Global Pricing of Risk and Stabilization Policies

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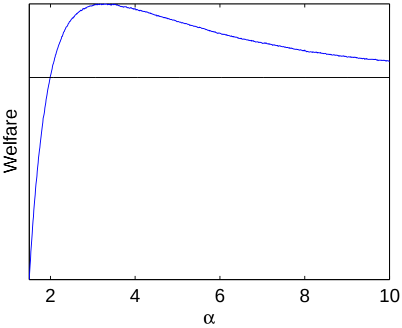
Risk-Return Tradeoff and Economic Policies

Previous work: Theory of Adrian and Boyarchenko (2012)



This talk: Document risk-return tradeoff empirically

1. For global pricing of risk exposures
2. For monetary, fiscal, prudential policy

Our Logic

1. Global financial institutions impact the global pricing of risk
   - volatility is key state variable
2. Risk-return tradeoff: Larger global price of risk exposure accompanies
   - higher growth
   - higher volatility
3. Countries can mitigate this shift of the risk-return tradeoff via
   - monetary policy
   - fiscal policy
   - macroprudential policies

Outline

Global Institutions and Global Pricing of Risk

Global Pricing of Risk and the Macro Risk-Return Tradeoff

The Macro Risk-Return Tradeoff and Economic Policies

VIX as a Measure of Risk Appetite

- VIX measures global pricing of risk
  - Global capital flows, credit growth, & asset prices comove with the VIX (Rey (2015))
  - Price of sovereign risk correlates strongly with the VIX (Longstaff, Pan, Pedersen, and Singleton (2011))
  - Nonlinear function of the VIX forecasts stock & bond returns (Adrian, Crump, and Vogt (2015))

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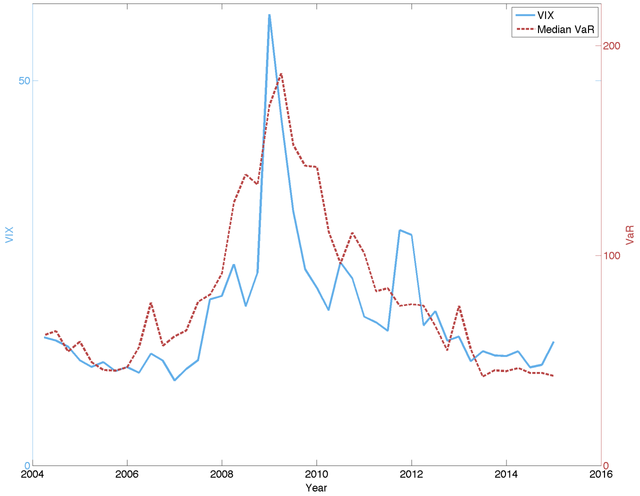
  - Nonlinear function of the VIX forecasts stock & bond returns (Adrian, Crump, and Vogt (2015))
- Monetary policy and the pricing of risk interact
  - Policy rate reacts to the VIX (Bekaert, Hoerova, and Duca (2013))
  - Substantial variation in the VIX attributed to rate shocks (Miranda-Agrippino and Rey (2014))
  - Risk taking channel of monetary policy (Borio and Zhu (2012))
- Why is the VIX so important?

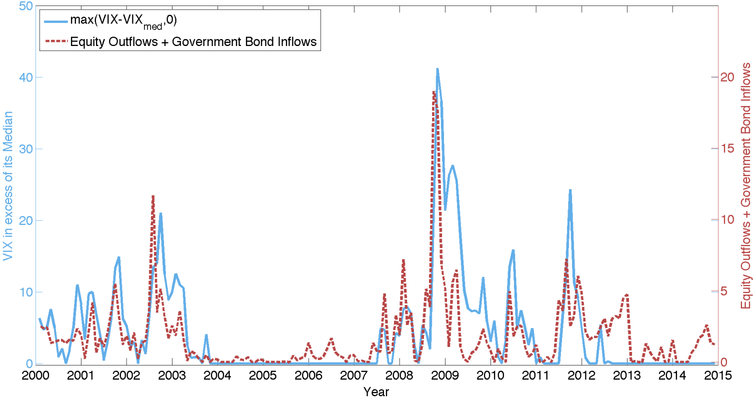
Global Financial Institutions

- Asset allocation is largely delegated to financial institutions
- The delegation gives rise to principal agents problems
- Contractual features between institution and their investors
  - redemptions for asset managers (Vayanos (2004))
  - high water marks for hedge funds (Panageas and Westerfield (2009))
  - VaR constraints for banks (Adrian and Shin (2014))
- Intermediary constraints tend to correlate with volatility
- In equilibrium, such constraints impact pricing
  - intermediary asset pricing He and Krishnamurthy (2008, 2011)

