

Inadvertently Engineering the Global Financial Crisis: Governance Lessons.

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AN ONGOING MASSIVE COGNITIVE FAILURE

- The economy is a **complex adaptive system** populated by **fallible agents** with **imperfect knowledge**.
- Financial regulation and large financial institutions have become themselves complex systems.
- In such systems economic policy and regulation may not be nearly as effective as predicted by models and will often backfire through unintended consequences. **Radical uncertainty is endogenous**.
- Wrong deregulation of markets and wrong regulation of banks set the stage for the Global Financial Crisis which was caused by massive **unavoidable cognitive failures**.
- We need to switch to new governance paradigms to understand what happened, why it will happen again, and hopefully be more resilient when it will.

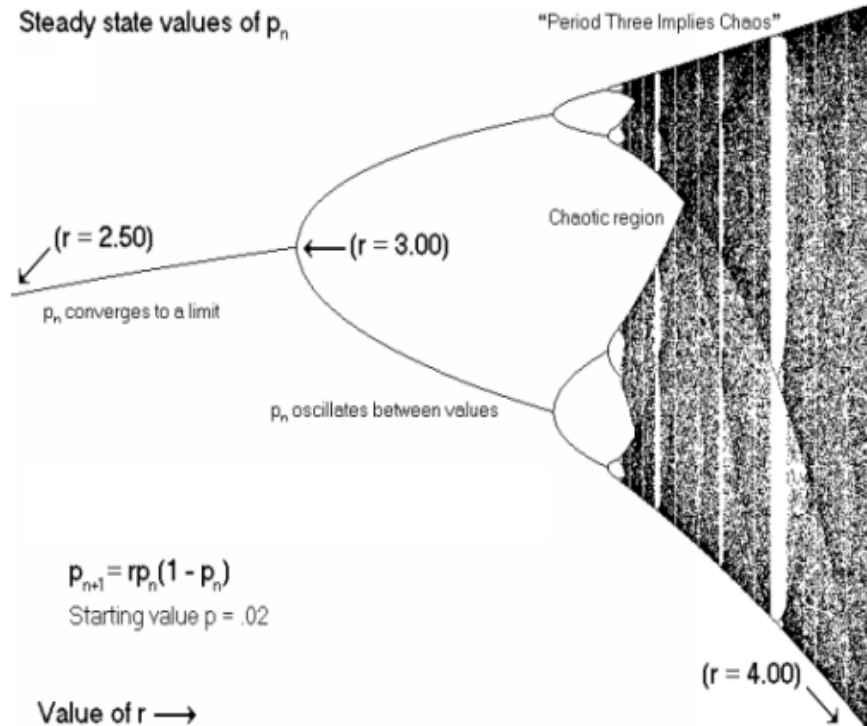
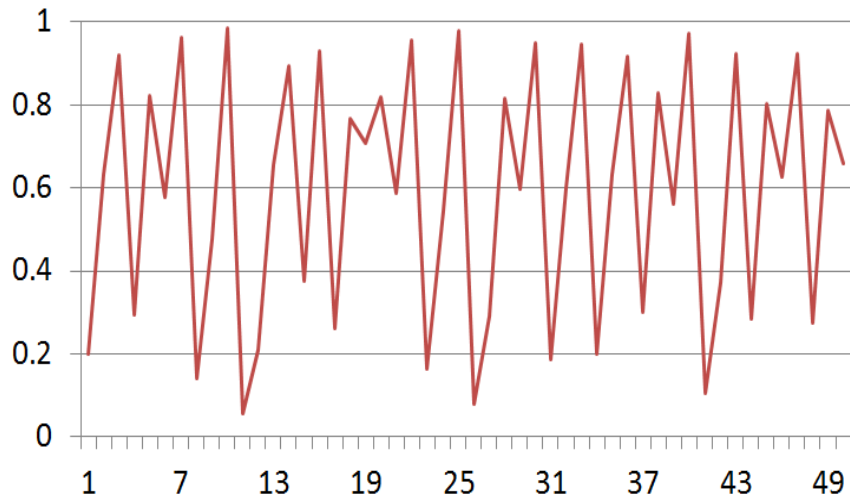
COMPLEX ADAPTIVE SYSTEMS

- Complex Adaptive Systems as a paradigm originates in Natural Sciences: Darwin's principles of Variation and Selection, Gould's Punctuated Equilibrium ...
- The idea that entirely deterministic processes governed by well known laws could lead to an unpredictable system was popularised by Edward Lorenz in 1963 showing how a pendulum with 3 degrees of freedom would generate chaotic movement.
- *Complexity is extremely multidisciplinary and involves scientists in a vast assortment of fields from Biology to Physics. It is also closely related to Fractal Geometry and Chaos Theory. Chaos is a new scientific theory for dealing with systems that are complex, unpredictable, and/or have random events, or, in other words, most of the real world. Natural systems are so complicated that no matter how carefully we measure them, we can't know everything about them. Although measurements can be extremely accurate, they can't be accurate to infinity, and tiny differences/errors in the beginning can lead to gigantic ones later. This is known as the Butterfly Effect, because under the right circumstances, the effect of the fluttering of a butterfly's wings can make the difference between whether or not there will be a tornado.*
[Wikipedia]
- Life thrives in Complexity, at the edge between Order and Chaos
- Limits to Prediction and Post-Diction in Complex Adaptive Systems

THE LOGISTIC EQUATION

$$x_{n+1} = rx_n(1 - x_n)$$

Do try out on a spreadsheet:
at values of $r=3.7$ and higher it
becomes interesting ...



COMPLICATED OR COMPLEX DYNAMIC SYSTEMS?

Complicated Machine



(Large Hadron Collider, CERN, Geneva)

Complex Ecosystem



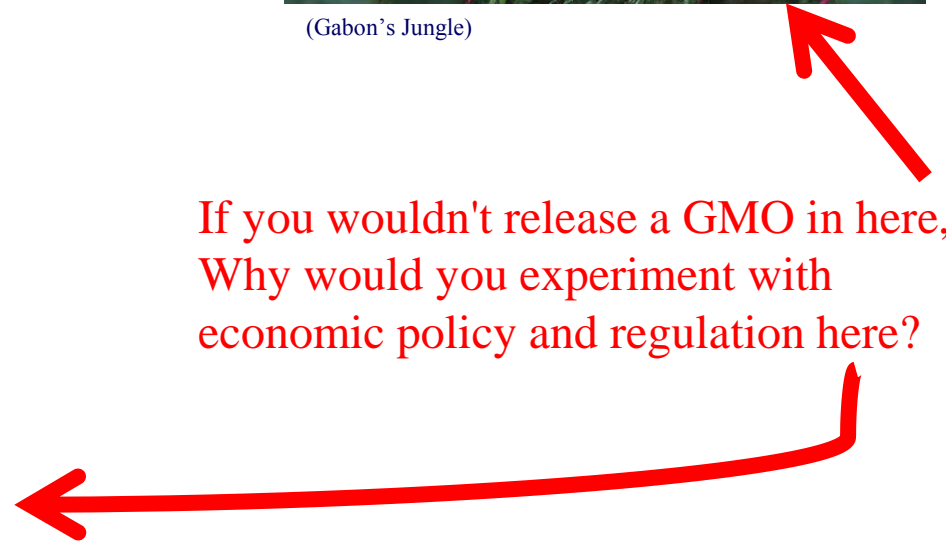
(Gabon's Jungle)

Man-Made Ecosystem



("Busy Times Square" by Paul Thompson)

If you wouldn't release a GMO in here,
Why would you experiment with
economic policy and regulation here?



- **GLOBAL FINANCIAL INTERMEDIATION MOVED AWAY FROM MARKETS AND ONTO BANKS' BALANCE SHEETS.**
- **RISING IMBALANCES AND WEAKER INTERMEDIARIES LED TO THE GREAT BANKING CRISIS.**
- **BANKS WERE REGULATED INTO BEING 3 TIMES RISKIER THAN UNREGULATED HEDGE FUNDS.**
- **THE REGULATORY RESPONSE TO THE FIRST EPISODE OF THE GREAT FINANCIAL CRISIS IS ALREADY SEEDING THE NEXT.**

