Financial Sector, Sovereign, Macro Spillovers and Risk Transmission

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Presentation to CSRA Meeting

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Outline of Presentation

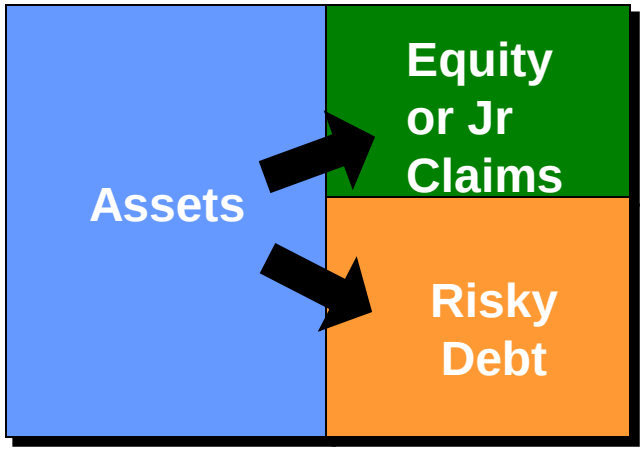
Market Implied Government Contingent Liabilities

Results from joint project with ECB "Modeling Banking, Sovereign, and Macro Risk in a CCA Global VAR" in Europe and US (IMF WP 13/218)

Further Research:

- **Sovereign-Banking Destabilization Spirals**
- **Stress testing banks and sovereign risk jointly**
- **CCA VAR models**
- **CCA Network Models**

Core Concept of Contingent Claims Analysis (CCA): Merton Model



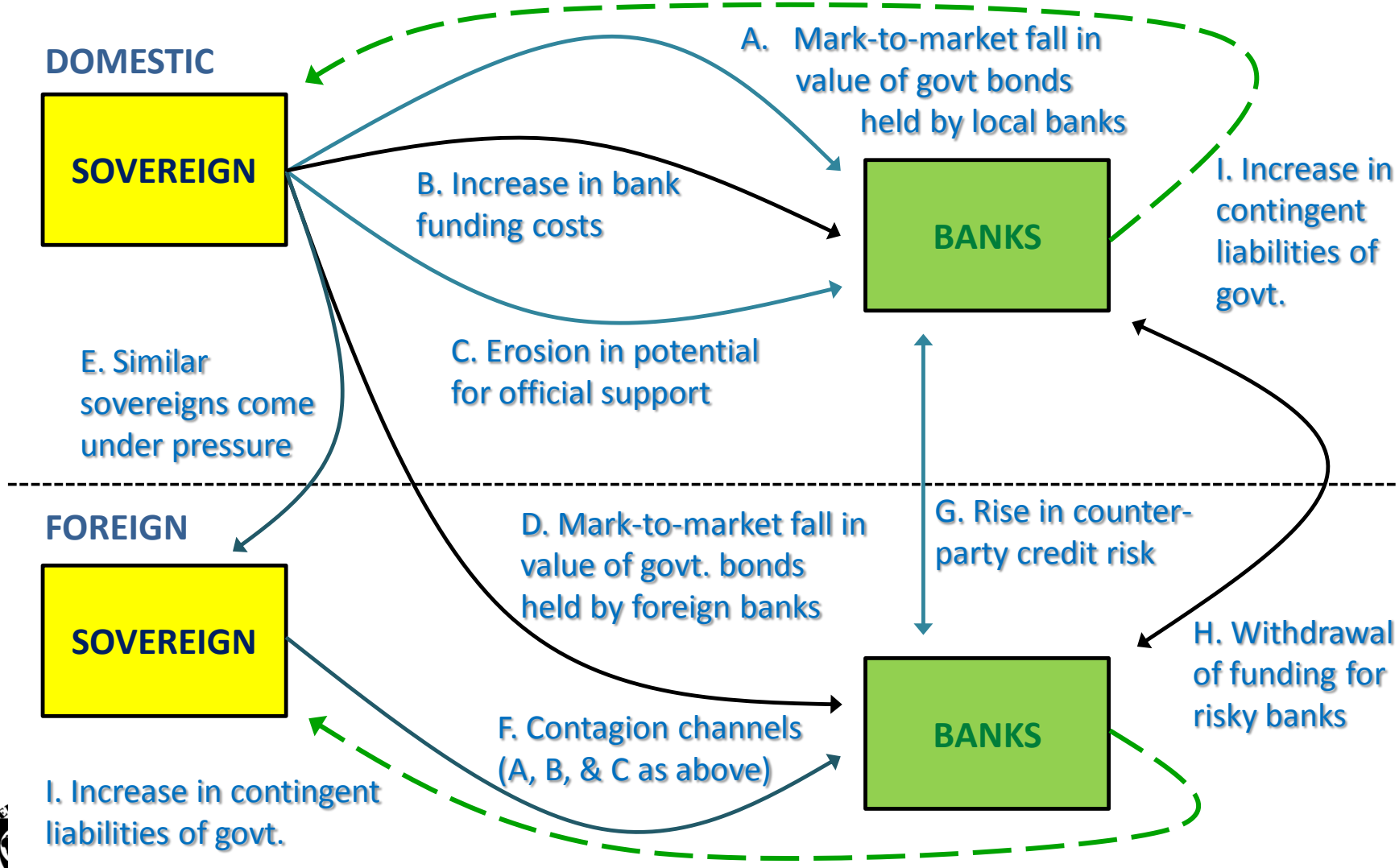
- Value of liabilities derived from value of assets.
- Liabilities have different seniority.
- Randomness in asset value.

Assets = Equity + Risky Debt

= Equity + Default-Free Debt – Expected Loss

= Implicit Call Option + Default-Free Debt – Implicit Put Option

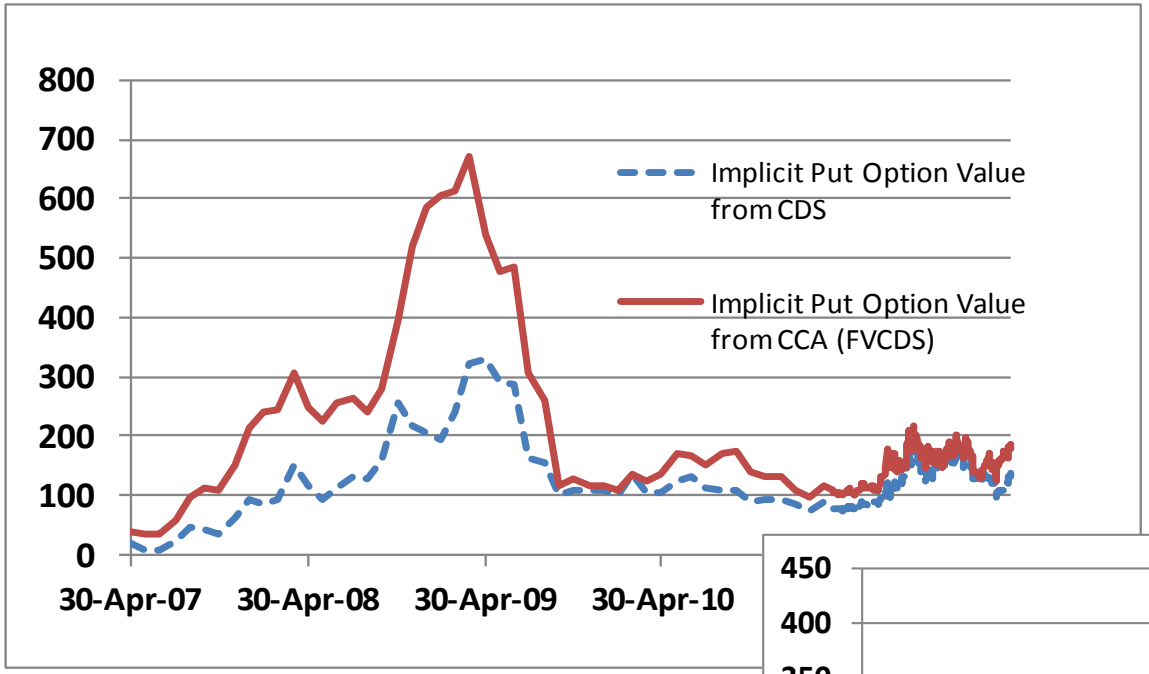
Spillovers from the Sovereign to the Banks and Banks to Sovereigns



