Modeling Financial Fragility: A Minskian Approach

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Road Map

- 1. Theoretical framework
- 2. Modeling Implications
- 3. Empirical Implications
- 4. Index of Financial Fragility

Financial Fragility: Theory

"The robustness or fragility of the financial system depends upon the **size and strength of the margins of safety** and the likelihood that **initial disturbances are amplified**." (Minsky 1986: 209)

"The overall **fragility**-robustness of the financial structure, upon which the cyclical stability of the economy depends, **emerges out of loans made by bankers**. […] An **emphasis** by bankers **on the collateral value** and the expected values of assets is conducive to the emergence of a fragile financial structure. […] One **measure of the riskiness of financial instruments is the expected source of the funds that are needed to fulfill financial contracts**." (Minsky 1986: 234-236)

Financial Fragility: Theory

- Financial fragility means that the risk of a debt deflation is high: risk of amplification of initial disturbance
- Initial disturbance: default, rising interest rate, disruption in refinancing sources, a natural disaster, etc.
- Given credit and liquidity risk, underwriting methods greatly affect financial fragility: dependence on position-making operations and collateral-based lending creates a high interdependence between asset prices and debt (debt-inflation).

Goal: find a way to measure financial fragility when default rates are low, foreclosures are low, profitability is high, net worth is rising, and overall economic growth is robust.

Typology of Financial Fragility

- *Hedge finance*
  - Net cash flow generated from its routine economic operations (work for most individuals, going concern for companies) (NCF_O) are large enough to service liability commitments (CC). At time o, when a debt contract is signed, the following state of expectation in terms of cash flows from routine operations prevails:

$$E_o(NCF_{Ot}) > E_o(CC_t)\ \forall t$$

  - In case of unforeseen deficiencies in realized net cash inflows from routine operations, available cash balance (M) is large enough

$$NCF_{Ot} + M_t > CC_t\ \forall t$$

  - Thus, defensive position making (NCF_{PM})—refinancing to service debts (ΔL_R) and forced sales of non-liquid assets ($\Delta(P_A Q_A) = o$)—are not expected and are not needed:

$$E_o(NCF_{PMt}) = NCF_{PMt} = \Delta L_{Rt} + \Delta(P_{At} Q_{At}) = o\ \forall t$$

Typology of Financial Fragility

- *Speculative finance*
  - routine net cash flows are expected to be large enough to meet the income component of liabilities contracts (iL) but not the capital component of liabilities (principal service, margin call and others) (aL).

$$E_o(NCF_{Ot}) < E_o(CC_t)$$

$$E_o(NCF_{Ot}) > E_o(iL_t)\ \forall t$$

$$E_o(NCF_{Ot}) < E_o(aL_t)$$

  - Available cash balance is to small to meet the foreseen shortage of net cash flow.
  - Position making: expected that debts will be rolled over so, the size of cash flow from position making relative to outstanding debts (L) should stay constant or decline:

$$E_o(NCF_{PMt}) = NCF_{PMt} > 0 \text{ and } d(E(NCF_{PM})/L)/dt \leq 0$$

Typology of Financial Fragility

- *Ponzi finance*
  - Expectations regarding cash flows from routine operations:

$$E_o(NCF_{Ot}) < E_o(CC_t)\ \forall t < n$$

$$E_o(NCF_{Ot}) < E_o(iL_t)\ \forall t < n$$

$$E_o(NCF_{Ot}) < E_o(aL_t)\ \forall t < n$$

  - If income-based lending, *n* is smaller than the maturity of the loan
  - If collateral-based lending, *n* tends toward infinity: income from routine economic operations are never expected to be large enough to service debts fully.
  - Position Making: Growing need to refinance or sell assets at rising prices in order to service debts

$$E(NCF_{PM}) = \Delta L_{Rt} + \Delta(P_{At}Q_{At}) > 0 \text{ and } d(E(NCF_{PM})/L)/dt > 0$$

"An increase in the ratio of Ponzi finance, so that it is no longer a rare event, is an indicator that the fragility of the financial structure is in a danger

Typology of financial fragility

- All three states of fragility should have an expected positive net worth bankers would not consider lending
- Fraud would add to financial fragility and can occur at all three stages of financial fragility: hedge finance with stated income, job and/or assets ("liar loans"). Fraud creates difficulties to detect financial fragility (unreliable data).
- Not a measure of existence of a bubble (no preoccupation about the deviation of P_A from its "fundamental value"): capture the debt-inflation linkage
- Main differences concern ways to generate positive net worth:
  - Expected reliance on defensive position-making operations
  - Underwriting based on income or collateral/asset price