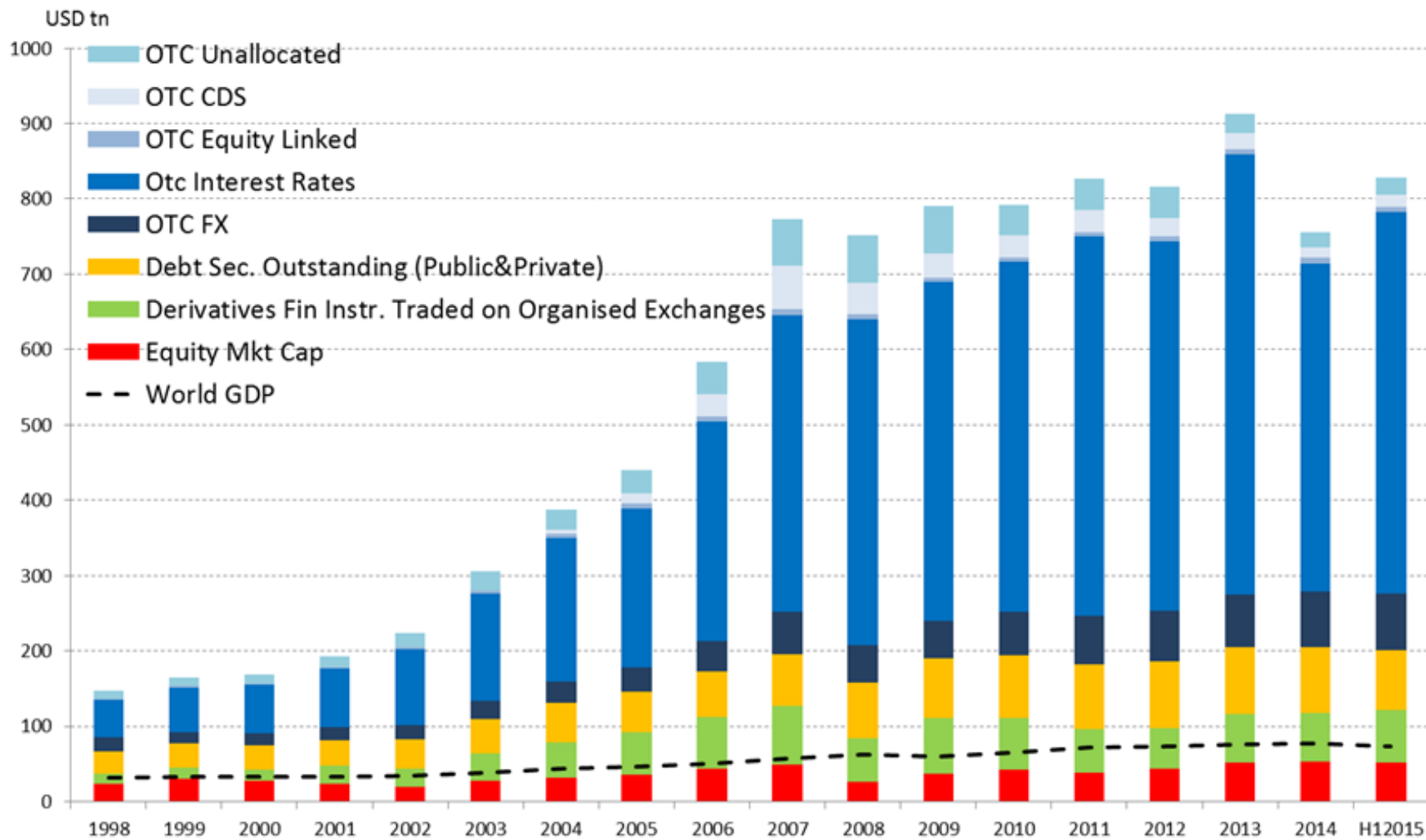
WRONG DEREGULATION: LONDON'S BIG BANG

- A sleepy **brokers' cartel** atrophied by the anti-market policies of the '70ies got a rude awakening from Mrs Thatcher's abolition of fixed commission.
- Addressing a fair UK Anti-Trust concern unleashed an unexpected revolution that gave us far **more oligopolistic markets**, but on a global scale.
- US commercial and investment banks, facing **constraints in their home market**, sought expansion abroad.
- Market fundamentalists think there should be **competition among markets** as well but:
 - Should markets be considered **public utilities**?
 - Does the **fragmentation** of markets help their users?

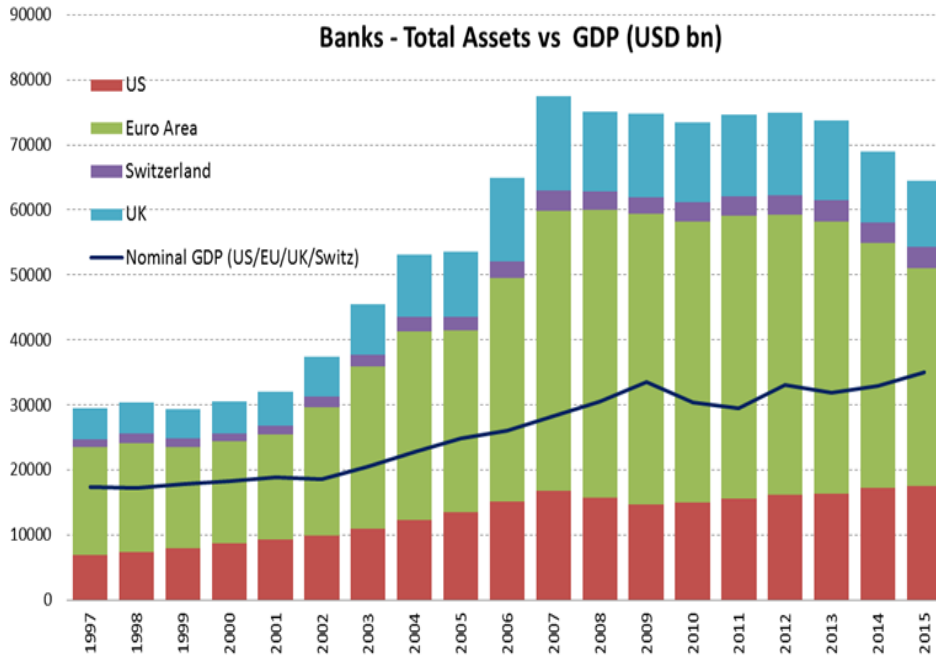
FROM MARKETS TO BANKS' BALANCE SHEETS

- Financial innovations of the 1970ies were **exchange-traded products**, like financial futures, traded in transparent markets.
- These products were adequately margined and were settled through agency-oriented **Central Clearing Counterparts** insulating end-users from broker and counterparty credit risk.
- Since the mid-1980ies financial innovation consisted of **Over The Counter traded** derivatives, like interest rate swaps or credit default swaps, that reside on banks' balance sheets.
- Principal-oriented balance sheet products expose end-users to **counterparty credit risk**, hence trading quickly concentrates on the Too Big to Fail institutions.
- These products swell banks balance sheets that became oligopolistic shallow trading domains where banks extracted the **TBTF position rent** by front-running captive clients (also known as “market making”).
- High volumes of Inter-bank dealing required to transfer risks, increasing interdependence and **appearing as excessive ‘financialisation’** of the economy.

FROM MARKETS TO BANKS' BALANCE SHEETS

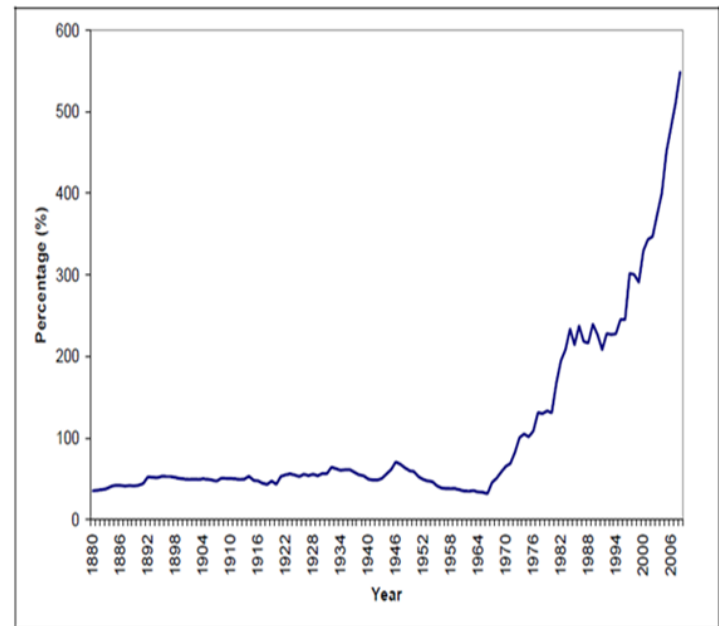


THE SWELLING OF BANKS' BALANCE SHEETS



Worldwide, but particularly in London !

UK banking sector assets as % of GDP



Source: Sheppard, D.K. (1971) and Bank of England.
 Note: The definition of UK banking sector assets used in the series is broader after 1966, but using a narrower definition throughout gives the same growth profile.

