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The Evolving Nature of Asset Price Bubbles, Financial Instability and Monetary Policy

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This paper links the bursting of the housing asset price bubble around 2007 in the U.S. to the instability that arose in financial markets with the bankruptcy of Lehman Brothers in September 2008, and both of these to the Great Recession and the unconventional monetary policy that followed. Similar narratives about the Stock Market Crash of 1929, the Crash of 1987 and the Internet Bubble of 2000 are briefly presented to show their evolving financial nature, describe the financial instabilities produced by them and their costs and, finally examine the responses initiated, primarily, by monetary policy. This analytical synopsis of the four best-known U.S. asset bubble crashes guides us to an articulation of a few basic lessons learned.

Keywords: asset price bubbles, financial instability, monetary policy; financial crises; the great recession

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I. Introduction

The U.S. economic downturn that resulted from the Global Financial Crisis of 2007-09 was the longest since World War II. It is named the Great Recession in contrast to the Great Depression of 1929. It began in December 2007 and ended in June 2009. Real GDP fell by 4.3 % from its peak during the 4th quarter of 2007 to its trough in June 2009. The unemployment rate increased from around 5% in December 2007 to around 10% in June 2009; this translated to more than 15 million workers permanently losing their jobs.

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Other indicators of the economic severity of the Great Recession include a 30% drop in housing prices; a 57% decline in the S&P 500 Index and a 20% decrease in the net worth of households. Equally dramatic were the economic and financial consequences of the Global Financial Crisis around the world, particularly in the Eurozone where some countries experienced a sovereign debt crisis that followed the Global Financial Crisis. Kolb (2011) offers a comprehensive analysis of the Great Recession documented by numerous references focusing on its diverse components.

Beyond the dramatic economic and financial developments that occurred during the duration of the Great Recession, the economic recovery that followed it defied, repeatedly, economic projections for a return to normal growth. Figure 1 illustrates how gradual the recovery has been and how the real potential output was adjusted downwards to reflect a slower rate of annual growth than the one experienced during the two decades prior to the crisis.

This evidence substantiates that financial crises are fundamentally different from regular business cycles. While business cycles portray relatively small deviations from a long-term trend in real growth for an economy that remains close to an equilibrium, the impact of some financial crises affects both the trend of output and its deviations both quantitatively and also in terms of length of time. Numerically, the average annual U.S. real GDP growth post the Great Recession, from 2009 to 2017 has fluctuated around 2.2% versus fluctuations around a 3.8% trend growth from the early 1950s to 2006. This dramatic swing in economic activity illustrates the substantial economic costs of the Global Financial Crisis.

This paper relates the bursting of the housing bubble to the subprime mortgage crisis and the turmoil in financial markets that caused a credit freeze and a serious decline in real economic activity. Both, the housing bubble bursting and the financial instability that resulted, produced the Great Recession, and induced monetary policy to employ new tools to restore financial stability. Similar narratives about the Stock Market Crash of 1929, the Crash of 1987 and the Internet Bubble of 2000 are presented to show the evolving financial nature of asset bubbles, describe the financial instabilities produced by them, examine the economic costs of financial turmoil and, finally, explore the responses initiated by monetary policy. The next three sections address the Housing Bubble of 2000-2010, in some detail, and the following three sections review rapidly three other famous bubbles. This analytical synopsis of the four best-known U.S. asset bubbles concludes, in the last section, with an articulation of few basic lessons learned from the bursting of asset price bubbles.

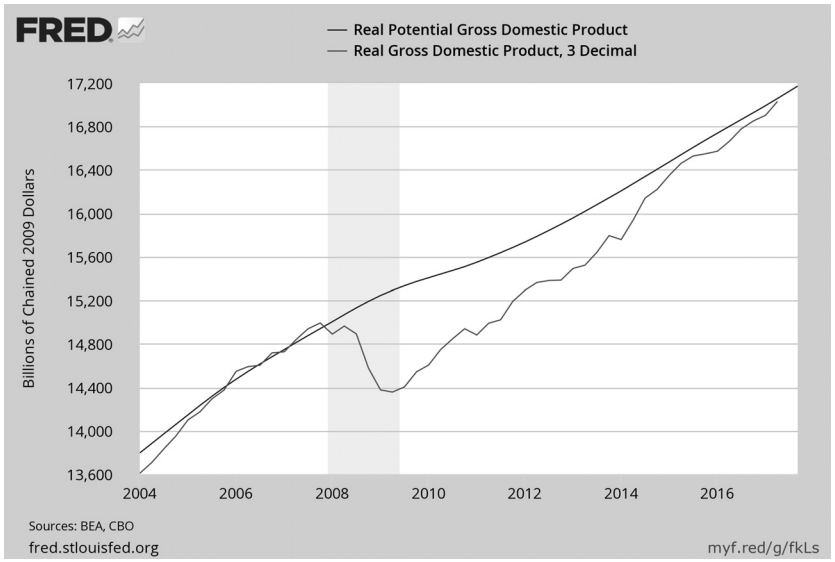

FIGURE 1.— The Recovery from the Global Financial Crisis Was Very Slow

II. The Housing Bubble of 2000-2007

The classic book that first addressed the importance of asset price bubbles and related them to market manias and crashes is Kindleberger (1978). This book and its latest seventh edition of Kindleberger and Aliber (2015) have refined the historical analysis but did not expand the scope of policy issues. From the first edition of this book to its most recent one, new bubbles were added to illustrate their continued presence in the economic landscape. What emerges from the Kindleberger and Aliber analysis is that asset bubbles have been occurring for the past few centuries across many countries. Often, they cause limited macroeconomic problems as in the case of the famous tulip bubble. However, in certain occurrences these bubbles may lead to an economic depression, as in the case of the 1929 Stock Market Bubble Crash or to a major recession as in the 2007 U.S. Housing Market Bubble Crash. Economic theorists and policymakers would like to know when the bursting of asset bubbles is followed by serious economic losses and when the crashing just restores market equilibrium with no economic repercussions elsewhere. Central banks are concerned

with asset bubbles because of the risks associated with their crashes.

Reinhart and Rogoff (2009) offer a more comprehensive quantitative analysis of economic crises than that of Kindleberger and Aliber (2015). The scope of their book is chronologically very long going back to pre-1800 and broad in terms of countries, covering as many as 66. Crises of various varieties are examined, such as inflation, currency crashes, banking crises, sovereign debt crises and others. Many economic crises are unrelated to asset price bubbles, but the authors describe how some banking crises develop from the bursting of stock market bubbles or housing bubbles.

