Speculative Enthusiasm: An Examination of the Role of Risk Appetite within the Framework of Minsky's Financial Instability Hypothesis

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Speculative Enthusiasm:
An Examination of the Role of Risk Appetite within the
Framework of Minsky's Financial Instability Hypothesis

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Contents

1—ABSTRACT

The spectacular collapse of the United States financial system in the fall of 2008 and severity of the subsequent recession were practically unforeseen by almost all market participants. Such a crash came as a surprise not only to laymen, but also to financial professionals and governmental officials charged with enacting regulation designed to prevent such scenarios. Unprecedented actions were taken by the Federal Reserve both to halt a complete collapse of crucial financial markets, and to ensure that at least some credit remained available to worthy borrowers. These actions were necessary to overcome the sudden reluctance of financial institutions to take any risks in an environment of such uncertainty. While the crash was unforeseen, it was simply the latest in a long series of financial crises dating ultimately to the foundation of a financial system within an economy—notable recent historical precedents include the stock market crash of 1929, Japan's real estate bubble in the 1980s, and the collapse of the NASDAQ stocks in 2001.

The dramatic nature of this crash brought renewed attention to the theories of a previously little-regarded economist known as Hyman Minsky. Disregarded during his lifetime for espousing unpopular views regarding the potential dangers of unchecked markets, Minsky produced work concerning the inherent instability of an economy with a thoroughly developed and complex financial system. Following the most recent spectacular crash, his ideas were suddenly revisited as a potential explanation for the reoccurrence of a type of crisis many had thought extinct.

Minsky developed a Financial Instability Hypothesis which sought to find an endogenous explanation for a modern economy's vulnerability to crashes. Specifically, he investigated the ways in which the financial structures of a modern economy might contribute to its instability. The hypothesis rests upon the twin assertions that some financial arrangements are more dangerous than others, and that during economic booms, investors' incentives are altered to favor these more dangerous arrangements. Essentially, in good times, the profit-seeking motive of investors overrides a diminished risk aversion, as memories of losses fade into the past.

This paper empirically tests Minsky's second assertion, by using econometric techniques to analyze the relationship between risk appetite and market returns. Spreads between the yields of bonds of different credit qualities are used as a proxy for wider investor sentiment toward risk. Regressions demonstrate that changes in risk appetite can be explained at least in part by historical market returns.

Such a finding supports Minsky's proposal that incentives of investors change in response to varying market conditions. It further implies that regulatory authorities might examine the level of risk appetite to determine whether increases in asset prices indicate the formation of speculative bubbles or are rather reflecting developments in the fundamentals underlying said assets.

2—BACKGROUND

2.1 Role of Markets within an Economy

The rise of efficient capital markets has proven to be a crucial component in the evolution of what might be considered a modern economy. These 'modern economies' found within developed nations depend largely upon the smooth operations of their financial markets: these markets play an extremely important role in the fundamental task of providing financing to firms who seek to engage in investment projects. Few economists seriously question the pivotal role that financial institutions and the primary capital markets have to play in the process of efficiently allocating the resource in question (money, or credit) from savers to borrowers, or that the efficient facilitation of such lending is a component essential to maximizing the efficiency and level of economic growth.

The distinction between primary and secondary markets however, is an important one, and many economists might argue that secondary markets have little if anything to add in the way of economic value to an economy.

2.2 Primary Markets

Primary markets generate funds for those firms and governments seeking to borrow in order to finance projects that require spending, thus allowing the borrowing firms to engage in profitable enterprises which they might otherwise be unable to pursue. Generally speaking, within the context of a primary market, firms issue financial securities (i.e. stocks or bonds) for a previously agreed-upon price. The price is set by the issuing firm and any financial intermediaries, i.e. investment banks, that agree to underwrite the securities issuance. The underwriting investment banks seek to accurately determine the market appetite for such a security and price it accordingly. For example, a well-capitalized firm with excellent prospects for both growth and profit, such as Google Inc., would likely experience high demand for securities it might issue. It would thus be able to issue bonds with a lower coupon rate—essentially allowing it to borrow money more cheaply. Conversely, a company with a less healthy balance sheet and only speculative prospects might not fare as well within the primary markets, and would be forced to pay higher coupons on any debt it would issue. The market, made up of individual investors, would thus be demanding a higher interest rate on credit it was willing to extend the second company, precisely as a bank or credit card company would choose to charge higher rates on loans to a customer with a poor credit history.[1]

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[1] An excellent example of this phenomenon can be viewed in the recent and ongoing Greek debt crisis. Because market participants doubt the Greek government's ability to cut its fiscal deficit and spur economic growth, Greece finds itself unable to borrow except at increasingly higher rates. The issue is deteriorating exponentially as the rates reach levels that suggest Greece's debt growth will outpace its GDP growth, and consequently ability to repay its debt.

2.3 Secondary Markets

Secondary markets, so-called because they follow temporally the action of the primary markets, are those in which previously issued securities are bought and sold by investors without the involvement of the issuing firm. Because the firms and governments whose debt is being dealt have no part in these transactions, the secondary markets do not offer such a direct benefit to the issuers of the securities as the primary markets. However, operational and efficient secondary markets play an indirect role in supporting the function of primary markets. As secondary markets allow holders of securities purchased in primary markets the ability to sell said securities, their existence greatly increases the liquidity of securities issued within the primary markets. This liquidity in turn increases the desirability of such instruments to investors, and consequently investors are willing to pay a greater price for the same security, all else being equal: i.e. they do not charge the borrowers a liquidity premium that they likely otherwise would. Hence, secondary markets contribute significantly, if indirectly, to general economic efficiency by greatly reducing the borrowing costs of firms issuing debt within primary markets.

The existence of secondary markets also significantly benefits the investors, or savers within an economy. Because participation in a primary issuance is usually limited, at least in practice, to those who have significant experience operating in financial markets and a good relationship with the underwriting institution, secondary markets allow other investors to invest in securities which they might not otherwise be able to purchase.

Finally, secondary markets benefit firms and governments by allowing them a measure by which to gauge investor sentiment and appetite. This information is indispensible in the pricing of new debt issues and can give a firm an idea of how its credit-worthiness as a borrower is viewed in the eyes of market participants. For example, a firm that wishes to issue new debt and already has bonds available in the marketplace might use the current yields on the outstanding bonds to help determine the pricing of the new issue: i.e. if the outstanding bonds are being bought and sold at a significant discount to their face value in the secondary market, their yield to maturity would be higher than the coupon rate with which they were originally issued[2], and this 'market-rate' would have to be considered as the basis for determining the pricing of any new issue.

2.4 Market Vulnerability

However, despite the important role that primary and secondary markets play in a healthy economy by allowing firms and governments access to efficient financing, lack of appropriate regulation can lead to abusive practices within markets. Such practices can unfortunately generate situations where markets are capable of wreaking real damage upon an economy. As the functioning of capital markets is vital to the success of a healthy modern economy, any disturbance to the operation of such a market is likewise damaging to the economy as a whole.

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[2] A bond's yield to maturity is calculated as the sum of the present values of all future cash flows divided by the price of the instrument. Consequently a bond's yield is inversely related to its price.

However, serious difficulties within financial markets are capable of causing damage to the economy beyond the destruction of their own function. A sudden market crash such as that of the New York Stock Exchange in 1929 can contribute to an economic downturn by causing panic, rapidly eviscerating paper wealth, and deeply damaging the confidence of both borrowers and lenders who might otherwise engage in productive economic activity.

2.5 Bubbles

Damaging market 'resets' or crashes, such as the incident of 1929, generally only occur after a period of extended buildup in market prices not based upon fundamental changes underlying those assets. Economists often refer to such peculiar growths in asset prices as 'bubbles'. The name is an apt metaphor and provides some basic insight into the behavior of bubbles; just as physical bubbles, after being carefully and slowly blown up, are extremely delicate and prone to bursting, market 'bubbles', though their creation requires a significant length of time and positive market sentiments, can be destroyed entirely in a matter of days or even hours as a single piece of news can induce a widespread selling panic. An initial wave of selling lowers prices by flooding the marketplace with excess supply. That drop in prices can prompt flighty investors to fearfully sell their own stakes before prices fall further—adding more supply to the marketplace and lowering prices further. This sort of psychological feedback process can get quickly out of hand, and is the mechanism by which markets crash.