FRAGMENTING MARKETS IN THE NAME OF COMPETITION

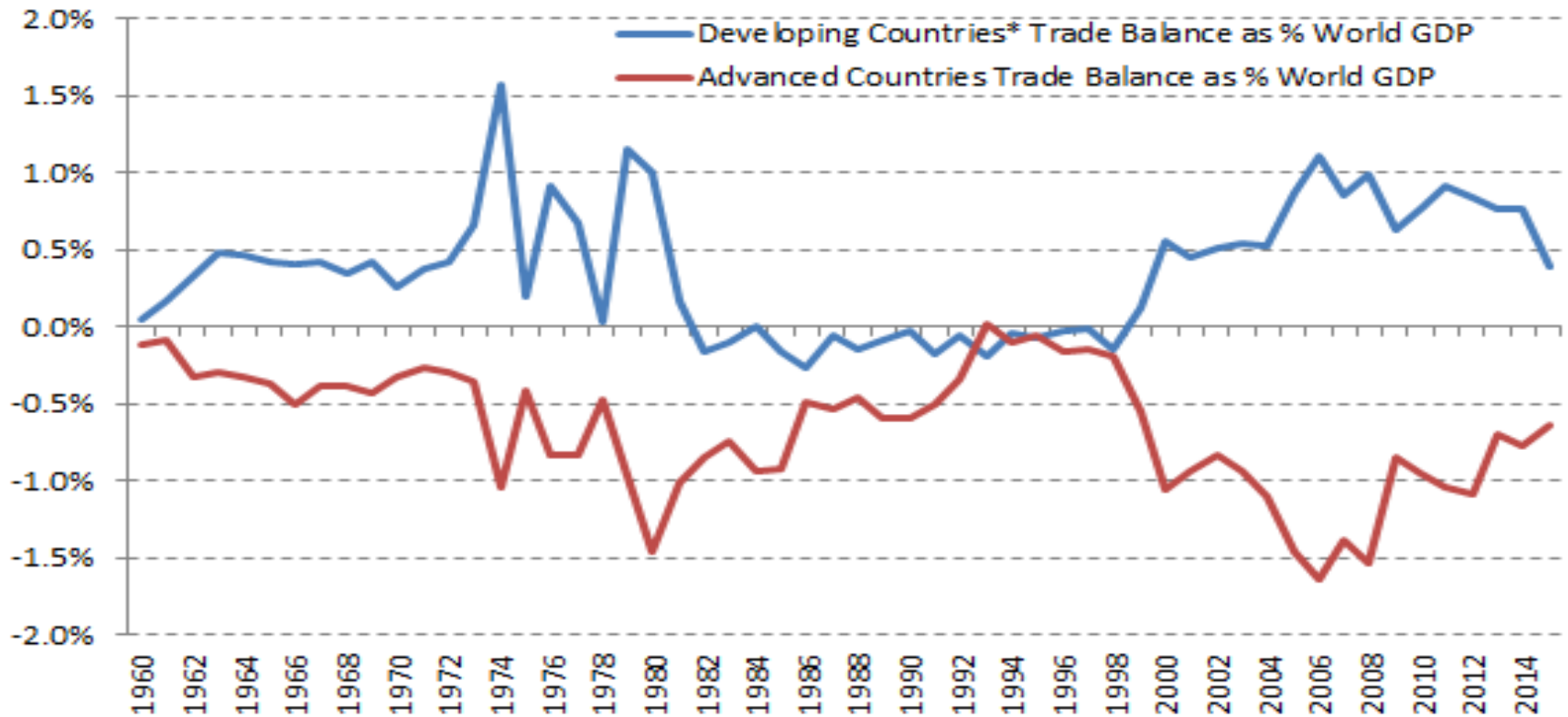
- Trading in S&P 500 equities and risk is fragmented over 100 or so different trading venues.
- High Frequency Trading is a direct consequence of trading venues fragmentation

MillionUSD Daily Traded Volumes		
Exchanges:	3m Avg.	
TRADING IN UNDERLYING SHARES		
FINRA ADF - (with DARK POOLS)	43,175	32%
NYSE	23,518	17%
NASDAQ OMX BX	13,876	10%
NASDAQ	12,676	9%
NYSE ARCA	11,488	9%
EDGX	9,364	7%
BATS BZX	8,075	6%
BATS BYX	4,474	3%
NSDQ OMX BX	2,739	2%
EDGA	2,734	2%
NASDAQ OMX PHLX	1,212	1%
CHICAGO	1,071	1%
NYSE ARCA AMEX	91	0%
Tot Underlying Shares	134,493	100%

Exchanges:	3m Avg.	
FUTURES		
S&P500 Fut. - Mini	117,471	99%
S&P500 Fut. - Std	624	1%
Tot Futures	118,095	100%
ETFs (SPY, SPDR, iShares, Vanguard)		
CHICAGO	13,161	27%
FINRA ADF - (with DARK POOLS)	10,779	22%
NYSE ARCA	9,428	19%
NASDAQ OMX BX	4,881	10%
BATS BZX	4,242	9%
EDGX	3,319	7%
BATS BYX	1,190	2%
EDGA	965	2%
NSDQ OMX BX	708	1%
NASDAQ OMX PHLX	469	1%
Tot ETFs	49,143	100%
OPTIONS		
Index and Stocks	?	-
Tot. Main Derivatives	167,237	
Derivatives/Underlying	124%	

THE FUEL OF GLOBAL FINANCIAL CRISIS

International imbalances



*Including oil exporters

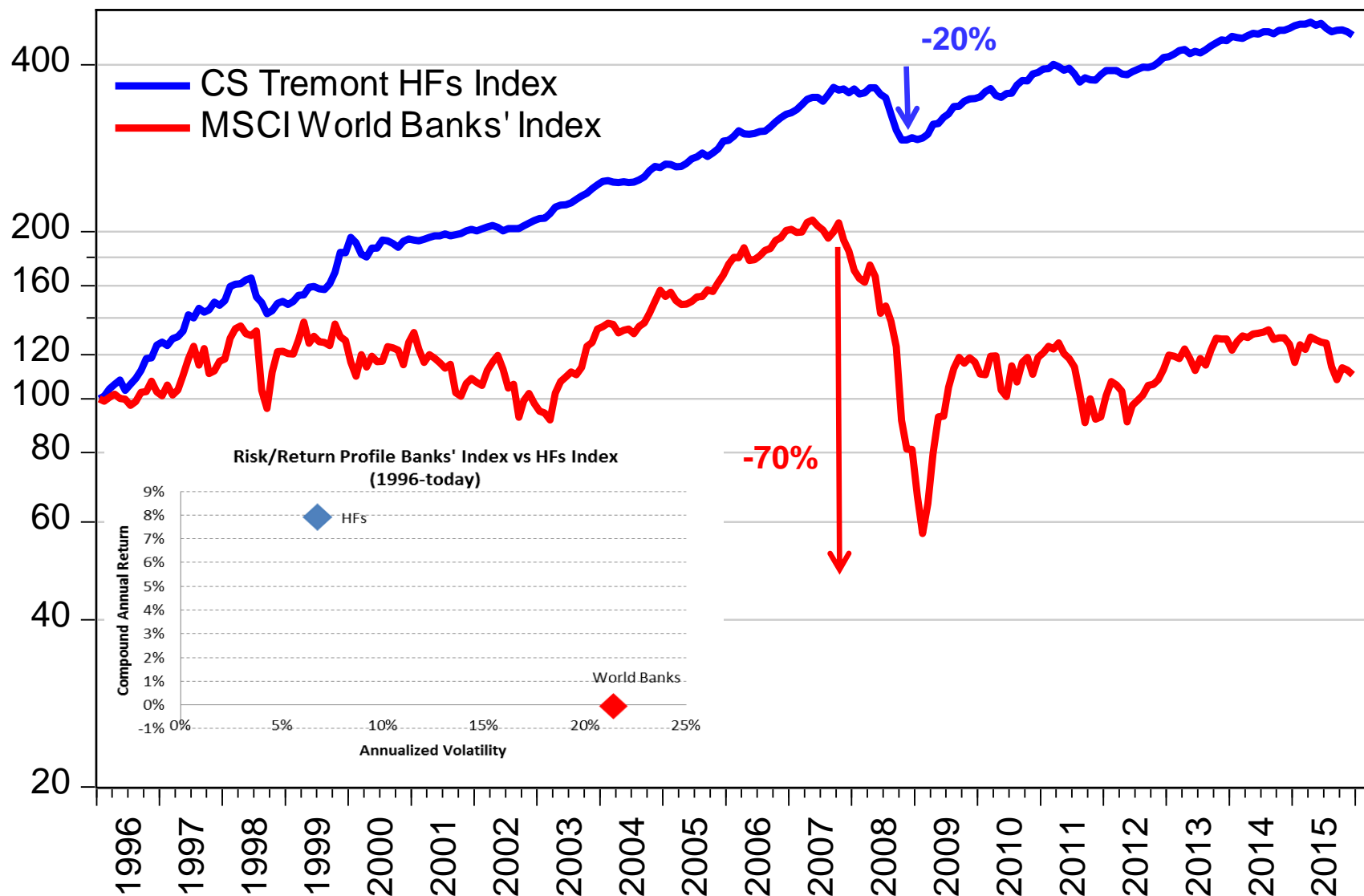
As before the banking crisis of 1982, that led to the Basel I regulations, international trade imbalances had created vast pools of savings that had to be recycled through the financial system. In the period leading to the 1982 crisis American banks, limited in their national ambitions by US regulations, recycled petrodollars into Latin America. Before the current crisis, banks were crowded out of the best credit markets (US Treasury and corporate AAA) by SWF and moved into riskier investments.

But why are banks always getting into trouble?

WRONG REGULATION: THE BANKING SYSTEM

- Banks are still regulated into being 3 times **riskier than Hedge Funds**
- A wrong **bank failure definition**.
- Risk weightings and capital requirements for **MTM resiliency**.
- **Reverse engineering Basel** to assess the risk on Banks' books.
- Inadequate capital requirements caused **excessive compensation**.
- Capital requirements insufficient to weather normal **NPL cycles**.
- The wrong response: more **arbitrary uncoordinated regulation**.
- New **structural weaknesses** induced by the new rules are emerging already

HEDGE FUNDS ARE THREE TIMES LESS RISKY THAN BANKS



THE IMPORTANCE OF FAILURE

- The economy is a complex adaptive system populated by agents with imperfect understanding and prone to errors.
- In such an environment, **failure is an inescapable** part of human progress and knowledge accumulation.
- **Early recognition and correction of mistakes** improves resilience, as do buffers and shock absorbers such as banks' capital or social safety nets.
- Error recognition and correction is crucial for survival in competitive market but fatal to survival in political or regulatory bureaucracies.
- Failure **must be built into the governance** structure of a world characterised by intrinsic fallibility and radical uncertainty.
- But **dynamic resilience of the system** can't be achieved through static robustness of the parts.