VaR Constraints of Global Financial Institutions



Large VIX and Fund Flows



Institutional Asset Pricing: Theory

Each global financial institution i maximizes

$$\max_{n_t^i} E_t[n_t^i r_{t+1}] - Cov_t[n_t^i r_{t+1}, X_{t+1}]\psi_t^i$$

$$s.t. VaR_t^i \cdot \alpha \leq w_t^i$$

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$$s.t. VaR_t^i \cdot \alpha \leq w_t^i$$

Then the demand for each risky asset is:

$$n_t^i = \frac{1}{\lambda_t^i \alpha}[E_t[r_{t+1}] - Cov_t[r_{t+1}, X_{t+1}]\psi_t^i][Var_t(r_{t+1})]^{-1}$$

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Market clearing gives equilibrium returns

$$E_t[r_{t+1}] = Cov_t(r_{t+1}, r_{t+1}^M)\frac{1}{\sum_i \frac{w_t^i}{\lambda_t^i \alpha}} + Cov_t[r_{t+1}, X_{t+1}]\frac{\sum_i \frac{w_t^i \psi_t^i}{\lambda_t^i \alpha}}{\sum_i \frac{w_t^i}{\lambda_t^i \alpha}}$$

Institutional Asset Pricing: Predictions

Global equilibrium expected returns are:

$$E_t[r_{t+1}] = \beta_t \Lambda_t$$

We assume affine prices of risk:

$$\Lambda_t = \lambda_0 + \lambda_1 X_t$$
$$X_t = \left[r_t^M, r_t^f, \phi(vix_t) \right]'$$

$\phi(vix_t)$ is a nonlinear function of the VIX that is forecasting returns.

Nonlinearities in the VIX Matter

- Adrian, Crump, and Vogt (2015): Compensation for risk and flight-to-safety in US stock and bond returns is nonlinear in the VIX

- Intuition: Large moves in VIX are potentially systemic events $\Rightarrow$ priced differently than day-to-day fluctuations in uncertainty

- $\phi\left(vix_t\right)$ captures these nonlinearities, consistent with
  - asset manager asset pricing, e.g. Vayanos (2004)
  - intermediary asset pricing, e.g. Adrian and Boyarchenko (2012)

Estimation of the VIX Pricing Function

- The global price of risk variable $\phi(VIX_t)$ is unknown
  - Estimate nonparametrically by running a forecasting regressions of global USD equity and bond returns of 27 countries on lagged VIX + global market

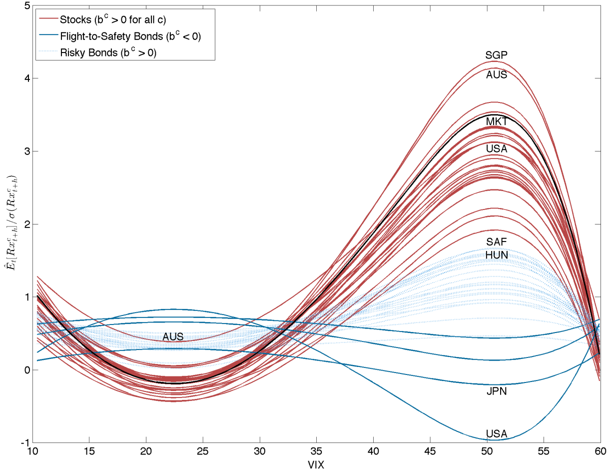
- Sieve Reduced Rank Regressions (SRRR) of (Adrian, Crump, Vogt)

$$r_{t+h}^c = a^c + b^c \phi(VIX_t) + \eta_{t+h}^c, \quad c = 1, \ldots, (n^{eqts} + n^{bnds} + mkt)$$

