What risk ?

- The main risk for financial institutions is insolvency,
  i.e. depletion of trading capital to the point that you have to stop operations or are severely impaired.

- Pension funds: not enough funds to cover retirement of pensioners

- Banks: insolvency, due to falling below capital ratios (regulated by the Central Bank)

- Hedge funds: losses may create a situation where Fund will experience massive redemptions from clients (loss of business)

- Asset managers: poor performance relative to peers generates redemptions (loss of business) to the point that running the fund is not profitable

- Stock exchanges and Central Clearinghouses: one or more clearing participants defaults and wipes out the reserve funds of the CCP

- Trading desks: outright positions can cause losses that exceed trading limit given by the bank (the ``tap on the shoulder'' risk)

Every financial agent operates with limited capital

Example: Trading account/investor

1. Total Cash

2. Stocks, bonds, derivatives and other financial instruments

3. Net Liquidation Value (Equity)

$$E = C + S$$

Risk-management for such an account means that equity has to remain larger than a certain amount (at least >0). If E<0, you're out.

Leverage

- Leverage: financial agents can borrow against their portfolio to take larger positions

Unleveraged trading account	Leveraged trading account
Cash = 100	Cash = - 300
Bonds = 500	Bonds = 500
Equity= 600	Equity = 200

Certain kinds of investment only make sense for some people if they are leveraged.

Example of why leverage might be necessary, however

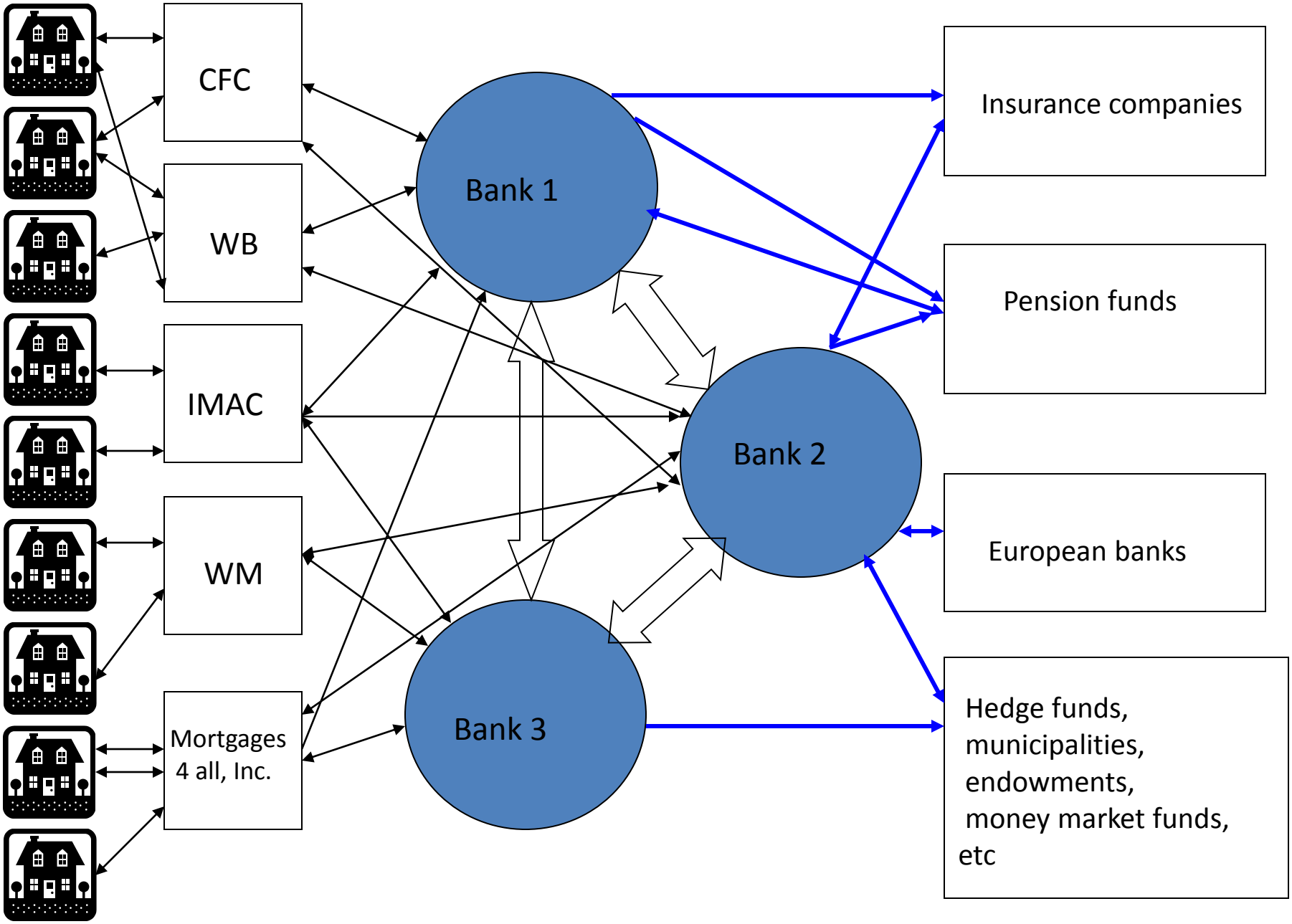
If bonds return 1% annually, then the annual return of the Unleveraged Portfolio is = 5/600= 0.8%