Modeling Implications

- Models must include a full-fledge financial side to understand financial dynamics: stock-flow consistent models
- Focus on the underwriting of banks: Show how the quality of underwriting declines during a period of long prosperity: underwriting norms that banks use to make decision loosen in terms of:
  - Cash-flow: "normal"/"acceptable" debt-service ratio increases
  - Liquidity: "normal"/"acceptable" liquidity ratio declines
  - Collateral: "normal"/"acceptable" LTV goes up
  - Expectations: more focus on refinancing or asset liquidation to service debts
- Loosening of norms can be explained by:
  - Long stream of positive information fed to banks: willingness to take more risk
  - Market saturation: "safe" borrowers become scarce so banks need to find new customers by redefining what "safe" means
  - No need to use irrationality or mania
  - No need for complex non-linear equations: changes in norms will introduce non-linearity (together with asset price and debt interaction that results from them).
- Focus on debt-asset price interaction rather than asset prices per se: there must be a debt-inflation before there is a debt-deflation.

Example of modeling

- For a given profit level, the amount of external funding is (Tymoigne 2009):

$$\Delta L_I = cc_n - cc\frac{\Pi}{a + i}$$

- ΔL_I is external funding of investment (change in debt outstanding)
- cc_n is the debt-service ratio norm (debt-service to profit)
- cc is the actual debt-service ratio (if above cc_n external funding is zero: credit rationing)
- a + i is the marginal cost of external funds

- cc_n goes up during periods of long prosperity (and so L_I given everything else)