HEDGE FUND FAILURES

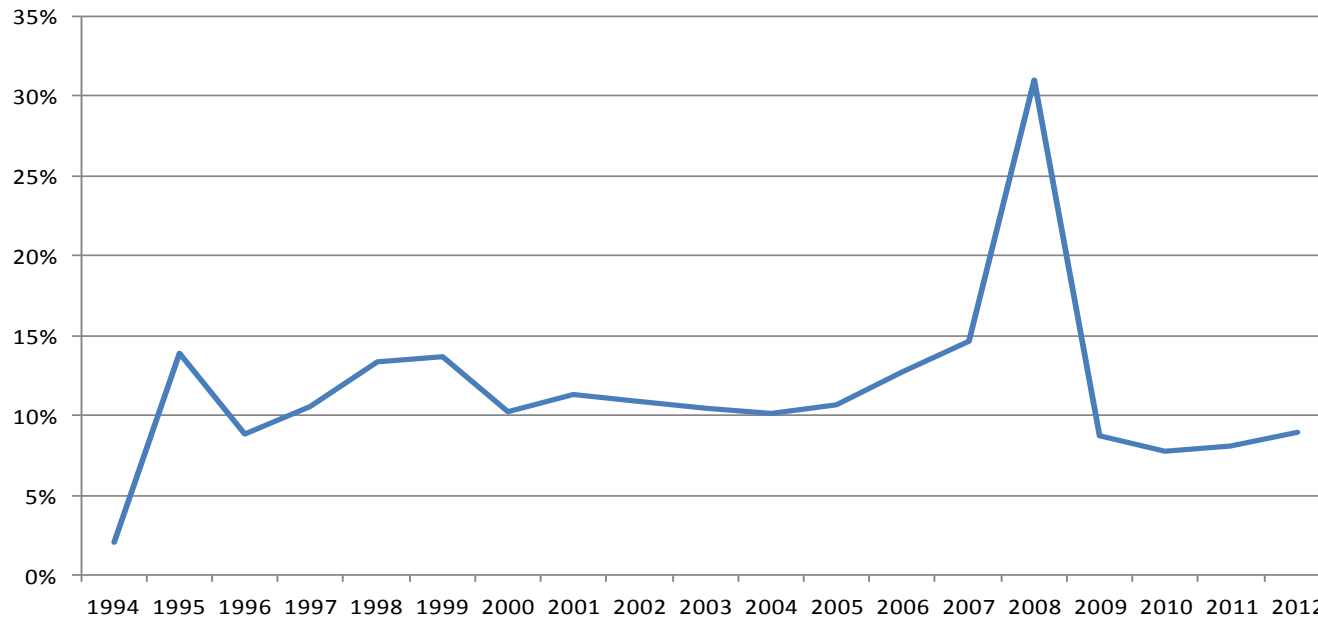
Failure, among HF, is defined as funds ceasing to exist. This “Attrition” usually occurs simply because returns don’t match investors’ expectation.

It very rarely occurs because of an insolvency. Notable exceptions were LTCM (1998) and Peloton (2009) which were among the very few HF that allowed their risk to balloon towards banking levels.

In a crisis, HF fail because disappointed investors redeem entirely after losses exceed expectations. This happens when a fund loses 3-4 times its annual standard deviations. An aggressive HF with a 12% annual standard deviation will probably be redeemed to oblivion if it suffers a drawdown of -50% or so.

CREATIVE DESTRUCTION

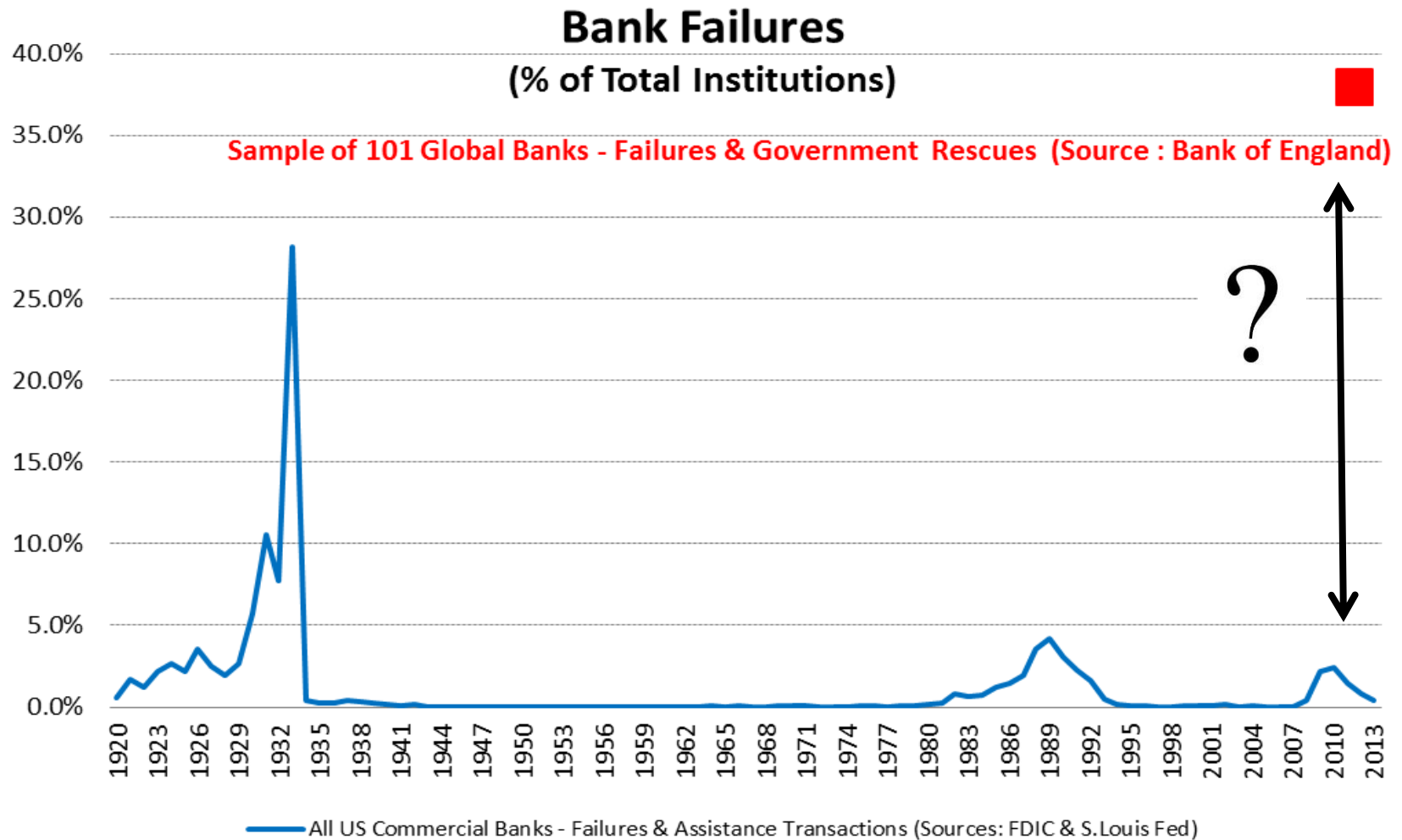
Hedge Fund Attrition Rate



Note: Attrition rate is the % of funds in a database that disappear each year, thus overestimating the actual shutdown rate. Source: CISDM (from 1994 to 2009), HFR (from 2010 to 2012).

Failure among HF is a frequent event that should never have systemic consequences (LTCM did).