This paper reviews four famous asset crashes: the first one is about housing and the other three are about the stock market. Figure 2 illustrates the S&P/Case-Shiller 10-City Composite Home Price Index for the period 2000 to 2010. It describes the Housing Bubble so we need to explain what the concept "bubble" means. Economists have not yet reached an agreement on a unique, unambiguously clear and precise definition. Following Barlevy (2007, 2015), Akerlof, and Shiller (2010) we describe the housing bubble as the evolution of housing prices during four stages. First, housing prices increase at some average trend rate when demand appears stronger than supply with prices going up. Notice that we do not specify exactly the rate of growth of these prices, nor do we quantify the length of the period of these increases. Ex post, one can observe, as in figure 2, that the trend from 2000 to 2004 was lower than the one that followed from 2004 to 2006.

The second stage involves the escalation of prices by speculative demand. In other words, the steady increases of the first stage generate a positive feedback to prices. Speculators who observe increases in past prices anticipate further increases in the future and buy now to sell later at an expected higher price.

Barlevy (2015) describes this process of speculators buying not because they believe the fundamental price is low and will therefore increase but because they hope to sell to another fool at a higher future price. Akerlof and Shiller (2010) emphasize the psychological euphoria of traders with an emphasis on behavioral exuberance. Since speculation and exuberance have now pushed prices above fundamentals, the probability of expecting further increases begins to decline which means the probability of a correction increases, both describing the third stage of a bubble. These conditions indicate the bubble is close to its peak. In figure 2, this stage was reached in early 2006 with a peak in late summer. The final stage is when some triggering factor reverses the

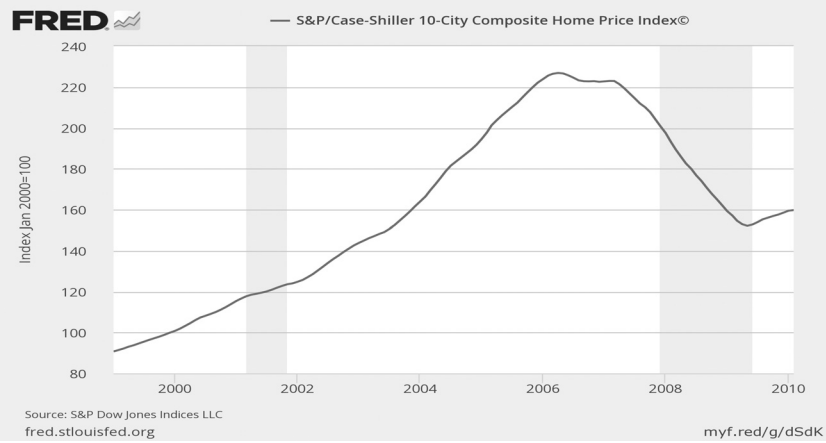

FIGURE 2.— The U.S. Housing Bubble 2000-2010

positive feedback mechanism that drove prices excessively high. Panicked speculators realize peak prices are fragile and begin to sell and this large selling volume overwhelms demand and prices collapse. This took place for the Housing Bubble between the end of 2006 and mid-2009 with a total correction of about 30%.

With this description of figure 2, we can offer an informal definition for a bubble as asset price increases driven by speculation and exuberance beyond what is justified by fundamentals that cannot be sustained beyond some high level at which time the asset's price is vulnerable to a collapse that eventually takes place. It is worth noting that both the illustration of the Housing Bubble and the definition require the crashing stage, otherwise the concept of the bubble cannot hold. If in figure 2, prices continued to move randomly past their highest level without crashing or if they declined over a long time in a disciplined fashion, one could not use the concept of a bubble to describe the housing market during this period. This means that asset price bubbles are identified with certainty only ex-post since their crashing is a necessary condition.

We emphasize that there is no consensus among financial economists about the size of the bubble's rise, the length of time required for this increase to materialize, and finally about the magnitude of the price collapse. While the search for a clear and mathematically unambiguous definition continues, both the history of bubbles and our recent experiences with them implicate a pricing that combines

fundamental (rational) reasoning with levels of irrational exuberance that generate positive feedback up to some high level of prices when the bubble crashes.

Similar to the narrative presented in figure 2, asset price bubbles begin when favorable fundamental conditions prevail with a growing economy driven by successful monetary and fiscal policies that generate above average asset returns. Uncertainty about future prices of an asset whose returns are currently unknowable in the Knightian sense of no available data, may drive a positive feedback mechanism. This develops when recent past prices weigh in more heavily than rationally expected future prices. If in addition, the asset's supply conditions are inelastic or short selling is difficult –new homes take time to build and cannot be sold short -- while leveraged credit conditions fuel demand increases, prices eventually reach unsustainable levels when some triggering event causes the bursting of the bubble.

III. Financial Instability

Thus far, we have described the specific Housing Bubble of 2000-2010 that motivated a tentative definition and a narrative for asset price bubbles in general. One may ask what causes bubbles to emerge. More specifically, what caused the Housing Bubble and how did it destabilize the financial markets? There are two broad hypotheses about the causes of the Housing Bubble, proposed by Taylor and Bernanke.

Taylor (2007) argues that the easy monetary policy followed by the Fed during the 2000-2004 period contributed to a dramatic increase in the demand for housing. In turn, this increased demand for housing caused prices to increase significantly during 2002-2006. Similar policies in several other countries such as the U.K., Ireland, and Spain, fueled a global real estate boom. Taylor (2007) grounds his hypothesis on the Taylor rule that mechanically computes the appropriate fed funds rate using as inputs the deviations from maximum employment and deviations from a long-term desired rate of inflation of about 2%. He computes the appropriate rates of fed funds using his rule and concludes that the actual rates targeted by the Fed during the 2002-2004 period were lower and fueled the Housing Bubble.

Bernanke (2010, 2013) critically evaluates the Taylor hypothesis and argues that the low interest rates observed in financial markets were not decided unwisely by the Fed but rather were the result of a substantial

global saving glut during the period of the housing bubble formation. These large savings were mostly originated in emerging markets, primarily China, with international financial institutions accumulating funds from saving countries and lending in the U.S. There is a long literature evaluating these two basic hypotheses. Hayford and Malliaris (2011), Bhar, Malliaris and Malliaris (2015) and Bhar and Malliaris (2016) offer a detailed overview of these issues and Bernanke (2010, 2013 and 2015) gives an exhaustive examination of the Housing Bubble, its causes, its consequences and the response of monetary policy.

