Sovereign Risk and Financial Risk

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Sovereign Debt and Default Risk

- Countries borrow on sovereign debt market
- Recurrent sovereign debt crises
- Country spreads on risky sovereign debt
- Question: how does global financial risk affect sovereign risk?

Literature on sovereign default and financial risk

- Risk premia on sovereign debt
  - Borri and Verdelhan (2011), Lizarazo (2013), Bai, Kehoe and Perri (2019), Morelli, Ottonello and Perez (2019)
- Impact of global shocks on sovereign spreads
  - Uribe and Yue (2006), Akinci (2013), Gilchrist, Yue and Zakrajsek (2019)
  - Longstaff, Pan, Pederson and Singleton (2011), Ang and Longstaff (2013)
- Global financial cycles
  - Rey (2013), Kalemli-Ozcan (2019), Miranda-Agrippino and Rey (2020)

This paper

- Construct an extensive micro-level dataset of sovereign bond spreads
- Examine the extent to which movements in sovereign bond and CDS spreads are driven by global financial risk factors.
- Explore the theoretical linkages between total intermediation capacity of the financial sector and sovereign bond risk premia

Measuring Sovereign Risk

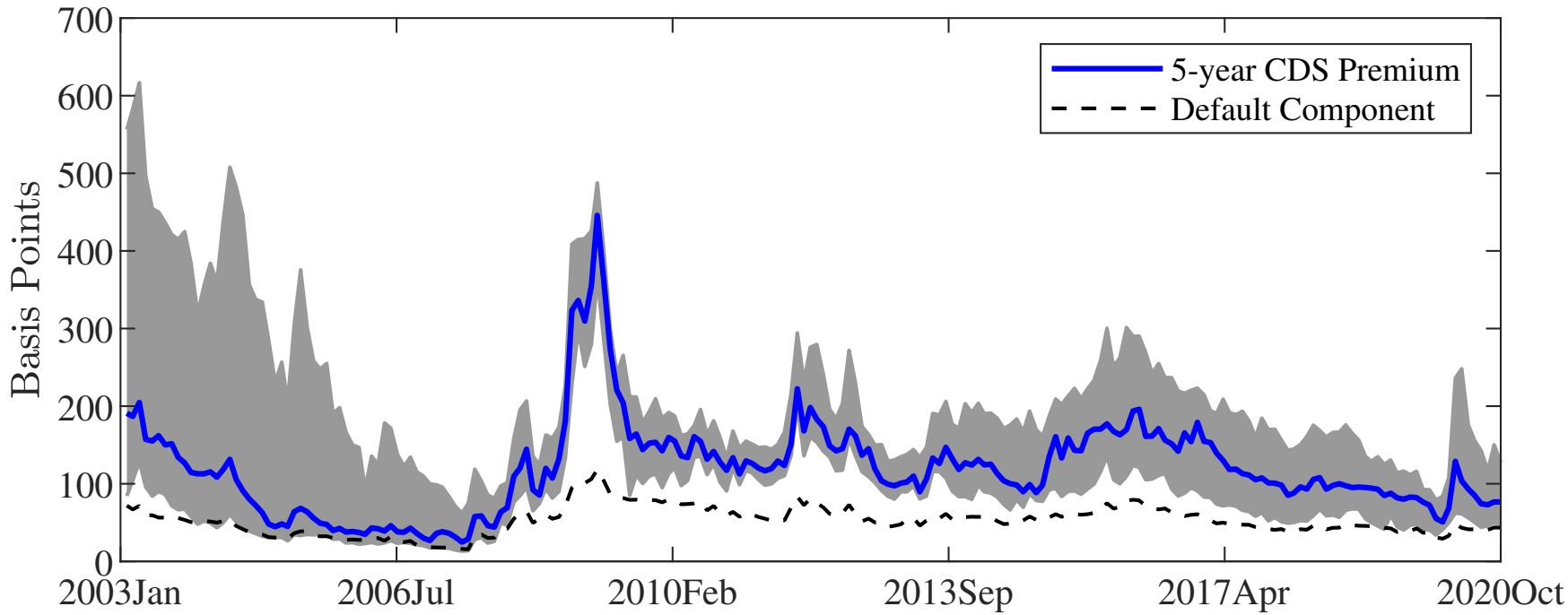
- Sovereign CDS Spreads (derivatives)
  - 15 developing countries
  - Jan 2003-Oct 2020
  - Decompose the CDS spreads into their default and risk-premium components.
- Sovereign Bond Spreads (cash)
  - Dollar-denominated bonds traded in the secondary market.
  - Jan1995–Oct2020; 1,794 securities; 53 countries; 94,521 bond/month observations
  - Construct micro-level credit spreads using synthetic risk-free securities priced off zero-coupon U.S. Treasuries:

$$P_{it}^{f}[k] = \sum_{s=1}^{S} C(s)D(t_s); \quad D(t) = \exp[-r_t^f t]$$

Sovereign Bond Characteristics

Bond Characteristic	Mean	StdDev	Min	Median	Max
No. of bonds per country/month	10.3	46.0	1	4	865
Term to maturity (years)	8.5	8.4	0.16	6.4	100
Yield to maturity (bps.)	375	300	0.09	303	2,309
Credit spread (bps.)	231	225	0.01	165	1,998
Percentage of IG bonds	69%				

Sovereign CDS Spreads



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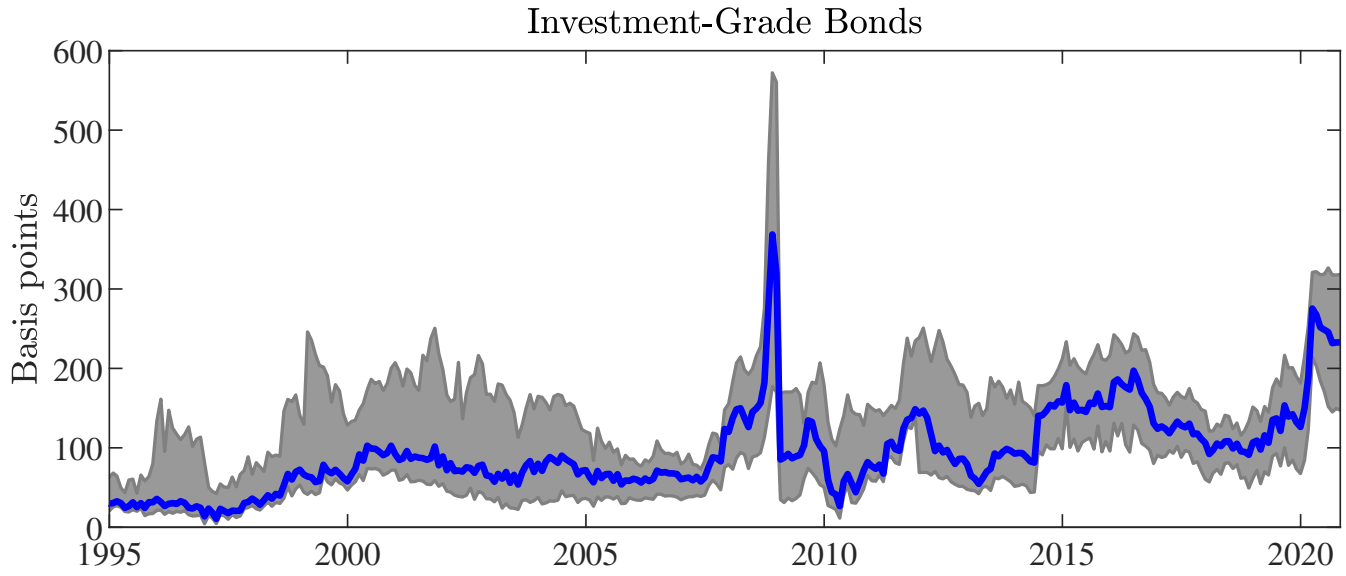
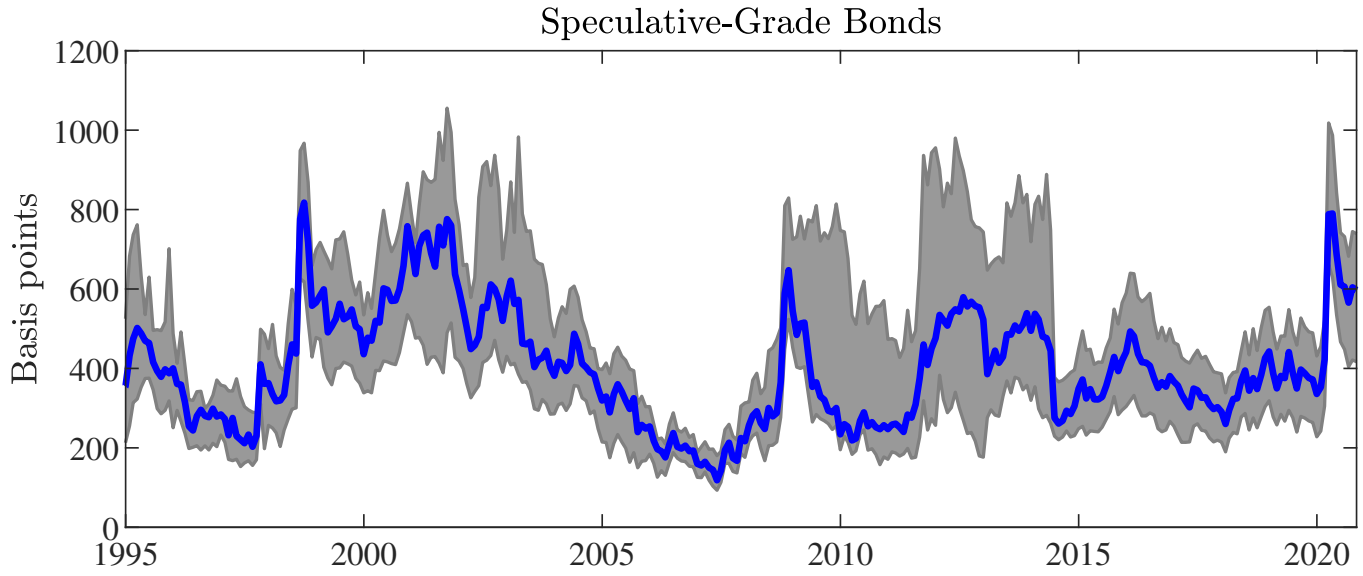