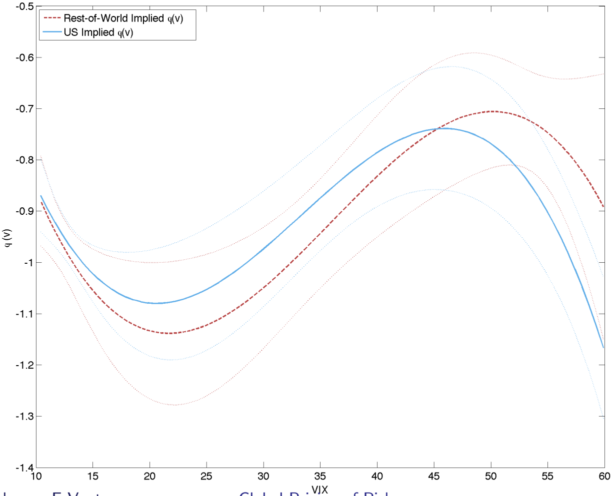
- Each expected asset return is an affine transformation of a **common** nonlinear function
  - SRRR advantage: all 27 equity and 27 bond returns are jointly informative about shape of $\phi(\cdot)$

Conditional Sharpe Ratios of Global Stocks and Bonds

$$\hat{E}_t\left[r^c_{t+h}\right] = \hat{a}^c + \hat{b}^c\ \hat{\phi}\left(VIX_t\right)$$



Robustness of the Shape of the Nonlinearity: $\phi(v)$ Separately Estimated for US and Rest-of-the-World



Global Pricing of Risk

Prices of Risk	*MKT*	*RF*	$\phi(v)$
λ_1	1.09***	-0.03**	-0.49***

$$E_t[r_{t+h}] \;=\; \beta(\lambda_0 + \lambda_1 X_t)$$

State variables $X_t = [MKT_t, RF_t, \phi(v_t)]'$ are

1. price of risk forecasting variables
2. cross sectional pricing factors

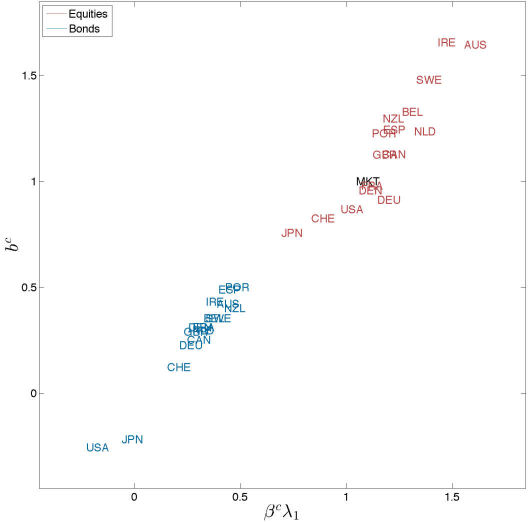
Global Equity Exposures

	β^i_{MKT}	β^i_{RF}	$\beta^i_{\phi(v)}$	$\beta^i \lambda_1$	$(\alpha^i + \beta^i \lambda_0)$
MKT	0.99***	0.49	0.02	1.05***	0.15***
aus Equity	1.10***	-5.50***	-0.42**	1.58***	0.23***
bel Equity	1.20***	-1.45	0.18	1.27***	0.19***
can Equity	1.01***	5.19***	-0.49***	1.17***	0.19***
che Equity	0.88***	1.81	0.15	0.83***	0.14***
den Equity	1.03***	5.51***	-0.15	1.02***	0.19***
deu Equity	1.24***	-1.33	0.52***	1.14***	0.15***
esp Equity	1.20***	-3.45*	0.49***	1.18***	0.18***
fra Equity	1.15***	1.83	0.28**	1.06***	0.16***
gbr Equity	1.00***	2.21*	-0.19*	1.11***	0.15***
ire Equity	1.17***	1.95	-0.44	1.42***	0.19***
jpn Equity	0.89***	0.53	0.45**	0.73***	0.05***
nld Equity	1.21***	0.21	-0.01	1.32***	0.17***
nzl Equity	0.68***	-4.65*	-0.66**	1.21***	0.19***
por Equity	1.28***	-1.31	0.65***	1.12***	0.13***
swe Equity	1.44***	4.23*	0.22	1.32***	0.21***
usa Equity	0.89***	0.94	-0.10	0.98***	0.16***