In particular, Bernanke (2010) gives detailed evidence that Federal Reserve fed funds policies are not responsible for the housing bubble; the central argument is the global character of the housing bubble. Since housing prices increased across many different countries, following dissimilar monetary policies, Taylor's argument fails to explain the actual determinants of the U.S. housing bubble. In addition, Bernanke argues that the housing market is driven by long-term interest rates that the Fed does not directly target. In particular, fed funds and long-term interest rates have complex nonlinear dynamic relationships and one cannot argue that low fed funds imply low mortgage rates. Bernanke (2015) revisits these issues arguing that Taylor's mechanistic approach cannot replace the extensive deliberations of the Federal Open Market Committee that has addressed the causes and consequences of the Housing Bubble in detail.

The two hypotheses proposed by Taylor –low fed funds rates—and Bernanke –the global saving glut with low longer-term interest rates—do not exhaust the causes of the Housing Bubble. Homebuyers usually finance the purchase of their home with a 20% cash down payment and a mortgage given to credit worthy households. During the Housing Bubble, down payments were reduced, the role of credit worthiness of borrowers was radically diminished and the volume of subprime mortgages was significantly increased. Financial markets seriously underestimated the risks associated with housing lending because they expected housing prices to continue rising. Furthermore, data about housing prices during the past 30 years prior to early 2006 clearly documented no price declines exceeding a 10% loss.

During 2003 and 2004, while the Housing Bubble was growing, Lehman Brothers acquired five mortgage lenders. One of them was BNC Mortgage that specialized in subprime mortgages, and another was Aurora Loan Services that specialized in making loans to borrowers

without full documentation. Lehman prospered during the boom until its bankruptcy on September 15, 2008.

Innovations in mortgage financing created private-label mortgage-backed securities providing most of the funding of subprime mortgages. From the pools of mortgage-backed securities, additional derivatives products were created by repackaging various levels of risk as well as derivative products hedging such risks, such as the credit default swaps. A buyer of such a product pays a monthly premium that ensures the expected income from the package of mortgages bought in case such payments cease to be paid. The global saving glut, articulated by Bernanke, fueled demand for such products that in turn contributed to increasing demand for housing. Lehman, Bear Stearns and other investment banks chose to invest themselves in these mortgage-backed securities, financing such holding with short-term credit.

Eventually in late 2006, house prices peaked; mortgage refinancing ended and selling existing homes became difficult. A large percentage of homeowners realized that the value of their mortgages was higher than the market value of their home and defaulted. Large pools of mortgage-backed securities were downgraded to reflect the realized risk of declining prices and several subprime lenders were bankrupted. The positive feedback of the Housing Bubble that prevailed up until mid-2006 was tested during 2007 but no one could anticipate the dramatic developments that followed. In December of 2007, the U.S. economy entered into a recession with fed funds around 5% and estimates about the total cost of the subprime crisis projected to be around $300 billion. The financial system however remained stable until the collapse of Lehman Brothers, on September 15, 2008.

Lehman Brothers was a large investment bank that had prospered during the Housing Bubble by issuing subprime mortgages and securitizing mortgage-backed securities. While the housing bubble was growing during the 2004-2007 period its profits increased dramatically and its stock had reached a record high price of about $85 in February of 2007 from around $30 in 2003. Lehman's leverage ratio of total assets to shareholders' equity was around 30 in mid-2007 but as the Housing Bubble continued to deflate in 2007 and 2008, Lehman's assets decreased in value and its stock price collapsed even faster. During summer 2008, Lehman management sought various solutions such as the sale of assets, raising more capital or finding a buyer among the largest banks. These strategies did not work and on September 15, 2008, Lehman Brothers with 25,000 employees worldwide filed for

bankruptcy with $639 billion in assets and $619 billion in debt. This event triggered financial instability with global equity markets experiencing a decline of $10 trillion in market capitalization.

What is financial instability? Economic and financial instabilities are complex phenomena. Broadly speaking, economists theorize that economies, with their subsets of the real and financial sectors, are inherently, and most of the time in a state of equilibrium. When a big market shock takes place--such as a stock market crash, bank runs, sovereign insolvency, currency devaluations and other similar events--the financial sector and the economy experience a major shock that causes a deviation from this equilibrium. These deviations are described as instabilities to capture disequilibrium states of the economy that persist without a systemic tendency to return to the prior equilibrium. These short-term deviations can be costly from a societal perspective as markets fail to perform their basic function of allocating resources efficiently.

Rosengren (2011) emphasizes that the central function of financial markets is to allocate capital efficiently. This requires financial stability. Rosengren argues that "financial stability reflects the ability of the financial system to consistently supply the credit intermediation and payment services that are needed in the real economy if it is to continue on its growth path." When the financial system suffers a major financial disturbance that interrupts or seriously freezes the process of allocating capital, two types of interrelated risks emerge. First, the system experiences valuation risk because the financial instability has increased uncertainty and traders have difficulty correctly measuring fundamental values of assets. Second, there is a macroeconomic risk. This means that traders also need to assess the likelihood of a recession because of financial disruptions in investment and consumer spending. Thus, financial instability creates uncertainty, asset price volatility, and misallocation of capital--all of which negatively affect the real economy. The Lehman Brothers bankruptcy was the event that triggered financial instability.

IV. Monetary Policy

When asset bubbles burst, financial markets freeze or stop performing their vitally important function of allocating capital and supporting economic activities. The responsible institution for restoring financial

stability is the Federal Reserve System. The Federal Reserve Act of 1913 established the U. S. central banking system, called the Federal Reserve System, and charged it to design a national currency and conduct a monetary policy to promote financial stability. In 1977, Congress amended The Federal Reserve Act, stating explicitly:

> "The Board of Governors of the Federal Reserve System and the Federal Open Market Committee shall maintain a long run growth of the monetary and credit aggregates commensurate with the economy's long run potential to increase production, so as to promote effectively the goals of maximum employment, stable prices and moderate long-term interest rates."

Among the three goals of maximum employment, stable prices and moderate long-term interest rates, the first two have received precedence and thus most consideration over the years. The pursuit of maximum employment and price stability as the Fed's primary goals has evolved into the Fed's current "dual mandate." The Fed cannot force prices in a market economy to remain stable or achieve maximum employment and output directly. During the past forty years, the Fed has endeavored to achieve its dual mandate indirectly by increasing or decreasing a short-term interest rate, called the federal funds rate, through open market operations. Figure 3 illustrates the monthly fed funds rate since 1955 and demonstrates that the Fed has been very actively pursuing its goals. What is eye-catching in this graph is that, since the Global Financial Crisis of 2007-09, the fed funds rate has dropped to close to zero and stayed there until late 2015. Even today in mid-2018, almost 10 years since the bursting of the housing bubble, the financial collapse and the Great Recession, fed funds remain around 1.75%.

