities) is equal to the covariance of the return on risk-less assets and the growth of future consumption, scaled by the Arrow-Pratt coefficient of relative risk aversion, $\gamma^\prime$.\(^{59}\) Assets with returns that are positively correlated with marginal utility should have a lower return. Conversely, assets which are negative correlated with marginal utility (i.e., whose returns are amplified during good times and dampened during bad ones) require a higher expected return to attract consumers.

**The Elegant Market**

Through rational expectations, spontaneous order became a mathematical identity; beautiful, precise and convenient. Dynamic stochastic general equilibrium implied that a set of prices exists to clear all markets, therefore gluts and downturns are only temporary. Arrow-Debreu state contingent claims allow actors to diversify away idiosyncratic risk, reinforcing the notion that new classes of derivatives can only be welfare increasing. Transitory stimulus checks, contrary to prevailing Keynesian theory, are ineffective at stimulating consumption. Deficit spending in general is ineffective at stimulating the economy because people expected future tax hikes that would offset accumulated deficits. Moreover, economic actors invest, not out of greed or fear, but according to their relative risk aversion and their expectations of future marginal utility. These insights reinforced the belief in

\(^{59}\) The Arrow-Pratt coefficient of relative risk aversion is derived from a simple utility function

$$u(c) = \frac{c^{1-\gamma}}{1-\gamma}.$$ The coefficient of relative risk aversion is determined by $\gamma = -\frac{cu''}{u'}$. 
efficient markets. They condemned active government monetary and fiscal policies. And they championed deregulation.

A more subtle implication of the New Classical models is the relative insignificance of finance. Little emphasis is placed on financial markets, institutions and money in general. Household choices are boiled down to decisions about consumption: quantity (to work or to relax); quality (what goods to consume); and timing (today or tomorrow). Financial intermediation is discarded in these models. The credit markets are represented merely as savings that accumulate through compounded interest. If financial assets reflected only fundamentals like relative-risk aversion and inter-temporal consumption preferences, why not simply model these fundamentals and ignore the complex shadows cast by Wall Street? Because all household decisions are rooted in choices about consumption, policymakers need only focus on the “real” economy. Commodity-price inflation is thus disconcerting to a central bank but asset price inflation is not. This characterized Fed policymaking during Alan Greenspan’s – and the first years of Ben Bernanke’s – tenure.

These purely academic theories, however, fly in the face of centuries of economic history chronicling periodic crises. Violent fluctuations in output, employment and prices are inherent in all economies. Modern history shows that even though America experienced an era of great tranquility after the early 90s, crises plagued Japan, Mexico, East Asia, and Russia. Nevertheless, many policymakers including the U.S. Federal Reserve and the European Central Bank
were guided by these New Classical models. Moreover, the Keynesian business cycle was rejected in favor of a new framework: real business cycles developed by Nobel prize-winning economists Finn Kydland and Edward Prescott. Real business cycles are once again grounded in a microeconomic framework of utility-maximizing responses to changes in external conditions. The model views aggregate economic variables like unemployment as the outcomes of collective responses to productivity and technology shocks. The choices of identical households that live forever are boiled down to two things: labor vs. leisure, and current vs. future consumption. Only productivity shocks affect these decisions. For example, a positive productivity shock from the integration of businesses through the internet encourages rational, forward-looking individuals to work more during the transitory productivity gain. In anticipation of future productivity declines, workers in aggregate would work more today and take more leisure tomorrow.

Despite the almost-implausible conclusions that sharp increases in unemployment during recessions are the result of workers taking more leisure because of declines in productivity, U.S. macroeconomic data from 1954 to 1985 fit the real business cycle model surprisingly well. The actual and projected growth rates of real output, consumption, investment, hours worked, and real wages share

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60 The Economist, “The Other-Worldly Philosophers,” July 18th, 2009. One extreme example is the Bank of England’s DSGE model, which does not even incorporate financial intermediaries such as banks.

an uncanny resemblance.\textsuperscript{62} Although post-crisis policymakers such as Larry Summers are skeptical of real business cycles, many of his predecessors embraced a model that assumed almost-perfect inter-temporal elasticity of substitution of labor supply and discarded the role of money.\textsuperscript{63}

These beautiful equations and their elegant conclusions somehow stripped many economists of their common sense.

First, labor supply is far from perfectly elastic. Most unemployment is not a product of personal preference, a natural response to falling real wages. It plagues economies and remains a constant challenge for policymakers. Second, in a modern globalized economy, international capital flows are increasingly powerful and complex. Financial markets may differ from real markets in meaningful ways and cannot be ignored simply for convenience’s sake. Most important, the twin-assumptions of representative agents and rational expectations supporting all New Classical theories are highly flawed. Myopia and euphoria often more accurately describe market sentiment than rationality and optimization. Blinded by the assumption of perfect inter-temporal labor supply elasticity (i.e., workers respond optimally to anticipated fluctuations in real wages by adjusting the amount of time they work), dynamic stochastic general equilibrium models consider persistent unemployment to be a fallacy. In order to show that business cycles are indeed compatible with their dynamic stochastic general equilibrium models, New Classicals

\textsuperscript{62} Ibid.

construct elaborate schemas to show that exogenous shocks (such as unanticipated government interventions and bad weather) promote errors in understanding the price signals.  

Much of the recent literature in behavioral economics revisits the claim that economic agents are indeed human. They suffer from greed, fear, stupidity, and error. They use flawed heuristic rules and display herd behavior, exhibiting many forms of “bounded rationality.” Yet despite all the contradictory evidence from business cycle and behavioral economics, the unrealistic assumptions were maintained. Rationality was always a convenient assumption rather than a supported claim.

**Cracks in the Price Mechanism**

The economic portrait painted by Keynesians is much more dismal: the price mechanism may not be sufficient in clearing all markets. A stronger version of this argument can also be explored: the price mechanism is the reason why markets do not clear. The labor market in particular periodically suffers from excess supply and inadequate demand, generating involuntary unemployment. To relieve this, governments must complement private demand through expansionary fiscal policies, i.e., tax cuts, public works projects, and public investments. Central banks too must accommodate markets through inflationary monetary policies such as

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65 At the end of the chapter on marginal propensity to consume, chapter 10 of *The General Theory* (1936), Keynes facetiously suggests that if Treasury were to fill old bottles with bonds, bury them at deep depths in disused coalmines, and hire private industry to dig the notes up, unemployment would be cured.
delinking national fiats from gold (or any pegged exchange rate regime), lowering benchmark interest rates, and intervening as lender-of-last-resort. Effective fiscal and monetary engineering could not only dampen the zeniths and nadirs of business cycles, but also promote long-run growth.

The price mechanism so cherished by Classical theory is flawed and incomplete in reality. Three Keynesian critiques strike hardest at its effectiveness in clearing gluts. First, prices and wages are sticky. Nominal rigidities exist in the economy due to human psychology, legal contracts, and inadequate information. For many goods in the economy (in particular labor), downward price movements are met with immense psychological resistance. For example, hope and delusion often compels firms to build-up inventories for good times rather than clear excess goods at depressed prices during bad times. During the financial turmoil, portfolio managers were reluctant to re-price deteriorating assets on their balance sheets, even though such write-downs would force prudent, but difficult, responses such as raising additional capital reserves.

The second reason why the price mechanism enhances rather than mitigates gluts is the fact that markets are incomplete. Simply put, the New Classical assumption that prices exist today for all goods, at every date, in every contingency is grossly heroic. Despite advances in globalization and telecommunication, markets are far from complete. When prices do not exist, buyers do not exist. Especially with the explosion in over-the-counter markets, financial instruments and assets have
become so highly customized that it is difficult to find market prices for these exotic “Type III” assets. \(^6^6\) Contracts lose all their value when the counterparty goes belly-up.

Finally, even when real wages and prices do adjust downwards, markets may not clear. This was Keynes’ revolutionary insight. \(^6^7\) There are a few reasons supporting this claim. The first is ironically rooted in rational expectations. Although households and businesses do not perfectly optimize inter-temporal consumption and investment choices to maximize utility and profits, they are capable of imperfect foresight. Anticipation of future price drops, especially for durable goods such as machinery and equipment that are highly price elastic (i.e., goods whose demand is very sensitive to price adjustments), will deter current consumption and investment. Although this may be prudent for individual firms and households, the unintended effect is a shriveling of aggregate demand that will encourage further price declines and reinforce the cycle. A vicious cycle of price declines deepened the severity and scope of the 2007-08 financial turmoil. As asset-backed securities deteriorated in value, portfolio managers began to dump them in the market. Insufficient demand in conjunction with excessive supply triggered fire sale prices. And even at distressed prices, many mortgage-related assets remained highly illiquid.

\(^{6^6}\) Financial institutions must file comprehensive reports to the SEC detailing information such as assets and liabilities, derivatives contracts, etc. Within these SEC 10-K reports are spreadsheets detailing the market value of difficult-to-value financial assets such as credit derivatives. The accounting standards for their valuation are tiered from one to three. Tier 3 financial assets are, according to the market, the most difficult to value and therefore enjoy the least stringent regulatory accounting treatment. The challenge of “fair-value accounting” becomes amplified during market distress.

A Powder Keg: Debt and Deflation

Deflation works havoc when combined with debt. Irving Fisher, a colleague of Keynes, offered this prescient insight about business cycles after the Great Depression.\(^{68}\) Declines in asset values raise the real burden of debt. This implies that the challenge of servicing this debt becomes magnified. Moreover, it reinforces a disastrous cycle of distressed selling where panic fuels more panic. Debt and deflation together have amplified the severity of financial crises in 1837, 1873, 1929-33, and, most recently, 2007-09. Over-investment and over-speculation are often important, but they would have far less serious results were they not conducted with borrowed money. According to Fisher, other economic frictions such as over-production, over-capacity, and price-dislocation are mere symptoms of the two dominant factors of over-indebtedness and deflation. At some point in a speculative boom, firms and households begin to rely increasingly less on personal equity (owned cash) to finance investment and consumption. This is a consequence of both relatively cheap credit and extreme euphoria. This state of over-indebtedness eventually leads to liquidation through the alarm of either debtors or creditors or both. Debt liquidation leads to distressed selling and to a contraction of credit. This leads to a fall in asset prices, which promotes a still greater fall in the net worth of businesses and households, precipitating bankruptcies and home foreclosures. National indices like S&P 500 or the Case-Shiller 20-city home price index reflect this macroeconomic deterioration and further deteriorate confidence. A reduction in

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\(^{68}\) Irving Fisher, “The Debt-Deflation Theory of Great Depressions” (1933).
output, in trade, and in employment is the most recognized consequence. However, the more subtle consequence of pessimism and a collapse in confidence is liquidity hoarding and the further deterioration in the flow of credit. This is reflected by complicated disturbances in interest rates (e.g., the London Interbank Offered Rate, LIBOR) and credit spreads (e.g., the Treasury-Eurodollar spread).

The ultimate conundrum of the debt-deflation chain of events is the fact that the very effort of firms and households to lessen their burden of debt increases it. Like the tragedy of the commons or the paradox of thrift or the scramble to exit a crowded burning theater, individually rational efforts in the collective promote sub-optimal results. The mass effect of the stampede to liquidate to reduce debt swells each dollar owed. In essence, the more debtors pay, the more they owe.

**Animal Spirits**

What triggers the initial accumulation of debt and the ultimate liquidation of assets to service that debt? The New Classical framework strikes the underlying motivations very poorly. If anything, rational expectations and prudent risk management would impose limits to initial borrowing and greater patience in final selling. As many behavioral economists note, the speculative excesses and famines of capitalism are the result of violent swings in public psychology from euphoria to panic. Debt starters are motivated by the lure of extraordinary future profits. The anticipated gains from lucrative investment opportunities promote reckless debt and risk-taking behavior. Likewise, the extreme fear of potential losses promotes
myopia, panic, and distress. Stripped of irrational exuberance, the risk-loving household or firm becomes extremely risk-averse.¹⁶⁹

This tendency to veer from euphoria to depression is rooted in human nature. More often than not, economic agents are far from the rational, forward-looking optimizers assumed in dynamic stochastic general equilibrium models. Their investment decisions in particular depend on spontaneous optimism rather than on mathematical expectations. Keynes laid the foundation for behavioral economics by exploring the psychology behind investing.⁷⁰ Investment is the product of animal spirits, a spontaneous urge to action rather than inaction, and not as the outcome of a sum of expected values weighted by quantitative probabilities. Keynes’ crucial point is that rational expectations inadequately stimulate investment in enterprise. Individual initiative will come to life only when “reasonable calculation is supplemented and supported by animal spirits, so that the thought of ultimate loss which often overtakes pioneers...is put aside as a healthy man puts aside the expectation of death.”⁷¹ The key point is that animal spirits veer quickly from extremes, exacerabing the peaks and troughs of business cycles. The euphoria necessary for speculation can rapidly deteriorate into panic.

Animal spirits often distinguish the stages of the business cycle more clearly than macro-economic indicators such as unemployment or inflation. Even with the

¹⁶⁹ In mathematical jargon, his Arrow-Pratt measure of relative risk aversion, \( \gamma = -\frac{cu''}{u'} \), shoots through the roof.
⁷¹ Ibid., 162.
globalization and securitization of financial capitalism, the anatomy of booms and busts remain relatively unchanged. The economic historian Charles Kindleberger made this brilliant point by studying perennial crises. There are generally five unique stages leading to all financial crises: displacement, euphoria, disquiet, panic, and crash. Although the specific details of each crisis differ, the underlying pattern of events occurs frequently and with sufficient uniformity.

The boom begins with displacement. Some event increases confidence and optimism in the investment outlook. This event could range from a regulatory change, such as the Commodities and Futures Modernization Act of 2000 (which officially left credit-default swaps unregulated), to a technological innovation, such as the internet (which fueled the dot-com boom), or even to a political catastrophe such as a revolution (which can disrupt the flow of commodities such as oil). Some external event punctuates the equilibrium, fueling expectations of extraordinary profit. A number of events, from the Commodities and Futures Modernization Act to the public policy initiative of expanding home ownership, and from the take-off of securitization to the build-up of global imbalances, fueled the displacement leading to the 2007-09 financial crisis. The housing bubble was the primary symptom of this displacement.

Collective euphoria or irrational exuberance characterizes the next stage. The distinguishing trait that plagues this stage is what is known as “the fallacy of

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The easiest interpretation of this phenomenon is that the sum is not equal to its parts. Gripped by collective euphoria, there is extraordinary, febrile speculation in the market. Expectations of future profits are far from rational; the underlying assumptions grounding models become increasingly heroic; and unsophisticated neophyte investors enter the market. Segments of the population that are normally aloof to investing fall victim to the lure of spectacular profits. From equity shares to real estate to tulips, the anticipated returns on these assets often bear flawed underlying logic such as the assumption that real estate prices can never decline. New opportunities for profits are seized, and overdone, in ways so closely resembling irrationality as to constitute a mania. People divest away from money or government bills, the safest, most liquid assets, and borrow to buy illiquid financial assets. The early stages of euphoria generate healthy enterprise. However, it is often prone to excess, encouraging destabilizing speculation.

Eventually distress curbs euphoria and turns the business cycle downward. Similar to the first stage of displacement, some external event unleashes apprehension and uncertainty. The remote possibility, the black swan, that institutions or individuals cannot meet their liabilities becomes increasingly clear for the astute. This increases pressure on balance sheets as asset managers, households and institutions doubt the potential returns on their investments. As a result, credit markets tighten and this is reflected by higher borrowing costs and an increased demand for collateral. A credit crunch is the primary symptom of distress. The disease is some incident that snaps market confidence. During this phase of disquiet,
the veteran “inside” investors leave the market by reducing their investments in the speculative asset. They decide to prematurely take their profits and sell out. In contrast, the neophyte investors, the new recruits of speculation, remain in the market.

The final stages of panic and crash reflect the bursting of the bubble. The hysteria that gripped the market transforms into panic. The financial system experiences a scramble to liquidity; a great deleveraging from real or financial assets to money, or repayment of debt with a crash in the prices of commodities, houses, buildings, land, stocks, bonds – in short, in whatever that was the subject of the mania. Once again the “fallacy of composition” plagues this stage. The sum is not equal to its parts, i.e., assets that are selling at distressed fire-sale prices during panic are often grossly under-valued. To satiate their fetish for liquidity, many are willing to compromise on price. A more subtle aspect of this phenomenon is a collective action dilemma. Like the panic that grips a burning, crowded movie theater, the action of each individual is rational – or would be, were it not for the fact that others are behaving the same way. This mob psychology exacerbates the problem (whether it is a fire or a credit crunch) and amplifies the risk that few will escape safely unscathed (either from a burning theater or a deteriorating portfolio). This ultimately leads to a crash in the financial system, a severe and abrupt halt in the flow of credit that strangles the broader economy.
The Financial Instability Hypothesis

One heated contention between the various interpretations of booms and busts is the source of business cycle fluctuations. According to the story told by Kindleberger, which is in essence the mob psychology story told by many behavioral economists, the catalysts that veer the business cycle from euphoria to panic (and vice versa) are exogenous to the market. Some external, outside event triggers displacement or distress. Like the perennial comet that destroys civilization, some exogenous shock punctuates the equilibrium and drastically alters behavior. Creative destruction runs amok as weaker financial institutions and practices collapse, while the stronger ones evolve. The New Classicals point to government intervention as the primary shocks, however, the jolts can include other political, technological and natural phenomena.

The economist Hyman Minsky disagrees: periodic financial crises are the consequence of endogenous shocks. According to Minsky, the major flaw of financial capitalism – which he defines as a market economy that becomes increasingly dependent on credit – is that it is unstable. This instability is not the result of external shocks or the incompetence or ignorance of policymakers. Rather, the instability is inherent in the processes of financial capitalism: the tendencies to increasingly depend on leverage or credit to finance profits, consumption and investment leads to the financial system’s collapse. This echoes the grave warnings

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of Karl Marx: the telos of capitalism is an inevitable and violent demise. This time, however, the contagion is debt rather than exploitation. Complex, sophisticated and evolving debt structures develop conditions conducive to runaway inflations and deep depressions. The ultimate conundrum is that debt is both a blessing and a curse: it is vital for growth, yet it destabilizes.

Building on the Keynesian framework, Minsky analyzes the phases of the business cycle through the lens of finance. Through the cycle, economic units fluctuate through three distinct income-debt relations, which Minsky labels as hedge, speculative, and Ponzi finance. Hedge financing is the ability to meet all contractual payment obligations (e.g., short-term liabilities such as making payroll and amortizing overnight loans) through cash flows. A unit that holds substantial equity or capital reserves on their balance sheet is likely to be a hedge financing unit.