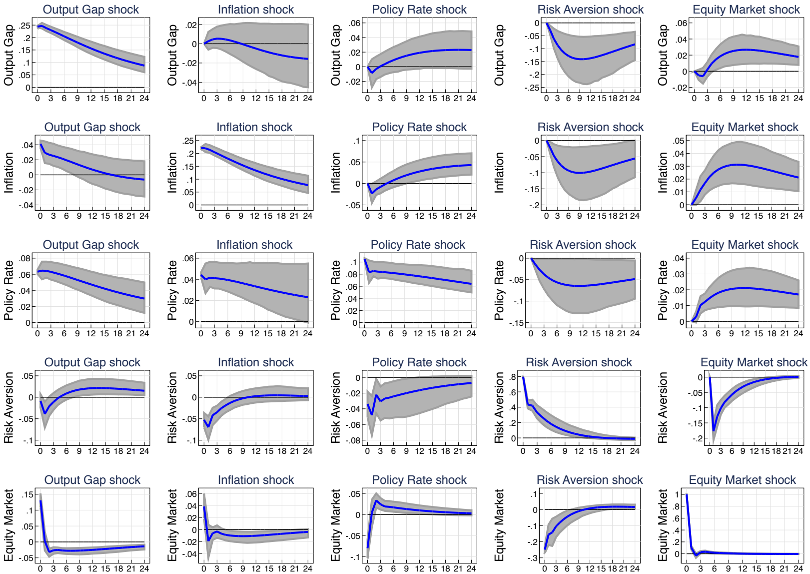
Global Bond Exposures

	β^i_{MKT}	β^i_{RF}	$\beta^i_{\phi(v)}$	$\beta^i\lambda_1$	$(\alpha^i + \beta^i\lambda_0)$
aus Bonds	0.15**	-3.05**	-0.28*	0.40***	0.11***
bel Bonds	0.14**	-6.66***	0.09	0.32***	0.09***
can Bonds	0.12**	0.07	-0.24**	0.25***	0.09***
che Bonds	-0.07	-5.93***	-0.09	0.16*	0.06***
den Bonds	0.07	-5.58***	-0.00	0.25***	0.08***
deu Bonds	0.04	-6.39***	0.08	0.21**	0.07***
esp Bonds	0.25***	-8.71***	0.30*	0.41***	0.12***
fra Bonds	0.10*	-6.95***	0.12	0.28***	0.08***
gbr Bonds	0.07	0.38	-0.30	0.20***	0.08***
ire Bonds	0.08	-5.49***	-0.11	0.32***	0.10***
jpn Bonds	-0.15***	-1.44	-0.09	-0.08	0.00
nld Bonds	0.06	-6.32***	0.01	0.27***	0.08***
nzl Bonds	0.16**	-4.29**	-0.24	0.43***	0.11***
por Bonds	0.43***	-8.07***	0.61*	0.44***	0.12***
swe Bonds	0.17***	-3.25*	-0.10	0.34***	0.10***
usa Bonds	-0.23***	-0.03	-0.05	-0.23***	0.03***

Institutional Asset Pricing Setup Implies $b^c = \beta^c \lambda_1$



Global Panel VAR



Takeaways from the Global Pricing of Risk

- Theoretically: VaR constraints of global financial institutions give role to volatility in the pricing of risk
- Empirically: VIX is a strong nonlinear forecasting variable as predicted by intermediary asset pricing theories
- Consequence 1: Cross country dispersion in the exposure to the global pricing of risk
- Consequence 2: Shocks to the global pricing of risk forecasts domestic macro performance

What are the macroeconomic consequences?

Outline

Global Institutions and Global Pricing of Risk

Global Pricing of Risk and the Macro Risk-Return Tradeoff

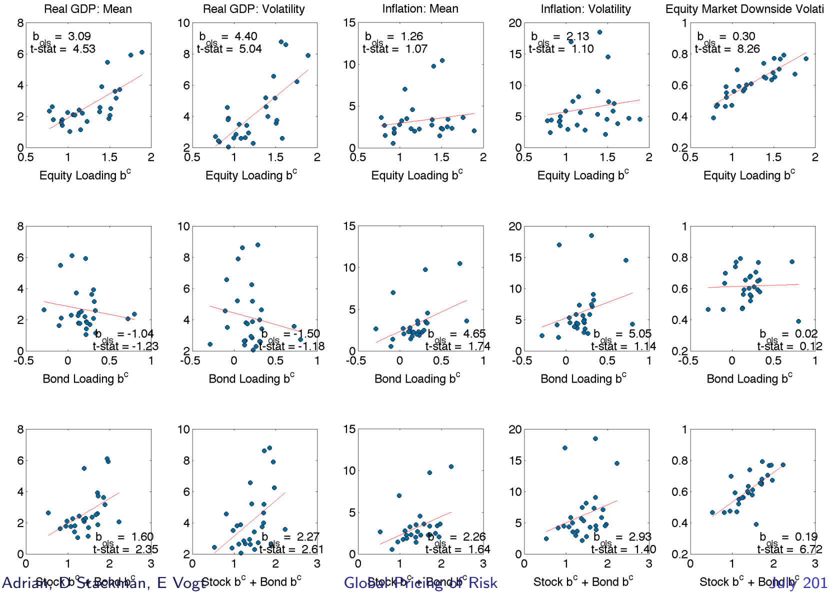
The Macro Risk-Return Tradeoff and Economic Policies