Figure 3 shows that that federal funds rate that stood at 5.25% in August 2007, by December 2008 were reduced to a range of 0 to 25 basis points. This rapid decline in the fed funds rate, in a little over a year, was the result of several factors that included, among others, the intensity of the bursting of the housing bubble, the impact of the financial instability and the scope of the Great Recession.

In late 2008, the Fed decided to use an unconventional method to stimulate the U.S. economy, which was constrained by the zero lower bound of fed funds. The tool used by the Fed was the, so-called, Large-Scale Asset Purchases (LSAP) or Quantitative Easing (QE). QE

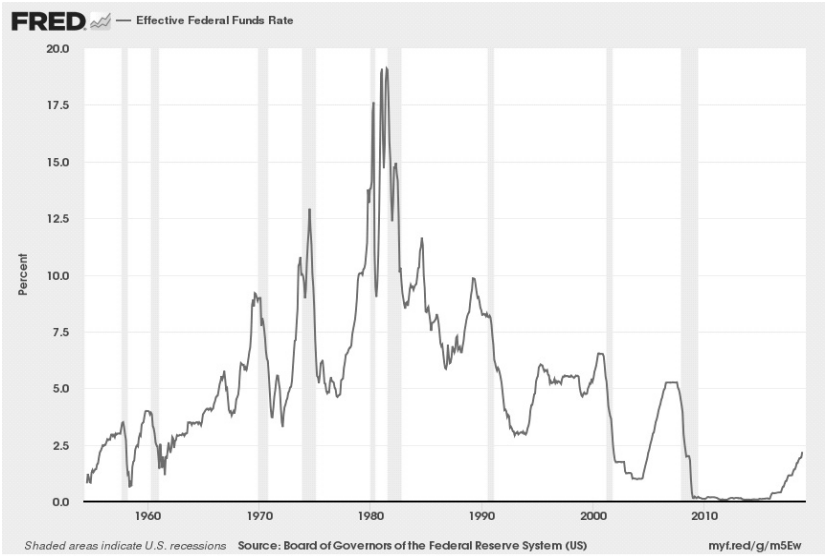

FIGURE 3.— Federal Funds Rates, 1955-2018

consisted of the Federal Reserve purchasing longer-term U.S. Treasury securities and agency mortgage-backed securities, with the aim of driving down longer-term interest rates, thereby stimulating economic activity. Bernanke (2013, 2015) discusses the progression of QE in detail. It was not known at the beginning how many rounds of QE were necessary for the restoration of stability in the financial sector and economic recovery in the real sector. Today, with the benefit of historical experience we know that the Fed executed three main rounds of QE. These three rounds of QE are also called "unconventional" monetary policy because they targeted long-term interest rates, in contrast to "conventional" monetary policy that employs short-term fed funds. The Federal Open Market Committee (FOMC) announced QE1 on November 25, 2008. The plans were for the Fed to purchase $600 billion on mortgage-backed securities (MBS) and agency debt. The strategy was officially implemented on December 15, 2008. It was extended on March 18, 2009 when the FOMC announced the purchase of an additional $750 billion of MBS and $300 billion of Treasuries. The plan was concluded in December 2009, about a year later.

After the termination of QE1 at the end of 2009, the labor and housing markets continued to be weak as the economy faced a slower

recovery. Although spending for household consumption and business investments had seen progress, there were substantial weaknesses in both the labor and housing markets that persuaded the Fed to announce QE2. The objective was to strengthen the economic recovery and to fight deflation, by lowering longer-term interest rates. By lowering interest rates, the goal was to increase consumer spending and business investments, in attempts to alleviate unfavorable conditions in the financial markets and pursue the Fed's dual mandate of maximum employment with stable prices. On June 22, 2011, the Federal Reserve released a statement stating, "To promote the ongoing economic recovery and to help ensure that inflation, over time, is at levels consistent with its mandate, the Committee decided today to keep the target range for the Federal Funds rate at 0 percent to 0.25%." The Fed also announced it would purchase up to 600 billion dollars of long-term treasury securities. The FOMC also decided to continue to maintain its previous policy of reinvesting funds from its QE holdings.

The FOMC announced QE3 on September 2012. It did not specify the total amount but indicated monthly purchases of $40 billion in MBS. This amount increased by another $45 billion of purchases of Treasuries on December 12, 2012. The monthly amount of large-scale asset purchases of $85 billion consisting of both MBS and Treasuries continued for all of 2013 and tapered gradually over 10 months prior to its termination on October 29, 2014.

During the seven-year QE period, numerous financial and economic developments took place that shaped these strategies. Numerous FOMC minutes, testimonies and speeches by Fed officials provide rich and useful information. Bernanke (2015) offers a detailed evaluation of QE. The primary lesson learned from this long period of seven years of unconventional monetary policy is how challenging it was to restore financial stability. The first increase in the fed funds rate took place in December 2015 to .50 %, the second increase in December 2016 to .75% and as the economy stabilized further and unemployment dropped below 4.5%, three additional fed funds increases occurred in 2017. Currently, in July 2018, fed funds are at 1.75%.

Because of these QE strategies, the balance sheet of the Fed has expanded from about $1 trillion of assets prior to the crisis to over $4.5 trillion in early 2018. The critical question is this: what have these three massive QE accomplished? There is a general and a particular response. The general response claims that when the Fed reached its zero lower bound, it became obvious that the stabilization of the U.S. economy

required additional monetary stimulus, because economic growth was very slow and there was no risk of inflation. The gradual return to moderate economic growth of the U.S. real economy since the end of the Great Recession in June of 2009 is partial evidence of the overall effectiveness of the three QEs.

The particulars of these strategies address the channels of monetary transmission: if QE reduces longer-term interest rates, then consumers may pay less for their debt obligations and thus have more income for consumption; simultaneously, longer-term interests also reduce the debt obligations of corporations and private firms, thus increasing their profits and contributing to higher asset valuations. In turn, these higher asset valuations encourage corporate business investments and increases in employment. In addition, as QE reduces interest rates, equity prices rise and consumers may increase their spending because of increases in the value of their assets, called the wealth effect. However, we also need to emphasize that lower longer-term interest rates also reduce the income of bond investors such as insurance companies and individual bond investors.

There are numerous studies evaluating the effectiveness of QE. Williams (2011) reviews several of these studies and reports that the estimated effects of QE on Treasury yields in these studies are very consistent, particularly when one considers the broad variety of sample periods and different econometric methods. Specifically, estimates of the impact of QE on longer-term Treasury yields that Williams reports range between 0.15% and 0.20%. These estimates may seem small but if one uses the benchmark that it takes on average a 0.75% cut in the fed funds rate to reduce Treasury yields by 0.15% to 0.20%, the impact of QE is significant. Thus, it is reasonable to hypothesize that QE had an impact in reducing long-term Treasury yields. It is more challenging, however to show empirically how these declines in Treasury yields have helped the Fed achieve its dual mandate of maximum employment with stable prices. Bernanke (2012) suggests that QE works through the portfolio channel, and Williams (2011) explains that the confirmation of this hypothesis is a more challenging empirical issue that remains to be conclusively established.