In contrast, speculative finance units are unable to meet their entire debt obligations. The cash payment commitments, typically near-term, exceed the expected revenues. They can repay the interest on their loans, however, they are cannot amortize the principal on their loans. Such units need to “roll over” or renew their liabilities, i.e., issue new debt to meet commitments on maturing debt. By its nature, speculative finance rests on the presumption that interest rates or borrowing costs will not deviate beyond some acceptable range. Other things equal,

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75 Minsky, pp. 371-9.
the ability to “roll over” debt depends on the ability to service loans, i.e., pay interest. This is because unpaid principal gets tacked onto the initial principal and the new sum gets compounded. The ability to service the debt is therefore contingent on the borrowing cost or the interest rate. Thus, speculative finance units are immensely vulnerable to upward interest rate shocks.

Ponzi finance is the final and most unstable form of debt-income relation. For Ponzi units, the cash flows from operations are insufficient to fulfill either the repayment of principal or the interest due on outstanding debts. To prevent bankruptcy, such units must sell assets or borrow. Borrowing additional funds to pay interest on outstanding debt, or liquidating assets to pay interest on liabilities, depletes the equity residual on balance sheets, the lifeblood of firms. One solution that can strengthen Ponzi units is to require additional capital reserves, creating a larger buffer that can absorb greater shocks. The human appetite for risk and profits, however, deter the buildup of common equity: the financing of asset purchases through borrowed money, rather than equity, amplifies returns. Thus, left to their devices, financial institutions (and also households) are prone to veer from hedge financing to speculative and Ponzi financing, enhancing vulnerability and amplifying risk.

Minsky’s insights are eerily prescient in describing the over-levered financial institutions and households before the housing crash. “Too-big-to-fail” investment banks borrowed heavily to finance the purchase of mortgage-related products. One
metric that captures the extent companies borrowed to fund their assets is the leverage ratio: a ratio of assets to common equity. During the second quarter of 2008, one quarter before the turmoil, Citigroup, then the largest bank holding company with $1.8 trillion in total assets and $42 billion in total common equity, had a leverage ratio of 43!76 Likewise, Pittsburgh National City (PNC), Wells Fargo, and U.S. Bancorp, firms that are all within the top twenty bracket of U.S. bank holding companies by total assets, had leverage ratios of 27, 25 and 23 respectively.77 A mere 2-3% drop in asset values could have bankrupted Citigroup and placed the other institutions on corporate life support.

During the 2002-07 residential real estate boom, households – aided and abetted by financial institutions – became increasingly reliant on speculative and Ponzi finance schemes. The deterioration of lending standards and the exotic deviations from the conventional 30-year fixed mortgage prove this point. The combined loan-to-value (CLTV) ratio, a simple ratio of the loan notional to the value of the property, reflects household equity. Historically, this ratio hovered near 75; in other words, households purchased their homes using at least a quarter of their own money. During the boom, however, the CLTV hovered near 80.78 Similarly, the emergence of 40-year fixed jumbo mortgages, 3/27 hybrid adjustable-rate mortgages, and negatively amortizing 2/28 interest-only option adjustable-rate

76 SEC EDGAR database, Citigroup’s 2Q08 SEC 10-Q filings.
77 SEC EDGAR database, companies’ 2Q08 SEC 10-Q filings.
78 See appendix 1.
mortgages describe the household shift from hedge or equity finance to speculative and Ponzi finance.

The rise in shadow banking and the overnight credit markets also captures this disturbing trend. Shadow banks, or non-bank banks such as investment banks, conduits, structured investment vehicles and hedge funds, raised funded operations in the non-deposit markets, notably through unsecured debt such as interbank borrowing and commercial paper and secured debt such as reverse repurchase agreements (repo’s) and asset-backed commercial paper. Besides amplified returns, such secured and unsecured borrowing enabled institutions to escape the regulatory framework, to reduce capital charges on holding long-term assets, and to speculate heavily in mortgage-related assets.

The broader implication of capitalism’s pro-cyclical dependence on speculative and Ponzi schemes is vulnerability: left to its own devices, the market becomes increasingly unstable. Sustained, stable-price, full employment equilibrium is impossible.79 Instead, according to Minsky’s theorem, periods of relative tranquility inevitably lead to immense turbulence. In contrast to Keynes’ and Kindleberger’s interpretation of periodic shocks, this turbulence is not the result of psychological animal spirits, the sudden and rapid transition from euphoria to panic. Rather, it is the system’s vulnerability that triggers perennial crises. By amplifying the level of debt in the financial system, securitization enhances the economy’s

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79 Minsky, p. 194.
vulnerability to sudden declines in asset prices. This echoes the warnings of debt-deflation by Irving Fisher. It is debt which makes the system so unstable.
Extraordinary Measures

“What is wanted and what is necessary to stop a panic is to diffuse the impression that though money may be dear, still money is to be had. If people could be really convinced that they could have money if they wait a day or two, and that utter ruin is not coming, most likely they would cease to run in such a mad way for money.”

– Walter Bagehot

“The Government and the Governor of the Bank of England will take whatever action is necessary to ensure that the banking system has sufficient funds – or liquidity – to function properly.”

– Alistair Darling, British Chancellor of the Exchequer

On September 18, 2008, three days after the collapse of Lehman Brothers – the catalyst that pushed the markets over a precipice – U.S. Treasury secretary Hank Paulson and Federal Reserve chairman Ben Bernanke met with Congressional leaders from both the House and the Senate to demand $700 billion to unfreeze the credit markets. Paulson confronted the overwhelming political resistance to a “financial bail-out” with this sober and serious statement: “unless we act, the financial system in this country and the world will melt down in days.”

Across the Atlantic, Alistair Darling, U.K. Chancellor of the Exchequer, also provided British Parliament with a counter-factual that no politician could afford. Likewise, in his tower in Frankfurt, Jean Claude-Trichet, governor of the European Central Bank, began aggressively cutting interest rates to accommodate the flow of credit. In contrast to their predecessors in the 1930s, these “lords of finance” jointly

81 Alistair Darling’s speech on October 8th, 2008.
82 Frontline, “Inside the Meltdown.” Interview with Christopher Dodd, chair of the Senate Banking Committee.
concluded that the government would take whatever action necessary to ensure the safety and stability of the global banking system.

The actions taken by many OECD governments over the past two and a half years have been unprecedented in degree and kind. The U.S. response in particular was remarkable. To revitalize the flow of credit, the Federal Reserve acted beyond its traditional monetary and supervisory duties, redefining its role as “lender-of-last-resort.” The U.S. Treasury, under a Republican administration, partially nationalized the banking system. Taxpayer dollars resurrected “systemically significant” institutions and left others to suffer the gales of creative destruction. Proponents argue that these extraordinary measures were critical in stabilizing the financial system. These measures prevented the extreme distress in credit markets from causing a deeper and wider recession. Because of the massive fiscal and monetary expansions, the economy eluded a second Great Depression by a hair’s breadth.

Opponents, in contrast, dispute the merits of their success on both economic and political grounds. First, the “bailout” of finance was ineffective: U.S. Treasury’s partial nationalization of the banking system and the Federal Reserve’s extraordinary measures failed to prevent the “Great Recession.” Pundits dismiss the normalized credit flows to large corporations and instead emphasize the weak lending activity to households and small businesses. More important, the trebling of the size of the Fed’s balance sheet will cataclysmically raise future inflation. The Fed will not be able to withdraw from its expansionary policy in time or in degree to

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83 See Appendix 19.
curb inflation expectations. Higher inflation expectations, coupled with the seemingly endless rise in federal unfunded liabilities, will dampen long-term U.S. economic growth. The second, political argument is much more normative: the expansion of federal power as a response to the crisis is not only potentially irrevocable, but also unacceptable. From the creation of a central clearinghouse for derivatives to state-imposed limits on executive compensation, the financial system will not escape the increasingly potent grip of U.S. Treasury. Likewise, the Federal Reserve exceeded its authority as an impartial central bank by targeting individual failing institutions and markets. This sets precedence for potentially unwarranted future expansions of power.

Another contentious debate about government support of money and banking, either explicit or implicit, revolves around the issue of moral hazard. The pretext of systemic significance grants the financial sector the special privilege of periodic government rescues. Put crudely, Uncle Sam offers the industry a blank check when the going gets tough. Perhaps necessary to prevent further economic deterioration, “bailouts” dilute the discipline of the market and promote reckless risk-taking behavior. The gains of risk that preceded the financial turmoil were mostly privatized through shareholder profits and executive compensation. Every link of the securitization chain from the lax mortgage originator to the risk-loving asset manager profited during the housing bubble. Yet when the bubble burst, the down-side risks of imprudent lending and febrile speculation were socialized through higher borrowing costs and disrupted credit flows. Creditworthy households
and small businesses from Anchorage to Albuquerque who were completely removed from the process suffered. The contagion spread beyond America’s borders as well. With financial globalization, the default of the subprime borrower in Memphis indirectly contributed to the default of the Bank of Iceland in Reyjavik.

As in past financial crises, the government once again stepped in. This time they used bailouts, credit facilities, and partial-nationalizations to stabilize the markets. Few other sectors share this privilege of periodic government rescues. The securitization market in particular received special attention. The bundling and tranching of all types of loans, from equipment leases to time shares on yachts, into supposedly lower risk securities that could be sold, traded, or used as collateral fueled specifically the cheap credit, and more broadly consumption-driven economic growth, in the U.S. for much of the past decade. When securitization died during the credit crunch, when this modern form of financial intermediation completely collapsed, the Federal Reserve and U.S. Treasury scrambled to revitalize this mechanism. In the spring of 2010, more than two years after the fall of Lehman, the primary programs still in commission are the ones aimed to resuscitate securitization. Securitization was the fuel to our consumption-driven economic engine. Without it, the engine collapses; U.S. economic growth decelerates.

This chapter explores the government’s extraordinary measures during the financial turmoil. The first section defines the role of a central bank. It then explores the Federal Reserve’s extraordinary responses to the acute liquidity crises of 2007-
09. Assessing the central bank’s efforts to revitalize the flow of credit in the economy, the author asks whether the extraordinary measures were within the scope of lender-of-last resort lending. The second section explores the federal government’s partial nationalization of the banking system, known as the Troubled Asset Relief Program (TARP). U.S. Treasury’s unprecedented $700 billion plan that injected taxpayer capital into many bank holding companies, among other things, was intended to trickle credit to the average household and small business. Were the efforts effective? If so, could success justify financial regulatory reform and, more broadly, a more dominant role of government in finance? In the end, the author wishes to address two questions. The first is a positive one: whether the facilities were effective in normalizing the flow of credit. The second and more complex question concerns moral hazard: can financial markets be structured in a way that periodic government interventions are unnecessary? Can we disentangle the merits of financial intermediation, of securitization, by eradicating the ills?

The Role of a Central Bank

As a central bank, the Federal Reserve has three primary responsibilities: monetary policy, supervisory authority, and “lender-of-last resort.” Effective monetary policy, or control over the money supply, promotes price stability and full employment. Price stability is one precondition for output growth – volatile commodity or asset prices discount the incentives to accumulate capital or supply/hire labor. By increasing the real price of goods and labor, deflation, or a
significant drop in prices and wages, discourages consumption and investment.\(^{84}\) Central bankers learned an important lesson from the Great Depression: in economic troughs, loose monetary policy is necessary to stimulate aggregate demand. It is extremely difficult for policymakers to cure the ills of deflation under a pegged exchange rate regime like the gold standard. Indeed, a money supply too rigidly linked to the gold standard contributed to the Federal Reserve’s inept policymaking during the Depression. Moreover, premature monetary tightening to curb infant inflation expectations may do greater harm than good. These were the conclusions of Ben Bernanke, Fed chairman, and Christina Romer, head of the Council of Economic Advisors.\(^{85}\) Many of today’s most influential economists were once scholars of the Depression and drew on these lessons during the crisis.

Policymakers also learned important lessons from the era of stagflation. Expansionary monetary policy failed to push the economy past full employment and the breakdown of the Phillips Curve unemployment-inflation tradeoff during the 1970s challenged many Keynesian intuitions. Rational expectations transformed money into a neutral variable in the long run, creating a perfectly vertical, or inelastic, aggregate supply curve. Thus, only inflation expectations dictate price

\(^{84}\) In the *The General Theory* (1936), Keynes explores the dangers of deflation. From the consumer’s perspective, the increase in real purchasing power enhances the income effect: consumption increases because of a weaker budget constraint. Aggregate demand should increase through the multiplier effect. However, from the firm’s perspective, deflation raises the real price of labor and thereby deters hiring. The gains from the income effect are nullified by the reduction in employment. More important, agents defer consumption and investment as the real burden of debt increases. These two effects substantially reduce aggregate demand.

levels in the long run. According to New Classical monetarists like Milton Friedman and John Taylor, the only necessary condition for price stability is steady, predictable money supply growth. By controlling money supply growth, the Federal Reserve can anchor inflation expectations and maintain stable prices.

Interest rates are the primary tools for monetary policy. By raising or lowering borrowing costs, the Federal Reserve can slow down or accelerate money circulation, the “velocity” of money. The central bank can pressure interest rates through various mechanisms. As the bank of banks, the Federal Reserve mandates minimum levels of overnight reserves from all its depositors. Institutions that lack the required funds can borrow from those with excess funds. This overnight borrowing rate is known as the active Fed Funds rate. In essence, this government rate determines all other borrowing costs in the economy such as student loan and mortgage rates. Now the Federal Reserve cannot simply dictate its target rate to markets. Rather, it must intervene in private markets through open market repurchase agreements (also known as repo transactions) and exchange temporarily cash for eligible securities such as Treasuries and Agencies. Repos flood the market with liquidity. Likewise to drain excess reserves in the banking system and raise the price of credit, the Fed conducts reverse repurchase agreements (or reverse repos) with primary dealers to exchange temporarily eligible securities for cash. Through

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87 The primary concern was commodity price inflation. The Federal Reserve and its foreign counterparts have historically ignored asset price inflation.
the convergence of the target and active Fed Funds rate, the Federal Reserve can foster financial and monetary conditions consistent with policy objectives such as inflation targets, output growth, and full employment.

Beyond monetary policy, the Federal Reserve also supervises and regulates bank holding companies.89 The U.S. financial regulatory system is fragmented with many federal and state regulatory agencies.90 The Federal Reserve only has jurisdiction over financial institutions that are parent companies of various businesses ranging from commercial banking to investment broking. By regulating these umbrella institutions, the Federal Reserve acts as a systemic risk supervisor, examining macroeconomic risk horizontally across the financial system. It assesses bank holding companies using an undisclosed metric known as the CAMELS rating system: capital adequacy, asset quality, management, earnings, liquidity, and sensitivity to market risk. This broad perspective helps the Federal Reserve identify potential liquidity and solvency problems that can disrupt credit flows. The

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89 Bank holding companies are umbrella institutions that own or control one or more national banks, non-U.S. commercial banks, or commercial paper funding corporations. The nine largest U.S. bank holding companies by assets are Bank of America, JP Morgan Chase, Citigroup, Wells Fargo, Goldman Sachs, Morgan Stanley, Metlife, HSBC North America, and Barclays Group. For balance sheet data on each firm see: [http://www.ffiec.gov/nicpubweb/nicweb/Top50form.aspx](http://www.ffiec.gov/nicpubweb/nicweb/Top50form.aspx)

90 The U.S. financial regulatory framework is extremely complex. Each regulator supervises a specific type of financial institution. The Office of the Comptroller of the Currency (OCC) regulates all national banks. The Federal Deposit Insurance Corporation (FDIC) supervises state non-member banks. The now defunct Office of Thrift Supervision (OTS) oversaw national and state thrifts. The Securities and Exchange Commission (SEC) regulates broker-dealers. The Commodities Futures Trading Commission (CTFC) regulates derivative merchants. State regulators supervise state member banks and insurance companies. One flaw of this fragmented regulatory framework is the potential for regulatory arbitrage: financial institutions may select the weakest regulator with the most lax supervision and capital requirements. Indeed, AIG an insurance company was re-chartered as a thrift institution under the regulation of the Office of Thrift Supervision in order to expand their derivatives business.
bureaucratic U.S. regulatory structure, however, often prevents the Federal Reserve from acting preemptively and resolutely when problems are identified.

**Lender-of-Last Resort**

The Federal Reserve’s third role as the lender-of-last resort is the most controversial. Walter Bagehot, the first editor-in-chief of *The Economist*, defined this role over one hundred and thirty-five years ago. To stay a banking panic, “the bank supplying reserves must advance freely and vigorously to the public. These loans should only be made at a very high rate of interest. And at this rate, these advances should be made on all good banking securities, and as largely as the public ask for them.”91 In other words, the central bank stabilizes asset values and financial markets during times of distress. It provides public emergency lending to firms that cannot raise capital through private channels; it creates lending facilities to exchange universally accepted Treasury securities for hard-to-value illiquid assets; and it creates off-balance sheet structured investment vehicles to absorb the assets of systemically significant failing institutions. These actions directly or indirectly set floors under the prices of assets and ceilings on financing terms.

At its core, the objective of lender-of-last resort is to prevent, or at least mitigate, financial instability through the provision of liquidity support to either individual financial institutions or broader financial markets. Periodic crises can exhaust confidence between companies that regularly do business, creating liquidity

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shortages where institutions are unable to acquire cash or means of payment at low costs. This can lead to otherwise preventable failures of institutions that then result in spillover and contagion effects that may ultimately engulf the financial system and more broadly the real economy. By acting decisively, the central bank can restore confidence in the system by avoiding “fire sales” of assets and supporting market functioning.

The exact details of lender-of-last resort intervention depend on the kind of liquidity shortage experienced by market participants. It is useful to distinguish three types of liquidity: central bank liquidity, market liquidity, and funding liquidity.92 Central bank liquidity describes the deposits of bank holding companies at the central bank; it is synonymous with reserves, or settlement balances. These reserve balances are held by financial institutions to meet reserve requirements, if any, and to achieve final settlement of all financial transactions in the payments system.93 Individual institutions can borrow and lend these funds in the interbank market, but, for the system as a whole, the only source of these funds is the central bank itself.

Market liquidity refers to the ability to buy and sell assets in reasonably large quantities without significantly affecting price.94 An asset (such as government debt) that is actively traded in large volumes displays this quality. This is the conventional

93 Cecchetti and Disyatat, pp. 2-3.
94 Ibid.
textbook definition of liquidity: the ease with which an asset can be converted into means of payment, i.e., money or cash.