Fig. 2A

Real Price/Earnings 1980-2002: S&P Composite Index
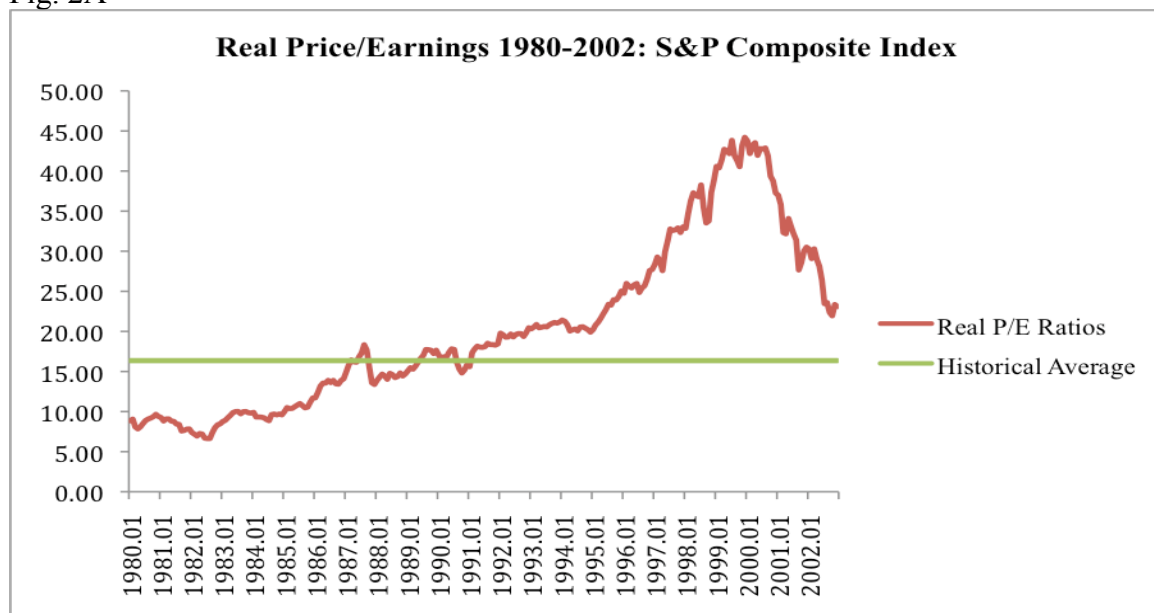
[3]

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[3] Source: Author's calculations. Earnings are average of 10 years lagging earnings in real terms. Data source: Robert Shiller

The above figure graphs the Price/Earnings ratio for Standard and Poor's Composite Index in real dollars for the years 1980-2002 against its average historical value since 1881 (16.35). As the Price/Earnings ratio can reasonably be understood as a measure of the value of an equity share, this graph illustrates that stock shares were considerably overpriced with respect to historical norms during the years of 1997 to 2001. The shape of this chart is typical for bubbles in any market or asset—a generally steady increase in price that quickens in pace until it reaches dizzying heights is followed by an abrupt correction and return to historic norms.

2.6 Speculation

The rapid buildup in asset prices that are already increasing in value is generally ascribed to the investment practice known as speculation:

> Speculation is conventionally defined as an attempt to profit from changes in market price. Thus, forgoing current income for a prospective capital gain is deemed speculative. Speculation is active while investment is generally passive. According to the Austrian economist J. A. Schumpeter, "the difference between a speculator and an investor can be defined by the presence or absence of the intention to 'trade,' i.e. realize profits from fluctuations in security prices."[4]

A speculator is thus understood to be a participant in an asset market who seeks to profit from capital gains in the asset: i.e. a speculator buys a security specifically with the intention of reselling it at a higher price in the future.

This approach to securities purchases might be contrasted with that of an investor who might purchase financial securities for the cash flows that they will generate in the future, with less emphasis on the price of the security itself. A speculator conversely is interested in a security not for its underlying cash flows, but rather for its ability to be 'flipped' to another market participant at a higher price, and thus a profit. As a speculator is less interested in the fundamentals of an asset than in how quickly its price might rise, his actions might be compared to those of a gambler simply betting that the price of a certain asset will increase. Indeed, it can sometimes be difficult to distinguish clearly between the actions of a speculator and a gambler—the only clear difference is that one deals in financial assets where the other deals in horse racing.

Speculation on the individual scale is of little consequence to the prices of an asset or the market in which it is bought or sold. However, speculation as a practice can present a real danger to economies thanks to positive feedback mechanisms that can enable it to get out of control. Literature on the topic describes these mass-psychological movements within markets as 'manias', or 'euphorias'. During one instance within the United States equity markets, the mass psychology of market participants was famously referred to by

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[4] Edward Chancellor. *Devil Take the Hindmost: A History of Financial Speculation* (Farrar, Straus and Giroux, New York: 1999), p. *xi.*

former Chairman of the Board of Directors of the United States Federal Reserve Bank Alan Greenspan as an "irrational exuberance".[5]

Such widespread irrational euphoria in the mass psychology of the market can only come about as the result of positive feedback cycles:

> In feedback loop theory, initial price increases…lead to more price increases as the effects of the initial price increases feed back into yet higher prices through increased investor demand. This second round of price increases feeds back again into a third round, and then into a fourth, and so on. Thus the initial impact of the precipitating factors is amplified into much larger price increases than the factors themselves would have suggested.[6]

In this manner, price increases in an asset due to other, fundamental, factors can become the cause of further price increases by ramping up demand for said asset in a competitive marketplace with limited supply. This cycle can theoretically feed upon itself indefinitely, and often does for periods of great duration, propelled by speculators who are incentivized to keep buying as long as prices are increasing:

> During these euphoric periods an increasing number of investors seek short-term capital gains from the increases in the prices of real estate and of stocks rather than from the investment income based on the productive use of these assets. Individuals make down payments on condo apartments in the preconstruction phase of the developments in the anticipation that they will be able to sell these apartments at handsome profits when the buildings have been completed.[7]

Speculation in markets is thus seen both to spur and be spurred by increases in market prices that may initially have had a fundamental backing. Through this type of feedback, speculation is thus capable of feeding upon itself; if left unchecked as a force, it is capable of creating the bubbles in markets previously discussed.

Speculative action within markets has existed as long as markets themselves. Numerous and notable historical examples give witness to the bubbles that can arise as a result. Instances that have gained notoriety include the Dutch 'tulip mania' of the 17th century, stocks on the New York Stock Exchange in the late 1920s, Japanese stock and real estate markets in the late 1980s as well as the US 'dot com' bubble of the NASDAQ in the

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[5] Alan Greenspan, "The Challence of Central Banking in a Democratic Society," speech before the American Enterprise Institute for Public Policy, Washington, D.C., December 5, 1996, *http://www.federalreserve.gov/BOARDDOCS/SPEECHES/19961205.htm*

[6] Robert Shiller, *Irrational Exuberance* (Princeton University Press, Princeton: 2005), Second Edition, p. 68-69.

[7] Charles P. Kindleberger and Robert Aliber, *Manias, Panics, and Crashes: A History of Financial Crises* (John Wiley & Sons Inc., Hoboken: 2005), Fifth Edition, p. 11.

1990s. The US (and in many cases international) real estate boom from 2001 to 2005 was of similar magnitude and will undoubtedly become a textbook scenario in the future.

2.7 Identifying Bubbles

One of the greatest difficulties in evaluating economic 'bubbles' is that they are almost impossible to identify except in hindsight. Most economists' work includes assumptions that incorporate some form of an Efficient Market Hypothesis, indicating that the price of assets within a competitive marketplace accurately reflect their intrinsic value. Given this belief, a 'bubble' can only be safely declared after it has already 'burst', or the market has 'reset' the value of the assets concerned. Until that sudden fall in prices, or 'reset' occurs, it is nearly impossible to distinguish with any certainty whether a continued increase in prices stems from changes in genuine economic factors or simple speculation on the part of the market.

The Efficient Markets Hypothesis is consistent with a widely held belief among most Keynesian economists that modern economies, perhaps with the help of regulation, should trend toward a stable equilibrium at which output is maximized for a given level of unemployment. Within this perspective, market bubbles can only be caused by exogenous shocks to an otherwise stable economy: rational players in efficient markets would have no other reason to temporarily overvalue or undervalue assets within a given market.

2.8 Introduction to Minsky

Economist Hyman P. Minsky offered a view that purports to contain greater explanatory power of bubbles. Observing the continuing tendency of economies and markets to overheat, he interpreted Keynes' work in a way that led him to a radically different conclusion from his contemporaries. Today, Minsky is perhaps best known for his Financial Instability Hypothesis (FIH), in which he theorizes that capitalist financial systems are inherently unstable. He concluded that modern economies sow the seeds for their own destruction by arguing that complex financial infrastructures encourage speculation and consequently the inevitably ensuing crisis.

Minsky believed that this financial fragility was inherently linked with the wider business cycle as a whole, and recent experience would seem to support this hypothesis: financial crashes in recent US history have all been followed by business cycle contractions, including 1929, 1989, 2000, and 2007. Indeed it is apparent that the 1929 and 2008 crises played pivotal roles in the Great Depression and current recession respectively.

3—MINSKY'S FINANCIAL INSTABILITY HYPOTHESIS

3.1 Overview

Hyman Minsky's views regarding the structure of a modern economy went against the grain of those of his more widely touted and studied contemporaneous colleagues. Observing the repeated cycle of boom and bust within financial markets and among the financial institutions that play dominant roles in such markets, Minsky began to think about the structure of a modern financial economy and its potential fragility. While other economists worked to explain away each of those instances individually, attributing each one to 'exogenous shocks', Minsky began to suspect that qualities of the economy itself might be a contributing factor to the apparently sinusoidal pattern that markets and economic production appeared to follow:

> The financial instability hypothesis has both empirical and theoretical aspects. The readily observed empirical aspect is that, from time to time, capitalist economies exhibit inflations and debt deflations which seem to have the potential to spin out of control. In such processes the economic system's reactions to a movement of the economy amplify the movement—inflation feeds upon inflation and debt-deflation feeds upon debt deflation…These historical episodes are evidence supporting the view that the economy does not always conform to the classic precepts of Smith and Walras: they implied that the economy can best be understood by assuming that it is constantly an equilibrium seeking and sustaining system.[8]

His observation of the historical economic experience within the United States led him to disagree with the predominantly held opinion among economists that an economy had a fundamental predisposition to seek and maintain a neat and tidy equilibrium. Consequently Minsky chose to examine how the structures and nature of a capitalist economy might contribute to its fragility and eventually downfall.