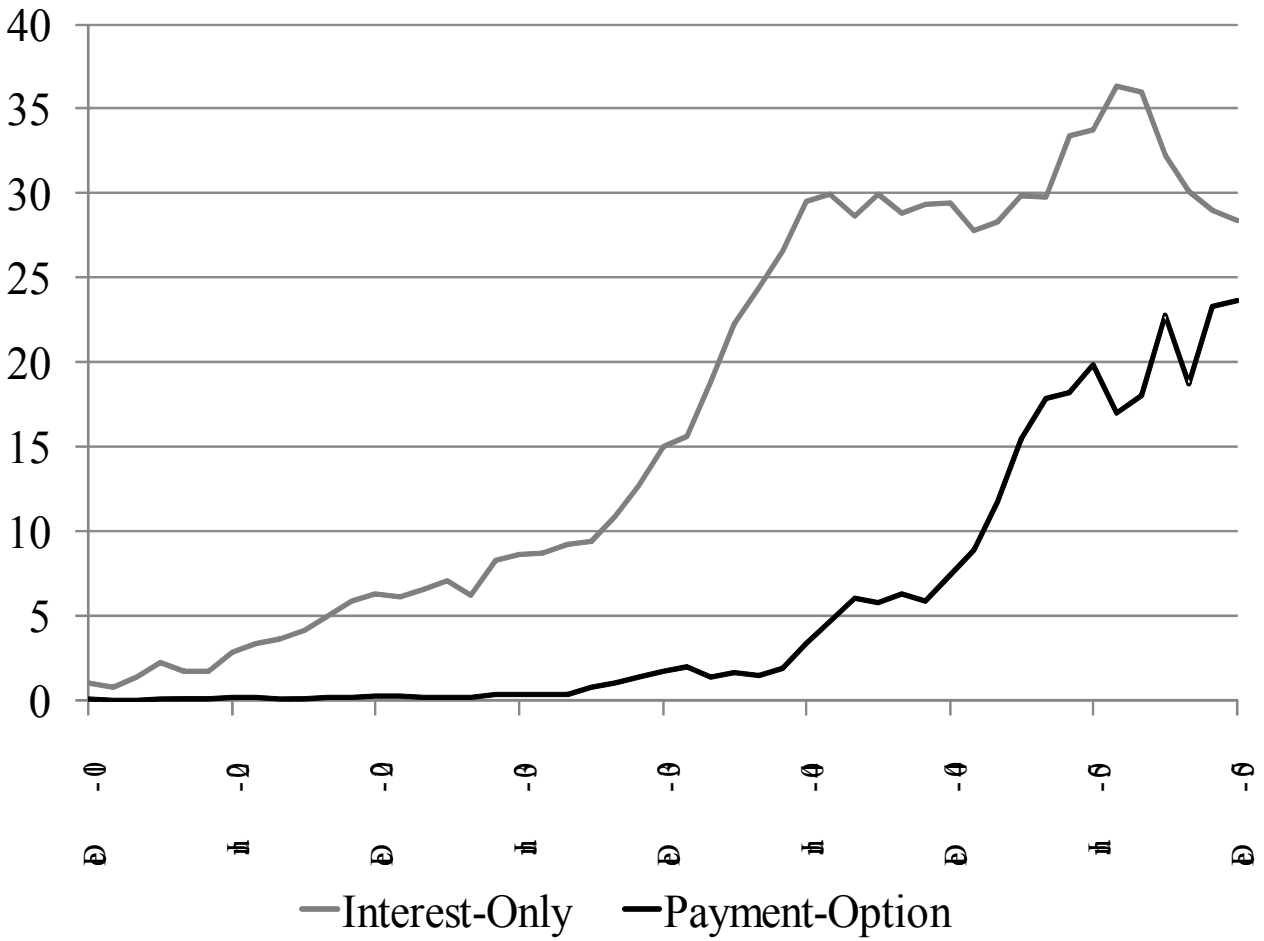
Empirical implications

- As an economic unit (be it an individual, an economic sector, or an economy) transfers from hedge to Ponzi finance, one should observe that:
  - debt burden rises (the ratio of debt service to routine income rises)
  - defensive refinancing needs and/or asset-based lending rise
  - asset prices rise (if a long position is taken),
  - the amount of liquid assets relative to liabilities declines.

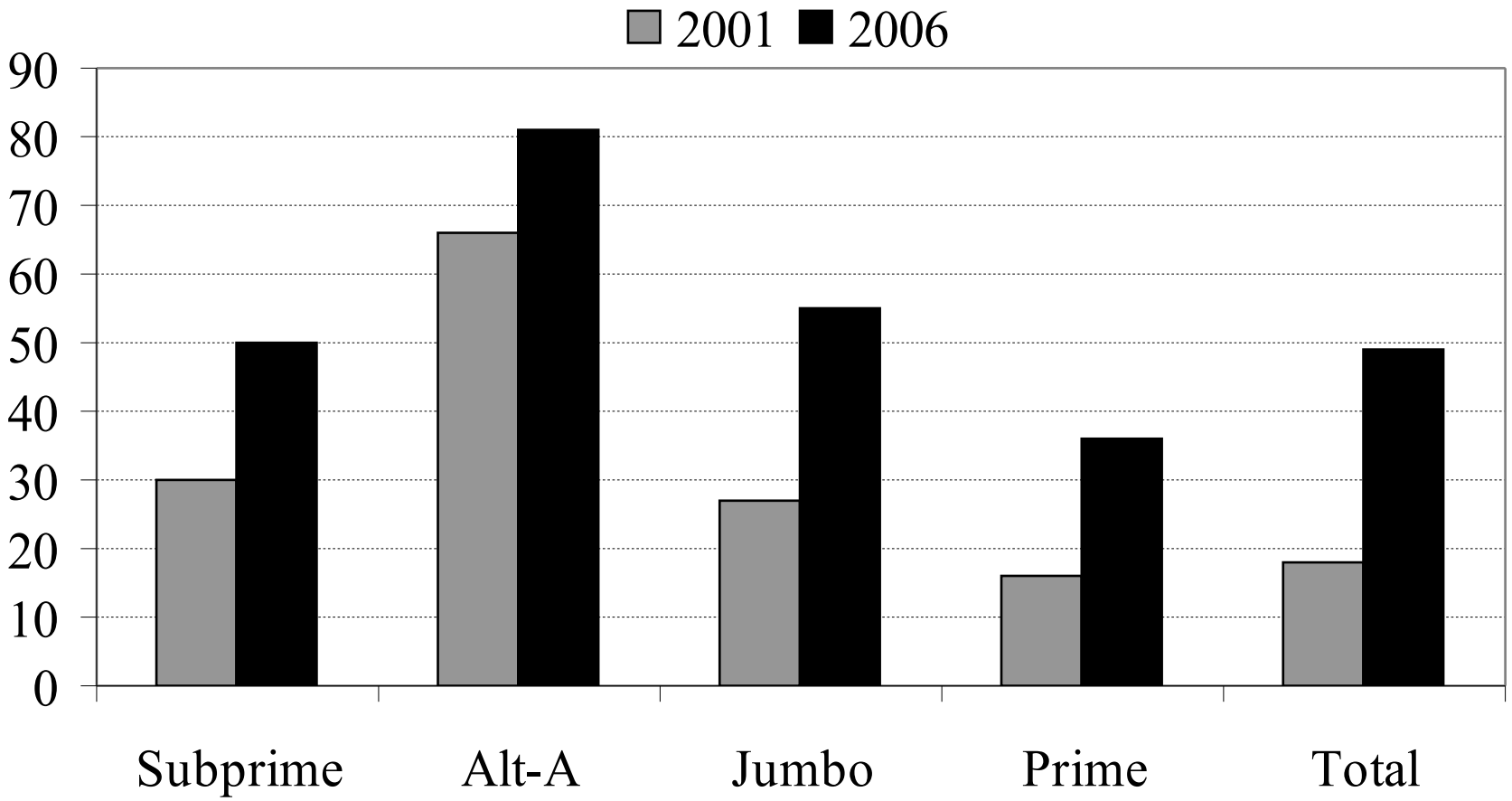
This should happen simultaneously if financial fragility is rising.