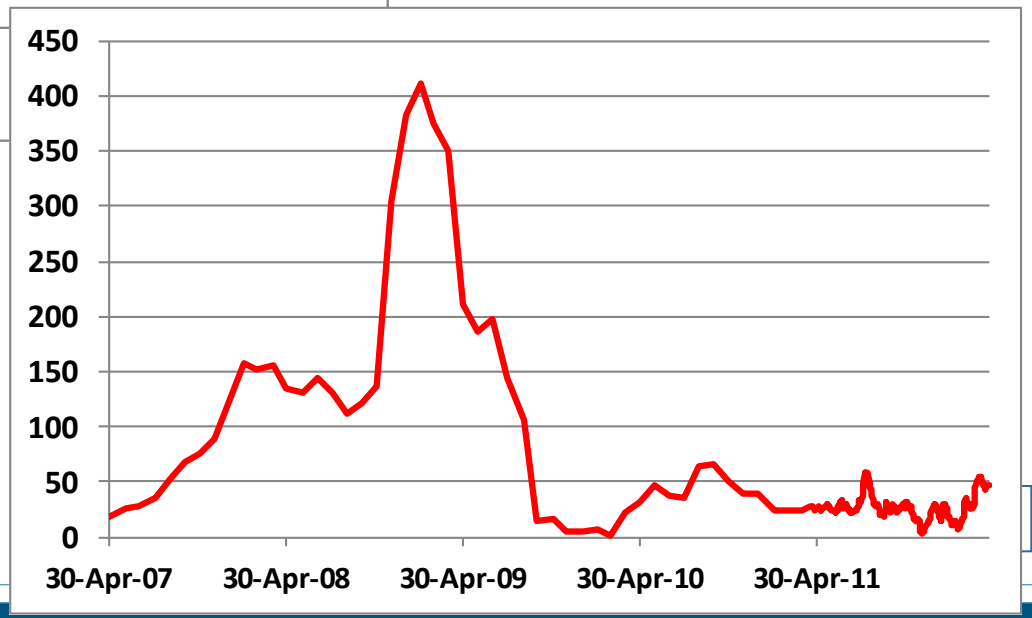
Estimating Risk Transmission from Banks to the Government

- Implied credit spreads derived from CCA models ("Fair Value CDS spreads") are frequently higher than the observed market CDS
- This is due to the depressing effect of implicit and explicit government guarantees on bank CDS spreads
- The 'market implied' contingent liablities can be estimated using CCA FV spreads and observed CDS

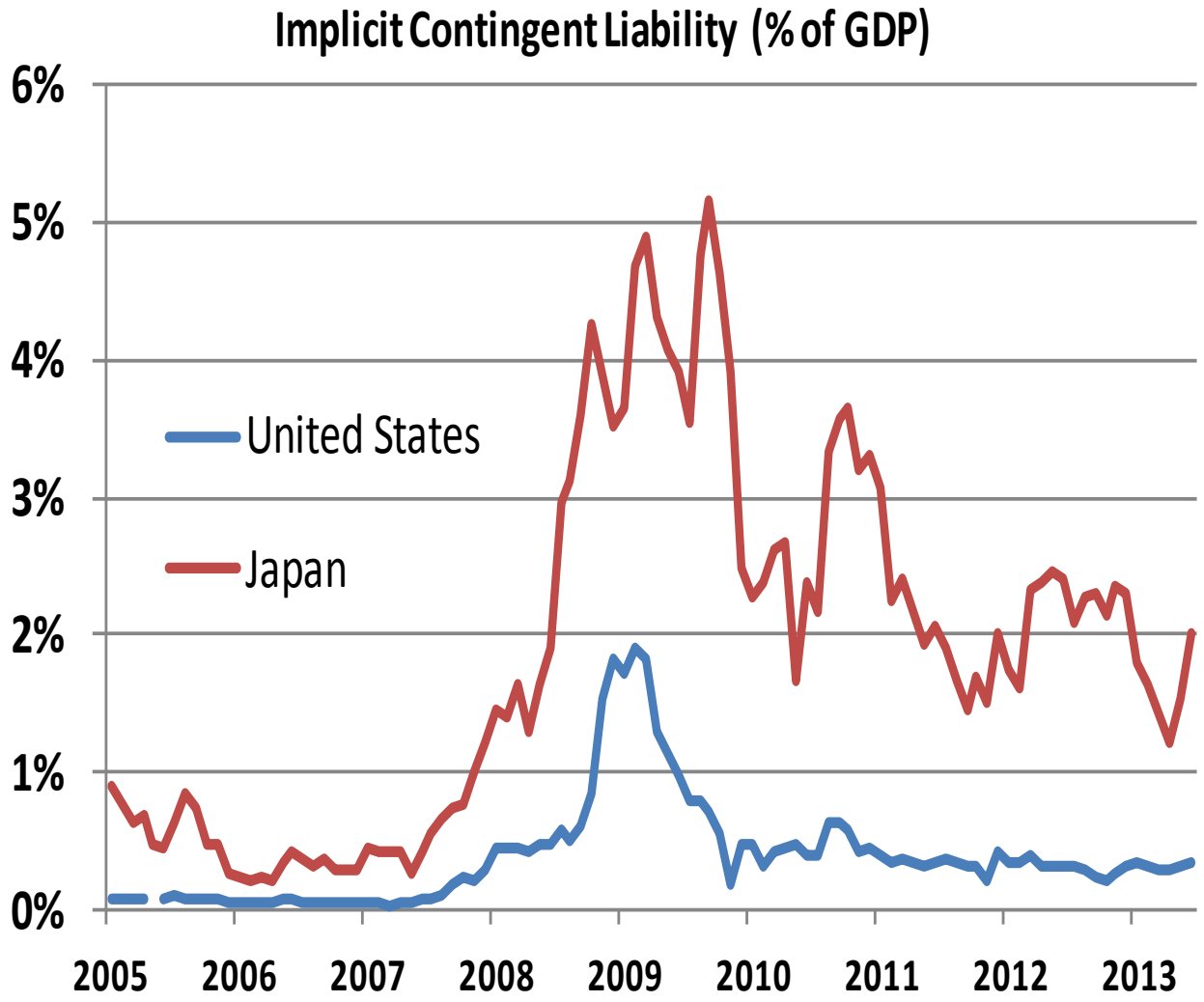
Citigroup: Example of Implicit Put Option Value Extracted from CDS vs from CCA model and Estimated Contingent Liability (billions of US$)