3.2 Financial System within a Modern Economy

Minsky highlights the importance of financing within a capitalist system while setting up his exploration of a capitalist economy. He observes "in a capitalist economy the past, the present, and the future are linked not only by capital assets and labor force characteristics but also by financial relations."[9] His recognition of finance and financing as an important factor when examining the functioning of an economy was a crucial step in discovering the reasons why a modern economy might be less stable than economists' models otherwise suppose.

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[8] Hyman Minsky, "The Financial Instability Hypothesis". Working Paper No. 74. Jerome Levy Economics Institute of Bard College, 1992

[9] Hyman Minsky, "The Financial Instability Hypothesis". Working Paper No. 74. Jerome Levy Economics Institute of Bard College, 1992

Observing the interactions within an economy through the lens of financing, Minsky consequently devotes some focus to financial institutions and their role in facilitating business expansion through the extension of finance. Rather than limiting his understanding of finance to simply examining firm and business behavior from their incentives according to finance (i.e. engaging in balance sheet examinations of liabilities and assets) however, he comes to the conclusion that other players in the economy who have access to financing must also have their behavior explained in terms of these fundamental incentives, and the role they play upon the banks and each other:

> In the modern world, analyses of financial relations and their implications for system behavior cannot be restricted to the liability structure of businesses and the cash flows they entail. Households (by way of their ability to borrow on credit cards for big ticket consumer goods such as automobiles, house purchases, and to carry financial assets), governments (with their large floating and funded debts), and international units (as a result of the internationalization of finance) have liability structures which the current performance of the economy either validates or invalidates.[10]

Minsky's financial system thus encompasses all sectors and players in a modern economy where access to capital is widely available. This broadened view of a financial system means that his study encompasses the incentives of any and all debtors and lenders in his analysis of the fragility of a financial economy.

3.3 Importance of Financial Sector in Modern Economy

Central to Minsky's argument regarding the unpredictability and instability of a modern economy is the role of finance and financial institutions within such an economic system. He goes so far as to explicitly state: "Our economy is unstable because of capitalist finance."[11] Minsky would thus not have been at all surprised that the increasingly serious financial crises that have taken place since the end of World War II have been accompanied by a continual increase in the relative importance of the financial industry within the United States economy. The following chart tracks the Economic Share of the Finance Industry within the US over time, as measured by the ratio of annual Financial Industry income to GDP.

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[10] Hyman Minsky, "The Financial Instability Hypothesis". Working Paper No. 74. Jerome Levy Economics Institute of Bard College, 1992
[11] Hyman Minsky, *Stabilizing an Unstable Economy* (McGraw Hill, New York: 2008), originally published Princeton University Press: 1986, p. 244.

Fig. 3A   GDP Share of U.S. Financial Industry
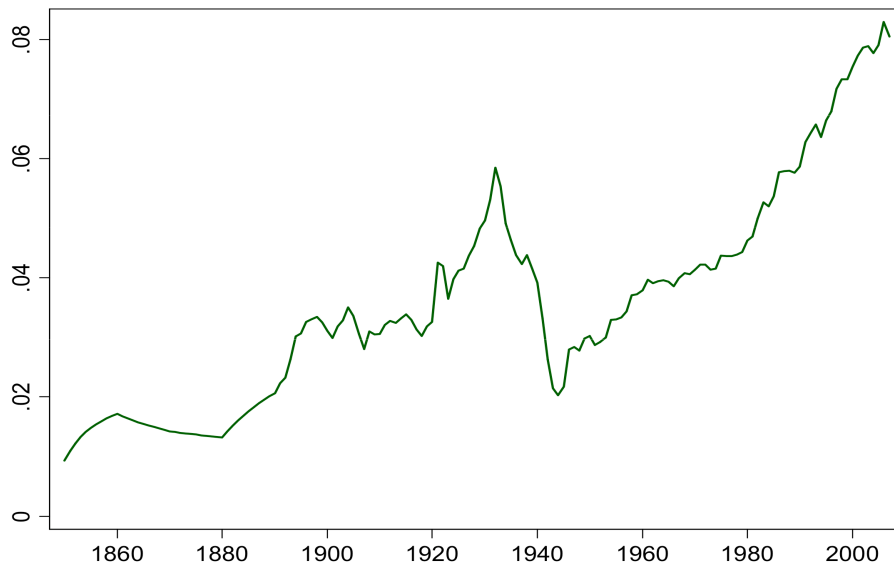
A cursory glance is enough to indicate that over the last century and a half the Financial
Industry has been consistently more important to the US economy. The notable
exception to this trend are the years following the stock market crash of 1929, i.e. those
of the Great Depression, when the financial industry was in dire straits. Since the
emergence of the US from the Depression and following the end of World War II, the
Financial Industry has grown consistently relative to the rest of the US economy. Indeed,
over the last 150 years it has evidently roughly quadrupled its share of the GDP.

This growing weight of the financial industry within the US economy has unsurprisingly
been accompanied by financial innovations, increasingly complex financial instruments,
greater and more intricate entanglements between financial institutions of growing
importance, and finally panics and crashes of increasing frequency and severity. Minsky,
writing in 1986, identified "In the years following 1965, at least four serious runs…on
financial markets or banks."[13] These included a credit crunch in 1966, as well as
liquidity issues in the commercial paper market in 1969-1970. Since the time of the
writing, the crises have continued and even worsened—the Savings and Loans crisis in
1989-1991, the collapse of the stock market in 2001, and most recently the collapse of the
subprime mortgage market all demonstrate that despite assumptions to the contrary, our
economy is as susceptible as ever to speculative mania and crashes.

Indeed, as the financial sector has continued to grow in relative importance as a
component of the economy, the severity of these crashes have also continued to worsen.
Though the efforts of regulatory authorities have managed to stave off a downturn as
severe as the Great Depression, the attempts to stabilize the economy have apparently

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[12] Thomas Philippon, "The Evolution of the US Financial Industry from 1860 to 2007". New York
University, NBER and CEPR. November 2008
[13] Hyman Minsky, *Stabilizing an Unstable Economy* (McGraw Hill, New York: 2008), originally
published Princeton University Press: 1986, p. 106.

only succeeded in delaying inevitable crashes—crashes that apparently worsen as previous fixes to the system prove to be inadequate. It is unsurprising that a broader and more complex financial system has proven to be less stable and prone to more serious crashes—not only is such a system much more difficult to effectively regulate, but a financial system more widely embedded throughout the economy means wider exposure to various consumers, investors, firms and governments to problems within financial markets. This correlative relationship between the relative size of the financial sector and the apparent severity of its bouts of instability is one which Minsky would have predicted.

3.4 Theorems of Financial Instability Hypothesis

Minksy's Financial Instability Hypothesis rests upon two primary theorems:

> Theorem I: 'the economy has financing regimes under which it is stable, and financing regimes in which it is unstable.'[14]

> Theorem II: 'over periods of prolonged prosperity, the economy transmits from financial relations that make for a stable system to financial relations that make for an unstable system.'[15]

The logical sum of these theorems is the conclusion that the financial system contributes to the instability of an economy by shifting from predominantly reasonably safe and stable financial arrangements to arrangements that are prone to collapse and cause significant financial and economic damage.

3.5 Stable and Unstable Financial Arrangements

In order to satisfy his two theorems above, Minsky must demonstrate a difference between stable and unstable financing regimes. To that end, he identifies three distinct categories of financial arrangement that he terms hedge, speculative and Ponzi finance.

Hedge finance consists of financing whereby the borrower is able to meet all of his contractual payment obligations through his cash flows.

Speculative finance describes financing whereby the borrower is able to make interest payments through cash flows, but is unable to make payments toward the principle. In such a financial scheme, one must 'roll over' liabilities to maintain solvency: for example by issuing new debt to pay off maturing debt commitments.

Ponzi finance describes a financing whereby through cash flows alone the borrower is unable to meet either interest or principal payments, let alone both. Solvency for the

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[14] Hyman Minsky, "The Financial Instability Hypothesis". Working Paper No. 74. Jerome Levy Economics Institute of Bard College, 1992

[15] Hyman Minsky, "The Financial Instability Hypothesis". Working Paper No. 74. Jerome Levy Economics Institute of Bard College, 1992

borrower in this situation relies upon price inflation—as the asset he has financed appreciates in value, the debtor may take out additional debt against gains in equity. If the asset does not appreciate quickly enough, or even loses value, the debtor is unable to meet payment obligations.

