320.325 – Inflation and Business Cycles

Chapter 14

Asset Market

The most important asset markets are the following:

(i) Bond market

(ii) Stock market

(iii) Real estate market

(iv) Foreign exchange market (next lecture)

The Bond Market: Yield curves

Bond Prices and Yields

$$P_1 = \frac{1}{1+i_1} \qquad i_1 = \frac{1}{P_1} - 1$$

$$P_2 = \left(\frac{1}{1+i_2}\right)^2 \qquad i_2 = \frac{1}{P_2^{1/2}} - 1$$

$$P_{10} = \left(\frac{1}{1+i_{10}}\right)^{10} \qquad i_{10} = \frac{1}{P_{10}^{1/10}} - 1$$

where i_t denotes the annualized interest rate over the next t periods.

Normally, $i_1 < i_2 < \cdots < i_{10}$

Why Is The Yield Curve Usually Upward Sloping?

Answer: Long-term bonds are riskier than short-term bonds.

You could invest your wealth for the next year in a number of ways:
(i) buy now a one year bond
(ii) buy now a two year bond and sell it after one year.
etc.

The return you receive in one year from each of these strategies is as follows:

(i) i_1

(ii) i_2 only if P_1 is the same next year as this year.

If P_1 rises, with (ii) you receive more than i_2.

If P_1 falls, with (ii) you receive less than i_2.

If short-term interest rates stay fixed over time, then the price of a bond that matures in one year (i.e., P_1) is the same every year. However, in practice P_1 could rise or fall.

An investor who follows strategy (ii) therefore incurs risk while an investor who follows strategy (i) does not. Hence strategy (ii) requires a risk premium.

We obtain that

$i_1 + \psi = i_2$,

where ψ is the risk premium.

Note: the least risky thing for an investor who wants to invest for T years is to buy a T-year bond. The fact that the yield curve is upward sloping implies that most investors have a short-term focus. They only want to invest money for a short period of time.

More precisely, long term bonds are more risky for short-term investors. Most investors are short-term. Hence long-terms bonds must pay a risk premium.

Each Eurozone country has its own yield curve. Interest rates on Euro Area 10-year Government bonds are as follows:

	12 Nov 11	5 Nov 12	26 Oct 13	26 Mar 14
Austria	3.04	1.95	2.14	1.82
Belgium	4.37	2.41	2.61	2.15
France	3.19	2.22	2.33	2.09
Germany	1.73	1.44	1.77	1.57
Greece	27.9	18.22	8.81	6.86
Italy	7.51	4.99	4.12	3.34
Netherlands	2.17	1.70	2.12	1.75
Spain	5.80	5.75	4.24	3.27

(Source: The Economist and the Financial Times)

Why do these rates differ?

$i_{ITA} = i_{GER}$ + risk premium

The risk on bonds comes from the following:

(i) Inflation/Exchange rate risk
(ii) Default risk

In the Eurozone the fear is that highly indebted governments will either default (ii) or leave the Eurozone, leading to inflation and depreciation of the currency (i).