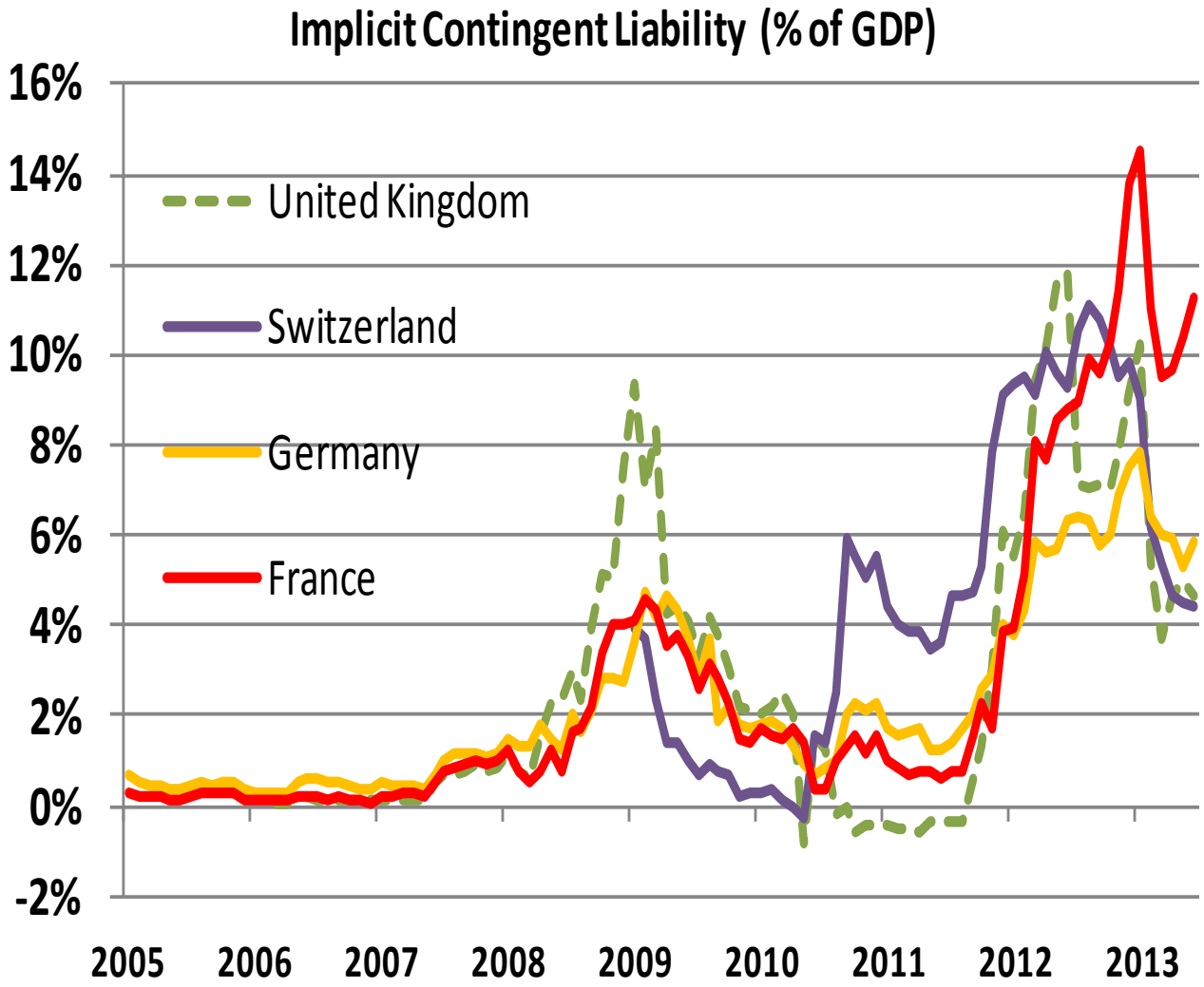
Estimated "market implied" government contingent liability



Size of Implied Contingent Liabilities Declining in US and Japan



Size of Implied Contingent Liabilities in Europe Higher in 2012 than the crisis, with some recent declines



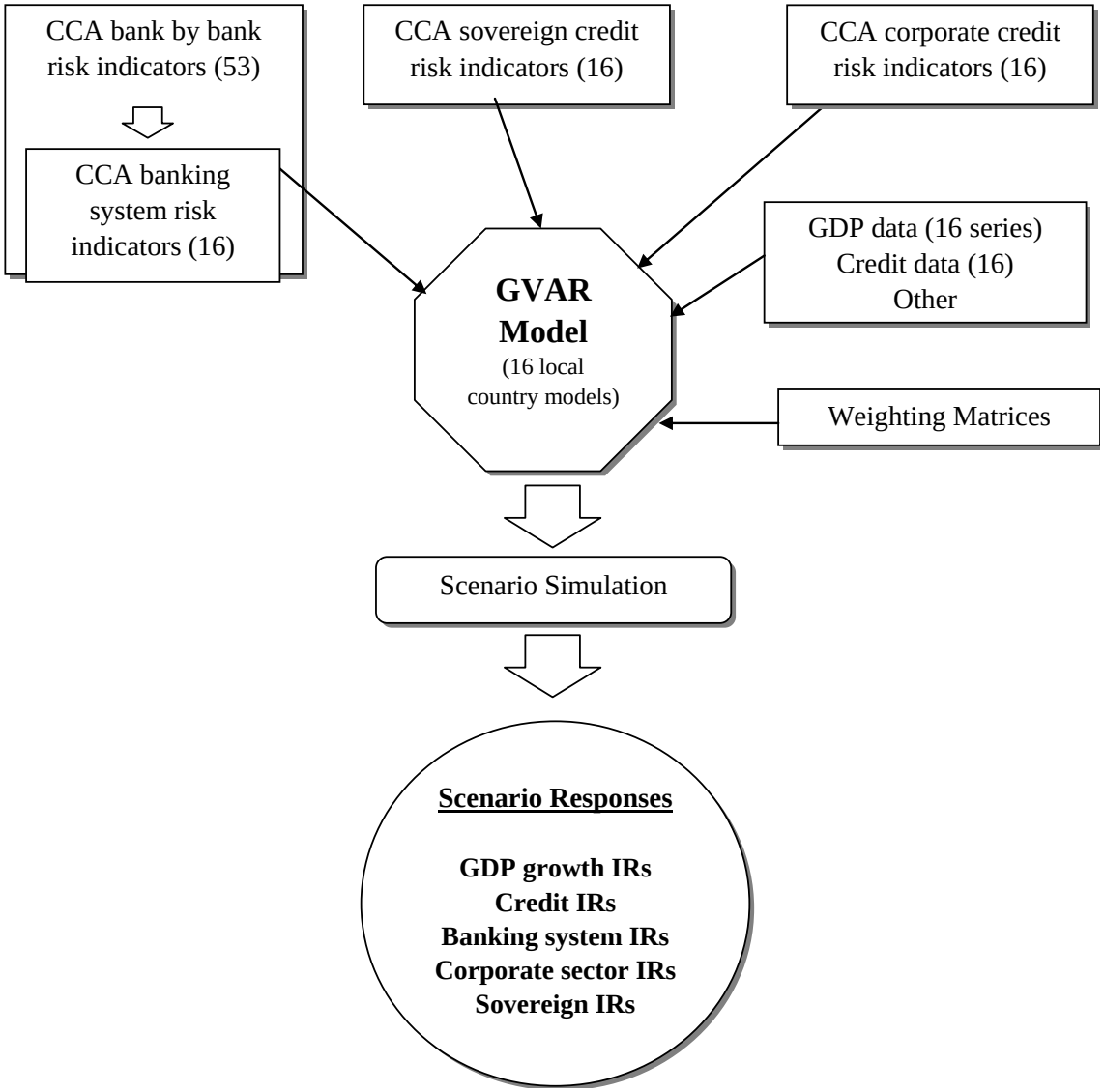
CCA-Global VAR for EU and US

IMF WP 13/218 (joint work with ECB staff Marco Gross, Matthias Sydow, and Joan Paredes)