Finally, there is funding liquidity. Funding liquidity describes the ability of financial institutions to raise cash by pledging assets as collateral. It is symbiotic with market liquidity: the health of one affects the other. With the rise in interbank borrowing, funding liquidity has become increasingly vital to the daily operations of firms. Leveraged ones tend to fund their long-term assets through short term liabilities, i.e., they lend long and borrow short. A mismatch between the extended timing on their cash inflows and the overnight timing on their cash outflows can leave leveraged institutions particularly vulnerable to liquidity shocks, or modern day bank runs. Creditors at any point can simply refuse to rollover overnight loans, exacerbating firm-specific capital shortages.

Whereas market and funding liquidity shortages are extremely difficult to fix, central bank liquidity shortages are easily manageable. Central bank liquidity shortages occur when institutions find themselves short of the reserve balances that they wish to hold. Credit markets are functioning normally but the aggregate supply of reserves is inadequate. The central bank in this case can simply lower the reserve requirement or increase the supply of reserves. Both of these solutions are a part of conventional monetary policy.

There are no quick fixes, however, to acute shortages in funding and market liquidity. For specific institutions these twin shortages could put a firm out of
business as counterparties become unwilling to lend or do business. The primary threat posed by an institution-specific acute liquidity shortage, and hence the main justification for any intervention, is that failure may result in contagion and spillover effects that could jeopardize the flow of credit and the broader real economy. Thus, the key criterion when considering whether the central bank should help the troubled institution is systemic significance: whether the bank is too interconnected to fail. There is a subtle difference between significance and size. Although the two qualities are often positively correlated, smaller firms – like Long Term Capital Management and Bear Stearns, both of whom were rescued from bankruptcy by the Federal Reserve – that specialize in the troubled asset of the crisis can also be considered systemically significant. Lender-of-last resort interventions in these cases include special liquidity provisions and government-directed privately-funded bailouts.

A systemic shortage of both funding and market liquidity for many market participants is the most catastrophic. It reflects tensions rising from an evaporation of confidence and from coordination failures among market participants that lead to a breakdown of key financial markets. Markets, like individual institutions, may suffer from runs. The result is a sudden and extended drying of market and funding liquidity, with serious consequences for the health of both the credit markets and the broader economy. Such crises are generally associated with a sharp rise in market participants’ uncertainty about asset values as well as about the solvency of potential counterparties, causing many players to quickly disengage. This
uncertainty siphons confidence in counterparties and collateral. As a consequence, assets that were once easily convertible into cash become highly illiquid. The lender-of-last resort must resort to esoteric measures beyond the conducting of open market transactions to address these low-probability, high stress events. The maturity, frequency, eligible financial institutions, and suitable collateral of these extraordinary measures differ in both degree and kind from conventional programs. These emergency measures normally include the outright purchase or sale of assets in the open market and the direct channeling of collateralized or uncollateralized funds to particular institutions.

**Moral Hazard**

The socialization of the pains involved in market gambling and speculation is one unintended consequence of lender-of-last resort interventions. To protect the health of interconnected markets and institutions, the central bank must generously expand its balance sheet, fueling inflationary pressures felt by the broader real economy. Yet the agents whom are “bailed-out” can be considered the prime culprits of the turmoil in the first place. The dampening of downside penalties creates acute problems of moral hazard. Without the discipline of creative destruction, the incentives for prudent risk-taking are diluted. During normal times, banks are less inclined to devote resources to enhancing the efficiency and effectiveness of their daily liquidity management operations. Moreover, excessive reliance on the central bank for overnight liquidity would substantially undermine private interbank activity. Without the highly punitive actions imposed by the
market, financial institutions are more lax in their risk management, which leads to a financial system ultimately more vulnerable to shocks.

Though issues of moral hazard exist, they are often exaggerated. Lender-of-last resort interventions such as golden parachutes for risk-taking executives, imprudent creditors, and profit-seeking shareholders are caricatured hyperboles. In reality, they often involve substantial compromises by all parties. A later section will positively and normatively address in detail the moral hazard of the Bear Stearns and AIG interventions. In general, the claim that prompt corrective action by the government creates a financial system more vulnerable to shocks is grossly exaggerated. Anticipation of central bank intervention was not a root cause of the complacencies in risk management leading to the 2007-09 crisis. The terms of the “bailout” of systemically significant institutions are reasonably punitive. Most important, even if the existence of the lender-of-last resort creates moral hazard, efforts to mitigate it can be more productively channeled elsewhere. Financial regulatory reform, better oversight of significant institutions, counter-cyclical capital requirements, and maximum leverage ratios are more effective measures of building a stronger, more resilient financial system than simply letting the gales of creative destruction run amok. Moral hazard does not constitute grounds for the central bank to refrain from providing support should a systemic crisis occur, nor does it suggest that provision at the time should be on highly punitive terms.
The Fed’s Initial Response to Liquidity Shocks

The credit markets began to tremble in the summer of 2007. A rise in mortgage delinquencies and foreclosures from the recent wave of subprime lending placed severe downward pressure on the value of mortgage-backed securities. Write-downs of mortgage-related assets not only ate up the thin capital buffers of highly levered financial institutions, but also prevented many firms from raising capital in the overnight loans and commercial paper markets. The securitization of home loans created an abundance of AAA-rated, highly liquid securities that were used as collateral to secure short-term liabilities needed to fund the daily operations of many financial institutions. Once these asset-backed securities were downgraded because of deteriorating housing conditions, lenders demanded better and greater collateral by imposing wider haircuts. Interest rate premiums on unsecured bank funding or longer rose precipitously while the volume of unsecured term funding contracted. This significantly increased short-term borrowing costs.

The substantial rise in the cost of credit affected the financial institutions most dependent on overnight lending, i.e., the firms that were most levered. Unregulated hedge funds and off-balance sheet structured investment vehicles (also known as special purpose entities) fit into that category and were the first to suffer from the credit crunch. Losses in mortgage portfolios triggered a freeze in credit. Healthy lenders demanded additional collateral, while shadow lenders refused to renew overnight loans. Many parent financial firms were compelled to reabsorb off-

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95 See Appendix 9.
balance sheet assets to protect their reputation. For example, in June 2007, the Wall Street investment bank Bear Stearns pledged $3.2 billion to aid its two ailing hedge funds – Bear Stearns High-Grade Structured Credit Fund and Bear Stearns High-Grade Structured Credit Enhanced Leveraged Fund – who gambled heavily in riskier tranched mortgage-backed securities. Likewise, in August 2007, France’s largest bank BNP Paribas froze three of its structured investment vehicles after an inability to value subprime mortgage-based assets. The inability to value these assets reflected poor market sentiment and trading activity. The principles of fair-value accounting dictate that all financial assets must be marked-to-market at the end of the trading day. An inability to price these once “safe,” highly liquid mortgage securities indicates a collapse in market confidence and demand. The immediate effect is a rapid deterioration in the value of mortgage securities. This harms firms with overweight mortgage portfolios. The more important effect is a rapid deterioration in the liquidity of mortgage securities. Like a worthless currency, mortgage securities are no longer readily accepted as a medium of exchange. This is especially catastrophic when an entire system of debt is financed using those securities as collateral.

The Federal Reserve responded quickly to the distress in the credit markets by cutting benchmark interest rates through open market operations. The operations mainly took the form of repurchase agreements against collateral such as

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Treasury and GSE-sponsored mortgage-backed securities (also known as agency MBS). September 18, 2007 marked the beginning of expansionary monetary policy as the Federal Reserve expanded its balance sheet to lower the target Fed Funds rate by 50 basis points to 4.75%. This was the first of a series of cuts that eventually culminated in a prolonged near-zero target Fed Funds rate of 0 to 25 basis points. Under normal conditions in the interbank markets, the primary dealers in the Fed’s open market operations would distribute the new reserves to other banks, facilitating transactions in the broader economy. Acute uncertainty about the losses in mortgage-related assets, however, eroded peer evaluations of the creditworthiness of counterparties. As a result, banks hoarded cautiously, refusing to renew or extend loans.

Conventional interest rate cuts were therefore not sufficient in reducing interbank borrowing costs. Interbank borrowing rates rose even as the Fed slashed its benchmark target rates. One metric that shows the rising borrowing costs is the spread between the London interbank offered rate (LIBOR) and the overnight index swap (OIS). A spike occurred in the 1 month and 6 month interbank loans. The average spread jumped from 6.4 to 55.4 basis points during the third quarter of 2007. Interest rates on other maturities displayed similar patterns of increased spreads and volatility. Increased spreads and volatility were results of siphoned confidence in the performance and value of mortgage-backed securities.

98 See Appendix 10.
As conventional interest rate cuts proved ineffective at reducing borrowing costs, the Federal Reserve made a number of changes to its discount window facility, a policy tool historically used to provide backup funds to depository institutions, especially during market disruptions. On August 17, 2007, the Fed announced the Term Discount Window Program, which allowed depository institutions to borrow funds for up to thirty days, with the possibility of renewal.\textsuperscript{99} Under normal conditions, the discount window (used by depository institutions to meet daily reserve requirements) only offered overnight loans. Moreover, the Fed reduced the discount rate, the premium to access the discount window, from 100 to 50 basis points over the target Fed Funds rate.

These tweaks to the discount window, however, generated little additional borrowing. A number of reasons explain why even an enhanced version of this conventional policy tool was ineffective. First, only depository institutions are eligible borrowers at the Fed’s discount window. These include behemoth bank holding companies like Bank of America and JP Morgan Chase, and smaller, regional commercial banks. The financial institutions most exposed to the housing market, and thus the ones facing the highest borrowing costs, were investment banks, or broker-dealers, hedge funds, and off-balance sheet vehicles, all firms that did not take deposits.

Another reason for the futility of the enhanced discount window is the perceived stigma attached to using it. By offering lower rates and extended maturities, the Term Discount Window Program should be more attractive than its private counterpart, the interbank market. Yet potential borrowers shied away because borrowing from the discount window is often perceived by market participants as a sign of weakness; the firm is not creditworthy in the eyes of private creditors. Going to the discount window can therefore be counterproductive: the associated stigma can impair more greatly a bank’s ability to borrow at favorable rates in the private market, exacerbating the drain in confidence. Despite encouragement by Fed officials, discount window borrowing remained modest at best.100

The Term Auction Facility (TAF)

As the credit crunch exacerbated in the fall of 2007, the Federal Reserve employed non-conventional monetary tools to inject liquidity to the markets. On December 12, the Federal Reserve, with coordinated actions by other central banks, announced the Term Auction Facility, a unique program that directly auctioned funds to depository institutions.101 This auction format had three particular benefits over traditional tools such as the discount window and open market operations.

100 On August 18, 2007, Donald Kohn, the vice chairman of the Board of Governors of the Federal Reserve, and Timothy Geithner, then president of the Federal Reserve Bank of New York, held a conference call with major banks advising them that discount window borrowing would be seen as a sign of strength. Their efforts proved futile. See: http://www.bloomberg.com/apps/news?pid=20601087&refer=home&sid=aE1A7RkmKsag
First, auctions would enable the Fed to control precisely how much, and when, liquidity would be injected into the markets. The frequency and magnitude of auctions were at the Fed’s discretion. The Fed could conduct an auction if there were sudden and drastic disruptions in the flow of credit. Second, competitive auctions for term credit could circumvent the stigma associated with the discount window. Auctions require banks to simultaneously bid for funds. The rate to obtain funds would be set by private demand rather than by Fed prerogative. Most important, the auction format would enable banks to approach the Federal Reserve collectively rather than individually. The intention was to dilute the stigma attached to last resort borrowing. And third, an auction would allow the Fed to preemptively allocate funds to a larger number of troubled institutions. The central bank already dispersed liquidity through its repo transactions in the open market. However, those repos were only extended to primary dealers and not depository institutions. With the facility, depository institutions now shared that privilege.

Designed to ensure the distribution of funds to banks, the Term Auction Facility provided a funding alternative to repos and the discount window. It operated in a similar fashion to the enhanced discount window. Depository institutions eligible for credit through the discount window, i.e., banks determined to be in sound financial condition by their District Reserve Bank, could participate. They could borrow the auctioned funds for a term of 28 or 84 days. Borrowing was fully collateralized; and the eligible collateral was an exact replica of the discount window’s. They included only the safest assets, ranging from AAA-rated
collateralized debt obligations to fully guaranteed agency debt.\textsuperscript{102} To offset the risk of losses from the pledged collateral, the Fed imposed haircuts.\textsuperscript{103} To promote a large number of winning bids, the Fed limited the maximum auction award to any individual institution to 10 percent of the announced auction quantity.\textsuperscript{104} The format was designed to encourage participation. The ultimate goal was to ease the crunch in the interbank funding markets.

The Term Auction Facility (TAF) was generally successful at doing both. The Fed conducted the first ten TAF auctions between December 17, 2007 and April 21, 2008. Participation was strong, never falling below fifty bidders per auction. Such participation suggests that depository institutions were finding the program valuable. There was also significant competition for the funds. One metric that indicates this is the bid-to-cover ratio: the total amount bid in an auction divided by the total amount available. This bid-to-cover ratio never dipped below 1.25.\textsuperscript{105} Most important, market rates tended to converge to the TAF stop-out rate, the auction clearing price at which aggregate demand absorbs all the funds at auction. The London interbank offered rate (a metric reflecting market funding costs) displays a near-flat valley hedged between twin peaks from December 2007, when TAF was

\textsuperscript{102} For a detailed spreadsheet on the exact types of eligible collateral that can be pledged at the discount window see: http://www.frbdiscountwindow.org/cfaq.cfm?hdrID=21&dtlID=#a1
\textsuperscript{103} As explained in the first chapter, a haircut is the percentage difference between the market value of the collateral and the amount that a lender can borrow. For example, on a haircut of 50%, one can only secure up to a $50,000 loan on $100,000 worth of collateral. For a detailed spreadsheet on the haircuts applied to various assets see: http://www.frbdiscountwindow.org/discountmargins.cfm?hdrID=21&dtlID=83
\textsuperscript{104} Armantier, Krieger, and McAndrews 7.
\textsuperscript{105} Ibid 8.
introduced, to October 2008, after the shock of the Lehman bankruptcy. This could indicate that TAF was successful at easing funding conditions. Moreover, with just one exception, the TAF stop-out rate always settled below the falling 1 month LIBOR rate, indicating that TAF may have influenced market rates. Greater empirical analysis, however, is needed to support the claim that the downward pressure came from TAF to LIBOR, rather than vice versa.

One major shortcoming of the Term Auction Facility, however, was its limited eligibility: only depository institutions could participate and receive liquidity support. Investment banks were deprived of Fed liquidity assistance. As servicers, bundlers, and investors of mortgage-backed securities, broker-dealers were more exposed to the housing market than their deposit-taking counterparts. Likewise, hedge funds, mutual funds and other key players were barred from access to TAF or the discount window. With substantial haircuts on highly rated debt securities, and halted lending against certain types of collateral altogether, these institutions faced increasingly acute funding difficulties. The overnight repo market in particular began to dry up by the spring of 2008. One well-known example is the liquidity run on the highly leveraged investment bank Bear Stearns. Overnight repo financing completely dried as creditors refused to rollover loans and as hedge funds pulled their account balances. Other financial institutions faced similar funding challenges.

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106 To see a chart of the 1 month LIBOR rate over the last 3 years, see: http://www.bloomberg.com/apps/cbuilder?ticker1=US0001M%3AIND

At its core, the problem was collateral: the mortgage-backed securities that served as collateral in the over-leveraged financial system were no longer an acceptable currency. Like the hyperinflated Argentinian peso, mortgage-backed securities no longer served as a medium-of-exchange, a store of value, or a unit of account. If isolated to a limited number of institutions, this problem would not be catastrophic. But because these securities appeared on the balance sheets of nearly every financial institution, and because they served as the backbone for leverage in a highly levered financial system, a collapse in great degree and speed would place enormous liquidity pressures on the broader real economy.

**The Term Securities Lending Facility (TSLF)**

To address these unprecedented liquidity pressures caused by a perhaps temporary market collapse in mortgage-related assets, and to address the eligibility shortcomings of TAF and the discount window, in March 2008 the Federal Reserve introduced the Term Securities Lending Facility (TSLF). This securities lending facility allowed primary dealers – institutions that serve as counterparties to trading transactions with the Federal Reserve Bank of New York – to bid a fee to borrow up to $200 billion in Treasury securities from the Fed for a term of 28 days. To secure this transaction, the dealers pledged mortgage-backed securities as collateral. They can then use the borrowed Treasuries as collateral to obtain cash in the private secured funding markets. By increasing the ability of dealers – especially leveraged dealers reliant on the repo market – to finance their positions, this security swap program reduced the need for a fire-sale liquidation of confidence-sapped assets.
into illiquid markets. By increasing the supply of Treasury collateral in the market and reducing the supply of less liquid collateral, the Term Securities Lending Facility was designed to inject massive liquidity in the secured funding markets. The ultimate goal was to reduce the private market costs of financing less liquid collateral.

The loan structure of the Term Securities Lending Facility was very similar to that of the Term Auction Facility. The program was designed to allocate Treasury collateral for a prolonged period of 28 days through auctions. The Federal Reserve Bank of New York would conduct weekly transactions exchanging liquid Treasuries for illiquid “schedule 1” and “schedule 2” securities. The auction format was again chosen over the standing facility to overcome the stigma of receiving Fed help: dealers could approach the Fed collectively rather than individually and borrowing rates were set at auction and not at a premium predetermined by the Fed. The day before each auction, the Fed would announce the par value of the offering amount, the particular basket of Treasury securities it was willing to lend, and the collateral eligible for delivery against the Treasuries. Auctions would open the next day for a brief thirty minutes. To encourage a large dispersion of collateral, each dealer can be awarded no more than twenty percent of the offering amount.