Negative Yields

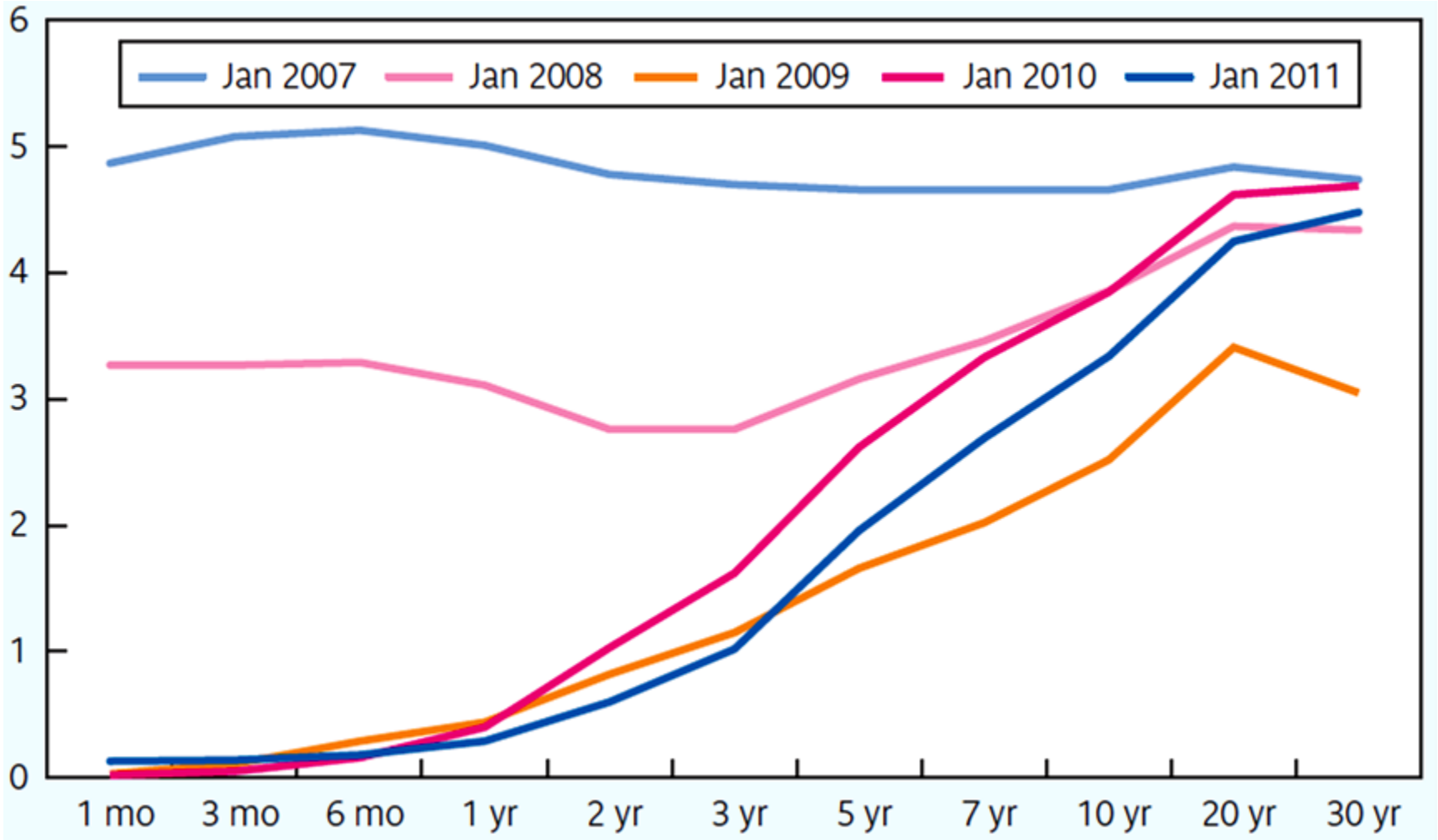
In 2012, negative yields were observed on some German Bundesbank 6-month bonds.

This means that the face value of the bond is less than the price at which it is purchased.

How can this happen?

It represents a “flight to safety”. Investors are worried the Eurozone will collapse, and that it is therefore safer to hold German Bundesbank bonds than to have Euros sitting in a bank deposit.

US Yield Curves



Source: Burda and Wyplosz (2013)

The central bank sets the overnight interest rate (or cash rate) at which banks lend to each other. It has only limited influence over longer-term rates.

The central bank can affect longer-term interest rates to some extent by intervening in the bond market (either buying or selling longer-term bonds).

An **inverted yield curve** is a situation where the yield curve becomes downward sloping as happened in the US in Jan 2007.

What Does It Mean When the Yield Curve Inverts?

An inverted yield curve can arise when market participants expect short term interest rates to fall in the next year or so.

Remember: a fall in short term interest rates implies a rise in short maturity bond prices.

To see why this is so consider the case of an investor with a 2-year investment horizon. She can invest for two years in a number of ways.