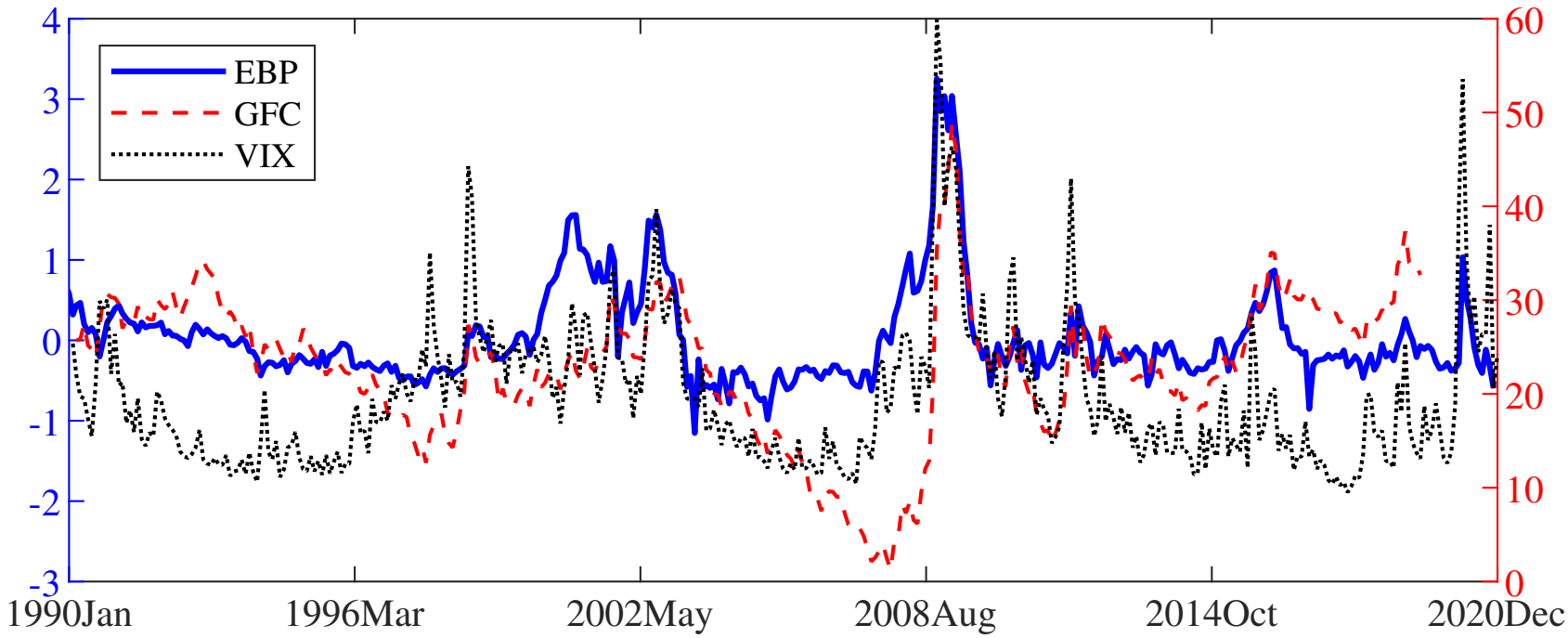
Measuring Financial Sector Risk

- Excess Bond Premium (EBP): an indicator of financial distress based on U.S. nonfinancial corporate bond spreads:
  (Measured as the difference between average U.S. corporate bond spread and average expected default risk Gilchrist & Zakrajšek [2012])

- Global Financial Cycle factor (GFC): an indicator of aggregate volatility or aggregate risk aversion in financial markets.
  (Measured as the global factor in world risky assets prices. Miranda-Agrippino & Rey [2020])

- VIX is an alternative measure of global financial risk due to aggregate volatility.

Measures of Global Financial Risk



Global Risk Factors and Sovereign CDS Spreads

	CDS Spread				Default Component				Risk-Premium Component			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
EBP	22.04*			−5.23	11.26**			2.57	10.78			−7.80
	(11.78)			(14.53)	(3.79)			(2.29)	(9.72)			(12.95)
GFC		38.10***		38.67***		9.33***		7.79**		28.78***		30.87**
		(9.39)		(12.31)		(2.81)		(2.80)		(8.83)		(11.33)
VIX			1.59**	0.24			0.62*	0.50			0.96*	−0.26
			(0.72)	(1.12)			(0.29)	(0.39)			(0.51)	(0.81)