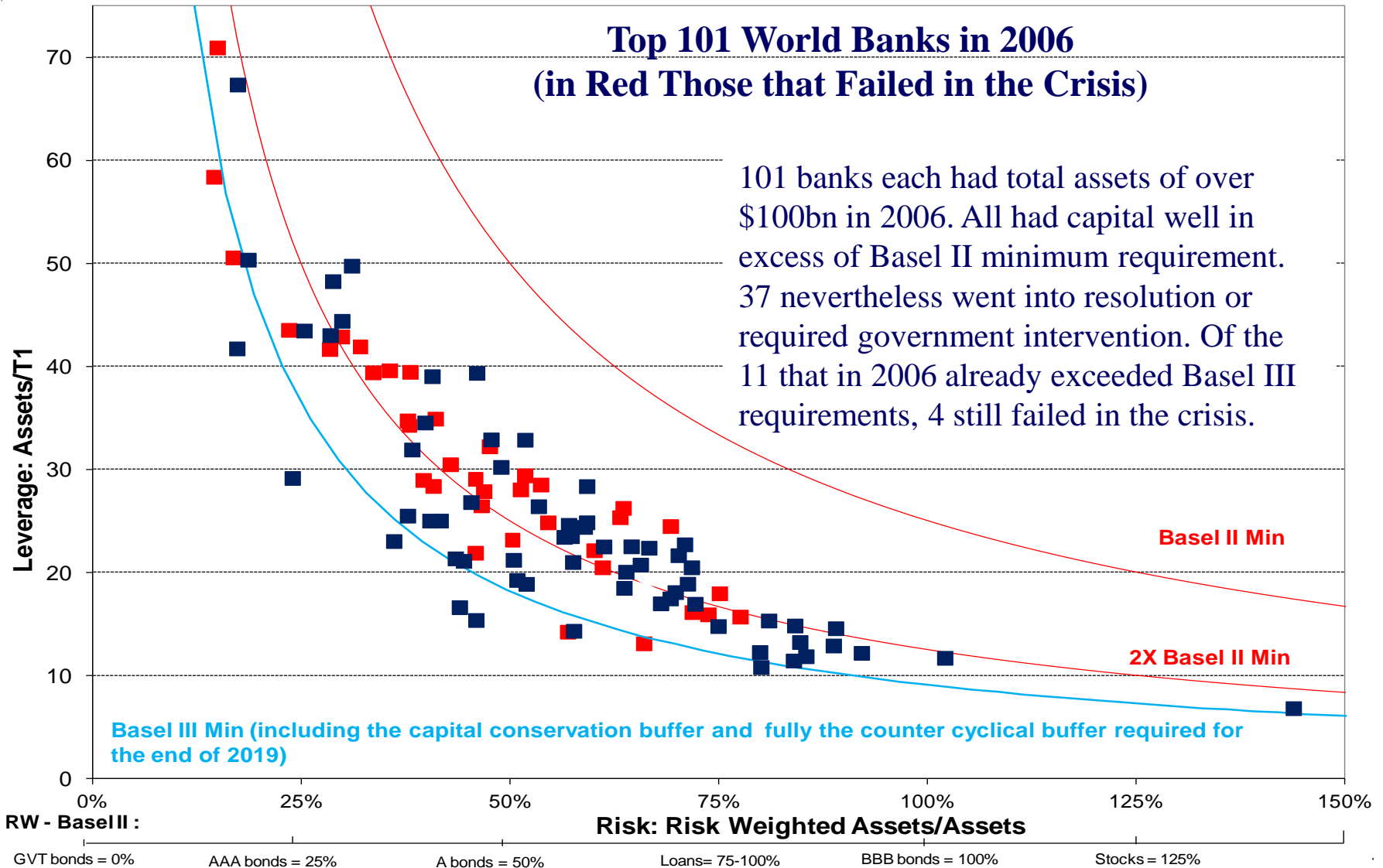
DISTORTING CONSERVATISM



Failure is a matter of definitions...

40% OF LARGE BANKS FAILED

Top 101 World Banks in 2006 (in Red Those that Failed in the Crisis)



Source of Data : Bank of England (A. Haldane: The dog and the frisbee, 2012); RW= «Swiss Finish»

CURRENT BANK FAILURE DEFINITION

- “The solvency of a bank depends on whether the value of its assets, if **held to maturity** , is sufficient to meet its obligations to depositors and holders of other bank debt” (John Vickers, “Some Economics of Banking Reform” Dec, 2012 – emphasis added).
- If banks are to rely on markets, rather than taxpayers, for their funding, they must remain solvent on a **mark-to-market** basis.
- The fuzzy and unworkable concept of “value if held to maturity” relies on estimates made by economic agents that are bound to be even more biased than the market.
- A **butterfly effect**: an apparently small mistake in the regulator’s definition of bank solvency has triggered the biggest financial hurricane in 80 years.

M-T-M INSOLVENCY RISK

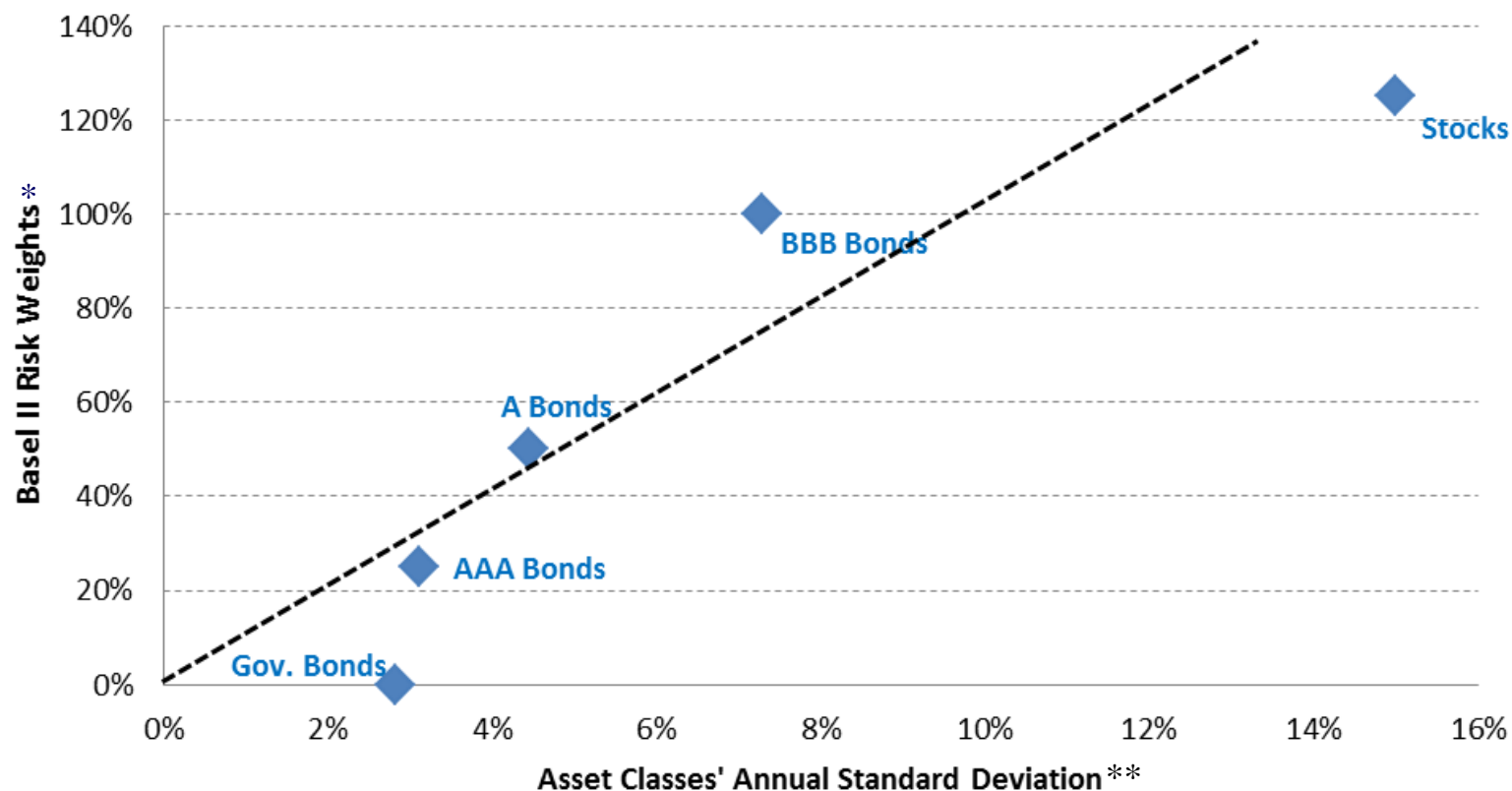
WHY IS CAPITAL NEEDED?

Capital is needed to absorb losses before they affect other liabilities and cause insolvency.

HOW PROBABLE ARE LOSSES?

For normally distributed returns, there is a 50% probability of encountering losses higher than 1 annual standard deviation every 4 years, and of suffering losses larger than 2 annual standard deviations every 30 years.

RISK WEIGHTING AND VOLATILITY



* RW= Standardised Approach and “Swiss Finish”

** Stand. Dev. of time series from CGBI World Gov. Bond Index, BOA/ML Bond Indices, MSCI World

Risk Weighting is broadly consistent with the volatility of each asset class.

CAPITAL AND RISK WEIGHTED ASSETS

	Gov Bonds	AAA Bonds	A Bonds	BBB Bonds	Stocks
Annual StDev	2.8%	3.1%	4.4%	7.3%	15.0%
Basel II - Risk Weight Coeff.	0%	25%	50%	100%	125%
Basel II Minimum Capital	-	2%	4%	8%	10%
Basel II - Allowed Leverage	∞	50	25	12.5	10
Basel III Minimum Capital (including capital buffers of 5% of RWA)	-	3.3%	6.5%	13%	16.3%
Basel III - Allowed Leverage	∞	30	15	8	6

* RW= Standardised Approach and “Swiss Finish”

** Stand. Dev. of time series from CGBI World Gov. Bond Index, BOA/ML Bond Indices, MSCI World

While the risk weights are broadly in line with volatility, Basel capital requirements at around one annual standard deviation of the assets they refer to is perplexing. And this is before exploiting the benefits of diversification and considering fat tails risk.