This can happen over several business cycles if recessions are mild (state of expectations is not negatively affected): period of prosperity is different from the business cycle (Great Moderation)

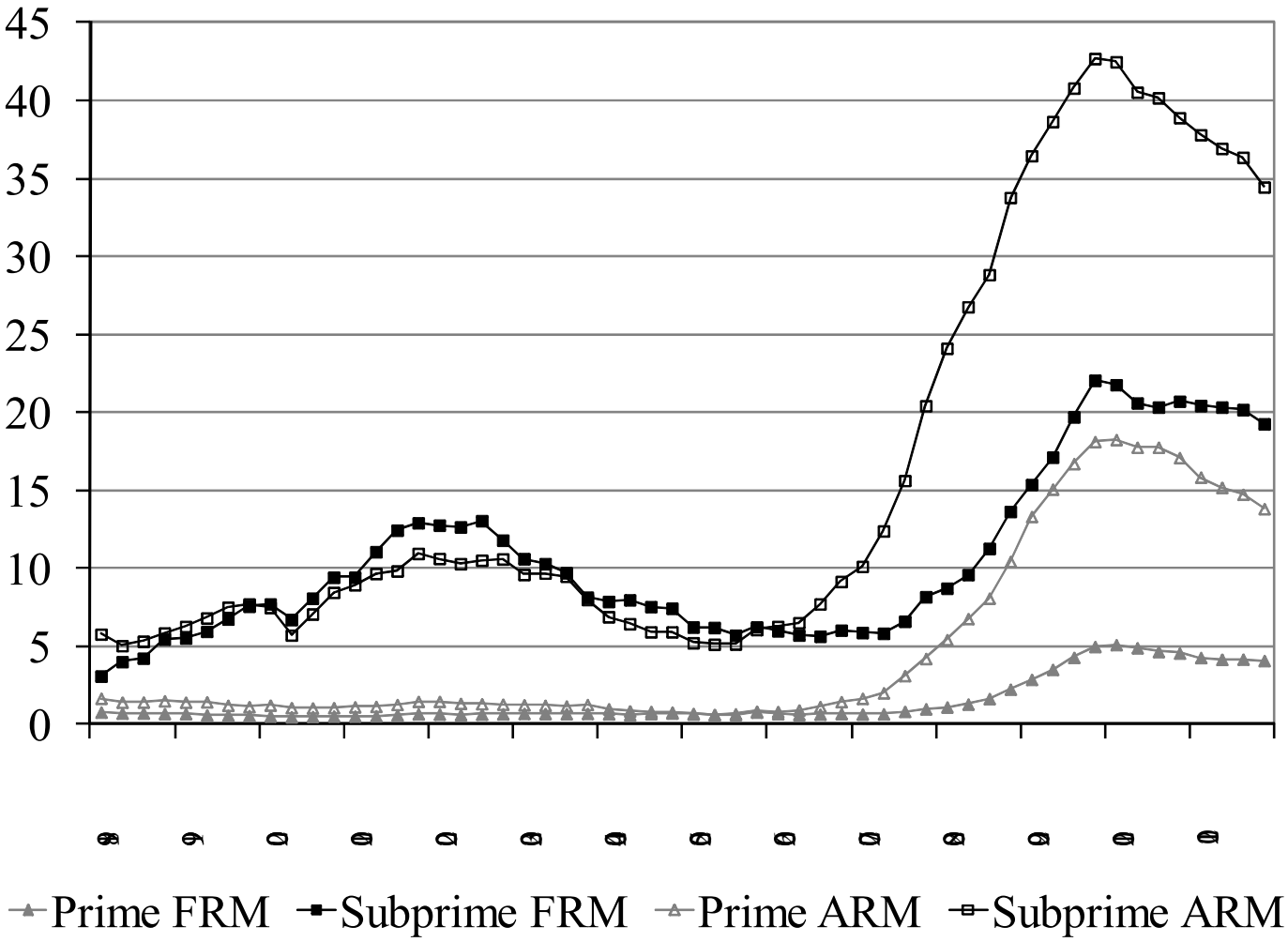
Example: Share of exotic mortgages in non-prime mortgages