3.6 Theorem I

In regards to Theorem I, Minsky makes the case that an economy dominated by hedge financing may well be equilibrium seeking and definitely possesses a degree of stability. Conversely an economy dominated by speculative and/or Ponzi finance will be prone to deviations from any equilibrium, as powerful feedback cycles are present.

The positive feedback cycle is self-evident: as a Ponzi economy progresses and asset prices increase from due economic gains, investors see gains and borrow to increase investment, pushing asset prices up further. As long as asset prices are rising, Ponzi investors are successfully making money, and will continue to invest in a Ponzi manner.

The negative feedback cycle involves what has come to be called a 'Minsky Moment': when asset prices cease to increase, Ponzi borrowers are unable to refinance to meet debt obligations. Failed payments will cause a 'domino effect' as financial institutions will mark down bad debt on their books. It can quickly create a perfect storm in financial markets, causing the shutdown of an entire financial system, as in 2008-2009. In such a situation, even hedge borrowers with sound investments are unable to secure financing as financial institutions are unable to cope with losses and are unwilling to extend any credit.

3.7 Theorem II

In regards to Theorem II, Minsky must prove that incentives change during a boom economy, causing investors to shift from sound hedge financing, toward speculative and Ponzi financing. The shift in financing schemes might be caused by an increase in risk appetite during the boom phase of an economy: as investors witness a trend of stability, they become more willing to invest in riskier assets and borrow to fund said investment.

This shift in investor sentiment cannot be explained adequately by rational investors acting with full information—such an investor has forward-looking expectations based upon the axiom that past performance is no indicator of future performance, i.e. one cannot predict future market movement based on past events. Instead, this change in sentiment comes about because investors are 'driving by looking in the rear-view mirror'; a strategy that succeeds while the road is straight but cannot predict turns. Investors as a whole are irrational and have short memories, and thus inexorably become convinced that recent economic and financial success will continue in the future if for no other reason than it has in the past. In this way, investor appetite across the economy shifts due to fluctuations in Keynes' 'animal spirits'.

Risk appetite might be considered the desire of an investor to achieve higher returns at the expense of certainty—it has a negative correlation with the risk premium demanded

by investors for taking on a riskier asset. For example, as an investor becomes more interested in riskier assets, he becomes more willing to accept a lower risk premium to invest in those assets. In such a situation, his risk appetite might be said to have grown.

According to Theorem II of Minsky's Financial Instability Hypothesis, as an economy experiences a 'boom', or prolonged stable growth, incentives must change so that investors begin to take on greater risk, and begin to engage in speculative and Ponzi finance as opposed to hedge finance. Minsky would expect to see risk appetite grow as a boom continues, eventually causing a greater proportion of the economy to be engaged in unsustainable finance.

3.8 Objectives

This paper will be concerned primarily with Theorem II, and will seek to investigate whether and how incentives of investors change during a 'boom' economy.

Specifically, it will primarily attempt to answer the following question: does risk appetite increase as an economy undergoes prolonged periods of growth and stability and assets from various asset classes produce positive returns? While this relationship is predicted qualitatively by both a variety of authors and common sense, this paper will test these assumptions empirically. Historical data and econometric techniques will be used to establish the nature of the relationship (if any) between market returns and economic gains, and risk appetite.

3.9 Thesis

Part I: **Positive market and economic results over a period of time cause investors to increase their risk appetite.**

Part II: Increases in risk appetite that accompany or predict market gains may indicate that market gains are due not to fundamental economic changes but rather widespread investor speculation. Such increases in risk appetite and asset value presage 'Minsky moments' wherein market resets will damage financial institutions and thus the wider economy. Such fluctuations in risk appetite might be used by central banks and other regulatory authorities as a consistent method of identifying when asset price increases are due not to changes in the fundamental qualities of the assets, but rather a wave of investor speculation. As such speculative bubbles are known to give rise to tenuously dangerous situations among financial institutions, regulatory authorities might use a rise in risk-appetite as a leading indicator of future bubbles. They might then take appropriate action to limit the expansion of credit accordingly.

4—LITERATURE REVIEW

Many books have been written about the history of financial crises and the apparently all-too-human penchant of speculators' overconfidence quickly leading to spectacular crashes. Notable titles include (in alphabetical order by author):

Chancellor, Edward: *Devil Take the Hindmost: A History of Financial Speculation*, 1999
Kindleberger, Charles: *Manias, Panics, and Crashes*, 1978
Reinhart, Carmen M. & Kenneth S. Rogoff: *This Time is Different: Eight Centuries of Financial Folly*, 2009
Shiller, Robert: *Irrational Exuberance*, 2000

These titles include an excellent review of the long history of financial crises, and offer documentation of the often-spectacular nature in which financial bubbles and crashes manifest themselves.

Chancellor's work primarily examines several notable financial crashes from the perspective of a historical narrative. Less concerned with compiling a unifying theory, *Devil Take the Hindmost* nevertheless provides an excellent and detailed overview of financial crises such as the U.S. stock market crash of 1929 and the Japanese economy during the 1980s. Beginning with a broad history of financial speculation and the role speculators play in the buildup of bubbles, Chancellor comes to the conclusion that:

> Momentum trading, trend-following currency speculators, overleveraged hedge funds, and corporate managements obsessed with daily fluctuations in share quotations are unlikely to produce the optimal distribution of scarce resources in the global economy.[16]

That is, the role of markets in contributing to the efficient allocation of funds within an economy can easily be overstepped when participants seeking to make quick profits dominate proceedings. Any contribution of such speculation to economic efficiency is apparently outweighed by the risks it presents to the stability of the financial system and wider economy as a whole.

Charles Kindleberger first published his *Manias, Panics, and Crashes* in 1978. His work seeks to reach conclusions regarding the general structure and nature of financial bubbles and subsequent crises through the examination of a variety of crashes across various markets throughout history. Interestingly for this paper, he was familiar with the theories of Hyman Minsky, and he made many of his historical studies through the lens of the then-nascent Financial Instability Hypothesis. He pays particular attention to the role of credit in facilitating the formation of bubbles:

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[16] Edward Chancellor, *Devil Take the Hindmost: A History of Financial Speculation* (Farrar, Straus and Giroux, New York: 1999), p. 346.

> Speculative manias gather speed through expansion of money and credit.
> Most expansions of money and credit do not lead to a mania; there are
> many more economic expansions than there are manias. *But every mania
> has been associated with the expansion of credit.*[17] (emphasis added)

He notes further that in many instances, the expansion of credit came not through an actual increase in the money supply, but rather in the development of substitutes to traditional currencies in settling debts and providing collateral. He thus makes the assertion that faster-than-normal expansion of credit is almost universally a crucial culprit in allowing enthusiastic speculation to become a force capable of creating dangerous asset bubbles. He also later expands upon Minsky's model by examining the often-international nature of such bubbles and crises. To that end, the book includes a discussion of the mechanisms by which such phenomena might cross national boundaries, and the role that exchange rates, currency crises and monetary flows play in 'spreading the contagion'.

Shiller's *Irrational Exuberance* in particular makes use of compiled data dating back to the late 19th century in order to trace his points through historical markets. In addition, he writes at length about the positive amplification mechanisms that lead to dramatic changes in investor confidence. He continues with an examination of various relevant ideas concerning the operation of markets, including the Efficient Market Hypothesis and what he terms investor 'learning and unlearning'. This refers to the same phenomenon discussed more empirically by Minsky as the shifting of investor incentives within an economy. He concludes by discussing methods by which speculative enthusiasm might be dampened by governmental and regulatory authorities—his ideas range from improving fundamentals such as fiscal responsibility through Social Security reform, and altering incentives to increase saving, to diversification and hedging of risks by amateur investors to contractionary monetary policy. However, he concludes by observing:

> Ultimately, in a free society, we cannot protect people from all the
> consequences of their own errors. We cannot protect people completely
> without denying them the possibility of achieving their own fulfillment.
> We cannot completely protect society from the effects of waves of
> irrational exuberance *or* irrational pessimism—emotional reactions that
> are themselves part of the human condition.[18]

Thus, Shiller believes that the variability of emotion ingrained within the human psyche gives rise to the possibly damaging cycles of pessimism and optimism witnessed in the broader markets. Removing completely the possibility of these waves from the markets is therefore impossible so long as humans—fundamentally emotional beings—remain the ultimate market participants.

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[17] Charles P. Kindleberger and Robert Aliber, *Manias, Panics, and Crashes: A History of Financial Crises* (John Wiley & Sons Inc., Hoboken: 2005), Fifth Edition, p. 64.

[18] Robert Shiller, *Irrational Exuberance* (Princeton University Press, Princeton: 2005) Second Edition, p. 230.

Shiller's book further proves useful as the source of much of the data used in the econometric analysis that this paper will pursue. The publication of his book required long-term data on stock markets, real interest rates, inflation rates, housing price indices etc. All of the data he uses to reach his conclusions is freely available in digital format online at: *http://www.econ.yale.edu/~shiller/data.htm*. The specific data this paper makes use of will be discussed in more detail below.