(i) Buy a 1 year bond, When it matures buy another 1 year bond.
(ii) Buy a 2 year bond.
(iii) Buy a 3 year bond and sell it after 2 years.

When short maturity bond prices are expected to rise, strategy (i) becomes less attractive and strategy (iii) becomes more attractive.

In equilibrium, the average investor should be indifferent between strategies (i), (ii) and (iii).

Hence investors will need a higher return on strategy (i) relative to strategy (iii) than before to make them indifferent.

This effect acts in the opposite direction to the risk premium. If the expected rise in short-term interest rates is large enough, it can dominate the risk premium effect and cause the yield curve to become downward sloping.

Implications of an inverted yield curve

An inverted yield curve is a leading indicator of recession (usually about 4 quarters later).

Why? Short-term interest rates are procyclical. Central banks implement expansionary monetary policy in a recession and contractionary monetary policy in a boom.

Can yield curve inversions cause recessions?

Perhaps. Banks make profits by “riding the yield curve”. They lend at higher interest rates over long horizons (e.g., 25 year mortgages) and borrow at lower interest rates over short horizons.

The profit comes from the differential between the long and short-term interest rates.

When the yield curve inverts, this strategy ceases to be profitable. Bank profits fall and they may stop lending, which may create a credit crunch. This in turn can cause investment to fall and send the economy into recession.

The banks' strategy of "riding the yield curve" also makes them vulnerable to credit crunches.

If liquidity dries up, banks are no longer able to rollover their short-term debt and may be forced to default.

Market Efficiency

Markets are efficient if it is not possible to obtain profits by instantaneously trading assets of equal risk.

This is known as the no arbitrage condition

Stock prices

Abstracting from risk, the no arbitrage condition implies that the yield on a stock should be equal to the yield on a bond.

The yield on a stock is calculated as follows:

$$\underbrace{r}_{\substack{\text{yield}\\ \text{on}\\ \text{safe}\\ \text{bond}}} = \underbrace{\underbrace{\frac{d_t}{q_t}}_{\substack{\text{dividend}\\ \text{yield}}} + \underbrace{\frac{\left(q_{t+1} - q_t\right)}{q_t}}_{\text{capital gain}}}_{\text{total return on shares}}$$

no-profit condition

Rearranging this equilibrium condition we obtain the price of a stock:

$$r = \frac{d_t}{q_t} + \frac{\left(q_{t+1} - q_t\right)}{q_t} = \frac{d_t + q_{t+1}}{q_t} - 1$$

$$1 + r = \frac{d_t + q_{t+1}}{q_t}$$

$$q_t = \frac{d_t + q_{t+1}}{1 + r}$$

There is a similar relationship between the price of shares in each of the next periods and dividends and share prices in the subsequent periods:

$$q_t = \frac{d_t + q_{t+1}}{1+r}$$

$$q_{t+1} = \frac{d_{t+1} + q_{t+2}}{1+r}$$

$$q_{t+2} = \frac{d_{t+2} + q_{t+3}}{1+r}$$

$$etc.$$

Recursively substituting out the future stock prices, we get an expression for the price of a stock in the current period:

$$q_t = \left(\frac{1}{1+r}\right) d_t$$

$$+\left(\frac{1}{1+r}\right)\left(\left(\frac{1}{1+r}\right) d_{t+1}\right)$$

$$+\left(\frac{1}{1+r}\right)^2 \frac{d_{t+2}}{1+r} + \left(\frac{1}{1+r}\right)^2 \frac{q_{t+3}}{1+r}$$

$$etc.$$

$$= \sum_{i=0}^{\infty} \left(\frac{1}{1+r}\right)^{i+1} d_{t+i}$$

Price = the net present value of future dividend payments

The formula is easily extended to allow for the greater riskiness in holding stocks by incorporating a risk premium into the stock return equation:

$$\underbrace{r}_{\text{yield on safe bond}} + \underbrace{\psi}_{\text{risk premium}} = \underbrace{\underbrace{\frac{d_t}{q_t}}_{\text{dividend yield}} + \underbrace{\frac{\left(q_{t+1} - q_t\right)}{q_t}}_{\text{capital gain}}}_{\text{total return on shares}}$$

which with recursive substitution reduces to:

$$q_t = \sum_{i=0}^{\infty} \left(\frac{1}{1 + r + \psi} \right)^{i+1} d_{t+i}$$

A higher risk premium (holding the expected dividend stream fixed) therefore acts to reduce the market price of assets.