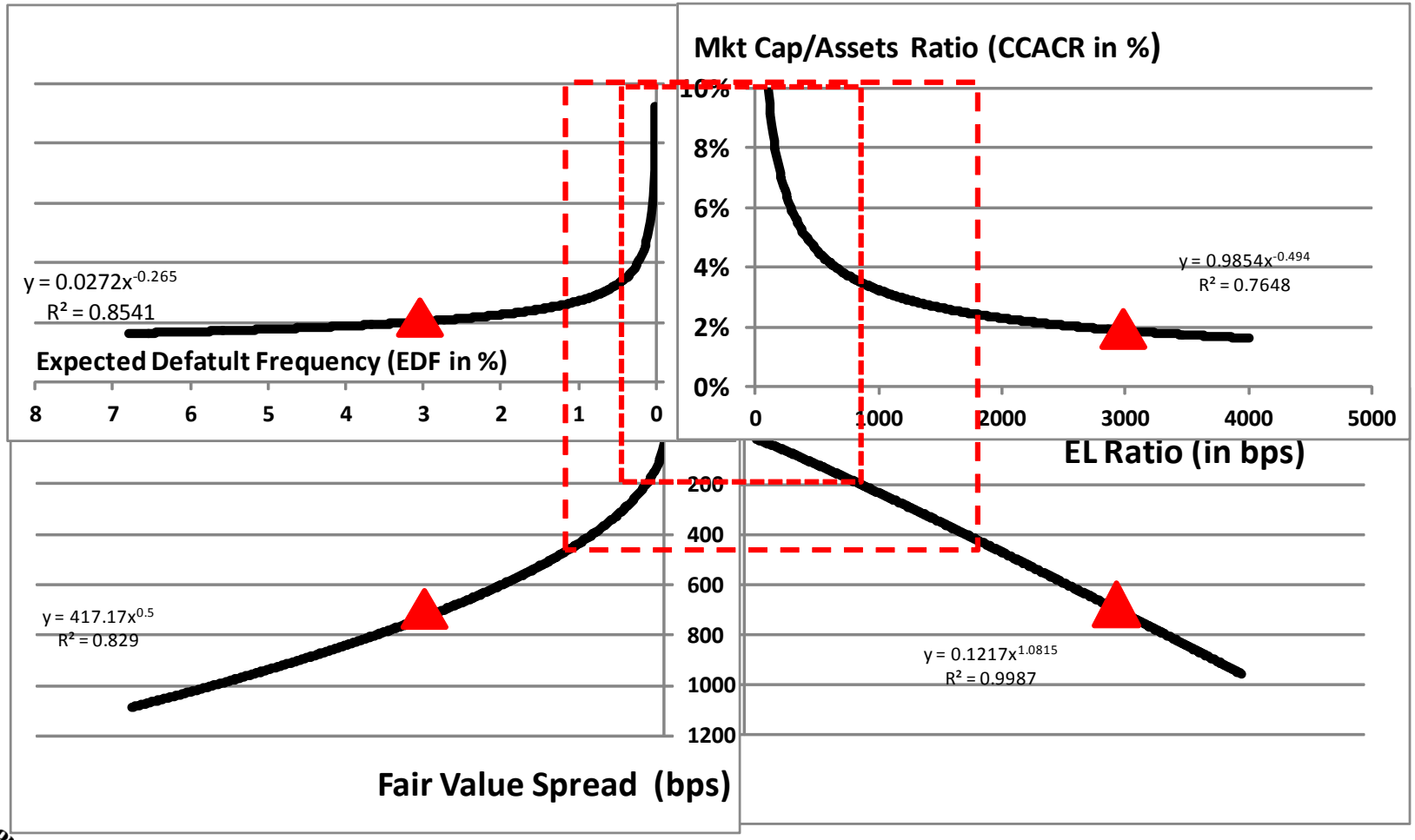
- Framework for analysis the interactions of banking sector risk, sovereign risk, GDP growth, credit for 15 EU countries plus the US. (55 banks total)
- Uses CCA risk indicators for the banking systems (derived from FVCDS) and corporate sectors and sovereigns in each country, Expected loss ratios from CCA for banks and corporates and sovereign EL backed out of sovereign CDS)
- Together with the GVAR (Global Vector Autoregression) model for each country, endogenous weight matricies
- Impulse responses captures the non-linearity of changes bank credit spreads, sovereign spreads and corporate credit risk and impact on GDP growth and credit

Model Structure: Inputs and scenarios/shock origins

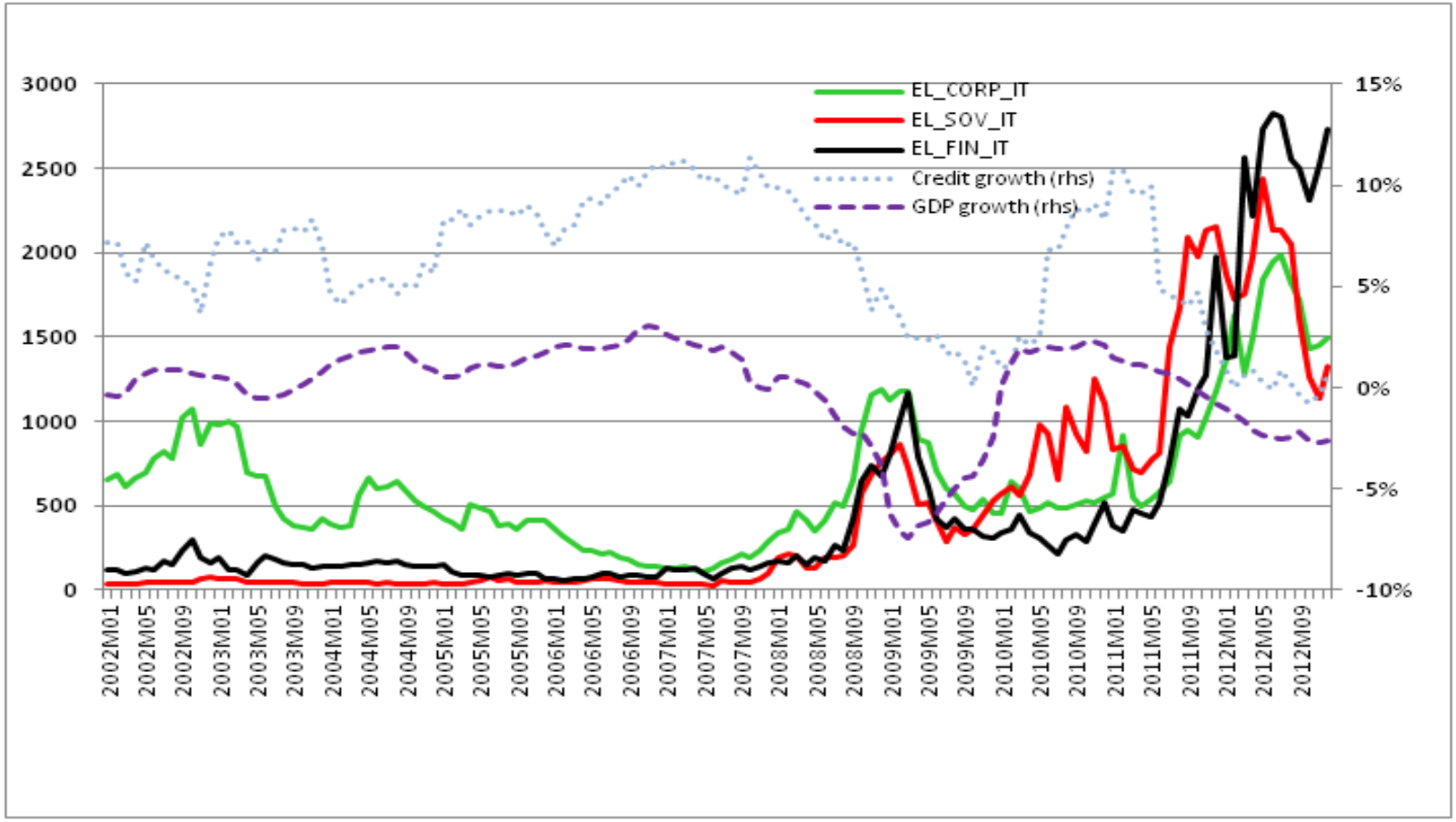
CCA-GVAR Model Framework



Nonlinear relationships for typical bank (EDF, capital ratio, EL, and FV spread) - "lower risk zone" and smaller "safe zone" show by red outlines



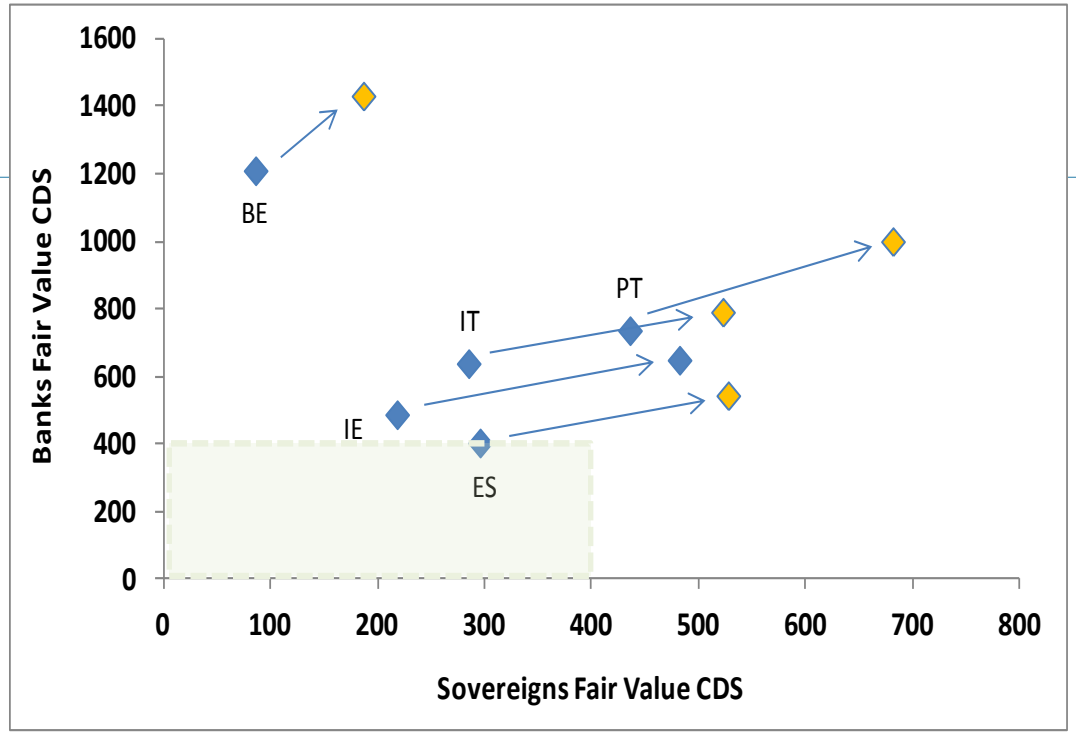
INPUT DATA: Example of Italy Risk Indicators (EL Ratios), GDP Growth and Credit Growth (monthly)