In addition to QE, the Fed has also used additional tools in its pursuit to restore maximum employment. Among these additional tools employed, we mention the continuous communications guidance supplied by the Fed. The Fed also initiated paying interest on excess reserves held by the banks on deposit at the central bank and it

employed the reverse repurchase agreement and the term deposit facility, both introduced during the recent financial crisis. Bernanke (2015) describes these tools in his memoir. He also discusses valuable initiatives in fiscal policy – the Troubled Asset Relief Program of 2008; the American Recovery and Reinvestment Act of 2009-- and financial regulation -- the Dodd-Frank Wall Street Reform and Consumer Protection Act of 2010.

When calculating the heavy economic costs of the Great Recession and the enormous efforts by the Fed over a period of eight years to restore financial stability, is it reasonable to ask what if monetary policy, instead of responding to the bursting of the housing bubble had anticipated it and leaned against it? This question is known in the monetary policy literature as the "lean vs. clean" controversy. Leaning against a bubble means that monetary policy, at some point during the period of the bubble's rise, chooses to increase the fed funds rate to discourage its further growth. However, bubbles cannot be identified easily during the build-up period and so it is very risky for a central bank to decide when and for how long to act. In addition, the impact of higher interest rates on a bubble is not quantifiable and the effectiveness of this tool is debatable.

Beyond such technical issues, central banks do not have a clear charge to deflate asset bubbles and if they chose to do so, by increasing fed funds, this may undermine their official dual mandate. In general, all of this leads a central bank to pursue the "clean" choice. When there is evidence, the bubble has crashed and the financial system is under stress, decreases in fed funds prevent financial panics. Thus, the "lean vs. clean" controversy is a choice by the central bank to respond asymmetrically. That is, ignore the bubble during its built-up but respond rapidly to the bubble's bursting. In an influential paper, Brunnermeier and Schnabel (2016) carefully review 23 identified bubble episodes and find that the severity of a bubble bursting is less linked to the type of asset than to the financing of the bubble. They also document that experience suggests that purely passive "cleaning" after the bubble burst is very costly, although correct methods and tools for "leaning" against a bubble remain loaded with complexities.

The "lean vs. clean" controversy continues to evolve and the question remains relevant: should asset price bubbles be considered as benign financial episodes outside the practical influence of central banks? A large literature, reviewed in Malliaris (2012, 2016) and Evanoff and Malliaris (2018), has grown that investigates the polar

answers "yes" and "no" and the in-between "it depends" to this concise question and its numerous reformulations. Our narratives that follow revisit this question.

V. The Stock Market Bubble and Crash of 1929

The stock market bubble of the 1920s and its crash in October 1929 remains the most devastating bubble in U.S. economic history. Its seeds were sown the early years in the decade with solid economic and technological fundamentals. Then, a positive feedback of increasing prices fueled speculation that eventually led to a crash and a financial panic that produced the Great Depression of the 1930s. Examining Graph 4, we can distinguish the four stages of the bubble. First, prices kept increasing from 1920 to 1927 based on a booming economy. During this period, people were leaving the farms and moving to big cities. There were great construction, booming retailing, banking and insurance services were growing, and new technologies such as telephones, automobiles, aeronautical, radio, movies, and chemicals created both new jobs and great optimism for future prosperity. Older industries such as railroads and oil were also doing very well.

A sample of great industrial companies that were included in the Dow Jones Industrial Index included American Can, American Tobacco, Bethlehem Steel, U.S. Steel, General Electric, Westinghouse, General Motors, Chrysler, General Railway, National Cash Register, Radio Corporation of America, Standard Oil, Wright Aeronautical, F. W. Woolworth, Sears and Union Carbide, among several others. The soaring economy and the financial success of these companies established a positive feedback mechanism. Investors bought stocks expecting good returns and paid higher prices than earlier investors, but with new investors entering the market, attracted by positive returns, prices continued to rise. Then we see in the graph that around early 1927 until the stock market reached its peak in September 2019, speculation intensified. Financial history suggests that innovations, such as the establishment of brokerage houses, investment trusts and margin accounts fueled this speculation further. The stable performance of increasing stock prices over the period from mid-1921 to late 1928, distorted the risks associated with equity and both investors borrowing to buy stocks and lenders offering these loans, drove the bubble to its peak during the first nine months of 1929. Thus, the Dow Jones Index

that stood at 63 points in August 1921 had climbed to 381 points in September 1929, a 600% increase.

On October 28, 1929, the bubble crashed with an initial 13% drop that was followed by additional big drops, some rebounds and further drops to end at around 40 points, in summer of 1932; this was a crash that shrunk the bubble by about 90%. What caused it? What destabilized the financial system and how was the economy affected? Lastly, what helped the economy recover?

We offer brief answers from a selective list of references. Galbraith (1954) presents a rich context of the speculation that brought the stock market to unsustainable highs by early 1929. Participants did not know what to expect next: further increases? A big correction? Stable prices? Newspapers at the time reported a divergence of opinions. Some experts argued prices were justified by fundamentals and expected them to stay at high levels; others believed prices were driven to very high and unsustainable highs. Galbraith goes day by day and identifies well-known financial leaders who offered their assessments of the market. The bullish sentiment slowly declined. Its advocates appeared less persuasive in generating support for the ever-increasing number of bearish sellers. Prices became more volatile. During early October 1929, speculators holding large positions started to lose confidence in the market and the imbalance between buyers and sellers crashed the market by the end of October.

Friedman and Schwartz (1963) enrich the descriptive presentation of Galbraith with a scholarly analysis of the role of monetary policy. They argue that the Federal Reserve, just established a few years earlier on December 1913, watched nervously the stock market bubble growing. The Fed knew that speculators purchased stocks with borrowed funds and the stock served as collateral, feeding further borrowing. The Fed also understood that stock market speculation differed from financing that went to productive investments in agriculture or industry. Thus, in today's language, the Fed aspired to reduce stock market speculation and "lean" against the bubble. However, there was no unanimous agreement about the appropriate management of the stock market speculation. In addition, the U.S. was under the gold standard that imposed constraints both to the U.S. Treasury in terms of the size of the federal deficit and the Fed in terms of interest rate policies.