The Leveraged Portfolio returns: 5/200=2.5%

This assumes of course that the bond value in a year remains the same (not true in general).

The math presented here is the basis for LBOs for companies and real estate.

The subprime crisis in the US: an origination and securitization smorgasbord



Leverage and capital requirements

- Most trading operation/funds/banks are required to have a minimum ratio of Equity (E) to total assets (|C|+|S|), or maximum leverage, where leverage is defined as

$$L = \frac{|C| + |S|}{E}$$

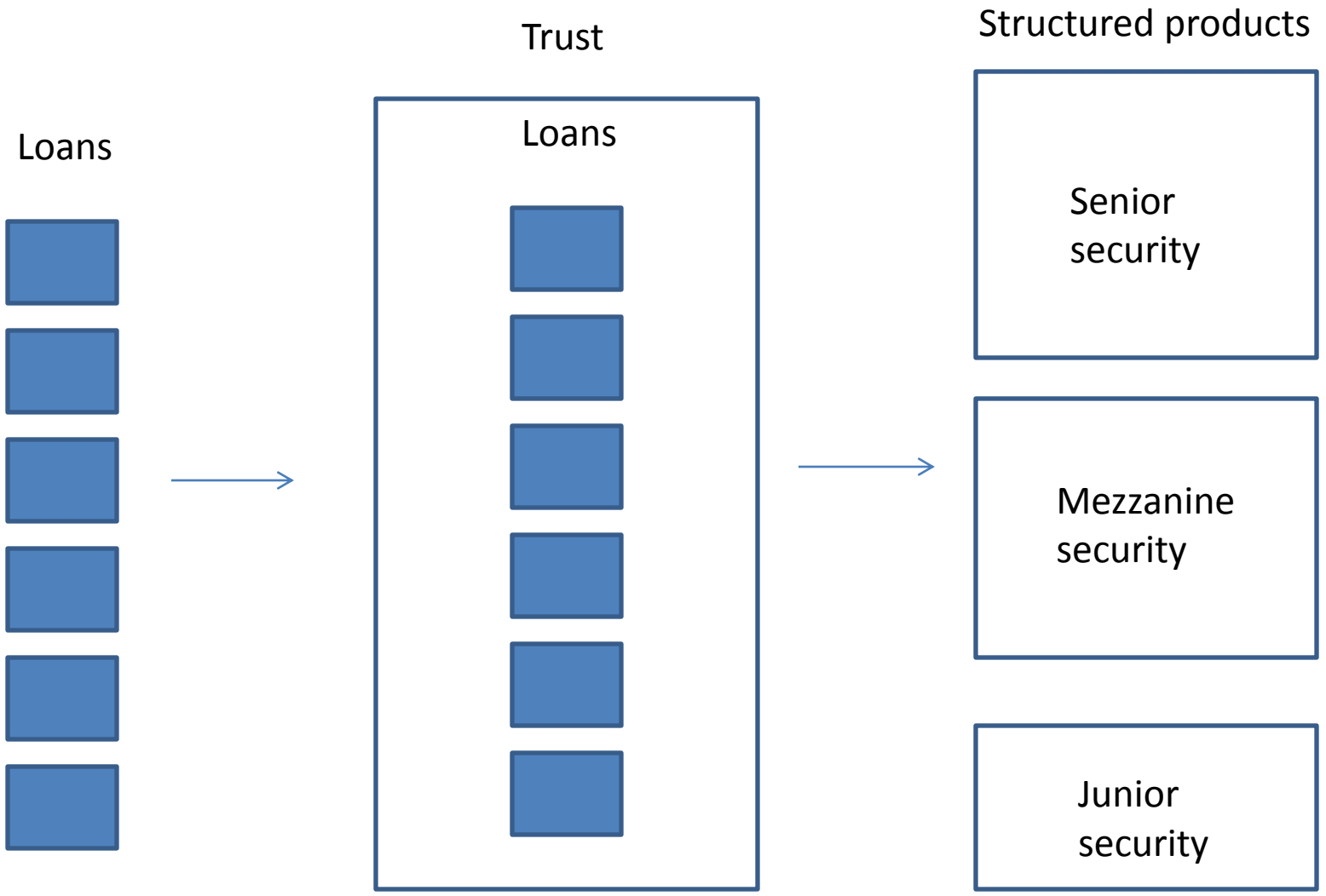
- Examples abound: Reg T versus portfolio margining, bank capital ratios.
  Credit rating agencies typically take leverage into consideration
  Hedge fund clients also take leverage into consideration