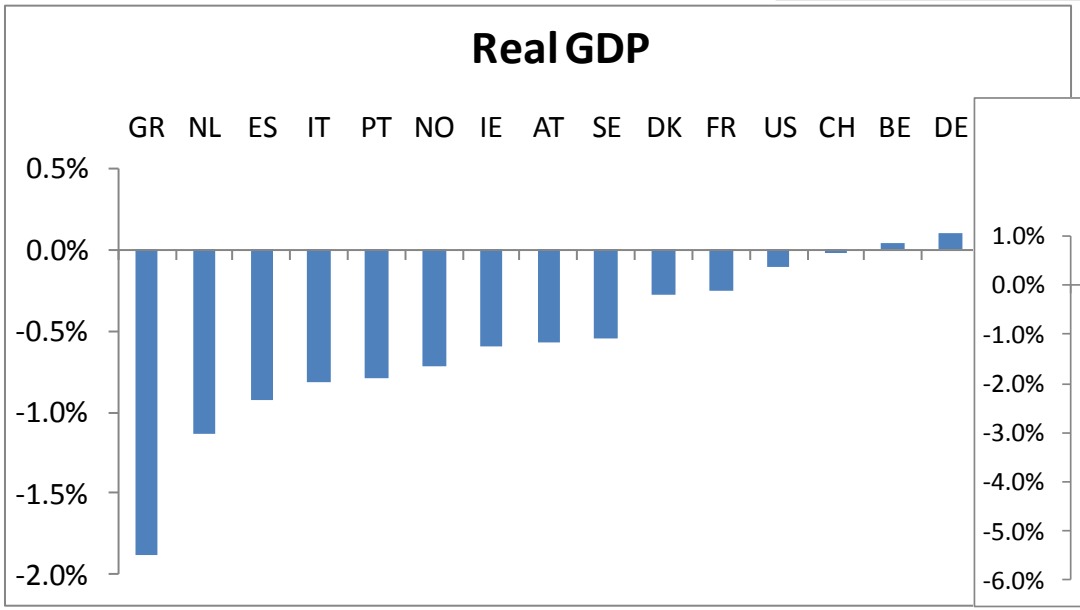


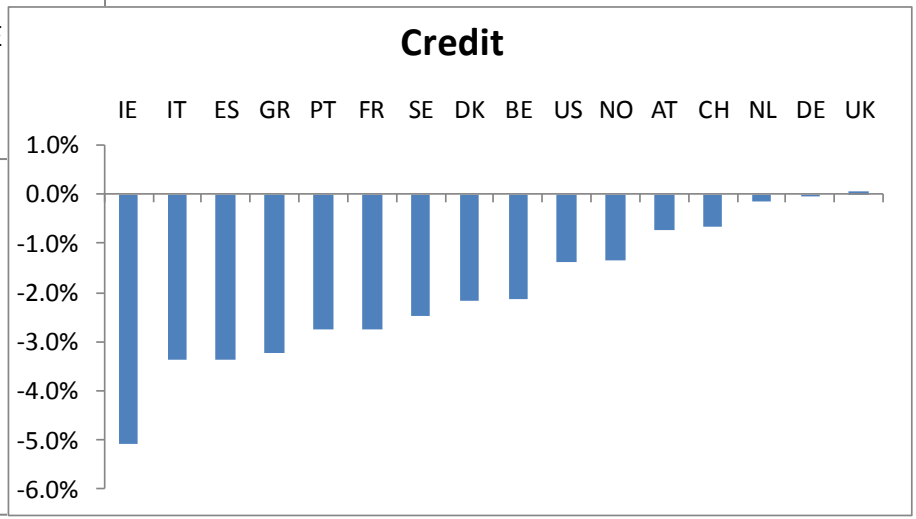
-(EL ratio for financial and corporate sectors weighted by assets)

Shock Scenario 1

Negative Shock to Spain and Italy Sovereigns: Bank and Sovereign FVCDS increase; Real GDP growth down; Credit growth down