One approach for the Fed was to focus on the stock market speculation and its funding. Another way was to increase the discount

rate, across all lending. In February 1929, the Federal Reserve Board asked Reserve Banks to deny requests for credit from member banks that loaned funds to speculators. However, the New York Fed favored raising the discount lending rate that by August 1929 was granted by the Federal Reserve Board. Increases in the discount lending rate in the U.S. were followed by increases in other countries, motivated by the gold standard that prevailed at the time. Central banks in other countries reasoned that if they did not follow the U.S. in increasing their interest rates, they would lose part of their gold reserves. This unfortunate global increase in interest rates during the summer of 1929 coincided with the beginning of an economic recession. The National Bureau of Economic Research reports that the U.S. economy experienced a recession during August 1929 to March 1933, that later was named the Great Depression.

The weakness in the real economy during the late summer of 1929 along with the increase in the discount lending rate contributed to a reassessment by speculators about the sustainability of the stock market boom. When optimists could not sustain the record-high levels of the Dow-Jones Index and prices started dropping in late October 1929, Friedman and Schwartz (1963) argue that the Fed was reluctant to act as a lender of last resort and supply the necessary funds to commercial banks. Initially, the New York Fed provided liquidity to commercial banks in New York City but its authority to do so was challenged by the Federal Reserve Board. Figure 4 illustrates the stock market continued its decline from late 1929 to early 1933. Commercial banks that had made loans to speculators saw their collateral value decline and without the clear determination of the Board to supply the necessary liquidity, their obligations to depositors could not be met. During this period nearly 10,000 bank failures occurred, credit essentially froze and unemployment from 3.2% in 1929 increased to about 25% by 1933. GDP declined by 8.5% in 1930, by 6.4% in 1931, by 12.9% in 1932 and by 1.3% in 1933. In addition, during the depression, wages declined by 42%, the money supply by 30% and deflation was about 310 % per year. Romer (1990), Calomiris (1993) and Bernanke (2004) offer a detailed analysis of the impact of financial developments on the real economy.

Our understanding today about the stock market bubble of the 1920s and its crash on October 28, 1929 is that the financial instability it produced that ravaged the real economy is, essentially, the result of wrong monetary policies. As the stock market bubble was collapsing,

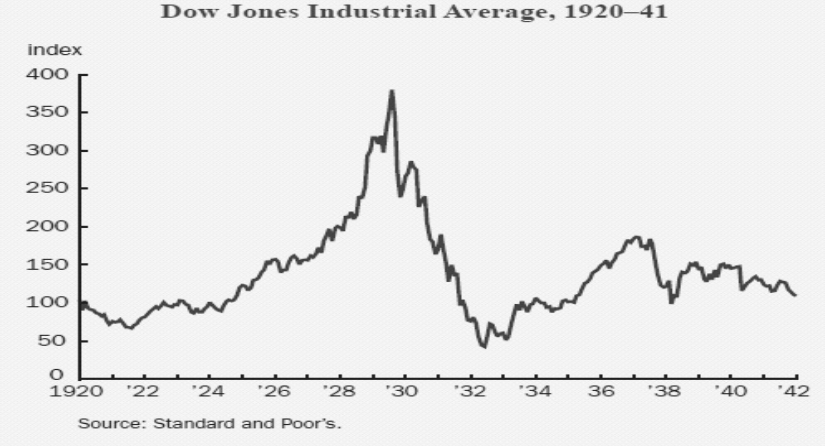

FIGURE 4.— The Stock Market Crash of 1929

the Fed was increasing interest rates. As speculators were moving from the stock market to currency markets, the Fed responded to preserve the value of the dollar fixed at $20.67 per ounce of gold instead, of giving priority to employment and GDP growth. Increasing interest rates and collapsing stock prices caused banks to fail, thus bank credit also collapsed. Panicked depositors withdrew deposits from banks and further contributed to bank failures. Increasing unemployment decreased demand and bred deflation. In an environment of declining prices of about 10% per year, past accumulated debts became an unsustainable burden for firms and households. The Fed did not respond to provide the necessary liquidity and bank failures continued to increase and the money supply continued its contraction.

This narrative gives perspective to the archetypical concept of financial instability. During the Great Depression, money supply declined, the stock market continued to collapse, a large number of banks failed, households lost their saving, the demand for goods and services plummeted dramatically because of deflation and unemployment and, finally, the demand for capital and supply of saving withered as financial risks skyrocketed. Therefore, the financial system had stopped performing its vital function of allocating capital, thus bringing blockages to the real economy.

How did the U.S. get out of the Great Depression? Franklin D. Roosevelt was elected President in 1932 and he believed that to end the depression the government needed to undertake a very aggressive

economic involvement. He called it the New Deal to create new jobs and stimulate economic growth. An extensive bibliography discusses numerous initiatives such as the creation of Social Security, the Securities and Exchange Commission, the Federal Deposit Insurance Corporation, the Civil Works Administration, abandoning the gold standard, the creation of the Home Owners Loan Corporation, and many more initiatives that involved the three areas of fiscal policy, monetary policy and regulation. Romer (1990, 1992) discusses in detail these remarkable initiatives.

VI. The Stock Market Crash of 1987

Figure 5 illustrates the one-day crash of the stock market that occurred on October 19, 1987. Unlike the other two crashes we have described, this one was the first crash since the Great Depression and one that influenced most global stock exchanges. Malliaris and Urrutia (1991, 1992) present detailed statistical evidence on the international linkages of this crash.

What is unique about this crash is that it is not the result of a big bubble bursting. Stock prices were increasing for several years before the crash but not in a bubbly way. In addition, as illustrated in figure 5, after the one-day big decline of about 22%, stock prices recovered and continued their upward trend. Therefore, the relevant questions for this crash are two. First, what triggered this crash and second, how did monetary policy respond?

Among economic fundamentals, it was reported in mid-October, that the U.S. trade deficit was larger than expected. The dollar fell. Volatility increased in global equity and currency markets. Treasury Secretary James Baker made certain remarks about the option of devaluing the dollar to narrow the nation's increasing trade deficits. These remarks undermined investor confidence. Beyond these important negative fundamentals, several innovations had been introduced in equity markets. These included the stock index futures contracts, computerized arbitrage between cash markets and index futures contracts and portfolio insurance. Portfolio insurance described a financial innovation that allowed equity funds to buy an appropriate amount of puts on an equity index to ensure (the exact concept here is "to hedge") the value of their holdings. These products were traded via open outcry methods at the Chicago Mercantile Exchange, the Chicago