R^2	0.40	0.44	0.40	0.44	0.65	0.67	0.64	0.67	0.29	0.33	0.29	0.33
N	2,924	2,672	2,924	2,672	2,924	2,672	2,924	2,672	2,924	2,672	2,924	2,672

NOTE: Standard errors are clustered in bond and date dimensions. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$
Other global factors: SP500 return, 2-year real rate, term spread
Local factors: stock returns and realized vol, FX returns and realized vol

Global Risk Factors and Sovereign Bond Spreads

	Investment Grade				Speculative Grade			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
EBP	0.13***			0.07	0.52***			0.11
	(0.05)			(0.05)	(0.11)			(0.14)
GFC		0.14***		0.12***		0.81***		0.83***
		(0.03)		(0.04)		(0.09)		(0.09)
VIX			0.01***	−0.00			0.05***	−0.02
			(0.00)	(0.00)			(0.01)	(0.01)
R^2	0.73	0.73	0.72	0.73	0.65	0.69	0.65	0.69
Obs.	65,116	65,116	65,116	65,116	21,605	21,605	21,605	21,605

NOTE: Standard errors are clustered in bond and date dimensions. * p $<$ 0.10, ** p $<$ 0.05, *** p $<$ 0.01
Other global factors: SP500 return, 2-year real rate, term spread
Local factors: stock returns and realized vol, FX returns and realized vol
Bond controls: coupon rate, coupon freq, time to maturity, par value