Example: Share of Low-doc, no-doc mortgages in new purchase mortgages



Example: Serious delinquency on US mortgages



Index of financial fragility for Residential Housing

- Variables used:
  - home mortgage of households relative to GDP (L): US, UK, France
  - home price index (P): US, UK, France
  - Mortgage-financial-obligation ratio (MOR): US
  - Interest-obligation ratio (MOR): UK, US
  - The proportion of home equity loans in all mortgages (HELOC): US, France (zero, revolving home equity lending forbidden until 2005)
  - The cumulative value of home equity withdrawals (HEW) relative to all mortgages: UK
  - The proportion of cash-out refinance mortgages among refinance mortgages (COR): US
  - The ratio of mortgage debt to monetary assets (MMR): US, UK, France

- Each variable is seasonally adjusted and indexed relative to the year 1996.

Index of financial fragility for Residential Housing

- Variable indexes are added and weighted to create an overall index of financial fragility in housing finance.

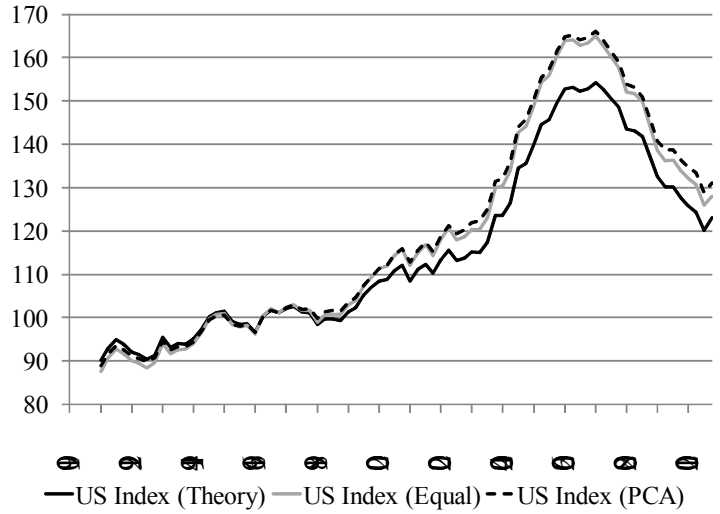
$$I_{US} = w_1 I_L + w_2 I_P + w_3 I_{COR} + w_4 I_{HELOC} + w_5 I_{MMR} + w_6 I_{MOR}$$

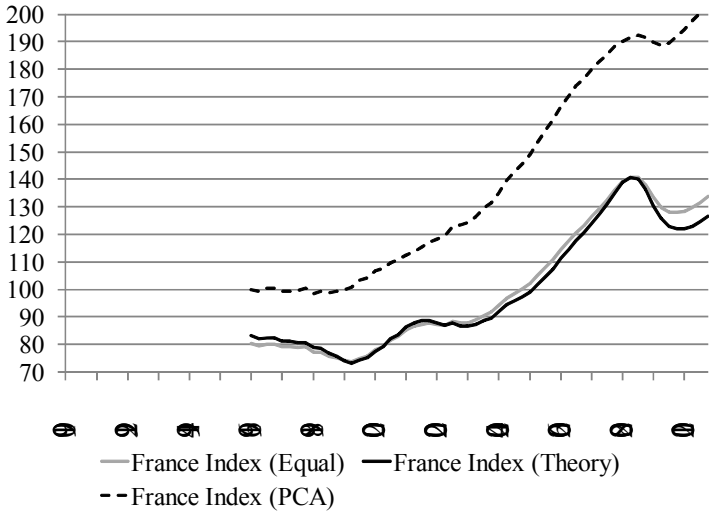
$$I_{UK} = w_1 I_L + w_2 I_P + w_3 I_{HEW} + w_4 I_{MOR} + w_5 I_{MMR}$$