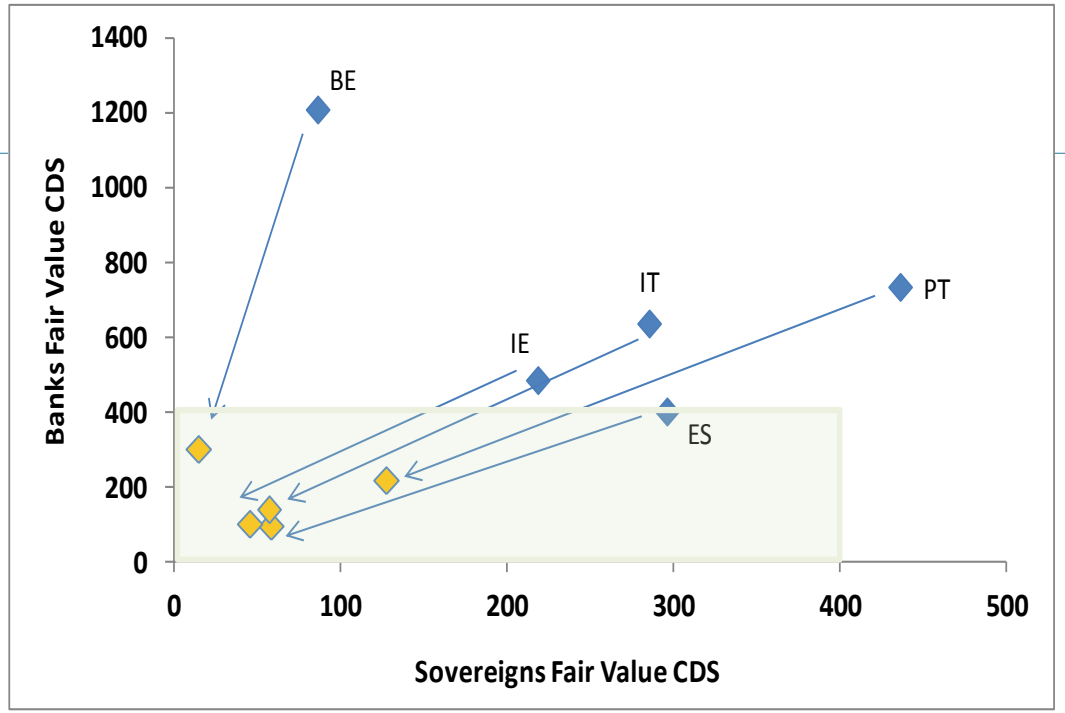


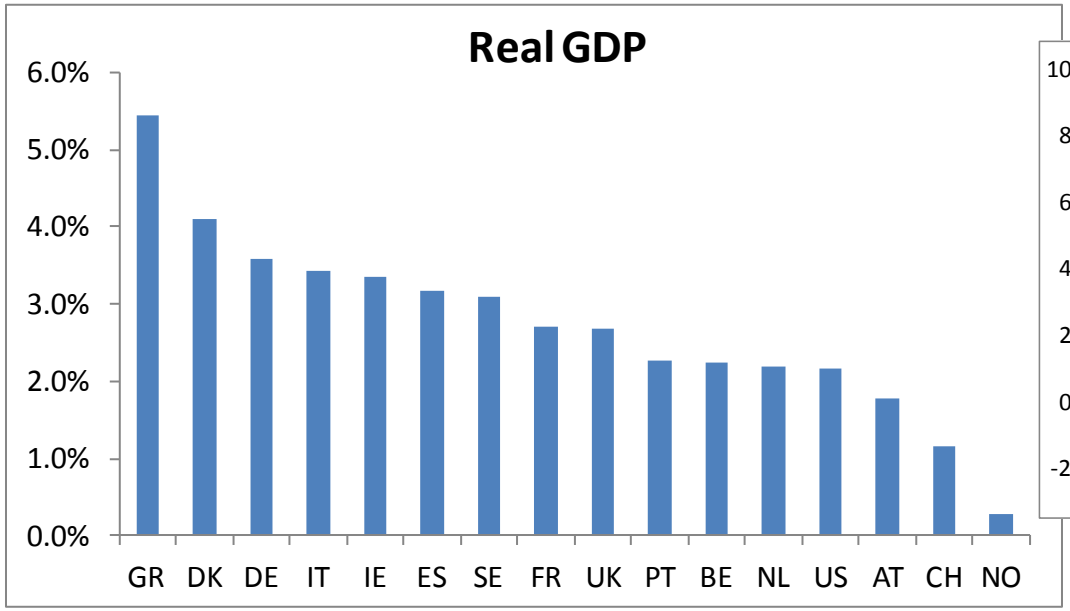


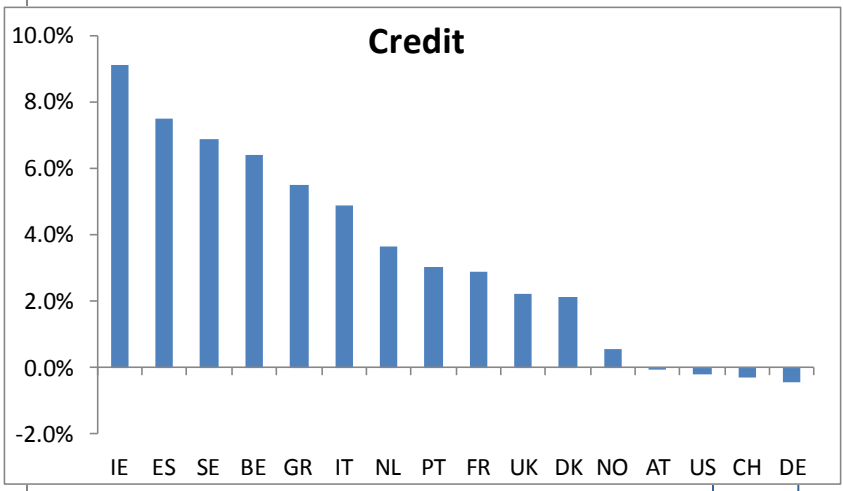
Shock Scenario 2

Positive Shock to Spain and Italy Sovereigns:

Bank and Sovereign FVCDS to "safe zone"; Real GDP up; Credit Growth up

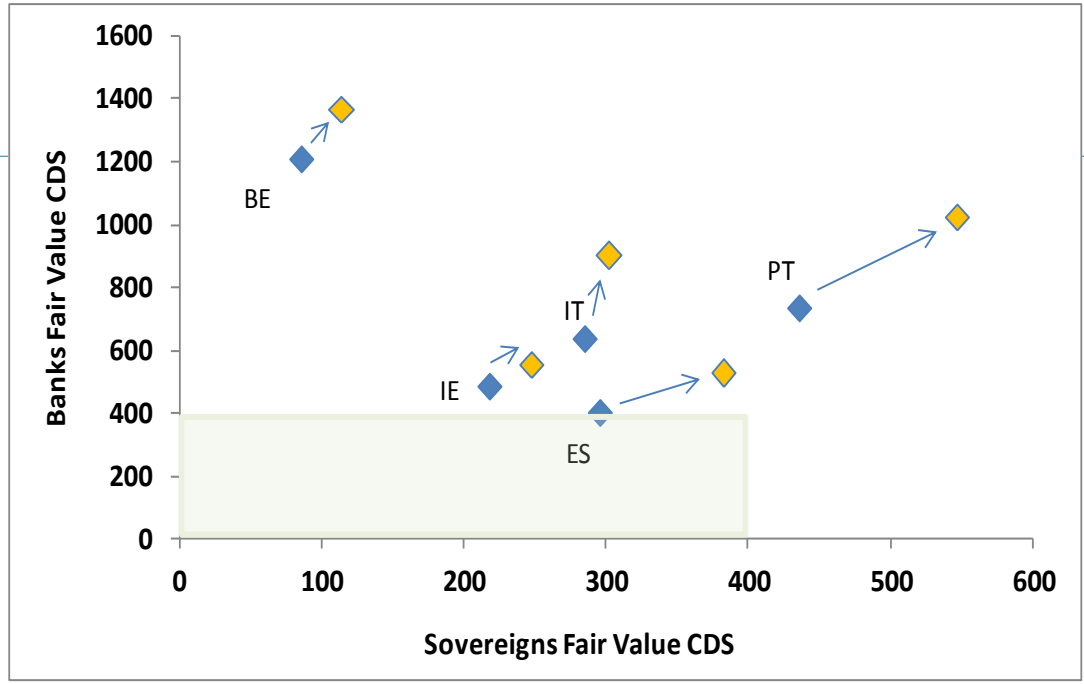


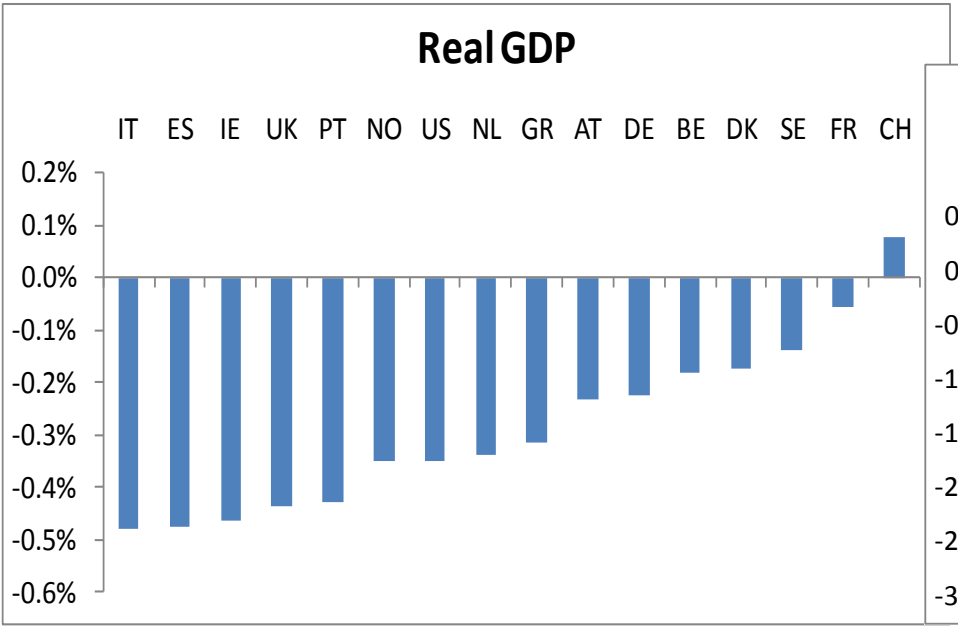


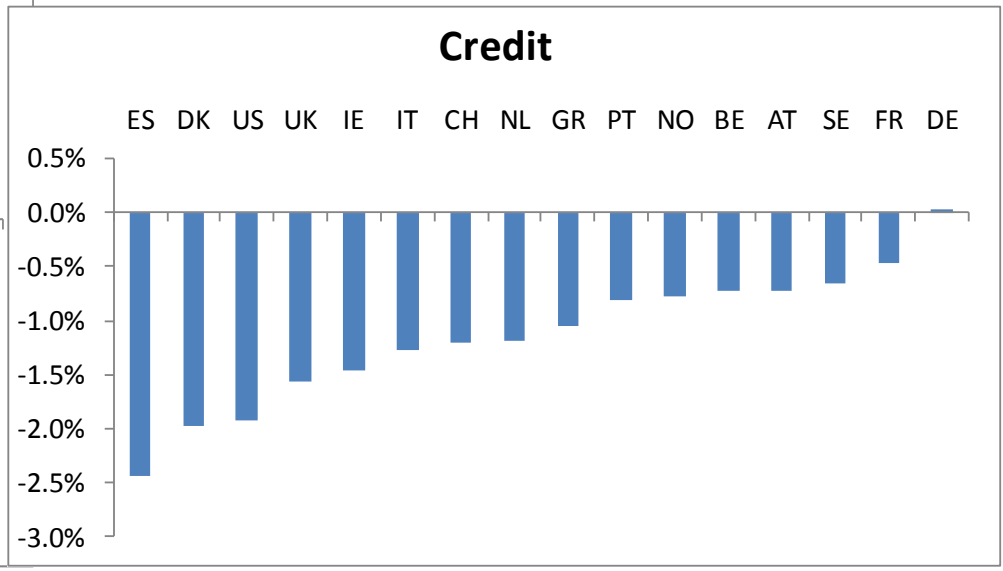


Scenario 3

Negative Shock to Spain and Italy Banks:
Bank and Sovereign FVCDS increase; Real GDP growth down; Credit growth down