Persistence of Global Factors' Effects

	CDS Premium		Default Risk		Risk Premium	
	1-month	6-month	1-month	6-month	1-month	6-month
EBP	−1.92	35.35*	2.94	13.51**	−4.86	21.84
	(13.99)	(17.92)	(2.49)	(5.48)	(12.27)	(13.33)
GFC	31.16**	−9.00	5.93**	−5.12	25.24**	−3.88
	(11.64)	(10.74)	(2.64)	(3.02)	(10.54)	(8.36)
VIX	−0.11	−1.83	0.41	−0.34	−0.52	−1.49
	(1.22)	(1.18)	(0.44)	(0.46)	(0.86)	(0.85)
R^2	0.45	0.38	0.67	0.63	0.34	0.27
Obs.	2,668	2,663	2,668	2,663	2,668	2,663

NOTE: Standard errors are clustered in bond and date dimensions. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$
Other global factors: SP500 return, 2-year real rate, term spread
Local factors: stock returns and realized vol, FX returns and realized vol

Persistence of Global Factors' Effects

Lag(months)	1	2	3	4	5	6	9	12	18
Panel A: Investment Grade									
EBP	0.06	0.11	0.15*	0.23***	0.26***	0.30***	0.23***	0.26***	−0.05
	(0.06)	(0.07)	(0.08)	(0.08)	(0.08)	(0.07)	(0.07)	(0.06)	(0.07)
GFC	0.07*	0.01	−0.05	−0.10**	−0.14***	−0.18***	−0.27***	−0.28***	−0.18***
	(0.04)	(0.04)	(0.04)	(0.05)	(0.05)	(0.05)	(0.06)	(0.06)	(0.05)
VIX	0.00	0.00	−0.00	−0.00	−0.01	−0.01	0.01	0.01	0.03***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Panel B: Speculative Grade									
EBP	0.22	0.41**	0.47***	0.53***	0.56***	0.64***	0.61***	0.61***	0.28*
	(0.15)	(0.16)	(0.17)	(0.17)	(0.16)	(0.16)	(0.18)	(0.16)	(0.16)
GFC	0.72***	0.57***	0.46***	0.33***	0.24**	0.16	−0.02	−0.18	−0.41***
	(0.09)	(0.10)	(0.11)	(0.11)	(0.11)	(0.12)	(0.12)	(0.13)	(0.10
VIX	−0.03*	−0.04**	−0.04**	−0.04**	−0.04**	−0.04**	−0.02	−0.01	0.05***
	(0.01)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.01)

NOTE: Standard errors are clustered in bond and date dimensions. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Impact of Global Financial Risk on Sovereign Spreads

- Local projection regression

$$
\begin{aligned}
s_{k,i,t+j} &= b_{0,i} + \sum_{q=1}^{p} \beta_{s,q,j} s_{i,t-j} + \sum_{q=1}^{p} \beta_{x,q,j} x_{t-q} + \sum_{q=1}^{p} \beta_{y,q,j} y_{i,t-q} \\
&+ \beta_{z,k,t} z_{k,i,t} + \beta_{x,j} \tilde{x}_t + \beta_{y,j} \tilde{y}_{i,t} + e_{it}
\end{aligned}
$$

  - $\mathbf{x}_t$ = global factors
    (real yield on U.S. 2-year treasury bond, slope of U.S. yield curve, S&P 500 return, VIX, EBP and GFC)
  - $\mathbf{y}_{it}$ = country-specific factors
    (stock returns, FX returns, realized equity volatility)
  - $\mathbf{z}_{it}[k]$ = bond-specific control variables
    (duration, par amount, age, coupon, coupon freq.)