Global Bond Exposures and Macro Outcomes

- Exposure **b** to global pricing of risk varies across countries
- How does it relate to macro outcomes?

- Are countries with higher exposure more volatile?
- Do countries with higher exposure grow faster?
- Are crises more likely?

Macroeconomic Outcomes and Global Risk Exposures



Cross-Section of Macro and Financial Outcomes

Panel A: Macro Outcomes	Real GDP		Inflation	
	Mean	Volatility	Mean	Volatility
Equities	3.16***	4.49***	1.05	1.90
Bonds	−1.34	−1.91	4.55*	4.87
p-val	0.00	0.00	0.20	0.36
R^2	0.56	0.55	0.22	0.09
Obs	27	27	27	27

Panel B: Banking Outcomes	Credit		Crisis Output	
	Boom	NPL	Pre-Crisis Gain	Crisis Loss
Equities	1.14***	28.38***	19.81***	60.58**
Bonds	0.21	−12.25	−3.44	−1.18
p-val	0.00	0.00	0.00	0.04
R^2	0.46	0.41	0.41	0.24
Obs	22	22	27	22

Panel C: Financial Market Outcomes	Equity Market		Bond Market	
	Mean	Downside Volatility	Mean	Upside Volatility
Equities	0.00	0.30***	0.25	−0.20
Bonds	0.07***	−0.01	5.20***	0.83**
p-val	0.02	0.00	0.00	0.01
R^2	0.26	0.74	0.59	0.22
Obs	27	27	27	27

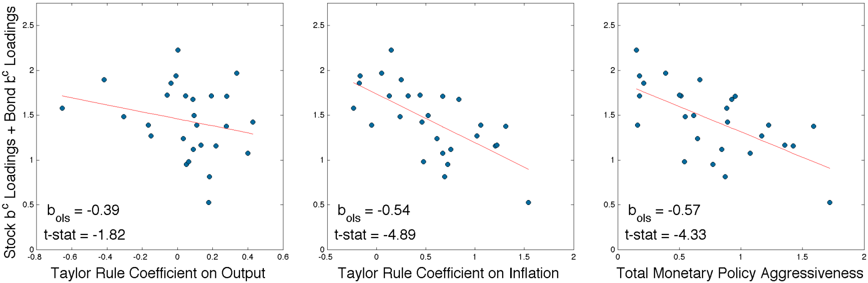
Global Bond Exposures and Economic Policies

- Is aggressiveness of stabilization policies systematically related to global price of risk exposure?
  - Aggressiveness of monetary policy
  - Degree of countercyclicality of fiscal policy
  - Macroprudential policies