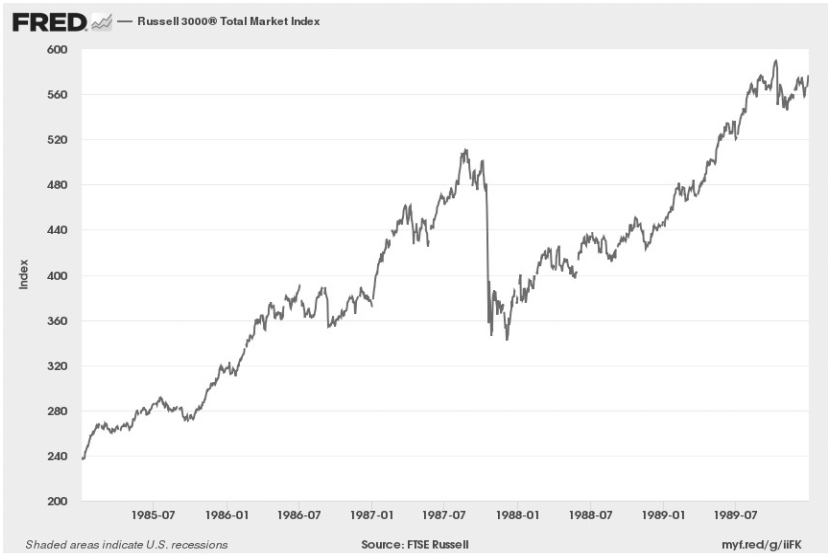

FIGURE 5.— The Stock Market Crash of 1987

Board of Trade and the Chicago Board Options Exchange that differed from the New York Stock Exchange that followed the specialist arrangements. Furthermore, traders in these markets were unable to exhibit a comprehensive financial condition so a winning one could not offset a losing position because they took place in different markets. The liquidation of losing positions intensified further price declines.

On October 19, U.S. markets opened with heavy selling following the plunging in European markets that had in turn followed the Asian markets. As prices were plummeting at the New York Stock Exchange, traders at the Chicago Mercantile Exchange took action by shorting the S&P 500 Index Futures contract. Arbitrage was triggered as the basis between the cash and futures widened. This added to volatility and added to further cash selling in New York. When prices quickly reached declines of 10%, some portfolio programs triggered the purchasing of puts and those traders who chose to sell these puts hedged their positions by selling the underlying stocks, adding further selling pressure to the New York Stock Exchange. Eventually, all trading stopped in New York, so there was no pricing information. However, The Chicago Mercantile Exchange chose to remain open and markets finally closed at the end of the day with large price discrepancies among

the numerous products.

The Fed acted very decisively by providing huge liquidity. During the evening of October 19, and before markets opened the following morning, the Fed contacted all banks involved in financing specialist firms. Most valued their inventory at about 20% less than when they started trading that day. Such losses, for some, were more than their capital. Banks instead of liquidating the remaining assets and causing a financial panic, extended unlimited credit that supported equity prices the following trading day. Markets calmed down and by late afternoon on Tuesday, October 20, some speculators started buying stock index futures in Chicago. Next, arbitrage triggered stock purchases in New York and both cash and derivatives markets stabilized. No market instability was experienced past the day of the crash and the real economy was not affected. Appropriate financial regulations were introduced by the exchanges to better manage the new financial instruments including clearing and settlement procedures and circuit breakers. Garcia (1989) discusses the role of the Fed in containing the 1987 crash.

VII. The Internet Bubble and Crash of 2000

The National Association of Securities Dealers Automated Quotations (NASDAQ) system started in 1971. By late 1997, NASDAQ had 5,500 listed companies. Technology companies were 35% of total market capitalization. Figure 6 illustrates the rapid increases in the NASDAQ 100 Index. This graph shows that the index was about 500 in 1995 and five years later, had climbed to about 4,700.

What caused the NASDAQ 100 bubble? There is wide agreement that it was driven by new technology. By the early 1990s, advances in internet connectivity, commercial usage of the internet, software and hardware advances for desk computers, all were growing rapidly. Numerous new companies had just started, among them Dell, Compaq, Gateway, Apple Computer, Silicon Graphics, America Online, Netscape, Microsoft, 3Com, Amazon, Cisco, and Sun Microsystems. There was financial exuberance everywhere and Fed Chairman Greenspan (1996) addressed it when he reflected

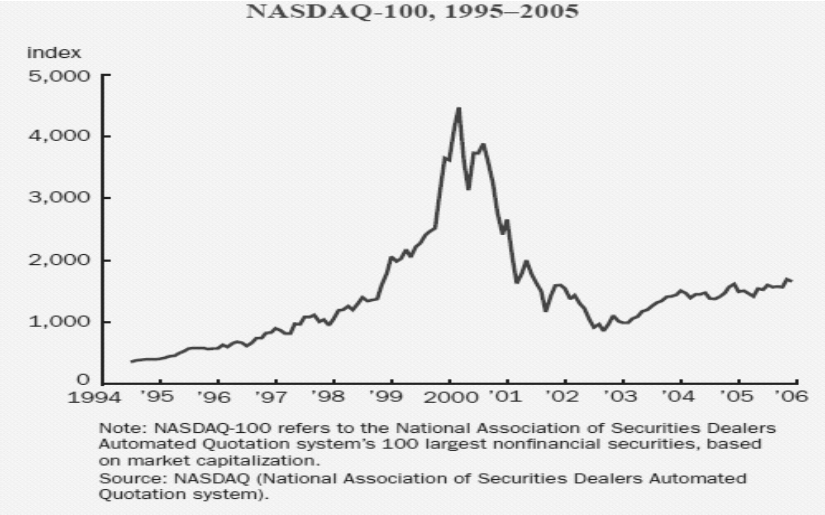

FIGURE 6.— The Internet Bubble, 1995-2005

> "But how do we know when irrational exuberance has unduly escalated asset values, which then become subject to unexpected and prolonged contractions as they have in Japan over the past decade? And how do we factor that assessment into monetary policy? We as central bankers need not be concerned if a collapsing financial asset bubble does not threaten to impair the real economy, its production, jobs, and price stability. Indeed, the sharp stock market break of 1987 had few negative consequences for the economy. But we should not underestimate or become complacent about the complexity of the interactions of asset markets and the economy. Thus, evaluating shifts in balance sheets generally, and in asset prices particularly, must be an integral part of the development of monetary policy."

The Fed's dual mandate made it focus on the real economy. Although Greenspan had raised the possibility of a bubble and economists were discussing the "lean vs. clean" choices, fed funds moved slowly. Actually, figure 3, discussed earlier, contains the behavior of fed funds during this period of the 1990s. Notice that fed funds were around 3% in December 1993, increased to about 6% in May 1995, and after a small decline rose again to 6.5% by August 2000. One way to describe Fed policy during this period is to say the Fed was

attempting a soft landing for the economy, also hoping for a moderation of the Internet Bubble. Hayford and Malliaris (2001, 2004, 2005) address how the Fed responded to the Internet Bubble and Kohn (2006) offers an overview of the role of monetary policy towards asset bubbles.