Impulse Response of Sovereign Spreads to Global Financial Risk

- Local projection regression

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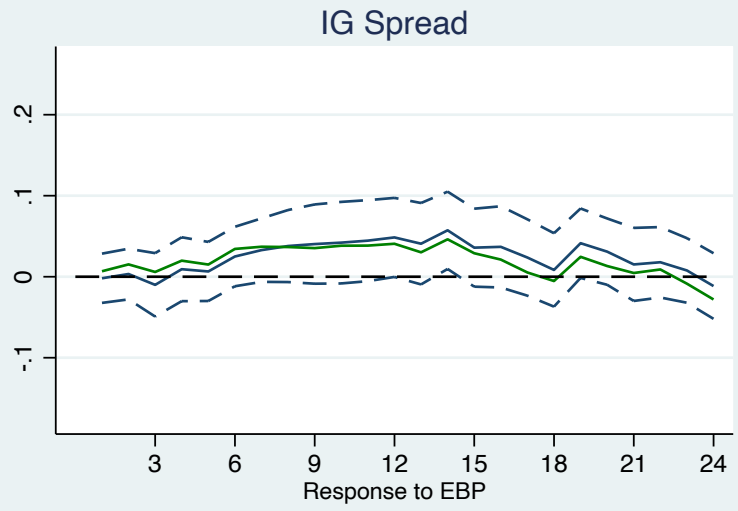
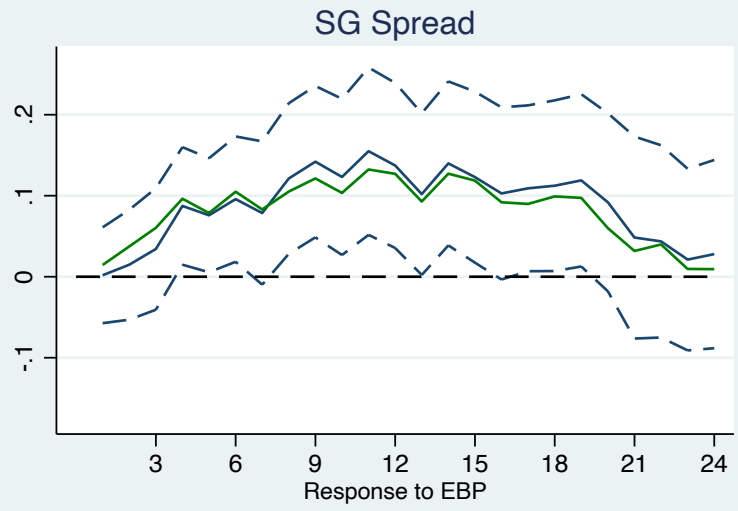
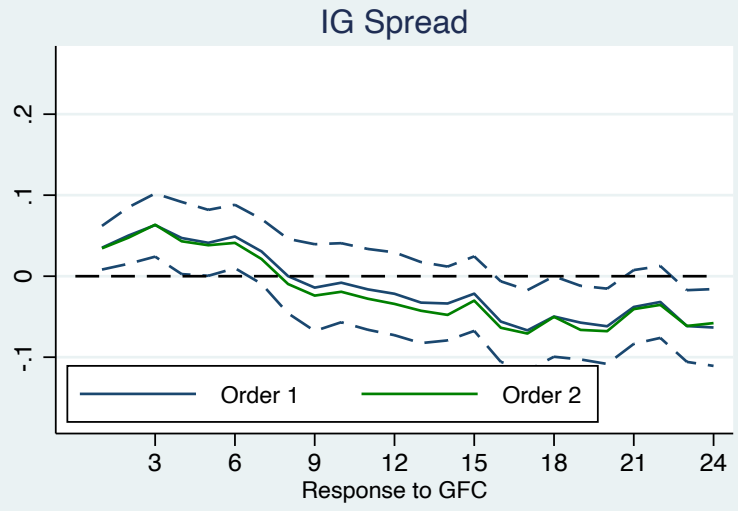
\begin{aligned}
s_{k,i,t+j} &= b_{0,i} + \sum_{q=1}^{p} \beta_{s,q,j} s_{i,t-j} + \sum_{q=1}^{p} \beta_{x,q,j} x_{t-q} + \sum_{q=1}^{p} \beta_{y,q,j} y_{i,t-q} \\
&+ \beta_{z,k,t} z_{k,i,t} + \beta_{x,j} \tilde{x}_t + \beta_{y,j} \tilde{y}_{i,t} + e_{it}
\end{aligned}
$$