108 “Schedule 1” collateral is all collateral eligible in the Fed’s open market operations: Treasury bonds, agency debt (i.e., GSE-issued debt) securities, and agency mortgage-backed securities. “Schedule 2” collateral includes all Schedule 1 collateral plus AAA rated non-agency residential mortgage-backed securities, commercial mortgage-backed securities, and agency collateralized debt obligations.
The lending of collateral rather than direct funds distinguished the TSLF from other Federal Reserve liquidity facilities. The program exchanged haircut-heavy, hard-to-value collateral for liquid, readily accepted Treasury securities. This was a unique way of injecting liquidity, in lieu of directly lending cash. As a result, the Term Securities Lending Facility had no impact on the supply of bank reserves. In contrast to other programs that swapped securities for cash, this security swap program did not impair the Fed’s implementation of interest rate policy. That is, the Fed did not need to add or drain funds to maintain bank reserves at their desired level. This reserve neutrality feature made the TSLF unusually flexible in terms of size; indeed, the only constraint on the overall size of the facility is the quantity of the Fed’s holdings of Treasury securities. Reserve neutrality gave the program extreme flexibility: a drastic expansion or contraction of the facility would not distort monetary policy. The feature also eliminated the need for offsetting operations if an auction was over or under-subscribed. In other words, fluctuations in facility use, in either direction, did not necessitate other actions by the Fed’s trading desk, such as security purchases, sales, or redemptions. In contrast, use of other facilities such as the special discount window and the term auction facility affected reserves in the economy and required offsetting open market operations.\(^{109}\)

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\(^{109}\) Open market operations are necessary to “offset” the injection of additional funds into the economy from the Fed’s liquidity facilities. Market interventions such as these programs hinder the Fed’s ability to set interest rates, i.e., conduct monetary policy. For example, using the Term Auction Facility, a massive injection of funds into a troubled institution – which will ultimately trickle through the broader economy – would depress the active Fed funds rate lower than the target Fed funds rate set by the open market committee. To offset this, the Federal Reserve must conduct open market transactions to drain funds elsewhere and reestablish the target rate.
Because the program focused on addressing deteriorating collateral values, the primary root of the credit crunch, the Term Securities Lending Facility was perhaps more risky than all the other emergency liquidity facilities. When market participants rejected mortgage-backed securities as eligible collateral (which reinforced the downward spiral of their value), the Federal Reserve intervened as lender-of-last resort to provide a price floor. Doing so, however, greatly exposed the Fed balance sheet to these potentially loss-inducing assets. In other words, by restructuring its balance sheet from Treasuries to asset-backed securities, the Fed took on significant credit risk. Although the Fed imposed haircuts on the collateral pledged by dealers, not all credit risk was mitigated. These haircuts paled in size compared to the ones imposed by the market. This again begs the question of moral hazard: to stabilize asset values and to facilitate credit flows, must the lender-of-last resort take on significant risk? There exists an inherent tension: actions to protect itself from potential losses (such as increasing haircuts or removing depreciating collateral from the eligible pool) are opposed to lender-of-last resort solutions.

The initial TSLF auctions attracted high levels of dealer participation. The bid-to-cover ratios never fell below 0.68 for “schedule 1” collateral and 0.96 for “schedule 2” collateral. This suggests that the perception of weakness was not a significant obstacle for the program. Much lower bid-to-cover ratios after May 2008 reflects a tapering off of demand by the summer. Dealers began to revert to the private market to finance program-eligible collateral. Under-subscriptions may

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indicate that the credit crunch was easing and that confidence may have returned to the once-rejected collateral. Indeed, the data suggest that the facility’s net effects on financing costs were positive. One way to assess the program’s success is to track the financing spreads between Treasury collateral and non-Treasury collateral. The spreads reflect the liquidity conditions in financing markets: spikes and volatility indicate a severe credit crunch. A well functioning liquidity facility should reduce spreads either directly, by striking a better balance between the supply and demand for safe collateral, or indirectly, by improving market sentiment and reducing uncertainty. According to the data, the spreads between the overnight agency mortgage-backed security (MBS) repo rate and the overnight Treasury general collateral repo rate narrowed considerably after the first TSLF auction on March 27, 2008. Just prior to the auction, the spread was 100 basis points. By May, it ranged between 0 and 20 basis points. Spreads in the less liquid, longer term market exhibited similar behavior. This lower financing spread suggests that the facility was effective in improving market liquidity.

**Falling Blue Chips**

These emergency liquidity facilities, however, did not prevent, nor help contain the consequences of, the near-collapse of Bear Stearns, one of the largest blue-chip investment banks. Bear Stearns, like many of its Wall Street peers, gambled heavily on real estate by using short-term borrowed money to expand its balance sheet exposure to mortgage-related assets. The firm had been one of the

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leading underwriters of mortgage-backed securities, even going so far as buying firms that originated mortgages to subprime borrowers so that it would have a ready source of mortgages to bundle and sell in bulk to the market. Profitable during the boom, these businesses quickly suffered losses as mortgage delinquencies rose and housing prices depreciated. Bear’s equity value plummeted by the start of 2008 as the firm posted a record loss in the fourth quarter of fiscal year 2007, its first quarterly loss in its eighty-five year history.

By March 2008, Bear Stearns suffered from a severe run on confidence. Market participants became extremely pessimistic about the firm’s ability to service its commitments and accumulated millions in shorts, put-options, and credit default swaps.112 Some creditors responded by demanding additional collateral, imposing ever-greater haircuts on Bear’s pledged AAA-rated mortgage-backed securities; others simply refused to renew loans.113 The rapid withdrawal of credit lines was especially devastating for a highly leveraged firm like Bear Stearns who had little capital reserves to absorb these liquidity shocks. Siphoned of confidence, counterparties also refused to do business and withdrew their account balances. Bear Stearn’s prime brokerage business, for example, began to hemorrhage money as hedge fund clients pulled their money. 114 According to SEC reports, Bear’s $18 billion dollars in excess reserves dwindled to $2 billion within a span of days.115 The liabilities continued to accumulate as creditors called in their loans. Depleted of

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113 Cohan 33.
115 Ibid 52.
capital reserves and unable to borrow more money at reasonable rates, Bear Stearns would be compelled to sell its mortgage-related assets at fire sale prices. This would place significant downward pressure on the mortgage portfolios of other institutions, potentially creating funding pressures for them as well. The asset-backed securities on Bear’s balance sheets were too systemically important to be sold in a fire sale.

The “bailout” of Bear Stearns was in essence the rescue of its portfolio of mortgage-backed securities. JP Morgan Chase, the second largest bank holding company in assets at the time, was interested in acquiring Bear. The primary reason that deterred JP Morgan from acting on its own volition was the approximately $30 billion dollar in hard-to-value, confidence-sapped mortgage-backed securities on Bear’s balance sheet. Under its role as lender-of-last resort, the Federal Reserve Bank of New York facilitated the deal by lending JP Morgan $30 billion dollars against that collateral. Ironically, the New York Fed created Maiden Lane LLC, one of the largest off-balance sheet special purpose vehicles, in order to do so. Maiden Lane borrowed approximately $28.8 billion from the New York Fed in the form of a senior loan. Together with funding from JP Morgan Chase of approximately $1.15 billion, the money was used to purchase the mortgage asset portfolio from Bear Stearns. With the consent of U.S. Treasury, the Fed targeted this ailing financial institution not to “bail-out” its imprudent executives or traders, but to provide a

\[116\] For greater detail on the Fed’s Maiden Lane transaction see: [http://www.newyorkfed.org/markets/maidenlane.html](http://www.newyorkfed.org/markets/maidenlane.html)
floor for troubled assets.\textsuperscript{117} A fire-sale liquidation of Bear’s mortgage portfolio would have significantly deteriorated the value of the mortgage portfolios of other financial institutions. This systemic write-down in asset values would have triggered additional collateral, or margin, calls, exacerbating the liquidity freeze in the funding markets. Even though the markets eluded a greater conflagration, they teetered on the brink of collapse.

\textbf{Financial Ice Age}

The bankruptcy of Lehman Brothers, another blue chip investment bank, became the final thrust that pushed financial system down a precipice. The credit markets, the lifeblood of global financial capitalism, froze immediately after. The most creditworthy firms, households, and small business could not acquire loans at reasonable rates. Borrowing in the interbank overnight repo markets became extremely expensive. The 1 month London interbank offered rate (LIBOR) spiked from 2.816 to 4.819 in a span of two weeks. The 3 month Treasury-Eurodollar (TED) spread more than trebled from 1.216 to 4.182 percentage points. And the LIBOR-overnight index swap (LIBOR-OIS), which historically hovered around 0, soared to almost 350 basis points.\textsuperscript{118}

The commercial paper market also completely froze as investors scrambled to riskless U.S. Treasuries. The commercial paper market is a short-term financing

\textsuperscript{117} On the contrary, the price of the Fed intervention was significant for Bear Stearns equity shareholders. The original tender offer for Bear stock by JP Morgan was $30 per share. Hank Paulson, Treasury secretary, however, adamantly opposed the deal and dictated a new offer of $2 per share. Ultimately, the deal closed at $10 a share.

\textsuperscript{118} See Appendix 10.
market similar to the interbank overnight repo, where commercial banks, non-bank financial institutions (like AIG and General Motors Acceptance Corporation), and corporations go to obtain short-term external funding.\textsuperscript{119} Like the mass exodus collectively rushing out of a burning movie theater, vast funds flowed out of money market funds and into Treasury-only funds. Lehman’s collapse, a supposed black swan event with a probability density function six standard deviations away from the mean, reinforced investors’ fears of a wide range of potential bankruptcies both within and outside the financial sector. Suddenly, investors became sensitive to these low-probability, high intensity “fat tail” events. This triggered an unprecedented flight to quality. For example, investors had reallocated $315 billion from prime to Treasury-only funds after a mere 3 days after Lehman collapsed.\textsuperscript{120} By October 2008, a month later, the reallocation amounted to $955 billion.\textsuperscript{121}

The commercial paper market froze as investors rapidly fled to government bonds. The demand for commercial paper, especially ones with longer-dated

\textsuperscript{119} There are two main types of commercial paper: unsecured and asset-backed. Unsecured commercial paper, like currencies, are promissory notes issued by firms. They have a fixed maturity of one to 270 days. Unsecured commercial paper is not backed by collateral, which makes the credit rating of the originating special purpose vehicle a key determinant in cost and liquidity. Asset-backed commercial paper (ABCP), on the other hand, is a promissory note that is collateralized by other assets, making it a secured form of borrowing. Corporations issue short-term commercial paper over long term corporate bonds because of an upward sloping, steep yield curve, which reflects more expensive long term borrowing costs. Commercial paper allows corporations to directly tap the money market for cheaper short term credit. All commercial paper is traded in the over-the-counter (OTC) market, where money market desks of banks and broker-dealers provide underwriting services. At its zenith, before the summer of 2007, the total amount outstanding of commercial paper holdings reached $2.2 trillion. That amount almost halved to $1.2 trillion by 2009.

\textsuperscript{120} The author was unable to acquire high frequency financial data on the commercial paper markets. Instead, the author used academic papers and publications, which posted graphs of this data. This graph on the online publication, Business Insider, website captures the mass exodus out of prime money market funds and into Treasuries: http://www.businessinsider.com/did-letting-lehman-go-crush-the-commercial-paper-market-2009-3

\textsuperscript{121} See Appendix 11.
maturities, declined sharply. As a result, the cost of issuance increased significantly and the volume of outstanding paper fell dramatically. More important, the term structure of the market changed. In the Lehman aftermath, more than 75% of commercial paper financing was rolled over each day, leaving the market extremely vulnerable to additional liquidity shocks. The shock of Lehman’s bankruptcy exacerbated market uncertainty. Investors became increasingly risk averse in not only the type of financial assets, but also the term of their assets. In other words, extreme uncertainty of the future deterred investors from long term commitments. This left the commercial paper market dangerously exposed to additional bank runs.

**Commercial Paper Funding Facility (CPFF)**

Because an increasing number of firms and non-bank financial institutions relied on the commercial paper market for short term funding, a severe disruption would greatly disturb the broader economy, exacerbating liquidity and solvency pressures. Again, the Federal Reserve intervened as lender-of-last resort to reduce these strains. On October 27, 2008, the central bank introduced the Commercial Paper Funding Facility (CPFF), which, in essence, extends discount window privileges to all issuers of commercial paper, regardless of their nature. In other words, the lender-of-last resort now assisted non-banks, an unprecedented responsibility outside the central bank’s traditional authority.

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122 See Appendix 12.
The Commercial Paper Funding Facility lent to corporations and finance companies that were traditionally excluded from the central bank’s open market operations. With the help of experienced private sector institutions, the Federal Reserve created yet another special purpose vehicle, CPFF LLC. Borrowing from the Federal Reserve Bank of New York, the limited liability corporation CPFF would enter the commercial paper market to purchase new issues, especially longer maturities ones. This would place downward pressure on funding costs and perhaps encourage a return of private investment. The limited liability corporation would accumulate interest on the paper until maturity, when the issuer repays the entire principal value. On the other hand, holding onto these assets would substantially increase the Fed’s exposure to the risk of default. Requiring collateral to satisfactorily secure the transaction and imposing haircuts on the pledged collateral were two solutions the Fed used to dampen their credit risk. Moreover, issuers who wished to participate were required to register with CPFF LLC, enabling the Fed to review the issuer’s credit quality and impose a transaction cost. This ensured that issuers applied for the liquidity support either because they found issuing to the facility, inclusive of all upfront costs, economic relative to private sector alternatives, or they found value in holding a contingency that allowed an issuer to access another source of liquidity.

124 Ibid.
By providing an additional channel of liquidity for companies outside the sphere of finance, the Commercial Paper Funding Facility helped stabilize credit flows. One metric of success for this program is its popularity: the amount of assets in the Fed’s special purpose vehicle as a percentage of total commercial paper outstanding in the market. Corporations who sell commercial paper to the Fed would do so only when (even with the upfront costs and the perception of weakness) it is more economic than private sector funding alternatives. Indeed, issuers lined up for this emergency program because market commercial paper rates became prohibitively expensive.\(^{125}\) The facility’s assets grew rapidly at inception, indicating strong demand. In the first week of operation, it bought $114 billion; it held $293 billion after one month and peaked in January 2009, exactly three months after the first issuance date, with approximately $350 billion in commercial paper held by the Fed’s special purpose vehicle.\(^{126}\) At the time, that was over 20% of the entire market.\(^{127}\) The explosion of assets in CPFF LLC contributed significantly to the trebling of the size of the Fed balance sheet. Relative to other newly created liquidity facilities or outright purchases, the CPFF had, on net, one of the largest impacts on the Fed’s balance sheet growth.

\(^{125}\) Ibid, 29-34.
\(^{126}\) Ibid.
\(^{127}\) See Appendix 12.
The Tyrant’s Plea: Extraordinary Circumstances Call for Extraordinary Measures

Central bankers seemed to have learned the lessons of the Great Depression. According to the monetarist Milton Friedman, the central causes of the Great Depression were bank failures and monetary tightening. The Federal Reserve, this time around, avoided a systematic failure of the banking system by addressing acute liquidity shortages. The enhanced discount window, the Term Auction Facility (TAF), the Term Securities Loan Facility (TSLF), and the Commercial Paper Funding Facility (CPFF) provided contingency funding to either specific institutions or entire markets. The Fed even expanded its list of counterparties to include normally excluded agents like primary dealers, finance companies, and corporations. Simultaneously, the Fed aggressively expanded its monetary base. It trebled the size of its balance sheet to $2.3 trillion through open market operations (the bread and butter of monetary policy), through secured loans that facilitated orderly wind-downs of systemically significant financial institutions (actions justified under lender-of-last resort), and finally through outright purchases of securitized assets in the open market (an unprecedented authority).

The final policy tool of direct purchases of asset-backed debt in the open market, however, required the aid of U.S. Treasury, and needed Congressional

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128 As Friedman and Schwartz argue in their influential book, *A Monetary History of the United States* (1963), the severity of the Great Depression was caused by a systemic collapse of the banking system. Depository institutions from New York to San Francisco faced bank runs. The principal root of the length of the Depression was inept monetary policy. Not only was the U.S. dollar fixed to the gold standard, but the Federal Reserve prematurely contracted the monetary base, creating a “double-dip” depression, or two severe recessions.
approval. Outright transactions aimed at affecting the market prices of financial assets that are not Treasury securities were quite controversial. Resembling fiscal intervention, such measures escaped the scope of monetary policy. Perhaps the central bank could have once again resorted to section 13.3 of the Federal Reserve Act – which granted the Fed the authority to lend cheaply to any individuals, partnerships, and corporations in “unusual and exigent circumstances” – to conjure legitimacy for the direct purchase of asset-backed securities. Section 13.3 was the pretext that justified all their emergency liquidity facilities. But such a bold, unilateral move could have faced severe political scrutiny, fueling Congressional outrage about an ever-encroaching central bank. To save securitization, the central bank had to go beyond broad provisions of liquidity backstops and instead directly support the purchase of asset-backed debt.

Even with the Fed’s ad hoc liquidity facilities, the economy was in free fall. The securitization ground to a complete halt at the height of the financial turmoil. From October 2008 to January 2009, not a single loan was securitized.129 The sustained drop in the Case-Shiller 20 city index indicated a rapidly deteriorating residential real estate market with no sight of the trough.130 Likewise, stock market indices continued to hemorrhage value. Financial stocks in particular took a hammering.131 Unhealthy banks (which served as traditional financial intermediaries) and collapsed funding markets (which served as the twenty-first

129 See Appendix 13.
130 See Appendix 14.
131 See Appendix 15.
century links connecting savings and investments) served as twin plagues infecting the broader economy. As a student of the Great Depression, Ben Bernanke was absolutely keen on avoiding a second depression. Credit must flow to the hands of consumers and investors in order for a sustained economic recovery. The Fed had exhausted all its ad hoc liquidity measures. The central bank needed a systematic plan to address lending. Following the footsteps of the Bank of Sweden and the Bank of Japan, Bernanke desired a partial nationalization of the U.S. banking system. The support of U.S. Treasury and the approval of Congress, however, were necessary to do so. Only then could it effectively reinvigorate securitization. Only then could Bernanke’s Fed steer the U.S. economy away from a repeat of history.

Astonished by the post-Lehman conflagration and confronted by credit-constrained constituents, the federal government responded swiftly and drastically to the financial crisis.\textsuperscript{132} Through the Emergency Economic Stabilization Act, Congress granted both the Federal Reserve and U.S. Treasury expanded powers to stabilize the financial markets.\textsuperscript{133} It expanded the Federal Reserve’s role as lender-of-last resort by giving it the right to purchase troubled assets. It also offered a partner for this massive venture, U.S. Treasury. The act provided both institutions broad and flexible authorities to buy or guarantee up to $700 billion in “troubled assets,” which included mortgages and mortgage-related assets, and any other financial instrument or institution whose purchase Treasury determined was needed.

to stabilize the markets.134 This program came to be known as TARP, the Troubled Asset Relief Program. In essence, TARP partially nationalized the U.S. banking system. See appendix 16 for a table detailing TARP’s exact allocation of funds.