REVERSE ENGINEERING BASEL RATIOS

- Banks have **large and complex portfolios** of assets, many of which are difficult to value.
- Given the vastness and complexity of banks' balance sheets, **management and regulators rely on ratios** but do not have a concrete perception of the risk of banks' books.
- In a paper published by the Swiss Finance Institute in late 2008*, I showed how Basel ratios can be **reverse-engineered** into a simple, but risk-equivalent, portfolio of 2 assets.
- This approach gives a **practical understanding** of the true level of riskiness of banks' balance sheets when viewed as an investment portfolio subject to mark-to-market volatility.

* http://www.swissfinanceinstitute.ch/op01_update.pdf

COMPARING RISKINESS

BANK BALANCE SHEET

EBA Stress Test Sample - End 2015

Capital/RWA (Tier 1 Ratio)	13%
RWA/TA	36%
Leverage	22.0

	Assets	Basel II Coeff.**	Risk Weighted*
Stocks	440	@100%	440
AAA Bonds	<u>1,760</u>	@20%	<u>352</u>
Tot Assets	2,200		792
Tier 1 capital	100		

* Does not include Operational Risk and other charges but doesn't benefit from diversification

** Standardised Approach

HEDGE FUND BALANCE SHEET

Sample Aggressive HF Balance Sheet

	Assets	Basel II Coeff.**	Risk Weighted*
Stocks Long	120	100%	120
Stocks Short	<u>60</u>	100%	60
Stocks Net	60		
Gvt. Bonds , 8y	100	0%	0
Corp Bonds BBB 3y	30	100%	30
Foreign currency	50		
Interest rate risk			29.0
Currency risk			<u>62.5</u>
Total Assets	<u>300</u>		<u>302</u>
Capital (NAV)	100		

Capital/RWA (Tier 1 Ratio)	33.2%
RWA/TA	101%
Leverage	3.0

BANKS STILL RUNNING CRAZY BALANCE SHEETS!

- A typical large European bank at the end of 2015 had a portfolio that has the same risk as one **leveraged 4.4x in equities and 17.6x in AAA bonds**. Other than in regulated banks, portfolios with so much risk do not exist because they would not survive long and hence the market would not fund them
- Simplifying assumptions:
 - a) No risk weight for other risks (operational etc.)
 - b) BUT no benefit from diversification, which usually cuts by about 40% RWA in banks' models
- **Diversification benefits and dynamic risk control suffer from fallacy of composition that makes them systemic problems.**
- Some consider the goodwill associated with a banking licence as an important hidden asset. But this also assumes a bank is allowed to continue operations through taxpayers' funding also when considered potentially insolvent by the market. It happened in the Financial Crisis but should not happen again.

AN AGGRESSIVE HF WOULD HOLD AT LEAST TWICE AS MUCH CAPITAL AS A BANK

	Bank	HF
<i>Equity/RWA (Tier 1 Ratio)</i>	13%	33.2%
<i>RWA/TA</i>	36%	100%
<i>Leverage (TA/Eq)</i>	22	3.0
<i>Capitalisation (Eq/TA)</i>	4.5%	33%
<i>Assets' Volatility</i>	4-6%	10-15%



- Banks, also under Basel III, will have capital equal to only roughly one annual standard deviation of their assets. This gives bank a 50% chance of becoming insolvent every 4 years.
- Aggressive HF have 2-3 annual standard deviation of capital at least.

BANK CAPITAL AND EXCESSIVE COMPENSATION

- The problem of excessive compensation in big banks can be read as one of **insufficient capital** which **leads to unreasonably high pre bonus ROE** (due to both fat “R” and too small “E”) which managements reduce to publishable ROE by pocketing the difference.
- The “R” is bigger than it should be also due to the “Too Big To Fail” rent position big banks enjoy as OTC market makers in securities and derivatives. There can be no differentiation between front running and market making when dealing with captive clients as in current oligopolistic OTC markets.
- The “E” is too small due to the grossly underestimated minimum capital requirement positions the banks have been regulated into. This was the devastating result of years of pondering by the sort of internationally coordinated regulatory effort, from which the solution to the current predicament is still expected.

2014 COMPENSATION LEVELS AND ROE

Top US Banks	<i>Total employees</i>	<i>Avg Actual Compensation (USD)</i>	<i>Actual ROE</i>	<i>ROE at Avg. Fin Sector Compensation</i>	<i>ROE at Avg. Fin Sector Compensation and 2x Capital</i>
Goldman Sachs	34,000	373,265	11.2%	25.6%	12.8%
Morgan Stanley	55,802	319,415	4.9%	27.0%	13.5%
Wells Fargo	264,500	113,202	13.7%	25.5%	12.8%
JPMorgan	241,359	124,959	9.8%	16.7%	8.4%
Bank of America	224,000	150,835	1.7%	15.1%	7.5%
Citigroup	241,000	99,415	3.4%	8.9%	4.5%
Average US	176,777	196,848	7.4%	19.8%	9.9%
Top European Banks	<i>Total employees</i>	<i>Avg Actual Compensation (USD)</i>	<i>Actual ROE</i>	<i>ROE at Avg. Fin Sector Compensation</i>	<i>ROE at Avg. Fin Sector Compensation and 2x Capital</i>
Barclays	132,300	137,029	-0.3%	11.6%	5.8%
Société Generale	148,322	81,047	5.0%	9.4%	4.7%
Credit Agricole	72,567	115,976	5.3%	7.2%	3.6%
DB	98,138	169,374	5.4%	19.0%	9.5%
BNP Paribas	187,903	104,644	0.2%	6.8%	3.4%
Credit Suisse	45,800	270,633	4.1%	17.2%	8.6%
UBS	60,155	277,799	7.0%	38.8%	19.4%
Average EU	106,455	185,215	3.8%	15.7%	7.9%
TOT AVERAGE	141,616	181,032	5.6%	17.8%	8.9%

Sources:

Banks' Balance Sheets (End 2014), US BEA, UK ONS, Swiss Federal Statistical Office

US Financial Sector's Average Annual Compensation = 68,000 USD

UK Financial Sector's Average Annual Compensation = 75,000 USD (45,000 GBP)

EuroArea Financial Sector's Average Annual Compensation = 75,000 USD (55,000 Euro)

Swiss Financial Sector's Average Annual Compensation = 135,000 USD (150,000 CHF)

Big banks pay over twice the average financial sector compensation to 1.8 million employees ...

CAPITAL AT NORMALIZED COMPENSATION

- Had banks paid in 2006 the average compensation of USD 75,000 for the financial sector (US Bureau of Labour; average US wages in all sectors were USD 39,200), a sample of the major US and European banks would have reported ROE of 31.5% versus the 19.5% ROE they actually reported given the excessive compensation they paid.
- In 2014, reported ROE fell to 5.6% on average. Of the decline from 19.5% in 2006, roughly 5% was lost due to higher capital and 9% due to worse business conditions. But had banks paid in 2014 only average financial sector compensation, the reported ROE would have been 17.8%, way too high for a business enjoying government support in a zero interest rates environment.
- If banks paid average financial sector compensation AND had twice the current capital, their ROE would be 8.9%, broadly in line with their cost of capital.

BANK CAPITAL AND THE CREDIT CYCLE

An impossible business proposition: we want banks to

- 1) make **risky loans** to the real economy
- 2) offer ultra **safe deposits** to clients

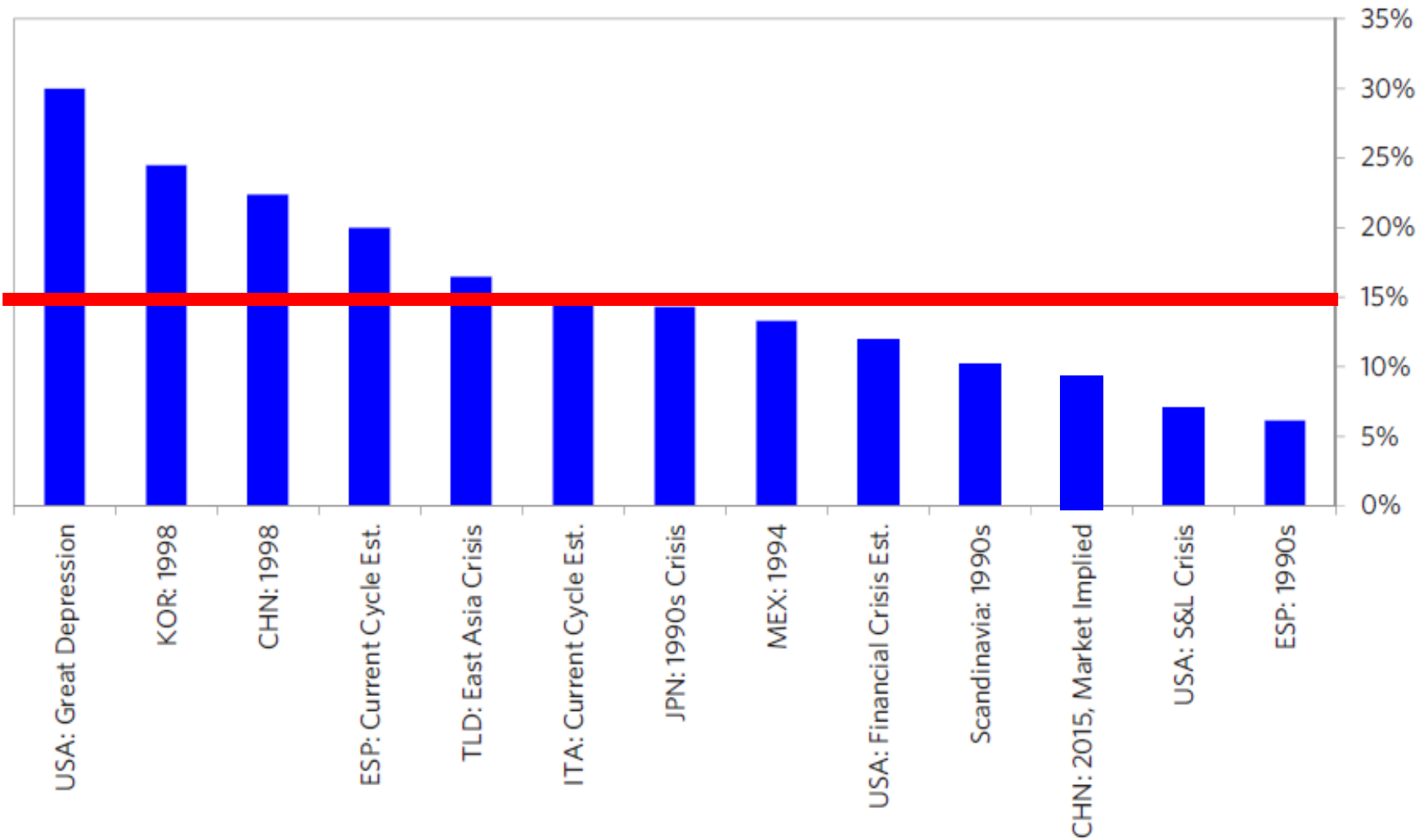
Capital is the buffer between these two incompatible objectives. It should be able to absorb losses from the risky loans and is remunerated by the levered spread between assets and liabilities.