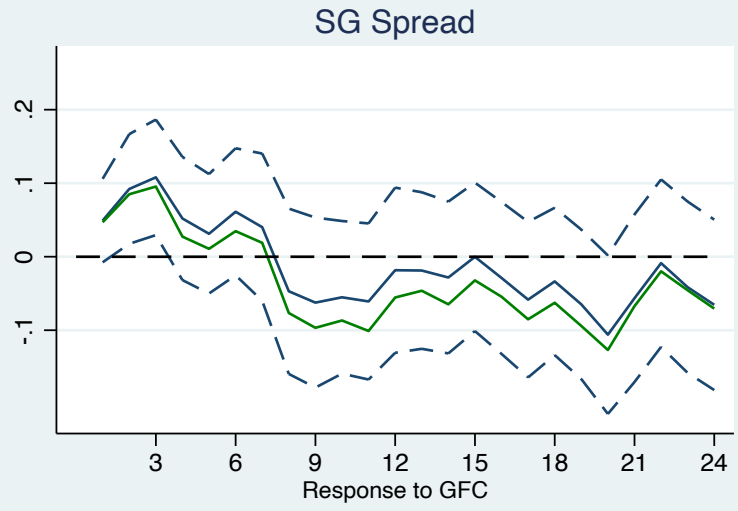
  - $\tilde{x}_t$ = shocks calculated as orthogonalized residuals obtained from a regression of x_t on six lags of x_t. $\tilde{x}_t$ = normalized by its std. Cholesky decomposition with ordering of
    (real yield on U.S. 2-year treasury bond, slope of U.S. yield curve, S&P 500 return, VIX, EBP and GFC)
  - $\beta_{x,j}$ = estimated impulse response of the sovereign spread $s_{i,t}$ at horizon j to a one-standard deviation shock
  - Alternative with EBP ordered last.

Implications of a Financial Sector Risk Shock









Simple Model to Illustrate Empirical Results

- Introduce international financial intermediaries into a model of sovereign debt

- Banks with Value-at-Risk rule and mean-variance investors (Shin (2012), Adrian and Shin (2011), Miranda-Agrippino andRey (2020))

Sovereign Borrowers

- A continuum of sovereign borrowers live for 2 periods

$$u(c_0) + \beta E u(c_1)$$

- Zero endowment in period 0.
- Log of endowment in period 1 given by

$$z_i = \rho Y + y_i$$

Both the aggregate and idiosyncratic factors are drawn from independent normal distributions

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Sovereign Default Risk

- Individual country borrows discount bond to smooth consumption and can default
- If a country defaults, its income drops to $(1-\phi)\exp(z_i)$
- The default cutoff z^* is given by

$$z^* = \log\left(\frac{b}{\phi}\right)$$

- Demand for sovereign bond for each country:

$$\max_{b>0;} u(q(b)\,b) + \beta \left[\begin{array}{c} \int_{z^*} u(\exp(z) - b)\, dP(z) \\ + \int^{z^*} u((1-\phi)\exp(z))\, dP(z_i) \end{array} \right]$$

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Financial Intermediaries

- FI takes equity E as given, lends out is $q(b)B^b$ at time 0 and borrows L at r^f.
  - Balance sheet identity is

$$qB^b = E + L.$$

- Financial intermediaries (FI) diversify away idiosyncratic credit risk.
  - Conditional on Y, sovereign defaults are independent

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Value-at-Risk Rule

- As in Shin (2012), financial intermediaries are risk neutral and maximize expected profit subject only to a Value-at-Risk (VaR) constraint that limits the probability of bank failure
  - FI limits insolvency probability to α

$$\Pr\left(\omega \leq (1+r_f)\, L\right) \leq \alpha$$

where ω is the value of the bank's assets at date 1

- Backbone of Basel capital requirement. [Danielsson, Shin and Zigrand (2009), Adrian, Etula and Shin (2011), Miranda Agrippino and Rey (2013) for evidence and applications on capital flow and risk premium.]

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Supply of Intermediated Credit

- Given individual country's default threshold z^*, value of the bank's assets at date 1 $\omega(Y)$ is

$$\omega(Y) = B^b * \Pr(z \geq z^* | Y) = B^b * \Phi\left(\frac{\rho Y - z^*}{\sigma_y}\right).$$

- Fix equity E, Intermediated credit supply B^b and demand for funding L are

$$B^b = \frac{(1+r_f)E}{(1+r_f)q - \varphi}$$

$$L = \frac{\varphi E}{(1+r_f)q - \varphi}$$

where the ratio of notional liabilities to notional assets in period 1 is $\varphi \equiv \frac{(1+r_f)L}{B^b} = \Phi\left(\frac{\rho\sigma_Y \Phi^{-1}(\alpha) - z^*}{\sigma_y}\right)$ derived from VaR rule.