The NASDAQ 100 reached its highest value of about 4700 in March 2000. From March to September 2000, the Index exhibited very high volatility and then it started its decline reaching its lowest value of 810 in October 2002, a decline of over 80%. As the NASDAQ 100 begun its final decline, fed funds stood at 6.5% in December 2000 and they started to decrease. By August 2003, fed funds had dropped to 1%. During this period, the U.S. economy also experienced a mild recession that started in March 2001 and ended in November 2001.

Thus, the five-year-long investor exuberance about the unlimited new business possibilities of internet deflated without financial instabilities and devastating economic costs. As the Fed attempted to soft-land the economy, without leaning against this bubble, it allowed markets to reassess risks, go through major price gyrations, and materialize significant wealth loses, experience a mild recession with unemployment growing from 4% to 6.5% and returning to normal few quarters later. While the fed funds increased slowly during the growth of the bubble, when the bubble deflated and the economy entered into a recession, the fed funds decline was rapid and significant. Jalilvand and Malliaris (2010) connect the internet bubble to the housing bubble that followed.

VIII. Lessons Learned

This paper focuses on the links that arise between asset price bubbles and financial instabilities and how both of them often cause economic recessions. The two famous asset bubbles discussed here are the Stock Market Bubble of the 1920s and its Crash of 1929 and the Housing Bubble of 2000-2007 that caused the Great Recession. The bursting of these two big bubbles produced severe financial instabilities and major economic downturns. Our analysis leads to four major conclusions.

First, despite the impressive evolution of economies in advanced industrialized countries, and to a lesser degree in developing countries, during the past century, these economies remain subject to booms and busts. The development of the recent housing bubble, its crash and the great recession that followed were essentially unexpected because the

business cycle methodology focuses on ordinary and minor deviations from long-run economic trends. Moving forward, policymakers need to expand their narrow focus on business cycles to include the assessment of risks of major financial crises. This paper highlights how asset bubbles often produce financial instabilities. Going beyond our focus on bubbles, other causes also exist that produce financial crises. These include banking crises, currency crises, sovereign debt crises as well as noneconomic shocks such as natural disasters, political instabilities or wars.

Second, the formation of asset price bubbles in global financial markets, mostly driven by sophisticated and rational traders, remains a challenge. The pre-Keynesian literature summarized in Kindleberger (1978) uses the concepts of "boom and bust" to describe rapid economic growth with rising asset prices and their eventual collapse. Keynes introduced the concept of "animal spirits". Greenspan in our earlier quote uses the notion of "exuberance". These concepts clearly describe human feelings. Our discussion included illustrations of such phenomena. Economists need input from psychologists to develop a methodology to analyze financial bubbles. Malliaris, Shaw and Shiffrin (2016) propose such an inter-disciplinary approach.

Third, since it takes much longer for the build-up and growth of a bubble compared to its collapse and rapid decline, this asymmetry is challenging for monetary policy. For the bubbles discussed in this paper, monetary policy responded to the crash rather than the build-up of the bubble. During 1929, the Fed increased interest rates few months before the crash to reduce speculation but this was unsuccessful. The last two bubbles, the internet and housing, have revived the "lean vs. clean" debate and new theoretical and empirical work is now created to resolve the appropriateness of these two choices.

Fourth, a desirable property of an economic and financial system is its stability. A system is stable if it recovers quickly from a shock that disturbs its equilibrium. The fundamental assumption of the modern capitalist system with free markets and a government sector is that it is stable. Recently, during the period from the mid-1980s to 2007, called the Great Moderation, the U.S. economy was very stable. Yet, this stability ended with the crashing of the housing bubble. This appears paradoxical. Yellen (2009, 2014) discusses how often stability creates its own instability by bringing attention to the works of H. Minsky (1986). The seeds of a major asset bubble are sown during a period of strong fundamentals. We emphasized this idea several times in this paper. Beyond fundamentals, however, speculation is also important and easy financing often drives excessive speculation. When the bubble's

positive feedback suddenly reverses and the value of collateral declines, this produces financial instability. In other words, the shock to the financial system is caused by the sudden devaluation of collateral repriced at the crashed price in comparison to the debt owed for buying the same asset at an elevated pre-crash price. Balance sheets of financial institutions are seriously impacted by crashes that reprice assets and liabilities and thus generate increasing uncertainty that often freezes the allocation of capital and brings economic recessions. Monetary policy with its tool of short-term interest rates is currently unskilled to promote ex-ante conditions for enduring financial stability. Buiter (2014) and Yellen (2017) discuss the role of central banks in financial stability and the task of macroprudential regulation as an engaging tool.

In conclusion, this paper illustrates that because bubbles and instabilities cannot be removed from modern economies, monetary policy has evolved, since the Great Depression, to tackle the economic costs of bubble crashes in terms of unemployment and lost output. This paper chronicles a series of initiatives taken by the Fed to restore financial stability during the past decade. These unconventional monetary policies were accompanied by fiscal and regulatory initiatives that all together have worked well so by 2018 the U.S. economy is back to its normal equilibrium.

Endnotes

This paper presents ideas I discussed, at the University of Macedonia, during my awarding of an Honorary Doctorate by the Department of Accounting and Finance, School of Business Administration, on December 19, 2017. I am most grateful for this distinguished academic recognition to Professor Christos Negkakis who first conceived the idea a few years ago and nurtured it big-heartedly to a splendid celebration. I am also thankful to Professors Achileas Zapranis, Panagiotis Taxinakis, and Athanasios Noulas for their support and participation during the ceremony and the entire faculty of the Department of Accounting and Finance that made this award possible with their gracious approval. I am also appreciative of the presence of Professor Panayiotis Theodossiou who traveled from Cyprus to participate and to the large audience of faculty, administrators, staff and students who attended the ceremony and offered their generous compliments. This paper draws on several of my published articles that address various aspects of asset price bubbles referenced in the text and listed in the bibliography. I am pleased to thank all of my co-authors for our valuable

collaboration: they include R. Bhar, Doug Evanoff, Marc Hayford, Abol Jalilvand, George Kaufman, Mary Malliaris, Hersh Shefrin, Leslie Shaw and Jorge Urrutia. This paper differs partially from my earlier work because it reflects my current focus on the relationship between asset bubble crashes and financial instability. The fresh idea that emerges from a review of both the Great Depression and the Great Recession is that the restoration of financial stability is very costly to the real economy and challenging to monetary policy and it is thus best to safeguard financial stability rather than to repair it.

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