Aggressiveness of Stabilization Policies

	Taylor Rule Coefficients			Fiscal Policy Variables		Macroprudential Index
	δ_c^{output}	δ_c^{infl}	$\lvert\delta_c^{output}\rvert + \lvert\delta_c^{infl}\rvert$	Mean Gov't Spending/GDP	Output Gap - Fiscal Exp. Corr.	Financial Inst. - Targeted
aus	-0.42	0.25	0.67	17.81	-1.38^{***}	1.00
bel	0.09^{**}	0.52	0.62	22.40	-0.45^{***}	2.00
can	-0.15	1.02^{***}	1.17	21.09	-0.23^{***}	3.00
che	0.05^{***}	0.72^{***}	0.77	10.95	-0.54^{**}	1.57
cze	0.06^{**}	0.48^{***}	0.54	19.93	-0.33^{**}	1.00
den	0.22^{***}	1.21	1.43	25.05	-0.50^{***}	
deu	0.40^{***}	0.67^{***}	1.07	18.79	-0.61^{***}	0.57
esp	-0.17	1.06^{***}	1.22	18.03	-0.33^{***}	2.00
fin	0.19^{***}	0.32^{**}	0.51	22.22	-0.51^{***}	0.07
fra	0.13^{**}	1.22^{***}	1.36	22.64	-0.78^{***}	2.21
gbr	0.09^{***}	0.75^{***}	0.84	19.16	-0.22^{***}	0.00
hun	0.00^{*}	0.15^{***}	0.15	21.35	0.27^{**}	0.50
ire	-0.04	-0.18^{*}	0.21	16.12	-0.32^{***}	0.00
ita	0.03^{***}	0.61^{*}	0.65	18.89	-0.70^{***}	2.00
jpn	0.18^{**}	0.69^{**}	0.87	16.70	-0.41^{***}	1.00
kor	0.34^{***}	0.05^{***}	0.39	12.30	-0.63^{***}	0.71
mal	0.11^{***}	-0.05	0.16	11.93	-0.44^{***}	1.00
nld	0.28^{***}	1.31^{***}	1.59	23.10	-0.25^{***}	0.14
nor	0.43^{***}	0.46^{***}	0.89	20.53	-0.21^{**}	1.07
nzl	0.05^{***}	0.13	0.18	17.99	-0.36^{***}	0.00
pol	0.28^{**}	0.67^{***}	0.95	18.35	-0.58^{***}	1.00
por	-0.31	0.24^{**}	0.55	19.39	0.20^{**}	0.50
saf	-0.65^{*}	-0.23	0.89	18.91	0.18	0.07
sgp	-0.01^{*}	-0.17	0.18	9.98	0.08	1.00
swe	0.09^{**}	0.84^{***}	0.92	25.46	-0.13	0.00
tha	-0.06^{***}	0.44^{***}	0.50	13.80	0.24^{***}	0.21
usa	0.18^{***}	1.54^{***}	1.72	15.38	-0.71^{***}	2.93

Global Risk Exposures and Taylor Rule Coefficients



More aggressive Taylor rule coefficients associated with lower *b*

Do Aggressive Stabilization Policies Attenuate Global Risk Exposure?

	Dependent Variable: (Stock b^i + Bond b^i)								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Taylor Rule: δ^i_{output}	-0.39*								
Taylor Rule: δ^i_{infl}		-0.54***							
Taylor Rule: $\lvert\delta^i_{output}\rvert + \lvert\delta^i_{infl}\rvert$			-0.57***						
Fiscal: Mean Gov't Spending/GDP				-0.00					
Fiscal: Output Gap-Fiscal Expend. Corr.					0.30				
Macroprudential						-0.22***			
Crisis: Fiscal Bailout Expenditure							0.03***		
Crisis: Liquidity Injection								0.02***	
Crisis: Monetary Expansion									-0.03
R^2	0.06	0.44	0.40	0.00	0.07	0.25	0.37	0.53	0.07
Obs	27	27	27	27	27	26	22	22	22

This also holds when we look at stock and bond loadings individually

	Dependent Variable: Stock b^i								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Taylor Rule: δ^i_{output}	0.08								
Taylor Rule: δ^i_{infl}		-0.37***							
Taylor Rule: $\lvert\delta^i_{output}\rvert + \lvert\delta^i_{infl}\rvert$			-0.46***						
Fiscal: Mean Gov't Spending/GDP				-0.02					
Fiscal: Output Gap-Fiscal Expend. Corr.					0.12				
Macroprudential						-0.13**			
Crisis: Fiscal Bailout Expenditure							0.02***		
Crisis: Liquidity Injection								0.01***	
Crisis: Monetary Expansion									-0.03*
R^2	0.00	0.32	0.42	0.07	0.02	0.14	0.50	0.29	0.14
Obs	27	27	27	27	27	26	22	22	22
	Dependent Variable: Bond b^i								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Taylor Rule: δ^i_{output}	-0.47***								
Taylor Rule: δ^i_{infl}		-0.18							
Taylor Rule: $\lvert\delta^i_{output}\rvert + \lvert\delta^i_{infl}\rvert$			-0.11						
Fiscal: Mean Gov't Spending/GDP				0.02**					
Fiscal: Output Gap-Fiscal Expend. Corr.					0.18				
Macroprudential						-0.09*			
Crisis: Fiscal Bailout Expenditure							0.00		
Crisis: Liquidity Injection								0.01***	
Crisis: Monetary Expansion									0.00
R^2	0.26	0.14	0.05	0.09	0.08	0.12	0.04	0.49	0.00
Obs	27	27	27	27	27	26	22	22	22

Takeaway from the Macro Risk-Return Tradeoff

1. Higher exposure to the global pricing of risk corresponds to higher growth and higher volatility
    - Macro risk-return tradeoff
2. Economic policies are systematically related to price of risk exposures
    - Monetary policy
    - Fiscal policy
    - Macroprudential policy

How does pricing of risk interact with economic policies?