In addition, Hyman Minsky's *Stabilizing an Unstable Economy*, (New York: McGraw Hill, 2008), outlines the fundamentals of Minsky's hypothesis that financial capitalist economies are inherently unstable. He discusses at length the natural inclination of complex economies toward instability due to speculative finance and high-risk lending practices. Finally, he proposes measures that ought to be taken by the government and Federal Reserve in order to increase oversight of banks and stop excessively risky speculative practices before they have the chance to disturb the economy as a whole. Further, he composed the paper "The Financial Instability Hypothesis", Working Paper No. 74 from the Levy Economics Institute of Bard College, 1992, which gives a brief summary of his FIH and the mechanisms by which financial structures within a complex capitalist economy give rise to instability. In it he outlines his theorems and the 3 types of finance discussed above.

Recent relevant papers include:

Reinhart, Carmen M. & Kenneth S. Rogoff: "This Time is Different: A Panoramic View
     of Eight Centuries of Financial Crises", NBER Working Paper No. 13882,
     available online at: *http://www.nber.org/papers/w13882*
Reinhart, Carmen M. & Kenneth S. Rogoff: "The Aftermath of Financial Crises", NBER
     Working Paper No. 14656, available online at
     http://www.nber.org/papers/w14656
Vercelli, Alessandro: "A Perspective on Minsky Moments: The Core of the Financial
     Instability Hypothesis in Light of the Subprime Crisis", Working Paper No. 579,
     The Levy Economics Institute of Bard College, October 2009.
     http://www.levy.org/vdoc.aspx?docid=1202
Vercelli, Alessandro: "Minsky Moments, Russell Chickens, and Gray Swans: The
     Methodological Puzzles of the Financial Instability Analysis", Working Paper No.
     582, The Levy Economics Institute of Bard College, November 2009.
     http://www.levy.org/vdoc.aspx?docid=1207
Whalen, Charles J.: "The U.S. Credit Crunch of 2007: A Minsky Moment", Public Policy
     Brief No. 92, 2007, The Levy Economics Institute of Bard College.
     http://www.levy.org/vdoc.aspx?docid=961

These papers address issues ranging from the widely negative effects that financial shocks have on wider economies as a whole (Reinhart & Rogoff's "Aftermath"), to closely examining mechanisms proposed by Minsky's FIH and how they might specifically function during the transition of financial calm to financial crises (Vercelli).

5—METHODOLOGY

5.1 Overview

This paper will attempt to answer its primary question through the use of a time-series regression. The dependent variable will be risk appetite, and independent variables will include historical asset yields in debt, equity and real estate markets as well as GDP growth data. Historical asset yields will be used to give some indication of the progress in a given economic market, while GDP data will be used to indicate the health of a domestic economy as a whole. All returns and the GDP data will be in real terms to factor out the influence of inflation on yields and GDP growth.

Risk appetite, the dependent variable, will be measured quantitatively as the spread between corporate bond yields of different credit quality and similar maturity. As the risk appetite of investors increases, investors will sell higher-rated bonds to buy higher-yielding, lower-rated bonds, narrowing the yield spread. Conversely as investors become more risk-averse, they will sell lower-rated bonds to buy higher-rated bonds, seen as the safer alternative, thereby widening the yield spread between the two. Thus risk appetite will have a negative correlation to the yield spread, and **a narrower spread will indicate a higher risk appetite**. It will appear in the regression as A_t.

5.2 Manipulating Data to Simulate Investor Memory

In Minsky's view the current investor risk appetite is not based solely upon current economic conditions and gains in asset prices, but also those of the recent past as well. This makes sense intuitively, as it is only through a string of consistent gains that naturally risk-averse investors might be convinced to abandon their normal reservations in favor of riskier investments. I.e., the assumption is that their perception of the risks that a given investment involves changes over time as the investment provides consistently positive returns, and soon investors imagine the instrument to be less risky than it actually is. Thus the independent variables in any regression must in some form take into account recent historical returns as well as current returns.

There are conceivably many ways to accomplish this, the easiest of which might be to simply add lag values of the independent variables into the regression, and examining their coefficients for significance to determine how many might be reasonably included. This regression would take the form:

$$A_t = \beta_0 + \beta_1 x_t + \beta_2 x_{t-1} + \cdots + \varepsilon_t$$

A second sensible method would be to transform the data using a simple moving average of present and historical returns. Thus one might create the variable v_t from individual observations over time $u_t, u_{t-1}, \ldots, u_{t-m+1}$:

$$v_t = \sum_{n=t-m+1}^{t} u_n / m$$

v_t here is simply the arithmetic mean of m observations, beginning with the current observation u_t and continuing backwards in time. This method would make sense, as it would allow the regression to be done over smoothed data, while still taking into account data from m observations in a single independent variable.

However, such a moving average is perhaps too limiting. It rigidly provides an equal weight to every observation u_{ti} included in v_t. Secondly, it necessitates a decision on the part of the author to determine the correct value of m to be used. Further, it suffers from a weakness in its treatment of data that is significantly outside the normal trend. Data from truly exceptional observations, such as the stock market crash of 1929, would necessarily have a tremendous effect on any moving averages in which it was included. Thus, as an example, if one were to use an m of 7—i.e. to include 7 data points in the moving average—and the observations from 1929 presented a radical departure from the ordinary trends, v_{1936} would likewise exhibit a huge jump from v_{1935}. This behavior clearly presents a problem for the purposes of this paper: it is not reasonable to suppose that an investor might have an equally weighted memory of the behavior of a given market for m years following a radical market event and then forget about it entirely. A simple moving average therefore is too arbitrary in its nature.

Instead, this paper will transform the historical time-series data into a useful form for a regression of 'memory' through the use of a Koyck distributed lag transformation.

A Koyck distributed lag takes the following form:

$$v_t = \lambda u_t + \lambda(1-\lambda)u_{t-1} + \lambda(1-\lambda)^2 u_{t-2} + \cdots$$

where λ represents the weight attributed to the current year.

$$v_{t+1} = \lambda u_{t+1} + \lambda(1-\lambda)u_t + \lambda(1-\lambda)^2 u_{t-1} + \cdots$$

Factoring out a $(1-\lambda)$ from all but the first term and substitution with the first equation yields:

$$v_{t+1} = \lambda u_{t+1} + (1-\lambda)v_t$$

And consequently:

$$v_t = \lambda u_t + (1-\lambda)v_{t-1}$$

Using a λ such that $0 < \lambda < 1$, the weight terms conveniently add up to 1, and can thus be considered probabilities or percentage weights.[19]

Thus, use of this transformation thus creates a variable that includes data from the current year with a percentage weight of λ assigned to the current year and $(1-\lambda)$ distributed over the previous years. A higher value of λ would thus indicate a 'weaker memory' on the part of the investor, as he gives greater attention to the current and most recent returns; conversely, one might use a low value of λ to indicate that an investor only puts slight weight on the current year and is mindful of historical returns.

The chart below illustrates three possible distribution profiles of the Koyck weights based upon three possible values of $\lambda = 0.1$, $\lambda = 0.2$, and $\lambda = 0.3$. As can be seen clearly, a higher value of λ indicates a greater weight given to the more recent observations at the expense of weight given to observations from the more distant past.

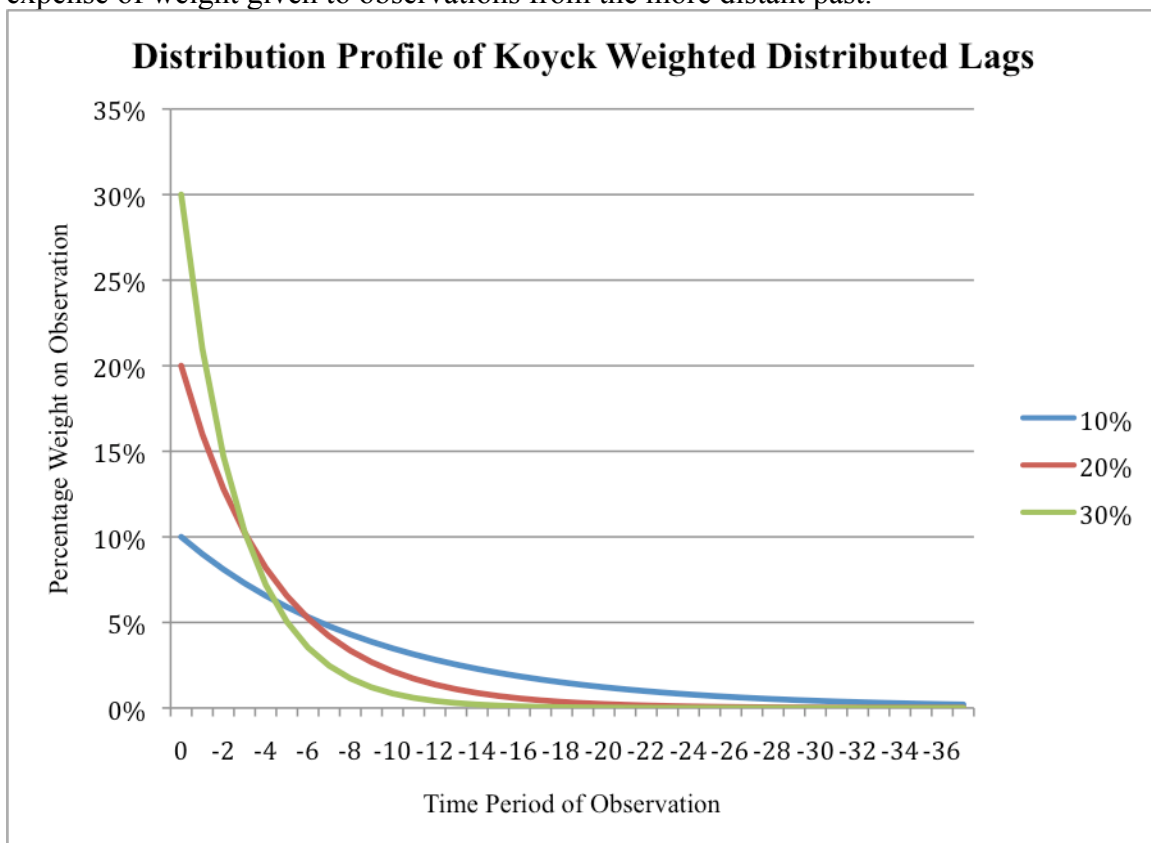**Distribution Profile of Koyck Weighted Distributed Lags**