The **equity premium puzzle** is the empirical result that the difference between the long run average return on shares and bonds implies an implausibly large risk premium.

There is no equity premium puzzle over the last 30 years due to the poor performance of equities since the start of the financial crisis.

Over the period 1900-2005 the equity premium was about 3.5 percent per year.

Based on standard macro models, the level of risk aversion implied by this premium would require that an investor would be indifferent between an equally likely payoff of $50,000 or $100,000 (with expected return of $75,000) and a certain payoff of $51,200. (Mankiw and Zeldes, 1991)

Such extreme risk aversion seems implausible.

Some stocks are more risky than others.

Example: small cap stocks may be more risky than large cap stocks for two reasons.

(i) Small cap stocks are less liquid
(ii) Small cap stocks are more likely to go bankrupt

Hence small-cap stocks should have a higher risk premium than large-cap stocks.

In the long run a portfolio of small-cap stocks therefore should outperform a portfolio of large-cap stocks.

This does not imply a violation of the efficient markets hypothesis.

Diversification of risk:
Risk can be reduced by constructing a diversified portfolio.

Example:

	Asset A	Asset B	Asset C
State 1	100	100	100
State 2	100	0	50
State 3	0	100	50
State 4	0	0	0

By forming a portfolio consisting of 50% asset A and 50% asset B we end up with a portfolio with payoffs as described by Asset C. C is less risky than A and B.

Diversification makes no difference in states 1 and 4, since A and B have the same payoffs in these states. It helps though in states 2 and 3.

The Subprime Crisis of 2007

Housing mortgages in the US were collected together into large pools, sliced up into standardized strips and sold to investors. This process is referred to as securitization.

Pooled and sliced mortgages of this type are also known as mortgage backed securities (MBS).

Problems:

(i) The mortgage initiator sold the mortgage on to a financial intermediary, who then packaged them into MBS and sold them to investors.

This created a principle-agent problem.

Bernanke raised this issue with regard to the subprime mortgage market in May 2007, just as the subprime crisis was beginning.

The purchaser of an MBS is the principle.

The mortgage initiator is the agent.

In the event of default it is the principle not the agent who bares the cost. The agent therefore does not care about default risk.

The extreme case was NINJA mortgages (NINJA=no income, no job or assets).

Buyers of MBS did not realize until too late that there was a principle-agent problem.

(ii) It was assumed that the correlation of default risks across individual mortgages was quite low.

Investors failed to realize that in the event of recession and falling house prices, many mortgagees would start defaulting on their mortgages simultaneously (particularly at the risky low end).

(iii) The house was used as collateral. If a mortgagee defaulted, then the house would be sold and the creditor would receive the proceeds. Hence it was assumed that defaults would not really hurt creditors.

When creditors sold foreclosed houses they got less than they expected, since house prices were falling. These forced sales also acted to push down house prices even further.

Bottom line: the risks of subprime mortgages were much more correlated than investors realized. Pooling them together did little to diversify risk.

Also, the principle-agent problem arising from the decoupling of mortgage initiation and bearing the risk of default meant that each individual subprime mortgage was more risky than investors realized.

Hence these securities ended up significantly over priced in the market.

(iv) Even worse, noone was sure exactly how much overpriced they were.

This is because the securities were so complicated. MBS were often packaged together with other debt products like credit card debt and student loans to form collateralized debt obligations (CDOs).

The rating agencies – Moody´s, Standard and Poor´s and Fitch – gave the CDOs and MBS good credit ratings until 2007.