But is the minimum "prudential" capital requirement the banks have been mandated to own enough of a buffer?

Is capital sufficient to absorb the Non Performing Loans that a negative credit cycle generates?

NPL CYCLES MAY CAUSE LOSSES OF 15% OF LOANS

Historical Credit Loss Cycles (% Loans)



Source: Bridgewater

BANKS CAN'T EVEN SURVIVE THE CREDIT CYCLE

- A negative business cycle routinely creates **credit losses of about 15%** of the banks' loan books in the affected countries.
- Banks, both in Europe and in the US, currently have only about less than **half the capital required to survive** a negative business cycle.
- Yet both the Fed and the ECB routinely pass almost all banks in their stress tests. A further proof the Global Financial Crisis was engineered by regulators totally **lost in the complexity of their rule books** and unable to see the incoherence of their grandiose designs.
- Bankers are just as **lost in the complexity of their business** and only concerned with remaining within the limits of prudential regulation.
- Unfortunately if **the speed limit was wrongly set** at 400 km/h, driving around at 300 km/h didn't prevent all buses from crashing at the first (second? think of LTCM ...) unexpected turn.

DANGEROUSLY PROCICLICAL RULES

Long-term rating category⁹⁵

External Credit Assessment	AAA to AA-	A+ to A-	BBB+ to BBB-	BB+ to BB-	B+ and below or unrated
Risk Weight	20%	50%	100%	350%	Deduction

Source: BIS, International Convergence of Capital Standards, June 2006

- A downgrade of an asset from AAA to A+ forces the bank to back the position with 2.5x more capital or sell 60% of it. Banks are not required to have that much spare capital, so they sell.
- Banks reaction to a downgrade is an example of **Soros's Reflexivity**. It sets in motion a negative loop: seeing the price collapse, rating agencies re-evaluate the credit and most likely downgrade it further. The increase in the cost of borrowing to the entity affected by the downgrade weakens it further validating the downgrade ...
- In 2009, over one third of AAA structured bonds were downgrades to A or below, absorbing 50% more capital.

THE DAMAGES OF WRONG CAPITAL REQUIREMENTS

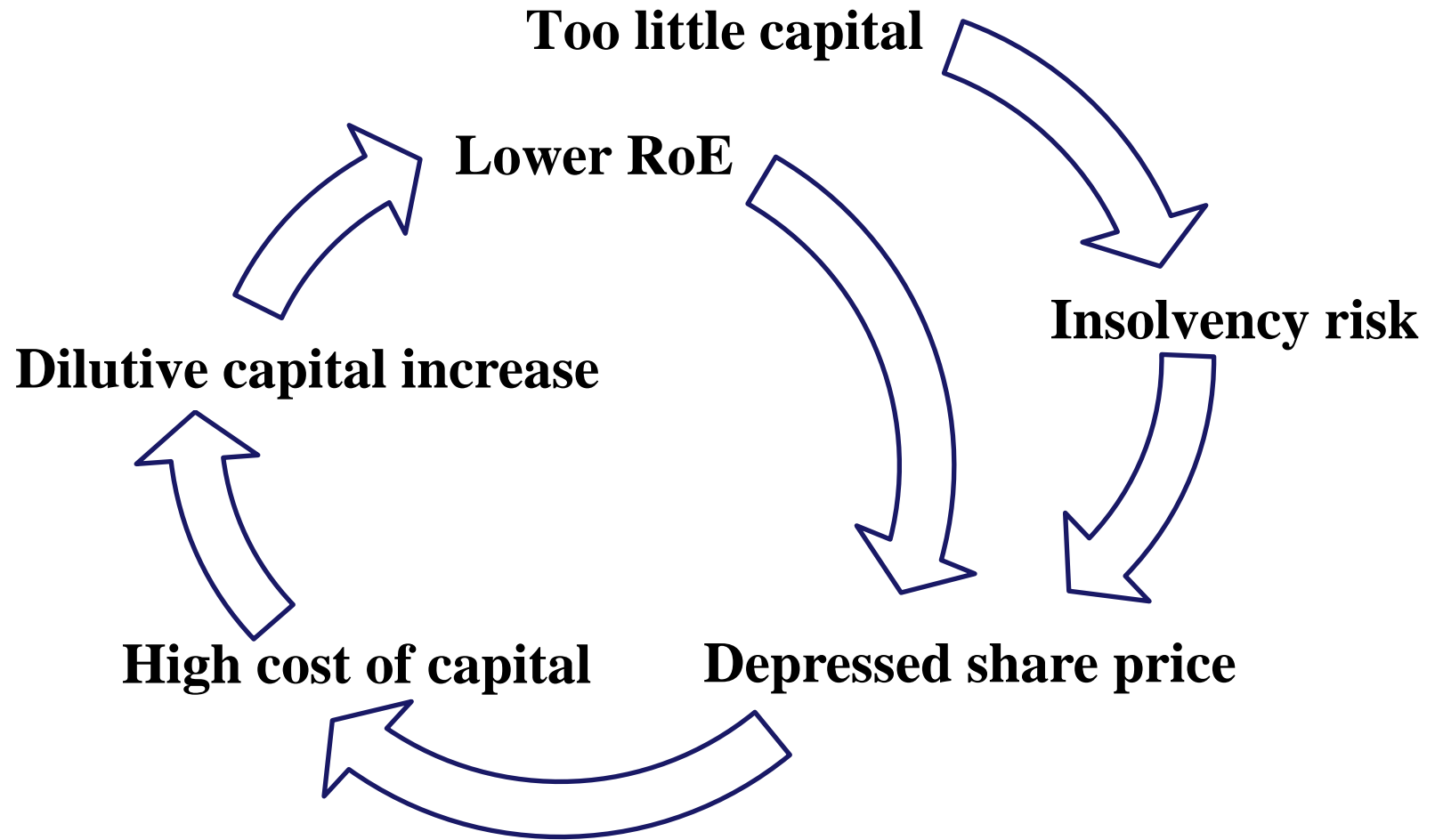
- Wrong prudential capital requirements caused:
 - Insufficient resilience to market volatility.
 - Excessive compensation.
 - Insufficient resilience to credit cycles.
 - Excessive sensitivity to Rating Agencies opinions.

Some of these facts became glaring after the Global Financial Crisis, but none of this was widely recognised before, **despite some loud warnings** like the 1998 LTCM crisis and industry-wide extravagant pre-bonus RoE.

Central bankers are still busy today **covering up their mistakes**. Admitting their errors might have lose them politicians' support.

Hence banks remain dysfunctional and caught in a **negative feedback loop**.