Warren on Leverage

"Leverage is the only way a smart guy can go broke … You do smart things, you eventually get very rich. If you do smart things and use leverage and you do one wrong thing along the way, it could wipe you out, because anything times zero is zero. But it's reinforcing when the people around you are doing it successfully, you're doing it successfully, and it's a lot like Cinderella at the ball. The guys look better all the time, the music sounds better, it's more and more fun, you think, 'Why the hell should I leave at a quarter to 12? I'll leave at two minutes to 12.' But the trouble is, there are no clocks on the wall. And everybody thinks they're going to leave at two minutes to 12."

Warren Buffet, *The Charlie Rose Show*

Derivatives have embedded leverage (financial engineering)



More Warren on Leverage

`` I've seen more people fail because of liquor and leverage – leverage being borrowed money. You really don't need leverage in this world so much. If you're smart, you're going to make a lot of money without borrowing.''

`` When you combine ignorance with leverage, you get some pretty interesting results''.

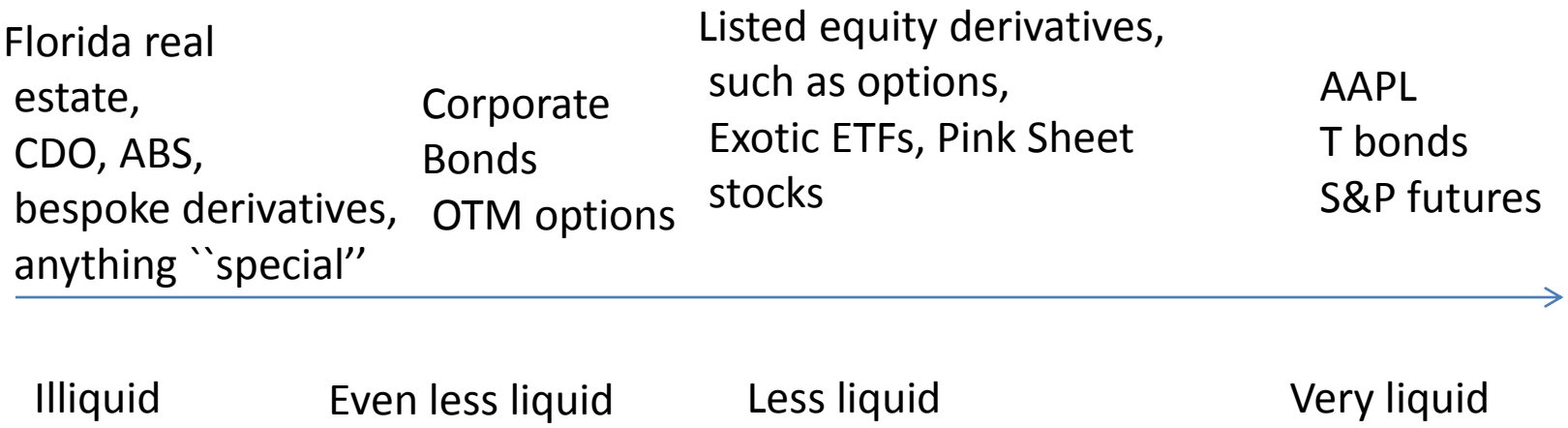
Basically, leverage magnifies losses, so it is a major source of risk.