Not knowing the value of their own balance sheets, banks did not know how much they could lend. Increased volatility in the markets also increased the perceived level for risk, causing banks to further cut back lending.

The result was a severe credit crunch that threatened to drive not only insolvent firms, but any but the most liquid firms into bankruptcy.

After the collapse of Lehman brothers in September 2008 even the payment system wobbled.

The whole financial system came close to collapse in late 2008.

MBS and the US Housing Bubble

There was until 2007 high demand for MBS securities.

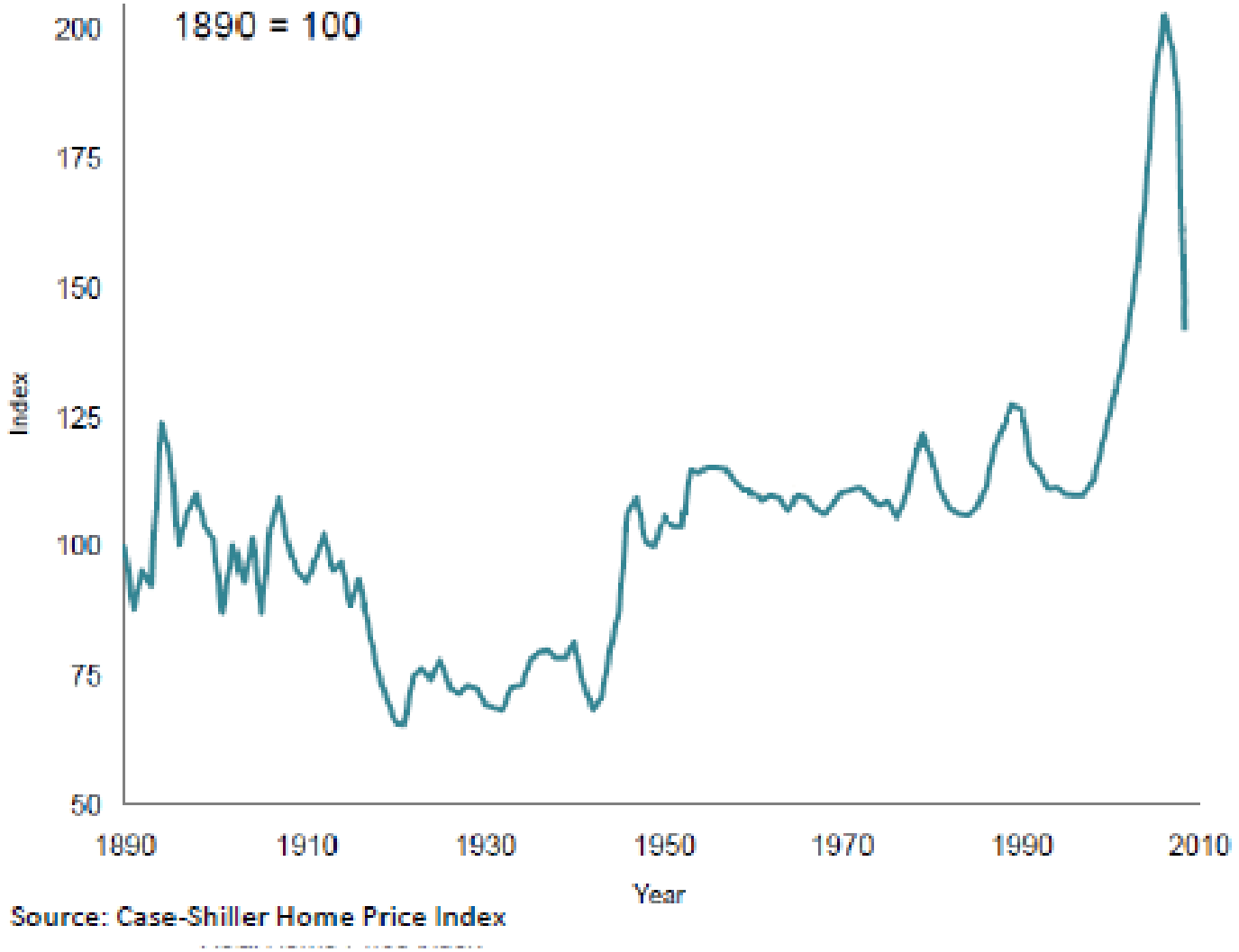
Investors (including banks) saw MBS and CDOs as a new *low risk* asset class that would allow them to further diversify their portfolios.