Fig. 5A

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[19] This is shown concisely in the following proof:

$$\lambda + \lambda(1 - \lambda) + \lambda(1 - \lambda)^2 + \cdots =$$
$$\lambda(1 + (1 - \lambda) + (1 - \lambda)^2 + \cdots) =$$
$$\frac{\lambda}{1 - (1 - \lambda)} = \frac{\lambda}{\lambda} = 1$$

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5.3 Considering Variance of Returns as an Independent Variable

If two different assets have identical expected returns and different variances or standard deviations of returns, a risk-averse investor will prefer the instrument with a lower variance of returns. This makes sense given that higher yields must generally compensate investors to accept instruments with a higher degree of risk—a risk-averse investor would thus prefer asset A with guaranteed return at rate x over asset B with an expected return of rate x and a variance of returns > 0.

Therefore one might also consider the variance of returns of various assets as a measure that might have some affect on Minsky's risk appetite. The expectation would be that historically lower variances of returns of assets would have the same effect as historically high returns of assets—by causing investors to forget about the risks involved, they would increase risk appetite and thus decrease the bond spread.

Because $\lambda + \lambda(1-\lambda) + \lambda(1-\lambda)^2 + \cdots = 1$ for $0 < \lambda < 1$, the weight term, $(\lambda(1-\lambda)^n)$, can be conceptualized as the percentage of weight given by an investor to the historical data of a specific year. As discussed above, the Koyck Distributed Lag thus provides a synthetic piece of data that is the sum of present and historical data, discounted by the weight terms.

Therefore a measure of variance using the Koyck Distributed Lag value as a benchmark will be considered. This measure, d_t, will be constructed as follows:

$$d_t = (u_t - v_t)^2$$

where u_t and v_t are the actual and Koyck-lagged returns for period t respectively. The difference between actual and expected value is squared as variance puts equal weight upon positive and negative deviations.

This measure, d_t will then also be transformed using the Koyck technique as discussed above, to provide a similar investor perspective on both recent and historical variance, but with an appropriate precedence given to the more recent variance over historical variance. This will then provide dependent variable var_t where:

$$\text{var}_t = \omega d_t + \omega(1-\omega)d_{t-1} + \omega(1-\omega)^2 d_{t-2} + \cdots$$

and ω plays an identical role to λ above, providing weights to the various terms.

5.4 'Deviations' of Returns as an Independent Variable

In many instances, standard deviations provide a more accurate illustration of variation within a set of data. Therefore regressions may also use the value dev_t, where:

$$dev_t = \sqrt{\text{var}_t}$$

These measures of deviation are simply designed to remove any distortions that squaring the differences between u_t and v_t may cause by taking the square root of the previously squared differences.

6—DATA

6.1 Data Sources

Data for the regressions will be compiled from a variety of separate sources.

For the sake of simplicity in equity markets, this paper uses historical data from Standard and Poor's Composite Stock Index. This data is taken from the collection of Yale economist Robert Shiller. It was originally compiled with for the purpose of his book *Market Volatility* (MIT Press, Cambridge, MA: 1989), and was subsequently utilized in his *Irrational Exuberance* (Princeton University Press 2000, Broadway Books 2001, 2nd ed., 2005). The dataset contains information about stock prices, dividends and corporate earnings extending back to January 1871, compiled from a variety of sources. It can be accessed online at *http://www.econ.yale.edu/~shiller/data/ie_data.xls*.

For historical data in the real estate market, this paper utilizes a similar source: the historical housing market data collected for use in *Irrational Exuberance* (Princeton University Press 2000, Broadway Books 2001, 2nd ed., 2005). The dataset has information on fluctuations in U.S. home prices since 1890. It is available online at *http://www.econ.yale.edu/~shiller/data/Fig2-1.xls*.

U.S. GDP data is taken from two sources. For the years 1929 to 2009 it is taken from FRED®, the Federal Reserve Economic Data source. It was accessed at the website of the St. Louis branch of the Federal Reserve Bank at *http://research.stlouisfed.org/fred2/series/GDPCA?cid=106*, and represents Real Gross Domestic Product for the U.S., chain-weighted in 2005 dollars. For years prior to 1929, the data is from a series compiled by Louis Johnston and Samuel H. Williamson, found online at *http://www.measuringworth.org/datasets/usgdp/*. This dataset is preferable to the GNP data available at The Historical Statistics of the United States website, as it requires no conversion of GNP to GDP, and is further priced in 2005 dollars just as the data taken from the Federal Reserve Economic Data series.

Real historical bond returns are taken from the Inflation Adjusted Annual Returns series of the Long-Term Corporate Bond Index used in the book *Ibbotson® SBBI® 2010 Classic Yearbook: Market Results for Stocks, Bonds, Bills, and Inflation 1926-2009,* (Morningstar, Inc., Chicago: 2010). The bond index is a combination of the Citigroup Long-Term High-Grade Corporate Bond Index (formerly Salomon Brothers) and Standard & Poor's monthly High Grade Corporate Composite.[20] Thus bond returns as used in the regressions represent the annual returns from a portfolio of high-grade, credit-worthy debt.

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[20] *Ibbotson® SBBI® 2010 Classic Yearbook: Market Results for Stocks, Bonds, Bills, and Inflation 1926-2009,* (Morningstar, Inc., Chicago: 2010), p.45.

For historical corporate bond yield information, this paper will make use of two data series made available from the Economic Research Department of the St. Louis branch of the Federal Reserve Bank. Both Moody's Seasoned AAA and BAA Bond yields are used, and the datasets are accessed at
http://research.stlouisfed.org/fred2/series/AAA?cid=119 and
http://research.stlouisfed.org/fred2/series/BAA?cid=119 respectively. This data is released in monthly increments, so for the annual regressions the simple arithmetic mean of the twelve individual months is used to create an annual interest rate in either series.

Historical bond spread information, or the proxy for risk appetite, is synthesized by combining the historical yield data for corporate bonds of differing credit quality. That is, the risk appetite for a given period, A_t, is simply equal to the yield spread between corporate bonds of similar maturity and differing quality: $A_t = \text{Yield}_{BBB} - \text{Yield}_{AAA}$.

6.2 Data Issues

One initial concern is a possibly high degree of correlation between two or more of the several explanatory variables. Because these variables are primarily concerned with capital and debt market returns, real estate market movements, and GDP growth, the expected level of correlation between two or more datasets might be high. After all, the financial markets are closely interconnected and could easily be considered two different asset classes in the same portfolios. Further, the stock market is often conceptualized as a leading indicator—because its prices reflect predicted future earnings growth, it could very possibly be closely tied to changes in real GDP. Even if it fails to predict them, it is unlikely that it would fail to reflect them in the aftermath—as GDP grows and companies become more profitable, their share prices increase to reflect this. The converse is also true, with stock prices falling in recessionary times in response to declining corporate profits.

A second potential issue is the suitability of the Koyck weighted lag as an appropriate transformation to the data to simulate investor memory. Figure 5A illustrates how such a manipulation of the raw data could be interpreted as the fading memory of past results. However, the task remains to select the appropriate weights of λ for each of the sectors being examined. It is even quite possible that in different sectors, different values of λ will be most appropriate, as investors may have effective memories of varying lengths in the different arenas. For example, investors may more quickly forget about a drop in GDP than a crash in the stock market—while the former is a negative indicator about the future prospects of the economy, the latter can directly affect their wealth if the value of their holdings are reduced.

7—REGRESSIONS

7.1 Regression I: Koyck Distributed Lags

The initial econometric exploration in this paper involved regressing the yield spread between Moody's AAA and BBB bonds against Koyck lags of changes in the real GDP, stock market returns, bond market returns and housing price changes. It took the form:

$$A_t = \beta_0 + \beta_1 Stock_t + \beta_2 GDP_t + \beta_3 House_t + \beta_4 Bond_t + \varepsilon_t$$

$A_t = \text{Yield}_{BBB} - \text{Yield}_{AAA}$ (yield spread between AAA and BBB bonds)
$Stock_t$ = Koyck distributed lag of annual returns in the stock markets, with a weight of 0.1 on the current year t.
GDP_t = Koyck distributed lag of annual change in real GDP, with a weight of 0.1 on the current year t.
$House_t$ = Koyck distributed lag of annual change in residential housing prices, with a weight of 0.1 on the current year t.
$Bond_t$ = Koyck distributed lag of annual change in index measuring bond returns, with a weight of 0.1 on the current year t.