There are others…

I don't believe anything anyone says without questioning it , including WB. ☺

Liquidity Risk

- Market risk is accentuated by leverage, as we argued
- Liquidity is the other key ingredient in understanding RM
- Liquidity is the degree to which one can buy or sell an asset without significantly affecting its price.



Liquidity brings the time dimension to risk

- Often, entering and exiting positions in illiquid instruments is a long process therein lies a big risk if you have funding restrictions which require you to have access to $$ *fast*.

Example: MF Global, 2012.

MFG finances (cheap) 2Y Italian bondsguaranteed by the European Financial Stability Facility (EFSF). Big size trade.

Financing is done via a repurchase agreement (repo) in which, essentially, MGF leaves the bonds as collateral with the financing counterparty (J.P. Morgan).

Even though the bonds do not default, they drop in credit quality and the financing counterparty demands more collateral, which MFG does not have.

Financing counterparty basically forces MGF to declare bankruptcy. (My interpretation).

Lesson: MGF did not have the cash to add as additional collateral

Money-market funds in 2008

- Money market funds invest cash in overnight positions in assets to generate interest for investors

- The trade is done as a *repo:* investor ``buys the bond'' today and sells it tomorrow morning for a little more to the repo counterparty (typically a bond investor that is financing the asset in the overnight market).

- If assets fall in price and are illiquid, the repo CP may default and the fund is left with the problem of selling the asset in the market with no bidders.

- In 2008, MMFs invested in Lehman Brothers commercial paper and other risky bond to get the extra yield that is not available in the most liquid and safe fixed income instruments (U.S. Government paper).

The London Whale

- Interestingly, the London Whale is French.
- JP Morgan CIO invests in very large positions in Index Credit Default Swaps (synthetic securities which insure against a basket of corporate credits)
- JPM CIO is allegedly hedging against the bank's exposure to these credits, but the position is huge.
- Since JPM is a regulated financial institution which must declare the value of is assets, it reports an initial loss of USD 2 billion on the trade.
- The trade was in the books for months (still is?) and cost an estimated USD 6 billion to unwind. Reason: the size of the position and the fact that the market knew of it made it impossible to liquidate in a short period of time.

What is this course about?

- This course will study systematic approaches to the problem of managing risk in financial institutions and trading accounts.
- This will done always in context (bank, CCP, hedge fund).
- The approaches covered are what is currently used in the financial industry.
- The general problem will be formulated as follows:

1. We are given a ``universe'' of investments of financial instruments (stocks, equity derivatives, mortgage-backed securities, etc).
2. Identify the relevant risk factors that drive the market prices of the securities
3. Model statistically the behavior of the factors using Extreme Value Theory and other tools.
4. Determine the liquidity of the different instruments in the universe
5. Estimate the cost of liquidating a portfolio of such securities in extreme market conditions and under limited liquidity assumptions
6. Deduce a reasonable capital requirement for this trade.

Portfolio Management

- Before managing a portfolio, especially a quant portfolio, it is nice to understand RM well to avoid ``whale problems''
- We will discuss trade execution algorithms: how to enter a portfolio trade and how to liquidate a portfolio without too much damage (execution algorithms a la Almgren-Chriss and others, in the context of portfolio trading).
- Some portfolio-building techniques will be discussed as well, if time remains.
- Philosophy: know your risk and be smart. Hopefully the rest will take care of itself.

Topics that I will cover, mostly sequentially

- Equity and equity derivatives portfolios: risk analysis
- Credit risk: derivatives, corporate bonds, CDS, sovereign CDS
- Mortgage-backed securities (FNMA pass-throughs, TBAs): [prepayment risk
- Exchange-traded derivatives in interest-rates, currencies, commodities: one-pot risk-analysis across different asset classes and different liquidities
- Central clearing of swaps and OTC derivatives combined with listed products: risk-issues, practical approaches
- CME's SPAN and its competitors
- Optimal liquidation, execution and risk-minimization when entering or exiting positions
- Suggestions