The high demand encouraged an increase in supply of MBS, thus eroding lending standards.

The stable macroeconomic environment also encouraged market participants to underestimate the level of systemic risk.

This effectively provided house buyers with a huge amount of additional funding to buy houses, which helped trigger a housing boom. The Figure on the next slide shows real house prices in the US from 1890 to 2010.

The Housing Bubble in the United States



Source: Malkiel (2010), Bubbles in Asset Prices, CEPS Working Paper No. 200.

Speculative bubbles:

Assuming a fixed dividend d every period and ignoring the risk premium we have the fundamental price of a stock:

$$\begin{aligned}
\bar{q} &= \sum_{i=0}^{\infty}\left(\frac{1}{1+r}\right)^{i+1} d \\
&= \left(\frac{d}{1+r}\right)\cdot\sum_{i=0}^{\infty}\left(\frac{1}{1+r}\right)^{i} \\
&= \left(\frac{d}{1+r}\right)\cdot\left(1+\left(\frac{1}{1+r}\right)+\left(\frac{1}{1+r}\right)^{2}+\left(\frac{1}{1+r}\right)^{3}+\ldots\right) \\
&= \left(\frac{d}{1+r}\right)\cdot\frac{1}{1-\left(1/(1+r)\right)} \\
&= \left(\frac{d}{1+r}\right)\cdot\left(\frac{1+r}{1+r-1}\right) \\
&= \frac{d}{r}
\end{aligned}$$

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Suppose now that the price of assets exceed the fundamental value:

$$q_t > \frac{d}{r}$$

Referring back to the original zero-profit condition we have that:

$$\underbrace{\underbrace{r}_{\text{yield on safe bond}} = \underbrace{\underbrace{\frac{d}{q_t}}_{\text{dividend yield}} + \underbrace{\frac{(q_{t+1} - q_t)}{q_t}}_{\text{capital gain}}}_{\text{total return on shares}}}_{\text{no-profit condition}}$$

$$r = \underbrace{\left(\frac{d}{q_t}\right)}_{< \frac{d}{(d/r)} = r} + \underbrace{\frac{(q_{t+1} - q_t)}{q_t}}_{\text{needs to be positive to fill the gap}}$$

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Thus any stock price higher than the fundamental value, can be justified by the expectation of an even higher price of the stock in the next period.

This is an example of a self-fulfilling prophecy. The price of stocks rise because they are expected to rise. This can lead to a speculative bubble.

In Jan 2013 Eugene Fama (a strong advocate of EMH) was asked the following question:
Many people would argue that … the inefficiency [in the GFC] was primarily in the credit markets, not the stock market—that there was a credit bubble that inflated and ultimately burst.

Fama's reply is illuminating.