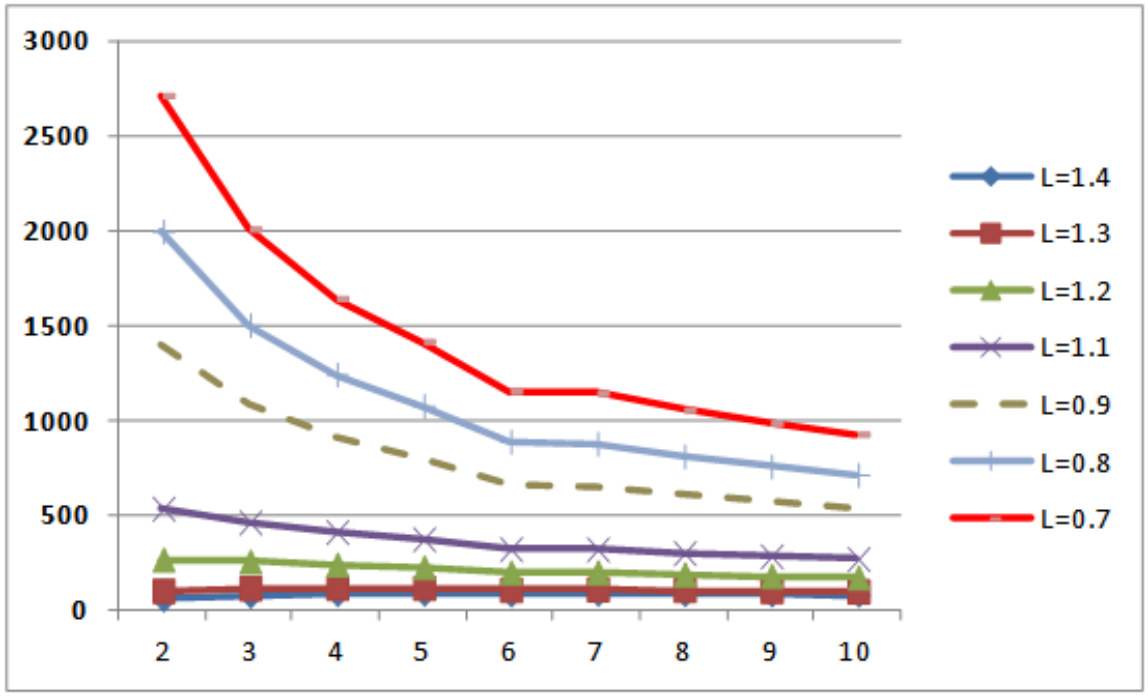


Current Extensions and New Work on Sovereign, Bank Macro Linkages

- Calibrating sovereign CCA balance sheets and modeling bank-sovereign destabilization risks
- Better analysis of how components of GDP (household consumption, investment, and government consumption) related to bank, corporate, and sovereign risk indicators (CCA-VAR models, joint work with ECB)
- Stress testing sovereigns and banks together
- Network models of sovereign, bank and insurance risks (extensions of Merton, Billio, Getmansky, Gray, Lo, Pelizzon 2013 papers)

Calibrating Sovereign CCA Balance Sheets

The full term structure of the sovereign CDS, (CDS for years 1,3,5,7 and 10) is used to estimate the implied (i) sovereign "leverage ratio" the ratio of sovereign asset to the present value of promised debt payments, and (ii) implied volatility and skew that most closely fits the observed sovereign spread term structure.



Sovereign CCA Models for Developed Countries (cont.)

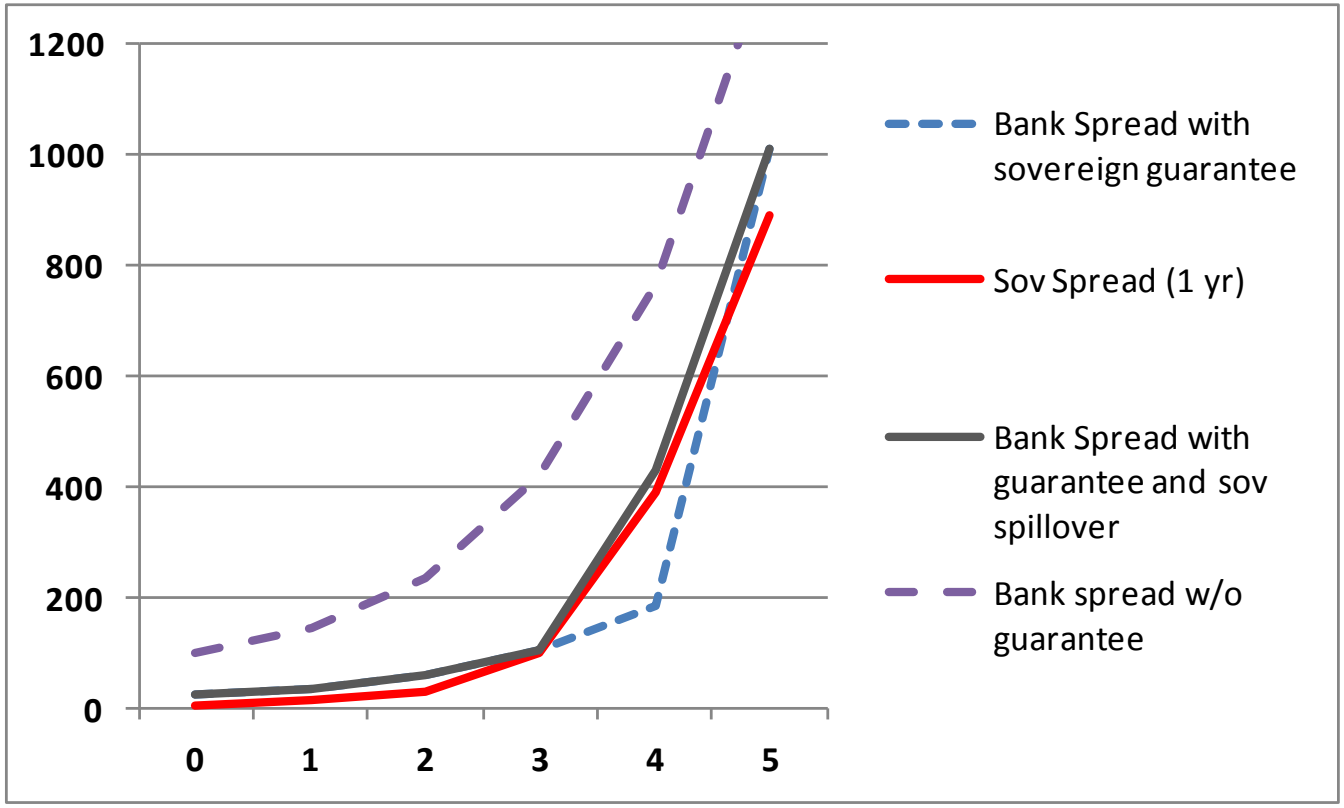
The implied sovereign assets can be estimated by multiplying the leverage times the present value of debt obligations ("distress barrier"). Then the expected losses on sovereign debt can be estimated.