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Bond Investors

- Measure N of mean variance investors with risk aversion parameter σ^H purchase a diversified portfolio of sovereign bonds and deposits in FI.
- Supply for direct credit is

$$B^h = N \frac{(1 - E\widetilde{p}) - (1 + r_f)\, q}{\sigma^H \cdot var\,(\widetilde{p})\, \frac{1}{q}}$$

where the default probability $\widetilde{p}(Y) = \Phi\left(\frac{z^* - \rho\, Y}{\sigma_y}\right)$ depends on the aggregate shock Y, given sovereign's default threshold z^*.

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Equilibrium

An equilibrium is $\left\{q(b), b, B^b, B^h\right\}$ such that

1. Given $q(b)$, b solves the sovereign borrower's problem. The default cutoff z^* characterizes the sovereign country's default decision.

2. Given $q(b)$ and z^*, B^b is the bank credit supply.

3. Given $q(b)$ and z^*, B^h is the households credit supply.

4. Sovereign debt market clears, such that

$$B^b + B^h = b$$

Parameters

Parameter	Estimate
σ_Y	0.1
σ_y	0.1
ρ	0.9
ϕ	0.2
r^f	0.05
β	0.95
γ^s	2
γ^h	2
N	0.1
α	0.001
E	0.01

Numerical Example

	Baseline (1)	$\sigma_Y = 0.15$ (2)	$\alpha = 0.005$ (3)	$\rho = 0.95$ (4)
Debt level b	0.156	0.146	0.157	0.157
Intermediated credit B^b	0.018	0.013	0.026	0.017
Direct credit B^h	0.138	0.133	0.131	0.140
Average default probability	0.035	0.033	0.035	0.039
Sovereign spreads	0.057	0.067	0.055	0.066
Risk premium	0.022	0.034	0.020	0.027
Notional leverage	0.369	0.145	0.552	0.313
Bank leverage qB^b/E	1.638	1.183	2.386	1.500

Baseline parameters: Aggregate volatility $\sigma_Y = 0.1$, Value-at-Risk parameter $\alpha = 0.001$, Sensitivity of a country's income to aggregate risk $\rho = 0.9$

Conclusion

- Global financial risk factors have a significant and persistent impact on sovereign credit spreads.
- Fluctuations in the risk-bearing capacity of the financial intermediary sector are an important driver of spreads.

Sovereign Bond Characteristics

Bond Characteristic	Mean	StdDev	Min	Median	Max
No. of bonds per country/month	10.3	46.0	1	4	865
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Credit spread (bps.)	231	225	0.01	165	1,998
Percentage of IG bonds	69%				

lags	1	3	6	9	12	18
A. Investment Grade						
EBP	0.06	0.15*	0.30***	0.23***	0.26***	−0.05
	(0.06)	(0.08)	(0.07)	(0.07)	(0.06)	(0.07)
GFC	0.07*	−0.05	−0.18***	−0.27***	−0.28***	−0.18***
	(0.04)	(0.04)	(0.05)	(0.06)	(0.06)	(0.05)
VIX	0.00	−0.00	−0.01	0.01	0.01	0.03***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
B. Speculative Grade						
EBP	0.22	0.47***	0.64***	0.61***	0.61***	0.28*
	(0.163)	(0.170)	(0.174)	(0.172)	(0.176)	(0.161)
GFC	0.72***	0.46***	0.16	−0.02	−0.18	−0.41***
	(0.09)	(0.11)	(0.12)	(0.12)	(0.13)	(0.10
VIX	−0.03*	−0.04**	−0.04**	−0.02	−0.01	0.05***
	(0.01)	(0.02)	(0.02)	(0.02)	(0.02)	(0.01)

NOTE: Standard errors are clustered in bond and date dimensions. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$