**The Troubled Asset Relief Program (TARP)**

The Troubled Asset Relief Program gave U.S. Treasury $700 billion and comprehensive authority to unfreeze the credit markets. Treasury immediately allocated over a third of that money towards a massive injection of capital into the financial system. Realized and potential losses on mortgage related assets ate up the thin capital of leveraged financial institutions. This jeopardized not only the health of individual institutions, but also the flow of credit to the broader economy. A massive capital infusion became the primary vehicle for stabilizing the markets. With greater capital, the financial system becomes more resilient to further macroeconomic deterioration and additional write-downs in asset values. This was the underlying logic behind the $250 billion capital purchase plan (CPP).

At its core, the capital purchase plan was a partial nationalization of the banking system. Uncle Sam became a preferred equity shareholder in many of the nation’s most important financial institutions. On October 28, 2008 U.S. Treasury initiated the program by purchasing $115 billion in preferred stock and warrants from nine of the nation’s top financial institutions. On November 14, 2008, it purchased an additional $33.6 billion in preferred stock and warrants from another

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134 Section 102 of the act, 12 U.S.C. § 5212, authorizes Treasury to guarantee troubled assets originated or issued prior to March 14, 2008, including mortgage-backed securities, asset-backed securities, and other agency debt.
21 financial institutions. By the end of March 2009, U.S. Treasury had invested almost $198.8 billion in preferred shares of 532 financial institutions. The types of firms that had received capital injections include 272 publicly held institutions, 248 privately held institutions, and 12 community development financial institutions.\(^{135}\)

The terms of the capital purchase program extended beyond simple equity injections; they also included limitations on executive compensation, dividends, and stock repurchases. Participating institutions were required to comply with stringent demands set by the government. Requirements unrelated to executive compensation focused on protecting the government’s massive investment. The deal was structured to minimize the credit risk of Treasury’s investment and to maximize returns for taxpayers. The taxpayer became the preferred shareholder with special rights and privileges over other shareholders. In addition, Treasury expanded their supervisory oversight, demanding firms to raise capital and reduce leverage. Through the capital assistance program, Treasury advised firms on how much Tier 1 capital in excess of regulatory requirements they needed to weather an even worse economic storm.\(^{136}\) This was the supervisory capital assessment program known as the bank stress tests. If institutions lacked sufficient capital in the eyes of the government, then they had to raise additional capital, either by selling assets on


\(^{136}\) According to the Bank of International Settlement’s Basel II capital requirements, which U.S. banks are subject to, all banks must maintain at least 6% of assets in Tier 1 capital. Tier 1 capital includes common stockholder’s equity, qualifying perpetual preferred stock, certain minority interests, and trust preferred securities. Two-thirds of the required Tier 1 capital (or 4% of total assets) must take the form of common capital, the first line of defense in the event of losses. Banks can always have capital above the required levels. However, doing so reduces the ability to expand balance sheets in order to profit.
their balance sheet or issuing more common stock. Treasury made sure that if economic conditions deteriorated, i.e., if the unemployment and loan loss rates reached double digits, each financial institution would be adequately capitalized to not only survive, but continue lending.

The rest of the Troubled Asset Relief Program targeted failing “systemically significant” institutions such as AIG and the Detroit automakers, distressed homeowners, and troubled mortgage-related assets. TARP allocated $70 billion to the rescue of one particular financial institution: AIG. Like the case with Bear Stearns, the efforts to save AIG were efforts to place a price floor in their mortgage portfolio. On November 10, 2008, the Federal Reserve Board and U.S. Treasury agreed to provide broad financial assistance to AIG, an international insurance company, to assist in their restructuring process. Under lender-of-last resort authority, the Federal Reserve Bank of New York lent $22.5 billion to a newly formed Delaware special purpose vehicle, Maiden Lane II LLC, to fund the purchase of residential mortgage-backed securities from the securities lending portfolio of several regulated AIG subsidiaries. The New York Fed created another limited liability company, Maiden Lane III LLC, to fund the purchase of certain multi-sector collateralized debt obligations from certain counterparties of AIG Financial Products Corp. Maiden Lane III borrowed approximately $24.3 billion to purchase the asset portfolio of collateralized debt obligations. In addition, Maiden Lane III paid another $29.6 billion to the counterparties of AIG Financial Products to terminate their credit default swap contracts.
Other TARP programs that deserve note are the “bailouts” of Detroit, the home affordability plan, and the Term Asset-backed Securities Loan Facility. The goal of the automotive industry financing program was to prevent a significant deterioration of the American automotive industry, which would pose a systemic risk to the country’s financial system.\textsuperscript{137} Even though General Motors and Chrysler were not financial intermediaries per se, they each had large financing subsidiaries that underwrote automotive and even mortgage loans. General Motors Acceptance Corporation (GMAC), a subsidiary of GM, for example, is still the fifteenth largest U.S. bank holding company by assets, financing as many home mortgages and student loans as car loans.\textsuperscript{138} Using Treasury’s loans and equity investments, the automobile industry went through a painful but orderly restructuring to achieve long-term financial viability.

Treasury also intended to achieve stability in the deteriorating housing market by offering grassroots assistance to homeowners. The most significant program was the tax credit to first-time home buyers. It served both a public policy and an expansionary fiscal agenda. TARP’s home affordability plan offered a comprehensive array of assistance: state and local housing agency initiatives to expand homeownership, tax credits for home buyers, neighborhood stabilization and community development programs, mortgage modifications and refinancing,

\textsuperscript{137} Explicitly stated by U.S. Treasury on its financial stability website: \url{http://www.financialstability.gov/about/index.html}

\textsuperscript{138} The Federal Reserve System’s National Information Center on the top 50 U.S. bank holding companies: \url{http://www.ffiec.gov/nicpubweb/nicweb/Top50form.aspx}
and support for the government sponsored entities Fannie and Freddie. This program reaffirmed public policy goals. Despite the contribution of the speculative housing bubble to the crisis, the federal government still firmly supported the idea of a property-owning democracy. The housing initiative had become woven into the fabric of American society.

The Term Asset-Backed Security Loan Facility (TALF)

By far, the program with the largest, as well as longest, impact on the Fed’s balance sheet, and the one that specifically targeted the collapsed securitization market was the Term Asset-backed Security Loan Facility, or TALF. With congressional approval from the Emergency Economic Stabilization Act, the central bank extended the scope of its lender-of-last resort authority and directly targeted the asset-backed securities market. Over the past two decades, asset-backed securities became a dominant means by which financial institutions funded loans to businesses and households. According to Federal Reserve data, over a quarter of all consumer credit in the years leading up to the crisis was funded through securitization. The tranching of risk and the subordination of debt attracted both risk-averse and risk-loving investors. Mortgages, commercial real estate loans, credit card loans, student loans, vehicle leases, and equipment leases were typical assets that were securitized. The boom in securitization substantially increased the availability of credit and significantly decreased borrowing costs. After the collapse

140 Ashcraft and Schuermann, p. 37.
141 Please refer to chapter one for a primer on the securitization process.
of Lehman, in the fall of 2008, the securitization market declined precipitously before grinding to a halt. No loans were securitized in the four months from October to January!142 This meant that all borrowers in the broader economy, from students to small businesses, were severely constrained for credit.

To restore the flow of credit and to return the economy to growth, the central bank and the U.S. government needed to resuscitate securitization. Three diseases crippled the securitization market. First, institutional investors such as pension funds and endowments became extremely risk-averse and divested their money away from asset-backed securities, even the AAA-rated ones. This drastically depressed security prices and raised premiums to painful levels. Moreover, boutique investors such as hedge funds, which may otherwise be willing to invest in these securities, were deprived of traditional and repo funding. Because of their mainly speculative nature, these boutique shops were also denied access to the Fed’s numerous emergency loan facilities. And finally, the innocuous fear that a deep recession would increase defaults on loans to households and businesses reinforced investor trepidation. The realization of potential loan losses deterred investors from investing in asset-backed securities.

The Term Asset-backed Security Loan Facility (TALF) was the central bank’s vaccine for securitization. It provided up to $200 billion in collateralized loans to market participants who were willing to invest in securitized assets. By offering

142 See Appendix 13.
interest rates lower than expected returns, TALF provided a source of cheap funding to holders of asset-backed securities. It absorbed some of the credit risk in investing in this market. When it was introduced in February 2009, investors immediately took advantage. From February to December 2009, TALF-facilitated issuance of consumer asset-backed securities supported the dying market. Indeed, for seven of those months, TALF consumer ABS issuance exceeded its non-TALF counterpart. The government began to withdraw the program in January 2010. Without government support, private issuance and demand of asset-backed debt remained weak at best.

The new form of financial intermediation that became so dominant before the crisis is perhaps permanently subdued. The key question going forward is whether securitization will return. Is it dead forever? Or is it merely in a temporary coma? The answers to these questions are crucial because they provide valuable insights on the recovery in lending and, more important, on the return of consumption-driven economic growth.

\[143\] Ibid.
Securitization is Dead; Long Live Securitization

“It is evident that Adam, with all his science, would never have been able to demonstrate that the course of nature must continue uniformly the same and that the future must be conformable to the past.”

– David Hume

“Of man’s first disobedience, and the fruit
Of that forbidden tree, whose mortal taste
Brought death into the world, and all our woe,
With loss of Eden.”

– John Milton

The 2007-09 credit crunch, and the recession that followed it, mark the dawn of a painful structural rebalancing of the U.S. economy, from debt and consumption to saving and exports. For over a decade, debt-fueled consumption and investment defined U.S. economic growth. Profligate households indulged themselves with extravagant homes, autos, and consumer goods. They maxed out their credit cards, took on numerous home equity lines of credit, and reduced their personal savings. Consumer debt rose from an average of less than 80% of disposable income in 1990 to 129% in 2007. Likewise, ambitious companies – in particular, financial institutions – drastically inflated their balance sheets. They merged with rivals, purchased commercial real estate, and expanded their businesses. With assets

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146 Federal Reserve Board, household debt service and financial obligation ratios: [http://www.federalreserve.gov/releases/housedebt/default.htm](http://www.federalreserve.gov/releases/housedebt/default.htm)
147 Gramm-Leach-Bliley’s (1999) repeal of the Glass-Steagall Act (1934), which separated commercial and investment banking, gave legislative approval to the rise of behemoth broker-dealer depository institutions like Citigroup, JP Morgan Chase, and Bank of America using economies-of-scale arguments.
valued at well over 20 times their capital levels, financial behemoths such as Bank of America and Citigroup were dangerously over-leveraged during the housing boom.\textsuperscript{148} By making the financial system more interconnected, and more vulnerable to liquidity runs, excessive levels of debt amplified the pain of wealth and asset losses in the broader economy. Indeed, the scramble to strengthen household and corporate balance sheets through drastic reductions in both the demand for and the supply of credit contributed greatly to the ills of unemployment increases and output contractions during the recent recession. It was debt that made the economy so unstable.

Yet at the same time, it is difficult to claim that debt was exclusively harmful. U.S. economic growth since the Second World War has perennially been financed by debt. By granting households the ability to live beyond their current disposable income and by offering producers the capital necessary to sponsor enterprise, debt expanded a property owning democracy, raised American standards of living, supported technological innovation, and nourished corporate entrepreneurship. Within America’s ivied citadels, prevailing theories from both the New Classical and the New Keynesian schools gave merit to such profligacy. Under the assumption that future income will exceed current income, the life cycle hypothesis encouraged inter-temporal borrowing in order to smooth out lifetime consumption — in mathematical jargon, inter-temporal consumption smoothing maximizes lifetime

\textsuperscript{148} The Federal Reserve’s National Information Center, quarterly balance sheet data on Bank of America and Citigroup: \url{http://www.ffiec.gov/nicpubweb/nicweb/Top50form.aspx}
utility given diminishing utility functions. Likewise, the paradox of thrift — which highlights how individual frugality can siphon aggregate economic life, contracting demand and exacerbating gluts — remained a cornerstone of Keynesian ideology. And resembling the constituents they represent, local, state and federal governments also discarded the restraints of frugality in favor of deficit spending on foreign wars, health care, old age pensions, pork projects, and low taxes.

From budget deficits to current account deficits, securitization financed America’s deficit spending. The bundling of loans into risk-tranched financial assets that could be sold to investors from Albuquerque to Anchorage and from Berlin to Beijing became the increasingly dominant form of financial intermediation, connecting frugal savers and prodigal consumers regardless of time zone. Extravagant homes with twelve-foot ceilings, sweeping staircases, and granite countertops serve as only one example of America’s debt-fueled binge. The Marxist claim that the developed West siphoned from the developing rest to fund consumer lifestyles deserves only partial merit. Indeed the thrifty East Asian economies and the oil-rich Arab states channeled a great portion of their savings into mortgage-backed, asset-backed, and Treasury securities, funding U.S. private and public debt. But domestic investors from university endowments to public pensions also channeled their capital into these securities, chasing excess return or, in financial jargon, alpha.
The cheap credit prevalent during the last decade was one primary symptom of securitization. Again, subprime home mortgages are but one example of the ease in acquiring loans. Financial institutions also extended credit to households through credit cards, auto loans, and home equity loans (also known as junior liens, second mortgages). Alan Greenspan’s critics often accuse the Federal Reserve’s over-extended lax monetary policy after the dotcom market bubble burst as a source of cheap money. This accusation, however, fails to acknowledge that even as the Greenspan Fed began raising target benchmark interest rates starting in June 2004, lending standards, most notably the ones for home loans, continued to deteriorate, and at a faster rate.\(^{149}\) Riskier Alt-A and subprime loans grew in size and volume. Moreover, banks required less stringent income documentation and lower credit scores for loan approvals. This is in stark contrast to the “It’s a Wonderful Life” model of financial intermediation, in which local banks and thrift institutions frisked their customers thoroughly before approving a loan. The incentives to prudent lending eroded as banks were able to sell assets from their balance sheets to non-local investors. Without information symmetry between the loan originator in Nashville, the mortgage-backed security issuer in New York, and the asset manager in Nice, securitization created a classic lemons problem: originators could remove and sell bad loans from balance sheets while keeping good ones.

One fascinating tension in securitization is the clash between depersonalization and personalization. Securitization, on one hand, depersonalizes

\(^{149}\) See Appendices 1 and 2.
individual loans that tell life stories of first-time homebuyers or middle income households into stoic bonds discerned by risk and return that cater to investors’ risk appetites. Though one can shed tears about this loss in sentimental value and complain about how soul-deprived financial capitalism is, the more important concern about depersonalization involves the decreasing significance of the characteristics of the borrower (whether household or firm) in the process of financial intermediation. Under securitization, borrowers are no longer judged worthy by conventional ability-to-pay metrics such as level of income, credit history, and FICO score. Instead, all that matters is collateral: whether the collateral is valuable enough to protect the lender if the borrower defaults. Collateral becomes the number one metric in determining whether loans should be extended. During the housing boom, lenders were less interested in the quality of the borrower than the quality of the underlying collateral. Credit continued to flow so long as house prices, the value of the underlying collateral, continued to rise. Indeed, this insatiable appetite for collateral also applies to shadow banking. By creating a plethora of AAA-rated, supposedly risk-free securities, securitization provided the collateral needed for the expansion of the overnight funds market. At its core, the repo market is an exchange of agreements for the purchase and repurchase of collateral. Loans were secured by the value of the underlying collateral rather than by the borrower’s ability to repay. The possession of widely accepted, AAA-rated asset-backed securities enabled highly leveraged, 20 times asset-to-equity ratio, firms like Citigroup and Lehman Brothers to accumulate more debt. Lending
activities ceased the moment market confidence in the collateral collapsed. When lenders deemed their borrowers too risky, they simply demanded additional collateral of greater value and volume by imposing haircuts. The soundness of institutions came second to the value of collateral. Rather than outright refuse loans to institutions with high indebtedness, low capital buffers, and poor quarterly performance, lenders demanded additional collateral to secure their loans. The latter compensated for the former.

Yet paradoxically, securitization also emphasizes personalization. It allowed homebuyers to customize the size, interest rate, and refinancing terms on loans. Banks offered financially unsophisticated customers increasingly exotic products with derivative-like features such as the negatively amortizing 2/28 interest-only option adjustable-rate mortgage (which required only interest payments in the initial 2 years while the principal of the loan grew over that time). Skeptics argue that these complex financial products, with their many pages of subtext, overwhelmed financially unsophisticated borrowers, fueling predatory lending. This is true if lenders misled customers or restricted borrowers from simpler fixed rate loans. However, one can make the argument that by structuring the loan in accordance with current and future stages of income, more people could tap the capital markets. Indeed, the young couple in the market for their first home can find the hybrid 2/28 interest-only option ARM an attractive option. Likewise, an immigrant family with little disposable income can find the longer 40-year ARM
tremendously appealing. Unbound by balance sheet constraints, lenders could more freely (and recklessly) allocate capital.

Without securitization, i.e., if banks had to hold mortgages until maturity, they would not offer the same degree of loan customization. Investors channeled capital into these exotic loans despite their increased risk for two reasons: first, they were protected from potential losses through the growing value of the underlying collateral (the house), and second, the process of pooling offered protection from idiosyncratic risk. So long as house prices continued to appreciate, credit flowed. Moreover, the aggregation of geographically dispersed loans sated investors’ increased risk tolerance. Theory states that the pooling process, through the law of large numbers, would normalize the distribution of losses and dampen idiosyncratic risk. One single 2/28 interest-only ARM, or even a dozen 2/28 interest-only ARMs, suffers from tremendous idiosyncratic risk. It is an extremely risky investment with a skewed penchant for potential losses. However, the bundling of 1000 ARMs throughout the country dampens the probability of losses and normalizes the distribution of losses. Thus, the law of large numbers, in addition to the subordinated debt structure that offered various risk-return tranches, allowed the end investor to tweak his investment in accordance with his risk tolerance. On the other end of the spectrum, it granted the original borrower expanded bargaining power over the terms of his loan. In theory, personalization should have more efficiently connected savings and investments, creating only welfare-expanding extensions of credit. In practice, however, human frailty barred this possibility.
Securitization died at the height of the financial turmoil, during the fall of 2008. For five months, not a single loan was securitized.\footnote{See Appendix 13.} Securitization was resuscitated only through the government’s TALF program.\footnote{See previous chapter for a detailed description of the Term Asset-backed Security Loan Facility (TALF).} Even so, private issuance of consumer asset-backed securities remains weak relative to government-funded issuance. And outside of the government sponsored housing entities, Fannie, Freddie, and Ginnie, mortgage-backed security issuance remains non-existent.