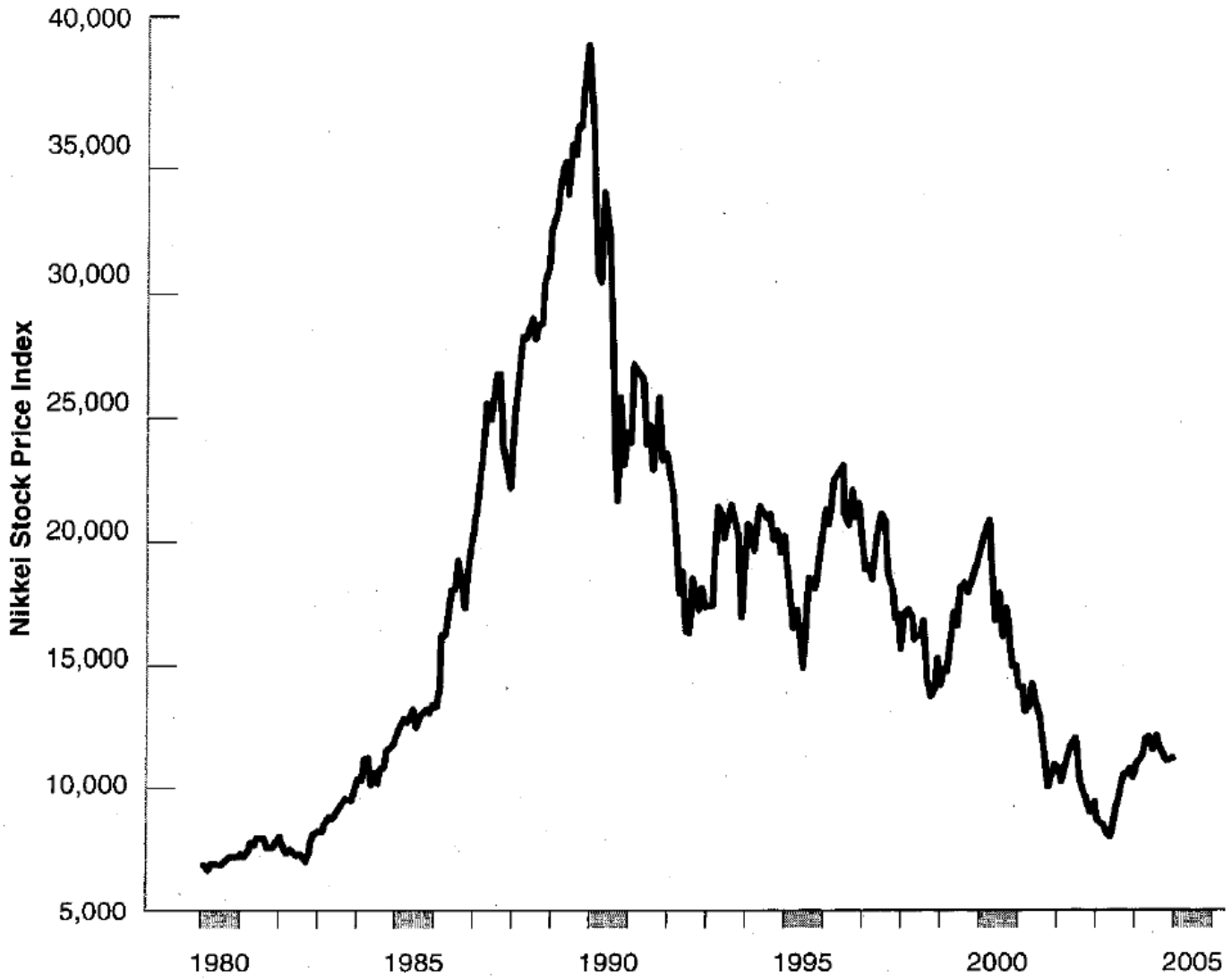
"I don't even know what that means. People who get credit have to get it from somewhere. Does a credit bubble mean that people save too much during that period? I don't know what a credit bubble means. I don't even know what a bubble means. These words have become popular. I don't think they have any meaning."

My opinion: I would agree that it can be hard to tell that there is a bubble while it is happening, since the expected earnings on an asset can also rise in a boom, pushing up the perceived fundamental value. Once a bubble bursts though I would say it is quite clear it was a bubble.

Figure 1-7

The Japanese Stock Market Index since 1980

The large increase in the index in the second half of the 1980s was followed by an equally sharp decline in the early 1990s.



Source: Blanchard, Macroeconomics, 4th Edition

Do Bubbles Invalidate the Assumption that Asset Markets Are Efficient?

Not necessarily. You cannot know when a bubble will burst.

Trying to profit from a bubble is risky since markets can stay irrational longer than you can remain solvent betting against a bubble.

Also, there is a self-fulfilling prophecy element to asset markets. If you think everyone else expects the price to continue rising then you should expect this as well.