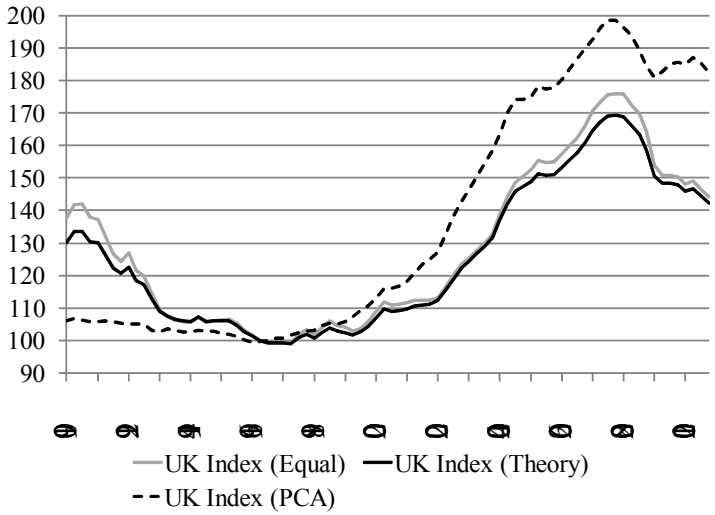
$$I_F = w_1 I_L + w_2 I_P + w_3 I_{HELOC} + w_4 I_{MOR} + w_5 I_{MMR}$$

- Three weight structures were used: equal weight, principal component analysis, theory

Index of financial fragility for Residential Housing

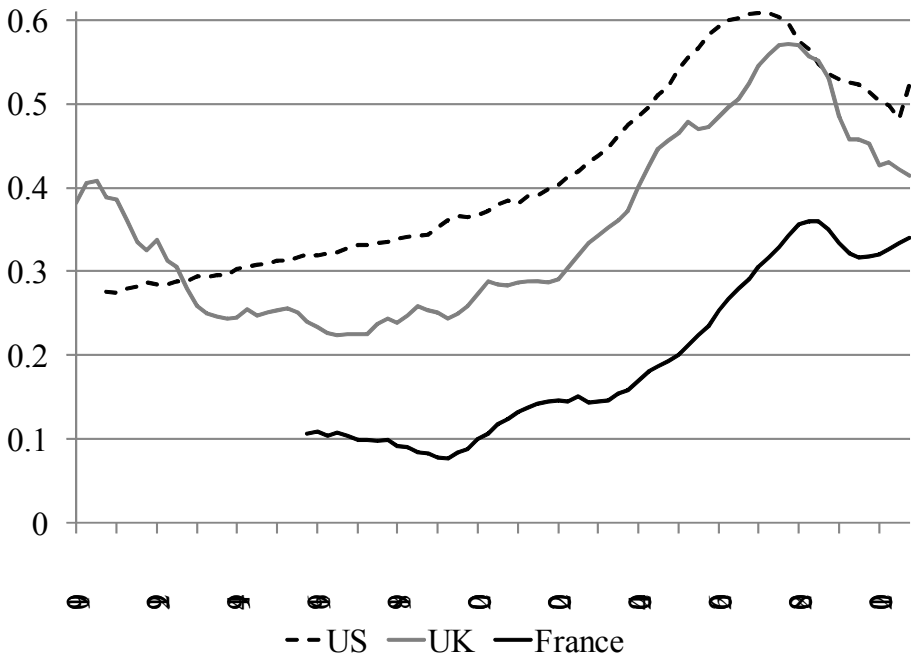






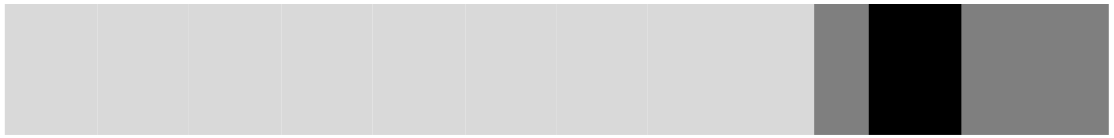
Comparing Countries

- Previous indexes are for each country. They can cannot be compared across country because they do not account for the level of each variable across country, they only account for the trend.
- It is possible to account for levels but at the cost of the loss of information



Heat Map: Abnormally high financial fragility

- Deviation from average on the upside: below one standard deviation (light grey), one to 1.5 standard deviation (darker grey), more than 1.5 standard deviation (black)



France

US

UK