This new form of financial intermediation that funded a substantial portion of consumer credit prior to the crisis astonishingly ground to a halt. As a result, the broader economy experienced a prolonged and severe contraction of credit. Households, large corporations, and small businesses all faced greater financing costs. Standards and terms on consumer loans, for example, tightened significantly throughout 2009.\footnote{Federal Reserve Board, “Semi-Annual Monetary Report to Congress” (Feb. 2010), p. 15.} Credit card companies across-the-board have reduced credit limits and raised interest rates.\footnote{According to a special report on America’s economy in the April 3rd, 2010 edition of The Economist, the number of credit cards in circulation has declined by almost a fifth. American Express, a leading credit card company for the more affluent, is pulling back from credit cards and issuing charge cards, which must be paid off in full every month. They are even consulting their customers on how to control spending. See article on: http://www.economist.com/specialreports/displaystory.cfm?story_id=15793036} Likewise, lending activity for commercial and industrial loans, commercial real estate loans, and small business loans remained weak even as U.S. economic growth returned in the third quarter of last year.\footnote{Federal Reserve Board, pp. 17-9.} In monthly surveys conducted by the National Federation of Independent Business, the net fraction of small businesses reporting that credit had become more difficult to
obtain hovered at an elevated 15% throughout last year.\textsuperscript{155} It is extremely disconcerting that even as the central bank trebled its balance sheet to over $2.3 trillion, aggressively pumping money into the economy, and even after U.S. Treasury injected $250 billion of capital into the banking system, strengthening bank balance sheets to deter the precautionary hoarding of cash, borrowing costs remained abnormally high and lending activity abnormally low relative to pre-crisis levels. Subdued lending is the legacy of securitization’s death.

\textbf{Securitization 2.0}

The author will not so boldly claim that securitization is dead forever. Weakness in lending is a consequence of both supply and demand. Surviving the recession, consumers and businesses, in addition to banks, are tightening their belts. Households have reached the limits of leverage on their balance sheets. With depressed home prices, net losses in investment portfolios, less disposable income, and increased personal savings, consumers are less likely to binge at the shopping mall using credit cards. Likewise, businesses are less likely to borrow and invest because of weak aggregate demand. Perhaps securitization only entered into a coma.

If securitization does indeed spring back to life, reinvigorating the flow of credit in the economy, policymakers should enforce minor regulatory changes in order to protect the financially unsophisticated consumer from predatory lending, to reduce information asymmetry throughout the various links in the securitization

\textsuperscript{155} See Appendix 18.
chain, and, in general, to limit welfare-reducing extensions of credit in the economy. The ability to sell traditional held-to-maturity assets eroded the incentives for prudent lending, encouraging banks to lend recklessly. Banks booked origination fees and profited during the housing boom by “passing the buck” to ABS issuers on Wall Street. They were able to hold good loans until maturity and sell bad loans to investors, creating a classic lemons problem.

To deter reckless lending, more “skin in the game” is necessary. In other words, prudent lending must be in the interest of the lender. One can compellingly argue that issuing 2/28 adjustable-rate mortgages to young couples with assets are reasonably risky, whereas it is much more difficult to justify issuing the same type of loan to borrowers without incomes, jobs or assets in order to book commission fees. To discourage reckless lending, lenders must be required to retain a portion of each loan on their balance sheets. For example, if lenders are required to retain 10% of every loan, they too would feel the pains of default. They would therefore lend more conservatively (though not as stringently as they would if they could not securitize the asset at all). Moreover, the Federal Reserve and other regulators demand contingency capital from each bank in order to ensure that potential losses would not lead a bank into bankruptcy. These are known as loan loss reserves, or capital buffers that protect banks from losses. By increasing the required money each bank must set aside to cover losses, regulators can also deter reckless lending. More “skin in the game” can preserve the merits of securitization (greater lending and more personalization) and also mitigate its ills (principal-agent and lemons problems).
Decreased information asymmetry can also deter financial intermediaries from fooling the borrower or the final investor. Exotic loans (like the negatively amortizing 2/28 interest-only option adjustable-rate mortgage) could be welfare-enhancing if counterparties, the borrower as well as the lender, fully grasp the conditions. During the housing boom, however, financially unsophisticated borrowers were persuaded into purchasing more complex loans without fully understanding all the terms and nuances. They understood the low teaser rates for the initial years but were baffled about when or how interest rates would reset. This led to many welfare-decreasing extensions of credit, as interest rate shocks triggered unaffordable rises in monthly payments, which triggered mortgage delinquencies and home foreclosures. The depreciation of home prices accelerated this process, as the borrower could no longer easily refinance his mortgage or sell his home.

Information asymmetry also plagued the next link in the chain between the original lender and the asset-backed security issuer. The local thrift, unlike the Wall Street investment bank, knew better the borrowers’ credit history, level of income, and value of assets. They had the incentive, however, to not disclose all relevant information the loans they sold to Wall Street.

A consumer financial protection agency that mandates a standardized form of information disclosure can establish transparency throughout the long securitization chain. This single primary federal consumer protection supervisor,
through periodic reviews of lending activities, can collect vital information on batches of loans such as the average FICO score and the average combined loan-to-value. Although this information is sometimes available through surveys conducted by trade magazines (such as *Inside Mortgage Finance* and *Loan Performance*), it is neither frequent nor systematic. Robust public disclosure of this information could help reduce some of the principal-agent problems that currently plague securitization. To protect the financially unsophisticated borrower from welfare-reducing extensions of credit, this consumer financial protection agency can also require that lenders reasonably communicate to their customers all the complex terms and conditions of their financial products. This includes a balanced presentation of the benefits of exotic types of loans, and a clear and conspicuous identification of their costs, penalties, and risks. Lenders should offer “plain vanilla” products that are simpler, with straightforward pricing, as prominently alongside their exotic brethren. A standardized information system similar to the Food and Drug Information’s nutrition tables would work well with financial products. Because of the incentives to conceal or to distort information, market participants will fail at making this process more transparent. Regulators must therefore take the initiative to make securitization a sustainable, welfare-increasing form of financial intermediation. Improving incentives for all agents in this process is merely the first step to creating a more resilient financial system.
Fixing Finance

Four inter-related factors directly contributed to the financial crisis: inadequate macro-prudential supervision by the Federal Reserve and other U.S. regulators; amplifying mechanisms that intensified euphoria during the boom and exacerbated the credit crunch during the bust; the increasing dependence on overnight, shadow banking; and the dangerous combination of debt and deflation. There are effective reforms that could address each issue. These reforms could strengthen the entire financial system and enhance its resilience to shocks in asset prices, institutional failures, and liquidity freezes. Because finance is so dependent on government to save it from the tyrannies of its own passions, its self-inflicted greed and fear, and because the collapse of finance is so devastating to the broader economy, it is difficult to argue that finance does not require greater government intervention. Just as the need for extremely accommodating monetary policies in banking crises was a lesson of the Great Depression, greater government supervision of financial intermediation was a lesson of the “Great Recession.”

The Federal Reserve’s passive stance on asset bubbles deserves much of the blame for the U.S. residential real estate bubble. Although asset bubbles differ in their causes, features, duration, and severity, the underlying pattern of price displacements significantly above or below fundamental forces of supply and demand is a recurring pattern. In other words, drastic price fluctuations stripped of economic fundamentals define asset bubbles. Gripped by collective euphoria or irrational fear, market participants overshoot and undershoot asset values. The
central bank’s dominant view before the crisis was that monetary policy can only be reactive, rather than proactive. In other words, central banks can neither identify nor prevent asset bubbles. Like janitors of the economy, they can only clean up after asset bubbles burst, at best, containing the contagion.

Proponents of this view claim two reasons of support. First, asset bubbles are hard to identify as they are inflating. What is the fundamental value of an asset? How much must an asset deviate from its fundamental value for it to be considered a bubble? Why is the central bank better at identifying bubbles than millions of market participants? It is easy to condemn policymakers for inactivity with the benefit of hindsight. It is much more difficult to escape the grip of collective euphoria in the heat of the moment. Second, conventional monetary policy, the setting of benchmark interest rates, is ill-suited to respond to bubbles. Raising the target Fed funds rate in suspicion of a looming speculative bubble, for example, would contract economic activity in the broader economy regardless of whether the bubble was correctly identified. The costs of contracting the money supply to control potential bubbles may outweigh the benefits. This is because monetary policy is a

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156 In 2005, for example, during the height of housing bubble, then Fed chairman Alan Greenspan refuted the claim that a nationwide housing bubble was developing under his watch, submitting only to the possibility of a froth of small regional bubbles. See The New York Times, “Greenspan is Concerned About Froth in Housing,” May 21, 2005: http://www.nytimes.com/2005/05/21/business/21fed.html

157 In the last decade and a half, the U.S. economy experienced two speculative asset bubbles, internet start-ups and residential real estate. Alan Greenspan’s Federal Reserve failed to preemptively puncture either. According to a strict interpretation of the Federal Reserve Act, asset-price inflation (in stocks, houses, gold, etc.) is excluded from the dual Congressional mandate of price stability and full employment. However, it is reasonable to argue that because extreme fluctuations in asset prices affect broader macroeconomic variables such as growth and inflation, the central bank should also mitigate wild swings in asset prices. Indeed, this can be considered one responsibility of the lender-of-last resort.
very broad tool that affects all economic sectors. Thus, monetarists argue that the Federal Reserve should only respond to speculative booms if asset bubbles affect the broader growth or inflation outlook. If the correlation between the two factors is weak, then the central bank should only be responsible for the cleanup. This reactive style of policymaking can be viewed as a response to the failure of aggressive monetary tweaking during the 1970s. Furthermore, New Classical economic theories such as the efficient market hypothesis substantiated this reactive style of policymaking: the central bank knows no better than the aggregate market; all prices accurately reflect all currently available public information.

Reactive monetary policy must be critically evaluated. The central bank can and should deflate speculative bubbles. The costs of inaction, of sitting idle until bubbles burst, are too excessive. As the supervisor of bank holding companies, the steward of macroeconomic stability, and a pioneer of national economic research, the Federal Reserve Board and its many regional branches have more tools and information than most institutions, public or private, at identifying asset bubbles. The claim that bubbles are impossible to identify, even during their later stages, is a gross exaggeration. Many micro and macro metrics can detect abnormally excessive increases or decreases in asset values that hold no truth in governing fundamentals. The U.S. residential real estate bubble, for example, was identified by many as early as 2005 through the study of deteriorating lending standards, compressed risk spreads, high debt-to-equity leverage ratios, and rapid home price appreciation.
above and beyond the growth of income. The inability to identify a bubble is different from the refusal to acknowledge one.  

There are instruments in the central bank’s arsenal that do not involve monetary policy that could diffuse asset bubbles without substantial tradeoffs to output growth, fully employment, and price stability. If existing instruments are inadequate, then perhaps additional supervisory tools that increase the cost of speculative borrowing such as leverage limits and collateral and haircut requirements might effectively temper the euphoric demand for hyper-inflated assets. If all else fails, the brilliant minds working at the Federal Reserve could simply give a well-supported warning of the dangers of an incipient bubble. Because asset bubbles vary in nature, magnitude, and timing, there are many ways of identifying and responding to speculative excesses. For example, the appropriate response to an equity bubble differs from that of a credit bubble: bubbles inflated by borrowed money are infinitely more catastrophic. Likewise, policy responses also depend on whether the bubble is incipient or mature. With the advantage of broad macro-prudential oversight, the Federal Reserve can discern and address alarming trends in the market. It may make mistakes by incorrectly identifying and over-reacting to speculative bubbles. Nevertheless, between inaction and mistake, error may be the more palatable option under cost-benefit calculus.

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158 On October 23, 2008, during the height of the credit crunch, the former Fed chairman Alan Greenspan acknowledged to the House Committee on Oversight and Government Reform that he placed too much faith in the market’s price mechanism, acknowledging that there was indeed a housing bubble. See The New York Times, “Greenspan Concedes Error on Regulation,” October 23, 2008: [http://www.nytimes.com/2008/10/24/business/economy/24panel.html](http://www.nytimes.com/2008/10/24/business/economy/24panel.html)
Amplifying forces that were individually rational but collectively destructive also plagued the interconnected financial system, intensifying institutional and systemic instability. With Gramm-Leach-Bliley’s repeal of the Glass-Steagall Act in 1999, many deposit-taking banks drastically expanded their businesses into securities trading, investment broking, wealth management, and insurance underwriting. Modern financial behemoths like Bank of America, JPMorgan Chase, and Citigroup – each with over $2 trillion in total assets – expanded aggressively to gain a competitive advantage. Although economies-of-scale do exist for large, interconnected firms dabbling in many global businesses, their failure, however remote, may freeze the flow of credit, creating problems of moral hazard and systemic risk. Too-big-to-fail, or more accurately, too-interconnected-to-liquidate immediately, created the risk that the failure of one firm would drag the entire financial system down a precipice. Too-big-to-fail also raised moral hazard issues: the tacit government backstop enabled larger firms to achieve lower funding costs relative to their smaller counterparts. Firms therefore held the perverse incentive to expand aggressively, not to gain greater efficiency, but to acquire that privilege.

Likewise, skewed compensation schemes and dividend payments also created negative feedback loops. During the boom, an increasingly large share of employee compensation, particularly for top executives, was tied to short-term revenue generation (such as mortgage origination fees and trading-book profits), rather than long-term, sustained profitability through the business cycle. This incentivized reckless risk-taking by individual employees that was eventually harmful
to both the firm and the system. Equity repurchases to indicate strength also backfired. For example, during the months before its demise, Lehman Brothers paid dividends and repurchased stock to indicate strength to the market. Perhaps in the short run it worked. In the end, however, the equity repurchases depleted precious capital, leaving the firm more vulnerable to sudden write-downs in asset values and withdrawals in credit lines.

A more destructive force was the impact of uncertainty on short-term collateralized lending. Securitization created an abundance of highly-rated debt securities that were pledged as collateral to secure additional debt in the interbank and commercial paper markets. After the collapse of housing, the poor performance on these highly-rated debt securities – due to higher mortgage delinquencies and foreclosure rates – triggered widespread credit downgrades. These credit downgrades led to increased collateral demands (calls for greater and safer collateral) which intensified the pressure on scarce liquidity resources. Capital-depleted firms were forced to sell their assets at distressed prices, which further weakened the firms, exposing them to even more collateral calls. The liquidation of troubled assets at fire sale prices by distressed firms forced healthy firms to also mark-down the same assets on their balance sheets, triggering more collateral calls across the financial system. When uncertainty about true asset values led to increased haircuts, the result was a vicious cycle of forced asset sales, higher volatility, and still higher haircuts.
A more resilient financial system requires countervailing forces that could dampen these vicious cycles. Though the author cannot engineer away all these amplifying forces in our financial system, he can provide a few feasible solutions. Ironically, all firms could use counter-cyclical Arrow-Debreu state-contingent claims to reduce the shock of a sudden withdrawal of credit. As their name implies, the state-contingent claims would act like financial derivatives, kicking in only under certain predetermined conditions.

Contingent convertible debt, also known as coco bonds, is one state-contingent instrument that could reduce a firm’s liquidity pressures under distressed conditions. A recurring problem during the crisis was an across-the-board reluctance to raise sufficient capital, by cutting dividends or issuing more stock, in order to withstand particularly adverse economic conditions. This reluctance stemmed, in part, from the perception that raising capital indicated weakness, and, in part, from management’s unwillingness to dilute equity shares. The reluctance led to greater uncertainty about the strength of banks’ capital positions, which, in turn increased concerns about counterparty risk and exacerbated the market’s scramble for liquidity. The hybrid nature of coco bonds could simultaneously ease liquidity constraints and strengthen incentives for prudent risk management. Contingent convertible debt would be debt instruments in “good” states of the world, but would automatically convert into common equity at predetermined trigger levels in

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159 Often, senior management had large personal stakes in the company as shareholders. Because issuing additional stock could depress their personal equity portfolios, management had the incentive not to strengthen firms’ capital buffers.
“bad” states of the world. These triggers could be tied either to firm-specific warnings, such as excessive leverage ratios, or market-wide metrics, such as spikes in the LIBOR-overnight-index swap (OIS) spread (which reflect abnormal shocks in interbank borrowing costs). And because coco bonds would automatically dilute shareholders’ value if the firm encountered short-term funding difficulties, management could be incentivized to avoid these bad outcomes. A regulatory mandate of specific levels of contingent capital, depending on institutional size, nature, and level of interconnectedness, could ensure a sufficient supply of capital during times of economic and financial distress.

The amount of capital necessary to protect a firm from rapidly depreciating asset prices, sudden withdrawals of short-term credit, and adverse economic conditions depends on the firm’s size, nature, and level of interconnectedness. Because their failure can pose a systemic risk to the entire financial system, “systemically significant” firms should face more stringent capital requirements, liquidity buffers, and regulatory supervision. Although the characteristic “systemically significant” is difficult to define, the general rule that larger firms should, on-the-margin, have more common equity holds. Thus, capital requirements must not only be countercyclical (like contingent convertible debt) but also countervailing. In other words, firms with larger balance sheets and more businesses should hold a greater portion of their total assets in capital. Under Basel II capital adequacy standards, all financial institutions, regardless of size or level of interconnectedness, must hold 6% of total assets in Tier 1 capital, and 4% in Tier 1
common equity. This meant, for example, that even though Wells Fargo held seven times the value of total assets on its balance sheet relative to both Webster Financial Corporation ($1.23 trillion relative to $17.7 billion), both institutions had the same capital-to-assets ratio. This failed to capture the exponential risk embedded in larger, more interconnected firms.

Because we live in a nonlinear, dynamic world with deterministic unpredictability, a better capital requirement scheme would share the qualities of a progressive tax system, in which larger firms would hold a larger proportion of equity reserves relative to their smaller peers. The author strongly believes that size and risk follow a power law model (similar to the Richter scale), rather than a simple arithmetic one. Not only would a progressive capital requirement scheme strengthen the shock absorbers of systemically significant institutions, but reduce the moral hazard that larger institutions are more likely to be “bailed out” simply because of their size. In general, greater capital across-the-board would create a stronger financial system because the institutions within are more able to withstand shocks such as losses in asset values, liquidity freezes, and eroding economic conditions.

160 According to the Bank of International Settlement’s Basel II capital requirements, which U.S. banks are subject to, all banks must maintain at least 6% of assets in Tier 1 capital. Tier 1 capital includes common stockholder’s equity, qualifying perpetual preferred stock, certain minority interests, and trust preferred securities. Two-thirds of the required Tier 1 capital (or 4% of total assets) must take the form of common capital, the first line of defense in the event of losses.