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Macro Risk-Return Tradeoff, Risk Exposure, and Stabilization Policies: Questions

- How do economic policies interact with the global pricing of risk?
- Is there a relationship between the macro risk-return tradeoff, global risk exposures, and stabilization policies?
- Estimate:

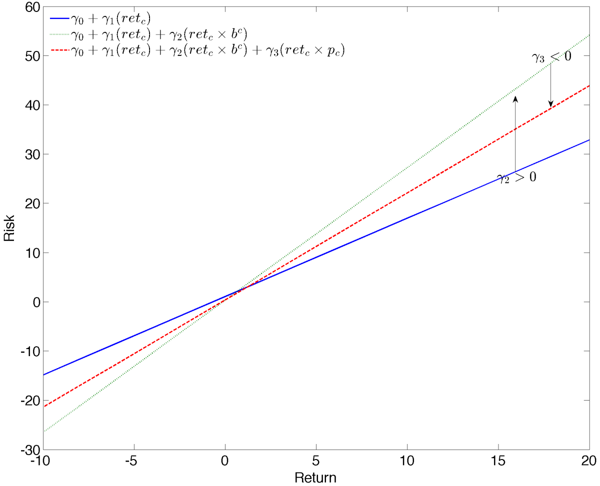
$$E[risk_c|\mathbf{x}] = \gamma_0 + \gamma_1 ret_c + \gamma_2(ret_c \cdot b^c) + \gamma_3(ret_c \cdot p_c) + \gamma_4(ret_c \cdot p_c \cdot b^c)$$

- **Risk-Return tradeoff** are given by partial effects:

$$\partial E[risk_c|\mathbf{x}]/\partial ret_c = \gamma_1 + \gamma_2 \cdot b^c + \gamma_3 \cdot p^c + \gamma_4(p^c \cdot b^c)$$

Macro Risk-Return Tradeoff

$$\partial E[risk_c|\mathbf{x}]/\partial ret_c = \gamma_1 + \gamma_2 \cdot b^c + \gamma_3 \cdot p^c + \gamma_4(p^c \cdot b^c)$$



Macro Risk-Return Tradeoff and Monetary Policy

	GDP Volatility				Inflation Volatility			
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
r	0.96***	−1.04**	−0.13	−0.20	1.59***	2.06***	2.13***	2.38***
$r \cdot b$		1.02***	0.57*	0.61*		−0.91***	−0.97***	−1.56***
$r \cdot p$			−0.50**	−0.41			−0.10	−0.47
$r \cdot b \cdot p$				−0.07				1.22*
R^2	0.45	0.55	0.60	0.60	0.78	0.83	0.83	0.85
Obs	27	27	27	27	27	27	27	27

	Crisis Peak NPL				Bank Flows Volatility			
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
r	8.01	−47.01***	−33.45*	−106.26***	0.93	0.58	2.16*	2.62**
$r \cdot b$		38.61***	31.86***	81.72***		1.39	0.25	−2.85
$r \cdot p$			−7.10	89.59**			−1.62**	−2.26***
$r \cdot b \cdot p$				−70.11**				3.98**
R^2	0.12	0.38	0.39	0.44	0.09	0.11	0.26	0.32
Obs	22	22	22	22	24	24	24	24

	Equity Downside Volatility				Yield Upside Volatility			
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
r	0.00	−5.22***	−5.15***	−4.35***	0.14***	0.19*	0.15*	0.16
$r \cdot b$		4.14***	4.10***	3.52***		−0.04	−0.04	−0.06
$r \cdot p$			−0.04	−1.06			0.07**	0.06
$r \cdot b \cdot p$				0.84				0.03
R^2	0.00	0.68	0.68	0.68	0.29	0.30	0.40	0.40
Obs	27	27	27	27	27	27	27	27