Performing this regression in *Stata* for the years available (1928-2009, n=81) yielded some fairly strong results:

A_t	Coefficient	Std. Err.	t	P>t
$Stock_t$	-10.66518	1.190445	-8.96	0.000***
GDP_t	-29.25349	3.727623	-7.85	0.000***
$House_t$	-9.575066	3.256409	-2.94	0.004***
$Bond_t$	2.98932	1.209069	2.47	0.016**

n = 81
$R^2 = .7538$

Stock_t, GDP_t, House_t, are all found to be statistically significant explanatory variables, at the 1% confidence level, with *p*-values of 0.000, 0.000, and 0.004 respectively. *Bond_t* is also found to be statistically significant at a reasonable confidence level of 5% with a *p*-value of 0.016. Further, the absolute value of its coefficient is significantly less than that of the others, suggesting that returns in the Bond market are relatively unimportant relative to the other three markets in determining risk appetite.

The three significant explanatory variables all have negative coefficients, as was expected in the hypothesis stated above. A higher value of any of the explanatory variables *Stock_t, GDP_t, House_t,* (or *Bond_t*) indicates greater gains (or growth in the case of GDP) in recent years in the market in question. The negative coefficients indicate that better performance in markets are associated with lower values of A_t, or the bond spread. As discussed above, such a tighter spread indicates a higher appetite for risk, and therefore ***the regression suggests that a trend of good performance in markets can in part explain an increase in risk appetite.*** Interestingly *Bond_t* has a positive coefficient,

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suggesting that better returns in bond markets are associated with higher values of A_t, or a higher yield spread and lower risk appetite.

This phenomenon is contrary to the expectations. One possible explanation is a consideration of the role debt instruments tend to play for investors as a 'safe vehicle' for gains—i.e. bond markets experience gains as investors plow money into bonds for fear of other markets performing poorly. A second explanation is that perhaps interest rates rise in good times (i.e. when other markets and GDP are performing well), and consequently bonds experience capital losses, though risk-appetite is still increasing.

A closer examination of the relationship between the Koyck lagged measure of GDP (with $\lambda = 0.1$) and the return of the bond index reveals that this might be the case. The two variables share a correlation of -0.3221.

Fig. 7A

Koyck Distributed Lag of Change in Real GDP (0.1 on Current Year)
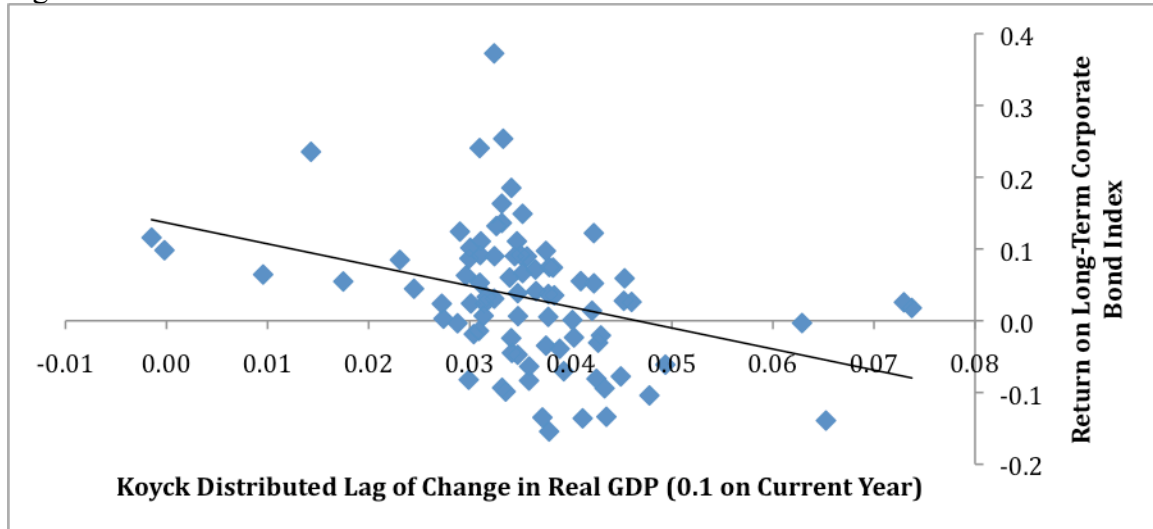
The above chart further illustrates the fairly strong linear relationship between the Koyck weighted changes in real GDP and the return on the corporate bond index, indicating that this relationship may have something to do with the unexpected positive value of $Bond_t$'s coefficient.

7.2 Robustness of Regression I

The robustness of this result might be called into question if either there were a high degree of correlation among the independent variables, or autocorrelation existed within the residuals.

The tale below shows the correlation statistics between each of the explanatory variables:

	$Stock_t$	GDP_t	$House_t$	$Bond_t$
$Stock_t$	1.0000			
GDP_t	0.0296	1.0000		
$House_t$	0.1782	0.2179	1.0000	
$Bond_t$	-0.0224	-0.4383	-0.2857	1.0000

Given that these variables measure rates of change/returns in interconnected financial markets and the domestic GDP growth that they seek to predict, the levels of correlation are not as high as might have been expected. The notable exception is the somewhat high negative correlation between GDP_t and $Bond_t$.
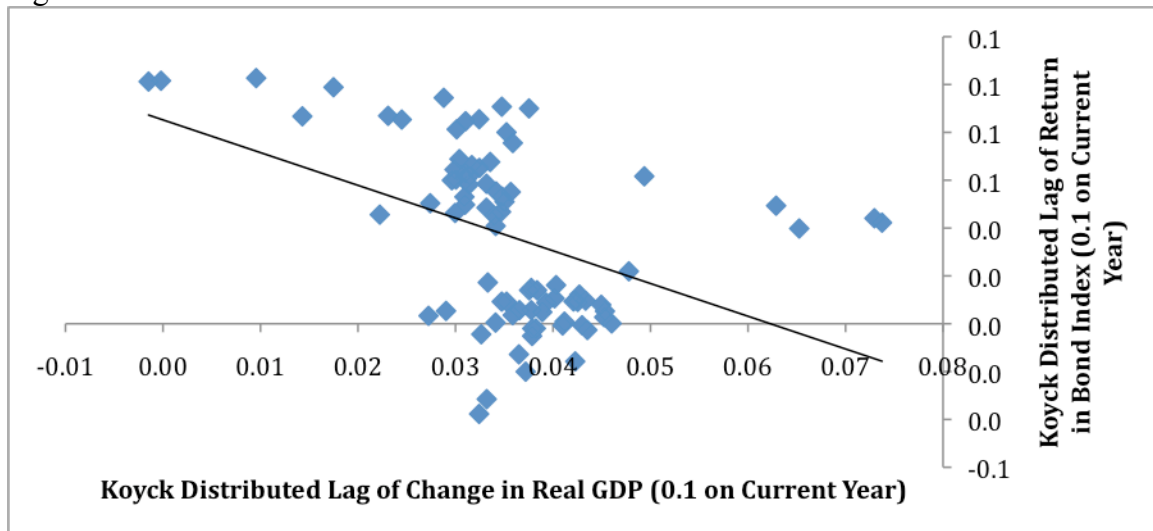
Fig. 7B

Koyck Distributed Lag of Change in Real GDP (0.1 on Current Year)

Figure 7B contains a scatterplot charting GDP_t against $Bond_t$ for the years 1926-2009 (both with a λ of 0.1). The closeness of this relationship is not surprising given the observation discussed above: that economic booms are often accompanied by increasing interest rates, and that bonds experience capital losses as interest rates rise.

The second major concern for robustness is the possible presence of serial correlation. Several methods exist to test for autocorrelation among time series residuals. This paper will make use of the Breusch and Godfrey (Godfrey 1998) test:

> In this test, the regression is augmented with *p* lagged residual series. The null hypothesis is that the errors are serially independent up to order *p*. The test evaluates the *partial correlations* of the regressors **x** partialled off. The residuals at time *t* are orthogonal to the columns of **x** at time *t*, but that need not be so for the lagged residuals. This is perhaps the most useful test for nonindependence of time-series disturbances, since it allows the researcher to examine more than first-order serial

independence of the errors in one test.[21]

When conducted on the above regression, the Breusch and Godfrey test for autocorrelation up to the 5th order yields the following results:

lags(p)	chi2	df	Prob > chi2
1	26.556	1	0.0000
2	28.335	2	0.0000
3	29.184	3	0.0000
4	30.410	4	0.0000
5	30.452	5	0.0000

This result reassures to a high degree of certainty (no P-value above .0000) that no autocorrelation exists among the residuals of the regression.

7.3 Regression II: Koyck Distributed Lags and Koyck Lagged Variance Measures

The next regression will add the variance measures discussed in 5.3 above to the regression. There will be one such independent variable for each of the four variables explored above. For this determining the Koyck weights in this regression, $\lambda = \omega = 0.1$ for all each independent variable.