161 As size increases arithmetically, risk increases exponentially. For example, a doubling of the magnitude of the balance sheet quadruples a firm’s risk exposure.
A robust financial system also requires that no individual firm is “too-big-to-fail.” To draw a concept from rocket engineering, the financial infrastructure must be designed as a modular system, in which the failure of one component, however integral, would not jeopardize the functioning of all other pieces. In the event of failure, the broken piece would be replaced easily, and the system restored quickly. Our financial system should be designed like a rocket ship. One way to do this is to mandate that all systemically significant financial institutions draw up living wills, or resolution trusts, that would address their potential failure. These resolution mechanisms would explicitly detail how each section of the firm would be liquidated and how counterparty contracts would be upheld, ensuring an orderly wind-down of a failing institution. If systemically significant firms like Bear Stearns, the GSEs, Lehman Brothers, Merrill Lynch, and AIG had resolution trusts, the contagion effect of their collapse, or near-collapse, could have perhaps been less disastrous.

At the heart of the crisis was a tremendous buildup in leverage, which our regulatory framework failed to prevent. The over-reliance on short-term liabilities for the funding of opaque, illiquid, long-term assets left even well-capitalized institutions vulnerable to liquidity shocks. Banks, financial institutions, and corporations borrowed secured cash from the overnight repo and commercial paper markets to fund their asset purchases, trading positions, and daily operations. Short-term borrowing was much cheaper than issuing long-term debt or new equity, and

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162 Because an increasing number of financial institutions have foreign subsidiaries, there are legal and logistical impediments to establishing effective resolution trusts. Thus, drawing up resolution trusts, or living wills, requires harmonized regulatory efforts across borders. This makes the reform much more difficult to implement.
was routinely available prior to the credit crunch. The textbook reason for this was that investors demanded a greater premium for long-term lending because longer maturity bonds were more exposed to interest rate and credit risk.\textsuperscript{163} The more nuanced reason for this – and one underlying point of this thesis – was that the plethora of readily-accepted, highly-rated asset-backed securities from securitization supplied the collateral needed for secured, collateralized lending, depressing borrowing costs and increasing lending activities. When the securitization market collapsed, and credit rating agencies downgraded the highly-rated debt securities that were pledged as collateral, short-term funding markets ground to a halt as lenders drastically increased their collateral demands or refused to lend. Extreme levels of short-term debt transformed the funding markets into a ticking atom bomb with the potential to “blow up” the entire system upon disruption. Because of over-leverage, many institutions were engulfed in an extraordinary credit crunch, a catastrophic conflagration, when the shadow banking system collapsed.

The tremendous buildup in leverage, reflecting an overreliance on debt, especially short-term credit, was the principal source of fragility in the financial system. High leverage ratios (measured as a function of total assets both on \textit{and} off balance sheets relative to shareholder’s equity) increased the firm’s and, more importantly, the financial system’s vulnerability to low probability, high intensity shocks like unexpected write-downs in asset values, cutbacks in credit, and

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\textsuperscript{163} As described in the first chapter, interest rate risk is the risk that changes in benchmark rates (like the Fed funds rate) would adversely lower the market value of the stream of payments on a loan. Credit risk is the risk that the borrower defaults on the loan.
deteriorating economic conditions. Limits on leverage would therefore be a welfare-enhancing regulatory measure, saving finance from the tyrannies of its own passions, its excess greed and fear. In fact, other OECD countries that suffered from banking crises have imposed regulatory caps on leverage without great trade-offs to competitiveness. Canada, for example, evaded the acute credit crunch that plagued the United States. After the collapse of its housing market, the Canadian system was immune to steep losses on mortgage-related assets and disruptions in interbank borrowing.\footnote{The author attended a June 23, 2009 conference at the Brookings Institute in Washington DC on the subject “Stable Banks, Stable Finance: The Canadian Experience.” Michael Wilson, Canadian Ambassador to the U.S., Mark Carney, governor of the Bank of Canada, and Nick Le Pan, chair of the board of directors of the Canadian Public Accountability Board, attended and spoke on how Canada evaded a severe contraction in credit. For a brief outline of the discussions, as well as supporting slides see: \url{http://www.brookings.edu/events/2009/0623_canada_banking.aspx}} Although other factors including different overall macroeconomic environments, public policies, and mortgage cultures were important, Canada’s leverage limits made their banking system more resilient to intense shocks. Other things equal, leverage caps curb the degree of permissible maturity transformation, i.e., the amount of short-term borrowing firms could use to finance long-term illiquid assets. Under more stringent liquidity standards, firms would need to fund long term assets mainly through equity or long-term debt, which ultimately makes finance more stable.

Ironically, the ultimate lesson going forward is the one the United States learned, forgot and relearned during the banking crises of 1837, 1873, and 1929-33: asset price deflation is catastrophic when combined with debt. This was Irving Fisher’s prescient insight after the Great Depression. Declines in asset values raise
the real burden of debt, magnifying the cost of servicing the debt. This leads to vicious cycles of distressed selling where panic fuels more panic. The ultimate conundrum of the debt-deflation spiral is the fact that the mass effect of the stampede to liquidate to reduce debt swells each dollar owed. In essence, the more debtors pay, the more they owe. In a distressed environment, individually rational efforts promote sub-optimal results in the collective. This tragedy of the commons is the most compelling argument for stronger coordination, supervision, and regulation of finance. An ideal solution would require no extended government authority. However, investors are plagued with short memories and myopia. In the face of future euphoria, they are likely to over-discount the lessons of this crisis and repeat their mistakes. Over the past few decades, there simply have been too many episodes in which asset prices have dramatically overshot on the upside and the violently corrected on the downside.

Finance requires comprehensive repair going forward. Left to its own devices, the financial system veers towards extremes, from speculative booms to painful busts. The broader economy suffers as a result of disruptions in financial intermediation. Thus, it is in each country’s best interest to reform finance and make it more resilient to booms and busts. The United States and other OECD countries should collaborate to achieve greater levels of capital, limits on leverage ratios, better aligned incentives, increased transparency, less-fragmented regulatory regimes, and enhanced supervision. As the financial crisis demonstrated, the default of a mortgage in Memphis, Tennessee, indirectly contributed to the first bank run in
over a hundred years in Newcastle, England, which indirectly contributed to the collapse of major national banks in Reykjavik, Iceland, which ultimately depressed manufacturing exports in Shenzhen, China. Although regulation remains local, contagion spreads globally in the 21st century. Remember, the goal of reform is not to completely avoid crises; such a task is both impractical and unrealistic. The goal of reform is to create a financial system, stronger and more resilient to shocks. Ironically, government intervention now is necessary to prevent future scenarios in which even greater government intervention, like government’s recent rescue of finance, is needed.

**The State of the Dismal Science**

The recent financial crisis also reveals the need to rethink economics. The elegant conclusions of dynamic stochastic general equilibrium models served as a poor guide to the origins of the crisis, and left its followers (central banks, ivied citadels, and Wall Street firms) blind during the economy’s greatest time of need. The acute credit crunch, along with its catastrophic impact on the broader economy, was absent from New Classical models and theories grounded in mathematical rigor and numerical precision. Despite all the contradictory evidence from behavioral economics, the twin assumptions of rational expectations and representative agents served as the cornerstones of many New Classical theories from efficient markets to Ricardian equivalence. Recent events prove, however, that finance is extremely vulnerable to coordination failures, where agents suffer from human frailty, avarice, and myopia. Indeed, economic agents’ collective response to the price mechanism
during the past few years established not a spontaneous order that efficiently channeled capital to its most effective avenues (like the Classicals predicated and the New Classicals proved), but instead a clash of weighted vectors bottlenecked, baffled, and blind.

Yet at the same time, little has changed in the economic curriculums universities teach. Likewise, outside America’s ivied citadels, the efficient market hypothesis is still the dominant theory governing markets. Wall Street firms still employ portfolio theory and risk management models. A quote from Myron Scholes, a leading finance economist and cofounder of the Black-Scholes options pricing theory, perhaps best captures the prevalent mood: “to say something has failed you have to have something to replace it, and so far we don’t have a new paradigm to replace efficient markets.” What should that new paradigm be?

Nothing; there are no universal truths, no teleological end to the development of the dismal science. The author firmly believes that no one paradigm should dominate economics. Indeed, the relative calm of the two-decade long Great Moderation swelled one particular view of the world. Economic theories drawn on two decades of experience were presumptuously exaggerated into categorical truths. Just because one has not seen a black swan yet, does not mean that black swans do not exist. Just because markets are efficient today, does not mean that

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they will remain so tomorrow. To broaden his vision, the economist must acknowledge the merits and flaws to all economic theories, whether mercantilist, neoclassical, Marxian, or Keynesian. The prevailing theory of today may become the scoff and scorn of tomorrow; lisping babes may learn to curse the ancients’ names. Because of this cyclical nature, it is foolish, perhaps even dangerous, to rely exclusively on one school of thought. The last century of economic thought saw many paradigm shifts. Old ideas clashed, died, and returned. This struggle allowed for the constant refinement of ideas. May this struggle return reinvigorated. It is this dialectic that makes economics a useful social science.

Although the perennial clash of other-worldly philosophies continues, the New Classicals have won the war on methodology: economics will remain highly quantitative, relying on mathematical and econometric models to substantiate claims. This can be attributed in part to advances in computing power and to the easy access to large quantities of data through the internet. Whereas, David Ricardo had to rely on economic intuition to prove that Britain held a comparative advantage in cloth-production and Portugal held one in wine-production, modern students of econometrics resort to model building, data retrieving, and empirical testing. One must, however, carefully distinguish convenience from accuracy. The fact that models use precise numbers rather than vague words to substantiate claims does not automatically mean they are better. Most important, one must not fall under the spell of mathematical elegance. The mathematical rigor and numerical precision of complex models and theories often conceals the weaknesses of assumptions.
Remember, numbers do not automatically translate into truth. Underlying assumptions are critical and must always be reviewed. This directly counters the oft-quoted advice of Milton Friedman, that underlying assumptions do not matter as long as the broader conclusions hold. Heroic assumptions, however, have a tendency to lead to unrealistic conclusions.

**The Legacy of Securitization’s Reign**

U.S. real gross domestic product increased at an annual rate of 5.6 percent in the fourth quarter of 2009, a significant increase from the 2.2 percent real GDP growth in the preceding quarter and the economic contraction of -0.7 percent in the second quarter.\(^{167}\) However, even as output growth returns, one must be cautious for America’s economic future. The fine print on the Bureau of Economic Analysis’s data tables reveals that the engine of U.S. economic growth may no longer be personal consumption expenditures, the principal driver of growth for the last decade. The replenishing of depleted inventories was the dominant source of growth, accounting for 4.39 percentage points or almost 80% of the 4Q09 annual growth rate. Moreover, the primary source of growth in the preceding quarter, and the backstop to further output contraction during the last six quarters, has been government stimulus, ranging from the clash-for-clunkers program to the first-time homeowners tax credit. This draws pessimism about the sustainability of the U.S. economic recovery because, one, both corporate inventory replenishing and

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For graphs on the author’s selected figures see Appendices 19 and 20.
expansionary fiscal spending are transitory shocks that will soon fade, and two, weak consumption growth places downward pressure on output growth. Simultaneously, the U.S. current account deficit, the broadest measure of America’s trade and payments with the rest of the world, shrank from 6% in 2006 to 3% last year, indicating that the global imbalance in the flow of goods and credit that accumulated over the past decade is slowly beginning to unwind.

The U.S. debt-fueled consumption binge is over. There are two reasons for this. First, American households have escaped the Great Recession battered and bruised. They continue to face a deluge of difficulties including high unemployment, losses in net personal wealth, depreciated home values, and overleveraged household balance sheets. With sizeable reductions in net wealth and debts equivalent to 120% of personal disposable income, it is unlikely that households will continue the profligate ways of the last decade. On the other side of the equation, the supply of credit remains weak because of the virtually dead private securitization market. Banks are not extending home equity loans, credit card companies are reducing credit lines, and small businesses still face high borrowing costs despite massive government intervention. Combined, this has drastic implications for the prospects of a quick and sustainable U.S. economic recovery. The author is highly pessimistic.

The U.S. economy faces a dilemma, a dynamic inconsistency: in the short-run, spending must increase to sustain economic growth, yet in the long-run, the
economy must transition towards savings and exports. The key argument of this thesis is that securitization enabled the American household to defer confronting this painful dilemma. The death of securitization, however, forces the private sector to face the difficult transition from profligacy to frugality. It also warns the public sector that perpetual deficit spending is unsustainable. Even Uncle Sam may one day run out of credit as China and the rest of the world loses confidence in either the U.S. as a borrower or the dollar as the international currency. Let us hope that day never comes. Securitization is dead; long live securitization.
Appendices

Appendix 1: The total origination and issuance of various mortgages and mortgage-backed securities, 2001-06\(^\text{168}\)

<table>
<thead>
<tr>
<th></th>
<th>Sub-prime</th>
<th></th>
<th>Alt-A</th>
<th></th>
<th></th>
<th>Jumbo</th>
<th></th>
<th></th>
<th>Agency</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>$ billions</td>
<td>Origination</td>
<td>Issuance</td>
<td>Ratio</td>
<td>Origination</td>
<td>Issuance</td>
<td>Ratio</td>
<td>Origination</td>
<td>Issuance</td>
<td>Ratio</td>
<td>Origination</td>
</tr>
<tr>
<td>2001</td>
<td>190</td>
<td>87.1</td>
<td>46%</td>
<td>60</td>
<td>11</td>
<td>18%</td>
<td>430</td>
<td>142</td>
<td>33%</td>
<td>1433</td>
</tr>
<tr>
<td>2002</td>
<td>231</td>
<td>123</td>
<td>53%</td>
<td>68</td>
<td>53</td>
<td>78%</td>
<td>576</td>
<td>171</td>
<td>30%</td>
<td>1898</td>
</tr>
<tr>
<td>2003</td>
<td>335</td>
<td>195</td>
<td>58%</td>
<td>85</td>
<td>74</td>
<td>87%</td>
<td>655</td>
<td>237</td>
<td>36%</td>
<td>2690</td>
</tr>
<tr>
<td>2004</td>
<td>540</td>
<td>363</td>
<td>67%</td>
<td>200</td>
<td>159</td>
<td>80%</td>
<td>515</td>
<td>233</td>
<td>45%</td>
<td>1345</td>
</tr>
<tr>
<td>2005</td>
<td>625</td>
<td>465</td>
<td>74%</td>
<td>380</td>
<td>332</td>
<td>87%</td>
<td>570</td>
<td>281</td>
<td>49%</td>
<td>1180</td>
</tr>
<tr>
<td>2006</td>
<td>600</td>
<td>449</td>
<td>75%</td>
<td>400</td>
<td>366</td>
<td>92%</td>
<td>480</td>
<td>219</td>
<td>46%</td>
<td>1040</td>
</tr>
</tbody>
</table>

Source: Inside Mortgage Finance

\(^{168}\) Note the trend of increasing non-conforming mortgage origination and issuance during the housing boom. By 2006, the total volumes of non-prime lending and issuance surpassed the equivalent volumes for prime loans.
Appendix 2: Industry data on the underwriting characteristics of loans in mortgage pools, 1999-2006

<table>
<thead>
<tr>
<th>Year</th>
<th>CLTV</th>
<th>Full Doc</th>
<th>Purchase</th>
<th>Average FICO</th>
<th>Junior 2nd lien</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Alt-A Loans</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1999</td>
<td>77.5</td>
<td>38.4</td>
<td>51.8</td>
<td>696</td>
<td>0.1</td>
</tr>
<tr>
<td>2000</td>
<td>80.2</td>
<td>35.4</td>
<td>68</td>
<td>697</td>
<td>0.2</td>
</tr>
<tr>
<td>2001</td>
<td>77.7</td>
<td>34.8</td>
<td>50.4</td>
<td>703</td>
<td>1.4</td>
</tr>
<tr>
<td>2002</td>
<td>76.5</td>
<td>36</td>
<td>47.4</td>
<td>708</td>
<td>2.4</td>
</tr>
<tr>
<td>2003</td>
<td>74.9</td>
<td>33</td>
<td>39.4</td>
<td>711</td>
<td>12.4</td>
</tr>
<tr>
<td>2004</td>
<td>79.5</td>
<td>32</td>
<td>53.9</td>
<td>708</td>
<td>28.6</td>
</tr>
<tr>
<td>2005</td>
<td>79</td>
<td>27.4</td>
<td>49.4</td>
<td>713</td>
<td>32.4</td>
</tr>
<tr>
<td>2006</td>
<td>80.6</td>
<td>16.4</td>
<td>45.7</td>
<td>708</td>
<td>38.9</td>
</tr>
<tr>
<td><strong>Subprime Loans</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1999</td>
<td>78.8</td>
<td>68.7</td>
<td>30.1</td>
<td>605</td>
<td>0.5</td>
</tr>
<tr>
<td>2000</td>
<td>79.5</td>
<td>73.4</td>
<td>36.2</td>
<td>596</td>
<td>1.3</td>
</tr>
<tr>
<td>2001</td>
<td>80.3</td>
<td>71.5</td>
<td>31.3</td>
<td>605</td>
<td>2.8</td>
</tr>
<tr>
<td>2002</td>
<td>80.7</td>
<td>65.9</td>
<td>29.9</td>
<td>614</td>
<td>2.9</td>
</tr>
<tr>
<td>2003</td>
<td>82.4</td>
<td>63.9</td>
<td>30.2</td>
<td>624</td>
<td>7.3</td>
</tr>
<tr>
<td>2004</td>
<td>83.9</td>
<td>62.2</td>
<td>35.7</td>
<td>624</td>
<td>15.8</td>
</tr>
<tr>
<td>2005</td>
<td>85.3</td>
<td>58.3</td>
<td>40.5</td>
<td>627</td>
<td>24.6</td>
</tr>
<tr>
<td>2006</td>
<td>85.5</td>
<td>57.7</td>
<td>42.1</td>
<td>623</td>
<td>27.5</td>
</tr>
</tbody>
</table>

All entries are in percentage points except FICO.
Source: Loan Performance (2007)

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169 Note the increasingly aggressive loan underwriting standards via higher combined-loan-to-value ratios and less rigorous documentation.
Appendix 3: A diagram depicting a special purpose entity purchasing assets to issue asset-backed securities

Source: U.S. Government Accountability Office
Appendix 4: Securitizing a pool of loans into residential-mortgage backed securities (RMBS) under Basel II capital requirements