Macro Risk-Return Tradeoff and Fiscal Policy

	GDP Volatility				Inflation Volatility			
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
r	0.96^{***}	-1.04^{**}	-0.50	-0.51	1.59^{***}	2.06^{***}	2.07^{***}	2.41^{***}
$r \cdot b$		1.02^{***}	0.82^{***}	0.83^{**}		-0.91^{***}	-0.93^{**}	-1.18^{***}
$r \cdot p$			-0.49^{**}	-0.44			-0.02	-1.09^{**}
$r \cdot b \cdot p$				-0.03				2.72^{**}
R^2	0.45	0.55	0.63	0.63	0.78	0.83	0.83	0.86
Obs	27	27	27	27	27	27	27	27

	Crisis Peak NPL				Bank Flows Volatility			
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
r	8.01	-47.01^{***}	-42.10^{***}	-4.01	0.93	0.58	0.19	0.35
$r \cdot b$		38.61^{***}	37.56^{***}	12.97		1.39	1.49	0.94
$r \cdot p$			-13.52^{*}	-133.42^{**}			0.70	0.20
$r \cdot b \cdot p$				76.53^{*}				1.57
R^2	0.12	0.38	0.43	0.45	0.09	0.11	0.13	0.13
Obs	22	22	22	22	24	24	24	24

	Equity Downside Volatility				Yield Upside Volatility			
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
r	0.00	-5.22^{***}	-5.24^{***}	-5.05^{***}	0.14^{***}	0.19^{*}	0.20^{*}	0.22^{**}
$r \cdot b$		4.14^{***}	4.14^{***}	3.98^{***}		-0.04	-0.06	-0.08
$r \cdot p$			0.15	-0.81			-0.02	-0.09
$r \cdot b \cdot p$				0.70				0.19
R^2	0.00	0.68	0.68	0.68	0.29	0.30	0.30	0.33
Obs	27	27	27	27	27	27	27	27

Macro Risk-Return Tradeoff and Macroprudential Policy

	GDP Volatility				Inflation Volatility			
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
r	0.99^{***}	-0.99^{**}	-0.13	-1.07	1.59^{***}	2.06^{***}	2.54^{***}	2.65^{***}
$r \cdot b$		1.00^{***}	0.67^{**}	1.48^{***}		-0.91^{***}	-1.32^{***}	-1.89^{***}
$r \cdot p$			-0.88^{**}	2.11^{*}			-1.17^{**}	-1.55^{***}
$r \cdot b \cdot p$				-2.61^{**}				2.61^{***}
R^2	0.46	0.56	0.65	0.72	0.78	0.83	0.88	0.90
Obs	26	26	26	26	26	26	26	26

	Crisis Peak NPL				Bank Flows Volatility			
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
r	7.38	-47.64^{***}	-53.77^{***}	-36.88^{***}	0.93	0.57	1.40	1.70
$r \cdot b$		38.61^{***}	41.80^{***}	28.92^{***}		1.39	0.19	-1.36
$r \cdot p$			7.12	-84.99			-2.05^{**}	-2.53^{**}
$r \cdot b \cdot p$				74.91^{*}				3.29
R^2	0.10	0.37	0.38	0.42	0.09	0.11	0.22	0.23
Obs	21	21	21	21	23	23	23	23

	Equity Downside Volatility				Yield Upside Volatility			
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
r	0.09	-5.26^{***}	-5.34^{***}	-4.93^{***}	0.15^{***}	0.20^{**}	0.21^{**}	0.22^{*}
$r \cdot b$		4.16^{***}	4.20^{***}	3.82^{***}		-0.05	-0.06	-0.08
$r \cdot p$			0.15	-1.51			-0.02	-0.03
$r \cdot b \cdot p$				1.55				0.06
R^2	0.00	0.67	0.67	0.67	0.31	0.32	0.33	0.33
Obs	26	26	26	26	26	26	26	26

Conclusion

We document that:

1. Global pricing of risk can be measured from nonlinear VIX forecasting
2. Exposure to the global pricing of risk increases both risk and return of macroeconomic and financial performance measures
3. Economic policies can mitigate the impact of the global pricing of risk on the domestic risk-return tradeoff

These stylized facts suggest rethinking economic policies in light of global financial institutions' role in the transmission of the pricing of risk

To do list

1. Instrumenting for the policies
2. Dynamic interactions
3. Magnitudes

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