BANKS' CAPITAL NEGATIVE LOOP



THE WRONG RESPONSE: MORE COMPLEX RULES

- The survival of Board Members and Top Management depends on compliance with rules and regulations. Drivers distracted by way too many sign posts are likely to miss the turn and crash.
- Boards (and other top governance bodies) overwhelmingly deal with rigid agendas dictated by the regulatory framework.
- The business risk is assessed essentially in terms of its distance from regulatory prudential speed limits. As prudential rules turned out to be grossly wrong, the banking system crashed unaware of its own risk and without breaking any rule.
- The new banking rules make the financial system more fragile by pushing it towards **HIGHER**

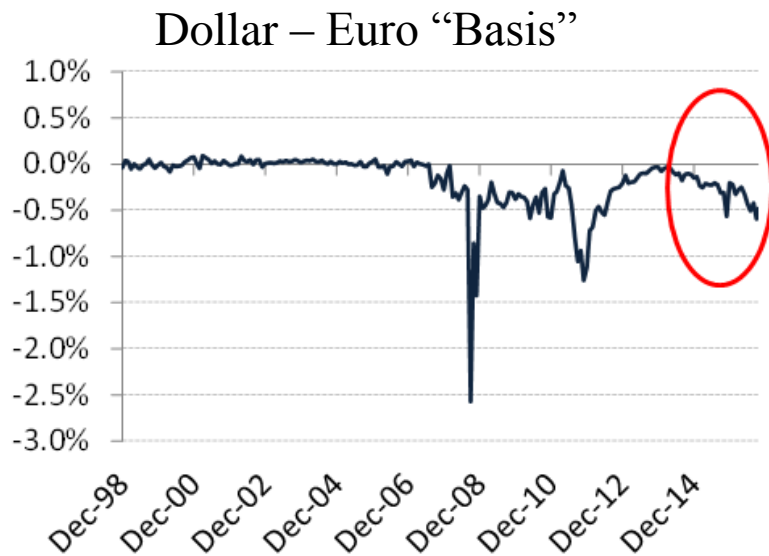


COMPLEXITY, RIGIDITY, CONCENTRATION, INTERDEPENDENCE

and inhibit the development of new markets, product and intermediaries.

- Open and transparent markets are the only remedy to the cognitive mistakes that precipitated the Global Financial Crisis

AN EXAMPLE: THE DISTORTIONS INDUCED BY THE LIQUIDITY COVERAGE RATIO



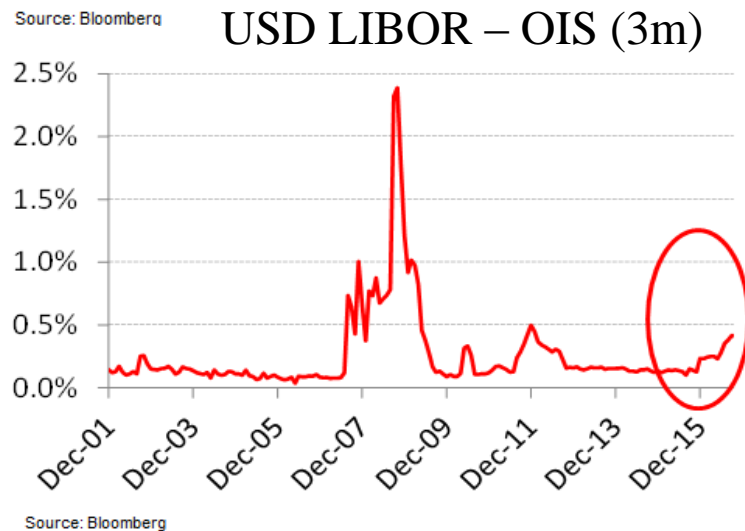
$$\text{LCR} = \frac{\text{High Quality Liquid Assets}}{\text{Expected 30 days Net Outflows}}$$

Outflows and Inflows in LCR are weighted arbitrarily and induce unprecedented distortions in money market only previously seen at times of exceptional stress.

The covered interest rate parity in forward foreign exchange rates no longer holds despite being a risk-less arbitrage.

LIBOR spread widening despite no visible stress in the banking system.

Banks rushing to buy retail deposits to fund short term trading due to more favourable treatment.



TOWARDS A SOUNDER MARKET-BASED FINANCIAL SYSTEM

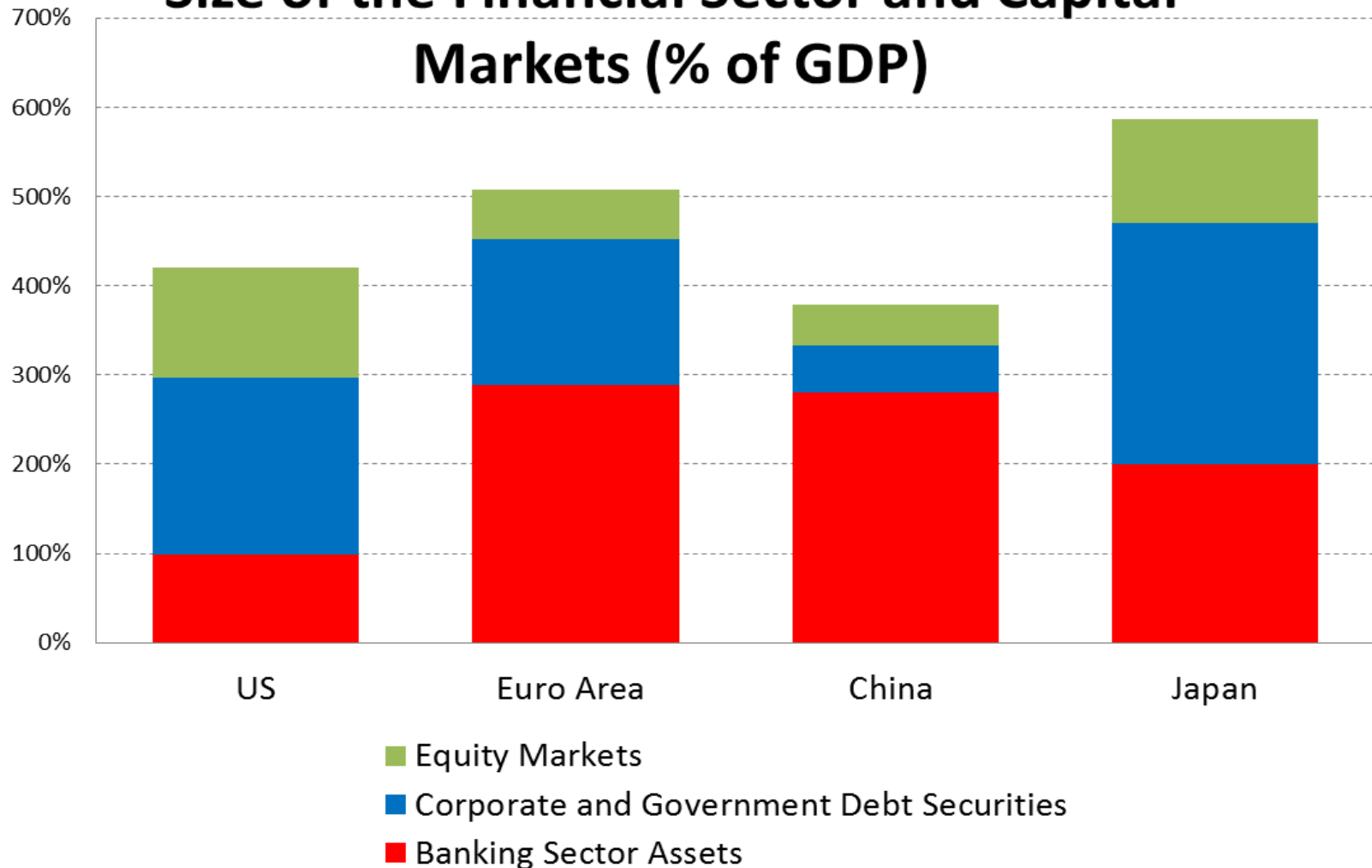
- Markets seen as a complex evolving systems. Man made ecosystems, and just as prone to potentially catastrophic changes and punctuated equilibrium.
- Banking is largely obsolete: all banking business lines have seen the emergence of specialised, financial intermediaries. They are a safer and more efficient evolution.
- Authorities and bankers have convinced politicians to clamp down by **misnaming market based finance as “shadow banking”** in what remains a major cover-up exercise for their mistakes that gave us the GFC.
- The dynamic properties of a complex financial system (volatility, creative destruction) implies trade offs: long term emerging efficiency requires the acceptance of volatility over time frames conflicting with the desire of politicians, authorities and bankers to see their mandates renewed.
- Effective social safety nets contain the economic damage of financial volatility. Financial crises mitigate inequality and encourage social mobility.

REGULATING FINANCIAL MARKETS

- Competition, not regulation, is the solution to cognitive limits and fallibility. Simplification helps. **History is a necessary and great guide.**
- Change in paradigm for financial stability: from the protection of intermediaries' static stability to the preservation of markets' **dynamic functionality.**
- Some key interacting variables:
 - ✓ Agents' degrees of **freedom** and **responsibility** (the importance of failure and biodiversity)
 - ✓ Agents' **incentives** (moral hazards, game theory, behavioural economics...)
 - ✓ Marginal returns' nature (**beware increasing marginal returns**)
 - ✓ **Network architecture** of agents' connections (beware hub & spoke)

LESS BANKS, MORE RESILIENCE

Size of the Financial Sector and Capital Markets (% of GDP)



MAIN TAKE-AWAYS

- Cognitive errors are unavoidable in complex adaptive systems populated by fallible agents with imperfect knowledge.
- Complex regulation can't govern a complex adaptive system successfully.
- Regulation caused:
 - Structural weaknesses in banks that triggered the GFC
 - Excessive compensation
 - Apparent excessive financialisation
- Banks worldwide are still far from having adequate resilience.
- New incremental rules are already creating visible damage to the financial system.
- Resilient markets as time tested solutions; demonising market based finance as “Shadow Banking” is counterproductive; volatility is necessary to expose fragilities.
- Markets do need some regulation: learn from history what works and why.

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