<table>
<thead>
<tr>
<th>Whole loans</th>
<th>Reserve requirement</th>
<th>Risk weighting</th>
<th>Minimum tier 1</th>
<th>Tier 1 allocation (B,*)</th>
<th>Total capital held (A*D)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pool of mortgage loans</td>
<td>1.0%</td>
<td>50%</td>
<td>8.0%</td>
<td>2.8%</td>
<td>3.8%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>RMBS</th>
<th>AAA</th>
<th>AA</th>
<th>A</th>
<th>BBB</th>
<th>Equity</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>(A)</strong></td>
<td>Reserve requirement</td>
<td>Split</td>
<td>75%</td>
<td>10%</td>
<td>8%</td>
<td>5%</td>
</tr>
<tr>
<td><strong>(B)</strong></td>
<td>Risk weighting</td>
<td>12%</td>
<td>15%</td>
<td>24%</td>
<td>75%</td>
<td>1250%</td>
</tr>
<tr>
<td><strong>(C)</strong></td>
<td>Minimum tier 1</td>
<td>8.0%</td>
<td>8.0%</td>
<td>8.0%</td>
<td>8.0%</td>
<td>8.0%</td>
</tr>
<tr>
<td><strong>(D)</strong></td>
<td>Tier 1 allocation (B,*)</td>
<td>1.0%</td>
<td>1.2%</td>
<td>1.9%</td>
<td>6.0%</td>
<td>100.0%</td>
</tr>
<tr>
<td><strong>(E)</strong></td>
<td>Total capital held (A*D)</td>
<td>0.7%</td>
<td>0.1%</td>
<td>0.2%</td>
<td>0.3%</td>
<td>2.0%</td>
</tr>
</tbody>
</table>

Source: Goldman Sachs Global Investment Research
Appendix 5: Transforming one tranche of RMBS into a collateralized debt obligation (CD) under Basel II capital requirements

<table>
<thead>
<tr>
<th></th>
<th>(A)</th>
<th>(B)</th>
<th>(C)</th>
<th>(D)</th>
<th>(E)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Split</td>
<td>Risk weighting</td>
<td>Minimum tier 1</td>
<td>Tier 1 allocation (B*C)</td>
<td>Total capital held (A*D)</td>
</tr>
<tr>
<td>RMBS</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BBB</td>
<td>100%</td>
<td>75%</td>
<td>8%</td>
<td>6.0%</td>
<td>6.0%</td>
</tr>
<tr>
<td>CDO</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AAA (super senior)</td>
<td>60%</td>
<td>12%</td>
<td>8%</td>
<td>1.0%</td>
<td>0.6%</td>
</tr>
<tr>
<td>AAA (super senior)</td>
<td>20%</td>
<td>12%</td>
<td>8%</td>
<td>1.0%</td>
<td>0.2%</td>
</tr>
<tr>
<td>AA</td>
<td>6%</td>
<td>15%</td>
<td>8%</td>
<td>1.2%</td>
<td>0.1%</td>
</tr>
<tr>
<td>A</td>
<td>5%</td>
<td>24%</td>
<td>8%</td>
<td>1.9%</td>
<td>0.1%</td>
</tr>
<tr>
<td>BBB</td>
<td>2%</td>
<td>75%</td>
<td>8%</td>
<td>6.0%</td>
<td>0.1%</td>
</tr>
<tr>
<td>BB</td>
<td>2%</td>
<td>442%</td>
<td>8%</td>
<td>35.3%</td>
<td>0.7%</td>
</tr>
<tr>
<td>Equity</td>
<td>5%</td>
<td>1250%</td>
<td>8%</td>
<td>100.0%</td>
<td>5.0%</td>
</tr>
<tr>
<td>Total</td>
<td>100%</td>
<td></td>
<td></td>
<td></td>
<td>8.8%</td>
</tr>
</tbody>
</table>

Source: Goldman Sachs Global Investment Research
Appendix 6: Deal summary for GSAMP Trust 2006-NC1, a Goldman Sachs special purpose entity that purchased a pool of loans from mortgage originator New Century to issue residential mortgage-backed securities

<table>
<thead>
<tr>
<th>Domicile of Assets</th>
<th>Closing Date</th>
<th>Original Amount ($000)</th>
<th>Arranger</th>
<th>Warehouse Lender</th>
<th>Servicer</th>
<th>Originator</th>
</tr>
</thead>
<tbody>
<tr>
<td>U.S. Home Equity</td>
<td>June-06</td>
<td>705,311</td>
<td>Goldman Sachs &amp; Co.</td>
<td>U.S. Bank</td>
<td>Litton Loan Servicing LP</td>
<td>New Century</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Class</th>
<th>Notional</th>
<th>Width</th>
<th>Subordination</th>
<th>S&amp;P</th>
<th>Moody’s</th>
<th>Coupon Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>A-1</td>
<td>310,299</td>
<td>43.99%</td>
<td>56.01%</td>
<td>AAA</td>
<td>Aaa</td>
<td>0.31%</td>
</tr>
<tr>
<td>A-2</td>
<td>224,955</td>
<td>31.89%</td>
<td>24.11%</td>
<td>AAA</td>
<td>Aaa</td>
<td>0.42%</td>
</tr>
<tr>
<td>A-3</td>
<td>42,565</td>
<td>6.03%</td>
<td>18.08%</td>
<td>AAA</td>
<td>Aaa</td>
<td>0.53%</td>
</tr>
<tr>
<td>M-1</td>
<td>23,213</td>
<td>3.29%</td>
<td>14.78%</td>
<td>AA+</td>
<td>Aa1</td>
<td>0.60%</td>
</tr>
<tr>
<td>M-2</td>
<td>21,784</td>
<td>3.09%</td>
<td>11.70%</td>
<td>AA</td>
<td>Aa2</td>
<td>0.62%</td>
</tr>
<tr>
<td>M-3</td>
<td>12,857</td>
<td>1.82%</td>
<td>9.87%</td>
<td>AA-</td>
<td>Aa3</td>
<td>0.64%</td>
</tr>
<tr>
<td>M-4</td>
<td>11,070</td>
<td>1.57%</td>
<td>8.30%</td>
<td>A+</td>
<td>A1</td>
<td>0.74%</td>
</tr>
<tr>
<td>M-5</td>
<td>10,714</td>
<td>1.52%</td>
<td>6.78%</td>
<td>A</td>
<td>A2</td>
<td>0.76%</td>
</tr>
<tr>
<td>M-6</td>
<td>9,642</td>
<td>1.37%</td>
<td>5.42%</td>
<td>A-</td>
<td>A3</td>
<td>0.84%</td>
</tr>
<tr>
<td>B-1</td>
<td>9,285</td>
<td>1.32%</td>
<td>4.10%</td>
<td>BBB+</td>
<td>Baa1</td>
<td>1.38%</td>
</tr>
<tr>
<td>B-2</td>
<td>10,000</td>
<td>1.42%</td>
<td>2.68%</td>
<td>BBB</td>
<td>Baa2</td>
<td>5.66%</td>
</tr>
<tr>
<td>B-3</td>
<td>6,428</td>
<td>0.91%</td>
<td>2.68%</td>
<td>BBB-</td>
<td>Baa3</td>
<td>5.66%</td>
</tr>
<tr>
<td>B-4</td>
<td>5,357</td>
<td>0.76%</td>
<td>1.01%</td>
<td>BB</td>
<td>Ba2</td>
<td>5.66%</td>
</tr>
<tr>
<td>X</td>
<td>7,142</td>
<td>1.01%</td>
<td>0.00%</td>
<td>NR</td>
<td>NR</td>
<td>N/A</td>
</tr>
</tbody>
</table>

Source: ABS Net
Appendix 7: Institutional Investors of collateralized debt obligations

<table>
<thead>
<tr>
<th>Holders of CDOs</th>
<th>A and higher rated tranches</th>
<th>BBB and lower rated tranches</th>
<th>All tranches</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bansk and investment banks</td>
<td>38%</td>
<td>33%</td>
<td>42%</td>
</tr>
<tr>
<td>Hedge funds / specialists</td>
<td>23%</td>
<td>46%</td>
<td>25%</td>
</tr>
<tr>
<td>Insurance companies</td>
<td>31%</td>
<td>4%</td>
<td>24%</td>
</tr>
<tr>
<td>Finaace companies</td>
<td>5%</td>
<td>9%</td>
<td>5%</td>
</tr>
<tr>
<td>Mutual funds / pension funds</td>
<td>2%</td>
<td>8%</td>
<td>3%</td>
</tr>
<tr>
<td>Total</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
</tr>
</tbody>
</table>

Source: Goldman Sachs Global Investment Research
Appendix 8: Key players and frictions in securitization

Source: The Federal Reserve Bank of New York
Appendix 9: Mortgage delinquency rates, 2001-09

Mortgage delinquency rates, 2001–09

<table>
<thead>
<tr>
<th>Year</th>
<th>Prime and near prime</th>
<th>Subprime</th>
</tr>
</thead>
<tbody>
<tr>
<td>2001</td>
<td>3%</td>
<td>8%</td>
</tr>
<tr>
<td>2002</td>
<td>4%</td>
<td>10%</td>
</tr>
<tr>
<td>2003</td>
<td>5%</td>
<td>13%</td>
</tr>
<tr>
<td>2004</td>
<td>6%</td>
<td>15%</td>
</tr>
<tr>
<td>2005</td>
<td>7%</td>
<td>16%</td>
</tr>
<tr>
<td>2006</td>
<td>8%</td>
<td>18%</td>
</tr>
<tr>
<td>2007</td>
<td>9%</td>
<td>20%</td>
</tr>
<tr>
<td>2008</td>
<td>10%</td>
<td>22%</td>
</tr>
<tr>
<td>2009</td>
<td>11%</td>
<td>24%</td>
</tr>
</tbody>
</table>

NOTE: The data are monthly and extend through December 2009. Delinquency rate is the percent of loans 90 days or more past due or in foreclosure.

SOURCE: For subprime, LoanPerformance, a division of First American CoreLogic; for prime and near prime, Lender Processing Services, Inc.
Appendix 10: LIBOR-OIS swap rate, 2007-10

Libor minus overnight index swap rate, 2007–10

<table>
<thead>
<tr>
<th></th>
<th>Basis points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jan. 2007</td>
<td>0</td>
</tr>
<tr>
<td>July 2007</td>
<td>0</td>
</tr>
<tr>
<td>Jan. 2008</td>
<td>0</td>
</tr>
<tr>
<td>July 2008</td>
<td>0</td>
</tr>
<tr>
<td>Jan. 2009</td>
<td>0</td>
</tr>
<tr>
<td>July 2009</td>
<td>0</td>
</tr>
<tr>
<td>Jan. 2010</td>
<td>0</td>
</tr>
<tr>
<td>July 2010</td>
<td>0</td>
</tr>
<tr>
<td>Jan. 2011</td>
<td>0</td>
</tr>
<tr>
<td>July 2011</td>
<td>0</td>
</tr>
</tbody>
</table>

**Note:** The data are daily and extend through February 19, 2010. An overnight index swap (OIS) is an interest rate swap with the floating rate tied to an index of daily overnight rates, such as the effective federal funds rate. At maturity, two parties exchange, on the basis of the agreed notional amount, the difference between interest accrued at the fixed rate and interest accrued by averaging the floating, or index, rate. Libor is the London interbank offered rate.

**Source:** For Libor, British Bankers' Association; for the OIS rate, Prebon.
Appendix 11: U.S. money market fund assets by fund type

U.S. Money Market Fund Assets by Fund Type

Source: Moneyfundanalyzer  Note: Shaded area September 16 - October 21
Appendix 12: Weekly commercial paper issuance, Fall 2008

Weekly Commercial Paper Issuance

Billions of Dollars

Percent

Source: Federal Reserve Board of Governors
Appendix 13: Gross issuance of selected commercial mortgage- and asset-backed securities, 2007-10

Gross issuance of selected asset-backed securities, 2007–10

<table>
<thead>
<tr>
<th></th>
<th>Billions of dollars</th>
</tr>
</thead>
<tbody>
<tr>
<td>TALF consumer ABS</td>
<td>35</td>
</tr>
<tr>
<td>Non-TALF consumer ABS</td>
<td></td>
</tr>
</tbody>
</table>

NOTE: Consumer ABS (asset-backed securities) are securities backed by credit card loans, nonrevolving consumer loans, and auto loans. Data for consumer ABS show gross issuance facilitated by the Term Asset-Backed Securities Loan Facility (TALF) and such issuance outside the TALF.

Appendix 14: Spreads on credit default swaps for selected U.S. banks, 2007-10

Spreads on credit default swaps for selected U.S. banks, 2007–10

<table>
<thead>
<tr>
<th></th>
<th>Basis points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Large bank holding companies</td>
<td>400</td>
</tr>
<tr>
<td>Other banks</td>
<td>350</td>
</tr>
<tr>
<td></td>
<td>300</td>
</tr>
<tr>
<td></td>
<td>250</td>
</tr>
<tr>
<td></td>
<td>200</td>
</tr>
<tr>
<td></td>
<td>150</td>
</tr>
<tr>
<td></td>
<td>100</td>
</tr>
<tr>
<td></td>
<td>50</td>
</tr>
</tbody>
</table>


NOTE: The data are daily and extend through February 18, 2010. Median spreads for six bank holding companies and nine other banks.

SOURCE: Markit.
Appendix 15: Equity price indexes for banks and insurance companies, 2007-09

Equity price indexes for banks and insurance companies, 2007–09

January 3, 2007 = 100

NOTE: The data are daily and extend through July 15, 2009.
SOURCE: Standard & Poor’s.
Appendix 16: Details on the troubled asset relief program

<table>
<thead>
<tr>
<th>Program</th>
<th>Amount of allocated funding</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capital purchase program</td>
<td>$218.0</td>
</tr>
<tr>
<td>Targeted investment program</td>
<td>$40.0</td>
</tr>
<tr>
<td>Capital assistance program</td>
<td>TBD</td>
</tr>
<tr>
<td>Systemically significant failing institutions</td>
<td>$70.0</td>
</tr>
<tr>
<td>Asset guarantee program</td>
<td>$12.5</td>
</tr>
<tr>
<td>Automotive industry financing program</td>
<td>$82.6</td>
</tr>
<tr>
<td>Making home affordable</td>
<td>$50.0</td>
</tr>
<tr>
<td>Consumer and business lending initiative</td>
<td>$70.0</td>
</tr>
<tr>
<td>Public-private investment program</td>
<td>$100.0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>$643.1</strong></td>
</tr>
</tbody>
</table>

Source: U.S. Government Accountability Office
Appendix 17: Federal funds rate and 1 month LIBOR and commercial paper rates
Appendix 18: Net percentage of small businesses that reported more difficulty in obtaining credit, 1989-2010

Net percentage of small businesses that reported more difficulty in obtaining credit, 1989–2010

Note: The data are drawn from a survey conducted monthly and are seasonally adjusted; the last observation is from the January 2010 survey, which covers December 2009. The data reflect the proportion of borrowers who sought credit in the past three months that reported more difficulty in obtaining credit less the proportion that reported more ease in obtaining credit.

Source: National Federation of Independent Business.
Appendix 19: Change in U.S. real gross domestic product, 2003-09

Change in real gross domestic product, 2003–09

Percent, annual rate

<table>
<thead>
<tr>
<th>Year</th>
<th>Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>2003</td>
<td>+3.1%</td>
</tr>
<tr>
<td>2004</td>
<td>+1.1%</td>
</tr>
<tr>
<td>2005</td>
<td>+0.5%</td>
</tr>
<tr>
<td>2006</td>
<td>+1.3%</td>
</tr>
<tr>
<td>2007</td>
<td>+0.8%</td>
</tr>
<tr>
<td>2008</td>
<td>-2.7%</td>
</tr>
<tr>
<td>2009</td>
<td>+3.4%</td>
</tr>
</tbody>
</table>

Note: Here and in subsequent figures, except as noted, change for a given period is measured to its final quarter from the final quarter of the preceding period.

Source: Department of Commerce, Bureau of Economic Analysis.

Personal saving rate, 1986–2009

Percent

9
6
3
0


NOTE: The data are quarterly and extend through 2009:Q4.
SOURCE: Department of Commerce, Bureau of Economic Analysis.
Bibliography


Ascraft, Adam B. and Til Schuermann. “Understanding the Securitization of Subprime Mortgage Credit.” Federal Reserve Bank of New York Staff Reports No. 318 (March 2008).


Bernanke, Ben S. “Statement” by the Chairman of the Board of Governors of the Federal Reserve System before the Committee on Financial Services U.S. House of Representatives on February 10, 2010.


# Glossary of Acronyms

<table>
<thead>
<tr>
<th>Credit Metrics</th>
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</thead>
<tbody>
<tr>
<td>LIBOR: London interbank offered rate</td>
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<tr>
<td>OIS: Overnight index swap</td>
</tr>
<tr>
<td>TED: Treasury-Eurodollar spread</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Financial Instruments</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABS: Asset-backed securities</td>
</tr>
<tr>
<td>ARM: Adjustable-rate mortgages</td>
</tr>
<tr>
<td>CDO: Collateralized debt obligations</td>
</tr>
<tr>
<td>CDS: Credit default swaps</td>
</tr>
<tr>
<td>MBS: Mortgage-backed securities</td>
</tr>
<tr>
<td>OTC: Over-the-counter</td>
</tr>
<tr>
<td>SPE: Special purpose entities</td>
</tr>
<tr>
<td>SPV: Special purpose vehicles</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>General Terms</th>
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</thead>
<tbody>
<tr>
<td>AAA: Best Standard &amp; Poor’s credit rating</td>
</tr>
<tr>
<td>DSGE: Dynamic stochastic general equilibrium</td>
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<tr>
<td>CLTV: Combined loan-to-value</td>
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</table>

<table>
<thead>
<tr>
<th>Government measures</th>
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</thead>
<tbody>
<tr>
<td>CPFF: The commercial paper funding facility</td>
</tr>
<tr>
<td>EESA: Emergency economic stabilization act</td>
</tr>
<tr>
<td>TAF: The term auction facility</td>
</tr>
<tr>
<td>TALF: The term asset-backed security loan facility</td>
</tr>
<tr>
<td>TARP: The troubled asset relief program</td>
</tr>
<tr>
<td>TSLF: The term securities loan facility</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Regulators</th>
</tr>
</thead>
<tbody>
<tr>
<td>CFTC: Commodities Futures Trading Commission</td>
</tr>
<tr>
<td>FDIC: Federal Deposit Insurance Corporation</td>
</tr>
<tr>
<td>LOLR: Lender-of-last resort</td>
</tr>
<tr>
<td>OCC: Office of the Comptroller of the Currency</td>
</tr>
<tr>
<td>OTS: Office of Thrift Supervision</td>
</tr>
<tr>
<td>SEC: Securities Exchange Commission</td>
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</tbody>
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