Expected Losses=Implicit Put Option
=f(Assets, volatility, skew, Debt Barrier, r,t)

We can analyze the impact on sovereign expected losses from changes in contingent liabilities

Assets = Reserves + PV(taxes minus revenues) +Other assets – Contingent Liabilities to the Financial Sector

Illustrative Joint Stress Test: Evolution of Bank and Sovereign Spreads (bps) with Feedbacks



Severe shock to GDP in periods 1 to 3 reduces bank assets and sovereign assets, bank assets decline from reduced value of sovereign debt, government contingent liabilities increase, sovereign spreads increase and spill over into bank spreads, destructive feedback process. Value of sovereign guarantee falls in period 5.

Ongoing work on Quantitative Analysis of Various Risk Mitigation Policy Options to Mitigate Bank and Sovereign and Boost Growth

On-Balance Sheet Adjustment Policies to Mitigate Risk to:			Risk Transfer-Type Instruments and Policies to Mitigate Risk to:		
Banks		**Sovereign**	**Banks**	**Sovereign**	**Corporates**
Increase market capital	Increase regulatory capital; Increase solvency ratio	Reduce or increase maturity of debt	Guarantees on bank senior debt; asset protection guarantees	Guarantees or insurance or selling CDS protection on sovereign debt	Incentives for banks to lend to corporates
Increase assets and lower asset risk	Macro-prudential policies that affect credit growth	Raise assets and lower asset risk	EU wide deposit insurance	Debt purchases by banks (e.g., LTRO) Debt purchases by public entity (SMP/OMT, EFSF/ESM, other)	Corporate debt (or equity) across the board purchases by government or central bank
Debt equity conversion/ Bail-in		Extending debt maturity or restructuring	EU wide bank resolution	Mutualize, socialize existing and/or new sov. Debt	

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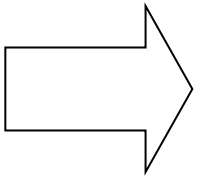
Merton, Billio, Getmansky, Gray, Lo, Pelizzon 2012 "New Approach for Analyzing, and Managing Macrofinancial Risks" FAJ 69 (2).

Appendix Slides

CCA Balance Sheet: Assets Minus Liabilities equal Zero

For a sector, sub-sector or individual institution



CCA Balance Sheet

Assets

+or - Implicit or Explicit Guarantees {Implicit Put Options}

minus

Equity / Jr. Claim {Implicit Call Option}

minus

(Default-free Value of Debt – Implicit Put Option)

= 0

Stylized Interlinked CCA Balance Sheets for an Economy

Sectors of an economy can be viewed as interconnected risk-adjusted balance sheets with portfolios of assets, liabilities, and guarantees—explicit and implicit.

	Corporates	Households		Financial Sector	Sovereign		Foreign
		H BS	H RE		Govt.	MA	
Asset	A_C	A_{FIN} $+A_L$ $+E_{H,RE}$	$A_{H,RE}$	A_F	$PV(T-G)$ $+A_{G,Other}$	$R_{FX}+$ θE_G+ $A_{MA,Other}$	
ContingentAssets & Liab				$+\alpha P_F$	$-\alpha_G P_F$		
Equity/Jr. & Sub. Claims	$-E_C$	$-E_H$ $-c_H$	$-E_{H,RE}$	$-E_F$	$-E_G$ $-\bar{B}_{SLC}-i_{SLC}$ $+P_{SLC}$	$-M_{BM}$	
Senior Claims (Default Barrier)	$-\bar{B}_C$ $-i_C$		$-\bar{B}_{H,RE}$ $-i_{H,RE}$	$-\bar{B}_F-i_f$	$-\bar{B}_{SFX}-i_{SFX}$		*Foreign*
Put	$+P_C$		$+P_H$	$+(1-\alpha)P_F$	$+P_{SFX}$		*Claims*
Sum	0	0	0	0	0	0	0

Economy-wide CCA Balance Sheet Models Capture Non-linear Risk Transmission

- **Interlinked implicit options result in compound options that exhibit highly non-linear risk transmission, as seen a variety of financial crises**
- **Note that if asset volatility in CCA balance sheets is set to zero:**
  - **Implicit put options go to zero,**
  - **Macroeconomic accounting balance sheets and traditional flow-of-funds are the result**
  - **Measurement of (non-linear) risk transmission is not possible using macroeconomic flow or accounting frameworks when fundamental structural volatility is ignored (i.e. = 0).**

UNIFIED MACROFINANCE FRAMEWORK

Targets: Inflation, GDP, *Financial System Credit Risk, Sovereign Credit Risk*

Financial Stability Policies:

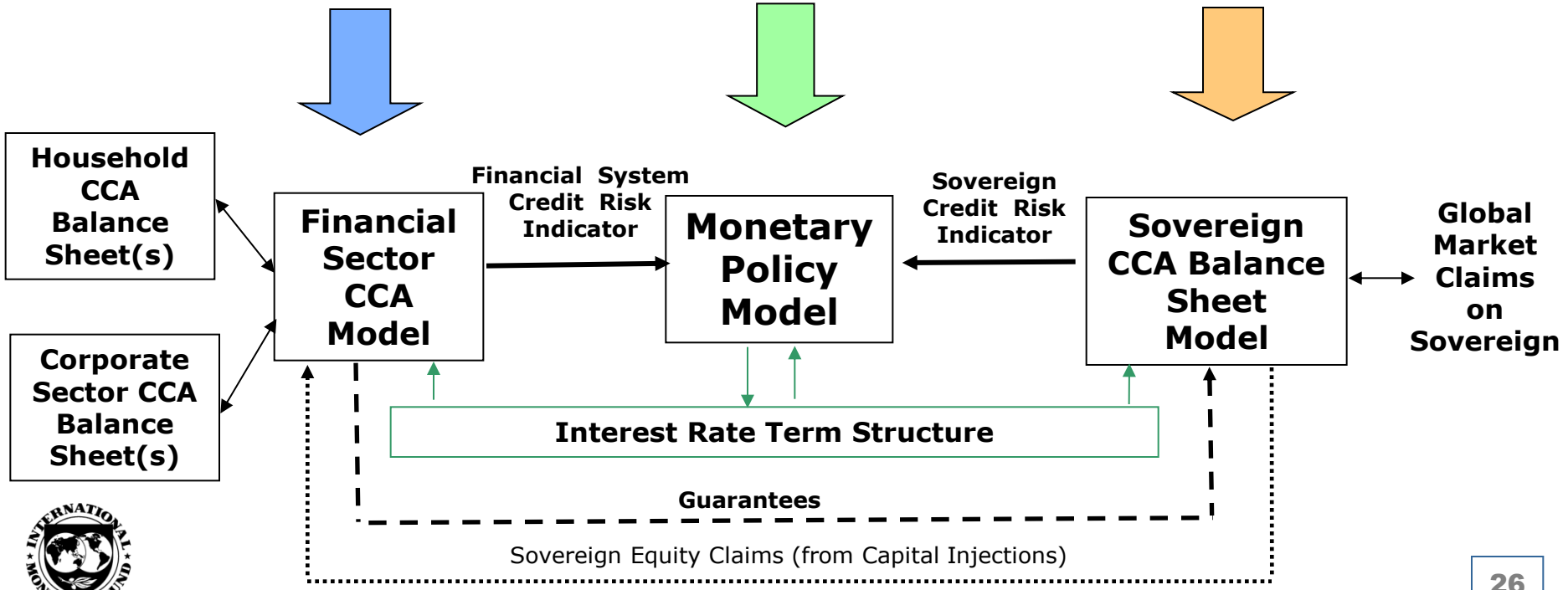
- *Capital Adequacy*
- *Financial Regulations*
- *Economic Capital*

Monetary Policies:

- *Policy Rate*
- *Liquidity Facilities*
- *Quantitative Actions*

Fiscal and Debt Policies:

- *Fiscal Policy*
- *Debt Management*
- *Reserve Management*



Traditional Flow and Accounting Framework
No Risk-Adjusted Balance Sheets (Asset Volatility = 0)
No Credit Risk or Guarantees; No Risk Exposures

Financial Stability Policies:

- *Capital Adequacy*
- *Financial Regulations*

Monetary Policies:

- *Policy Rate*
- *Liquidity Facilities*
- *Quantitative Actions*

Fiscal and Debt Policies:

- *Fiscal Policy*
- *Debt Management*
- *Reserve Management*