The regression takes the form:

$$A_t = \beta_0 + \beta_1 Stock_t + \beta_2 GDP_t + \beta_3 House_t + \beta_4 Bond_t + $$
$$\beta_5 StockVar_t + \beta_6 GDPVar_t + \beta_7 HouseVar_t + \beta_8 BondVar_t + \varepsilon_t$$

A_t	Coefficient	Std. Err.	t	P>t
$Stock_t$	-7.668063	1.363588	-5.62	0.000***
GDP_t	-29.02499	4.150915	-6.99	0.000***
$House_t$	-12.18303	3.28382	-3.71	0.000***
$Bond_t$	-.0152807	1.543665	-0.01	0.992
$StockVar_t$	17.57104	6.878973	2.55	0.013**
$GDPVar_t$	-30.33315	72.67892	-0.42	0.678
$HouseVar_t$	-22.96049	55.74776	-0.41	0.682
$BondVar_t$	14.10085	8.496105	1.66	0.101

$$n = 81$$
$$R^2 = 0.8187$$

The results are fairly interesting. $Stock_t$, GDP_t, and $House_t$ all retain statistical significance, with $House_t$ actually becoming slightly *more* significant (P-value of 0.000

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[21] Christopher Baum, *An Introduction to Modern Econometrics Using Stata* (Stata Press, College Station, TX: 2006), p. 156.

vs. 0.004). Further, the approximate value of their true coefficients are all reinforced, with the new coefficient values well within the 95% confidence range of Regression I. $Stock_t$'s β changed from -10.665 to -7.668, GDP_t's β remained practically unchanged from -29.253 to -29.025, and $House_t$'s β changed slightly from -9.575 to -12.183. Three of the four primary regressors thus have the approximate value of their true coefficients and their statistical significance confirmed. $Bond_t$ however completely lost any semblance of significant impact upon A_t, with a coefficient of -0.01528 and a new P-value of 0.992.

Of the new variance measures, only one, $StockVar_t$, was found to be statistically significant with a P-value of 0.013. $BondVar_t$ was close, with a P-value of 0.101, but neither $GDPVar_t$ nor $HouseVar_t$ were found to be significant, both with P-values > 0.6. As was expected, the significant coefficient has a positive value: this suggests that higher remembered variations in stock market returns imply a higher bond spread, or lower risk-appetite. Thus greater variance of returns can be construed as higher risk, and has the appropriate explanatory effect on risk-appetite.

This finding suggests that variance in stock market returns has real power in explaining the level of risk-appetite exhibited by investors—perhaps because equity markets are the most widely observed gauge of market strength and experience the greatest gyrations of any of the three markets measured or GDP. This is shown in the following table:

Variable	Obs	Mean	Std. Dev.	Min	Max
$StockVar_t$	138	.0252804	.0149404	0	.0797899
$GDPVar_t$	138	.0021912	.0017607	0	.0077449
$HouseVar_t$	119	.0075975	.0095601	0	.0430519
$BondVar_t$	84	.0066208	.0051348	0	.0202439

7.4 Regression III: Koyck Distributed Lags and Koyck Lagged Deviation Measures

The third regression will take a similar approach to the second, simply using measures of 'deviation' instead of variance in returns. As discussed in 5.4, these values of 'deviation' are simply the square roots of the variances, so that:

$$StockDev_t = \sqrt{StockVar_t}, \; GDPDev_t = \sqrt{GDPVar_t}, HouseDev_t = \sqrt{HouseVar_t},$$
$$\text{and } BondDev_t = \sqrt{BondVar_t}$$

The regression takes the form:

$$A_t = \beta_0 + \beta_1 Stock_t + \beta_2 GDP_t + \beta_3 House_t + \beta_4 Bond_t +$$
$$\beta_5 StockDev_t + \beta_6 GDPDev_t + \beta_7 HouseDev_t + \beta_8 BondDev_t + \varepsilon_t$$

A_t	Coefficient	Std. Err.	t	P>t
$Stock_t$	-7.343589	1.355864	-5.42	0.000***
GDP_t	-28.54597	3.743827	-7.62	0.000***

$House_t$	-15.39516	4.002414	-3.85	0.000***
$Bond_t$	-.4992686	1.673525	-0.30	0.766
$StockDev_t$	8.258447	2.461243	3.36	0.001***
$GDPDev_t$	-7.162408	6.813327	-1.05	0.297
$HouseDev_t$	.4797787	6.025321	0.08	0.937
$BondDev_t$	2.105854	1.449315	1.45	0.151

<div align="center">

n=81

R^2=0.8208

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As can be seen, the results are quite similar to those of Regression II. The coefficients on $Stock_t$, GDP_t, and $House_t$, all have their negative, significant coefficients confirmed. All are found to be extremely significant with P-values of 0.000, and have coefficient values similar to those found earlier. Conversely, the coefficient of $Bond_t$ has lost its significance with a P-value of 0.766.

In addition, while the deviations of changes in GDP and returns in the Housing and Bond markets are found to be insignificant (P-values of 0.297, 0.937 and 0.151 respectively), $StockDev_t$ is found to have a significant positive coefficient with a P-value of 0.001. As in 7.3, its positive value is expected given the risk-averse nature of investors, and this regression confirms the validity of those earlier results.

7.5 Significance of Results with respect to Minsky's Financial Instability Hypothesis

Such an econometric analysis of the relationship between risk appetite and market returns/GDP growth suggest that Minsky's Financial Instability Hypothesis may hold water. This finding lends credence to the supposition that the risk appetite of participants within an economy might change in response to market and economic performance; this in turn lays the groundwork for an effective positive feedback system as described earlier; finally, such feedback mechanisms enable the regular inflation of bubbles within one or a variety of markets. Thus, because in a financial market appetite for risk can change as a result of market returns, the possibility for a bubble in such an economy is omnipresent. This supports Minsky's fundamental assertion:

> The major flaw of our type of economy is that it is unstable. This instability is not due to external shocks or to the incompetence or ignorance of policy makers. ***Instability is due to the internal processes of our type of economy***. The dynamics of a capitalist economy which has complex, sophisticated, and evolving financial structures leads to the development of conditions conducive to incoherence—to runaway inflations or deep depressions. (emphasis added)[22]

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[22] Hyman Minsky, *Stabilizing an Unstable Economy* (McGraw Hill, New York: 2008), originally published Princeton University Press: 1986, p. 11.

8—Conclusion

The empirically demonstrable relationship between variances and returns in capital markets as well as growth in GDP and changes in risk appetite speaks volumes for the strength of Minsky's Financial Instability Hypothesis. Given that every financial borrower within an economy fits within one of his three financing schemes of hedge, speculative or ponzi, it is not unreasonable to imagine that as the risk appetite of market participants increases, they might be more inclined to engage in riskier financing schemes. Given recent experience in the United States financial industry, it is undeniable that such a build-up in risk appetite can lead investors to take risks that they do not fully understand or appreciate.

Minsky described the process by which such exposure creeps through an economy as follows:

> Our economy is unstable because of capitalist finance. If a particular mix of hedge and speculative financing of positions and of internal and external financing of investment rules for a while, then there are, internal to the economy, incentives to change the mix. Any transitory tranquility is transformed into an expansion in which the speculative financing of positions and the external financing of investment increase. An investment boom that strips units of liquidity and increases the debt-equity ratios for financial institutions follows. Margins of safety are eroded even as success leads to a belief that the prior—and even the present—margins are too large.[23]

Clearly then, the same incentives that cause a shift from hedge to speculative and ponzi financing likewise cause both borrowers and lenders to take on increased risk through leverage etc. to maximize profits. The 'transitory tranquility' inevitably causes humans with a short collective memory to imagine that good times will continue for the foreseeable future, and the 'erosion of margins of safety' is viewed as sensible in the context of what is viewed as a new and safe economy.

On an individual level, such risk-taking is not damaging to the wider economy, but as more and more individuals begin to make such bets, the risks involved can present real dangers to the solvency of the exposed financial institutions. Such exposure and the intricate interconnectedness of today's mega-financial institutions present a real threat to the system as a whole during panics. A 'Minsky moment' can destroy the functionality of financial markets and render leveraged borrowers and financial institutions insolvent overnight. The intertwining nature of today's financial system means that such failures on the part of an individual institution can very easily cause dangerous repercussions across the entire system and economy.

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[23] Hyman Minsky, *Stabilizing an Unstable Economy* (McGraw Hill, New York: 2008), originally published Princeton University Press: 1986, p. 244.

Thus it would behoove financial regulators to make a regular and thorough examination of risk appetite in financial markets. Such data could be taken to indicate whether an exuberance on the part of market participants is rational or irrational—i.e. whether or not increases in asset prices indicate the formation of a potentially harmful bubble. If it were determined that the cause of such a buildup might be speculative in nature, the appropriate regulatory authorities might take steps designed to prevent the inflation of the bubble. If bubbles could be stopped before they were fully formed in this manner, dangerous crashes, widespread financial panics and accompanying recessionary periods might well be prevented, or at least reduced.

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