Do Intermediaries Matter for Aggregate Asset Prices?

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Research Question

How much variation in aggregate risk premia can we ascribe to intermediaries rather than to households?

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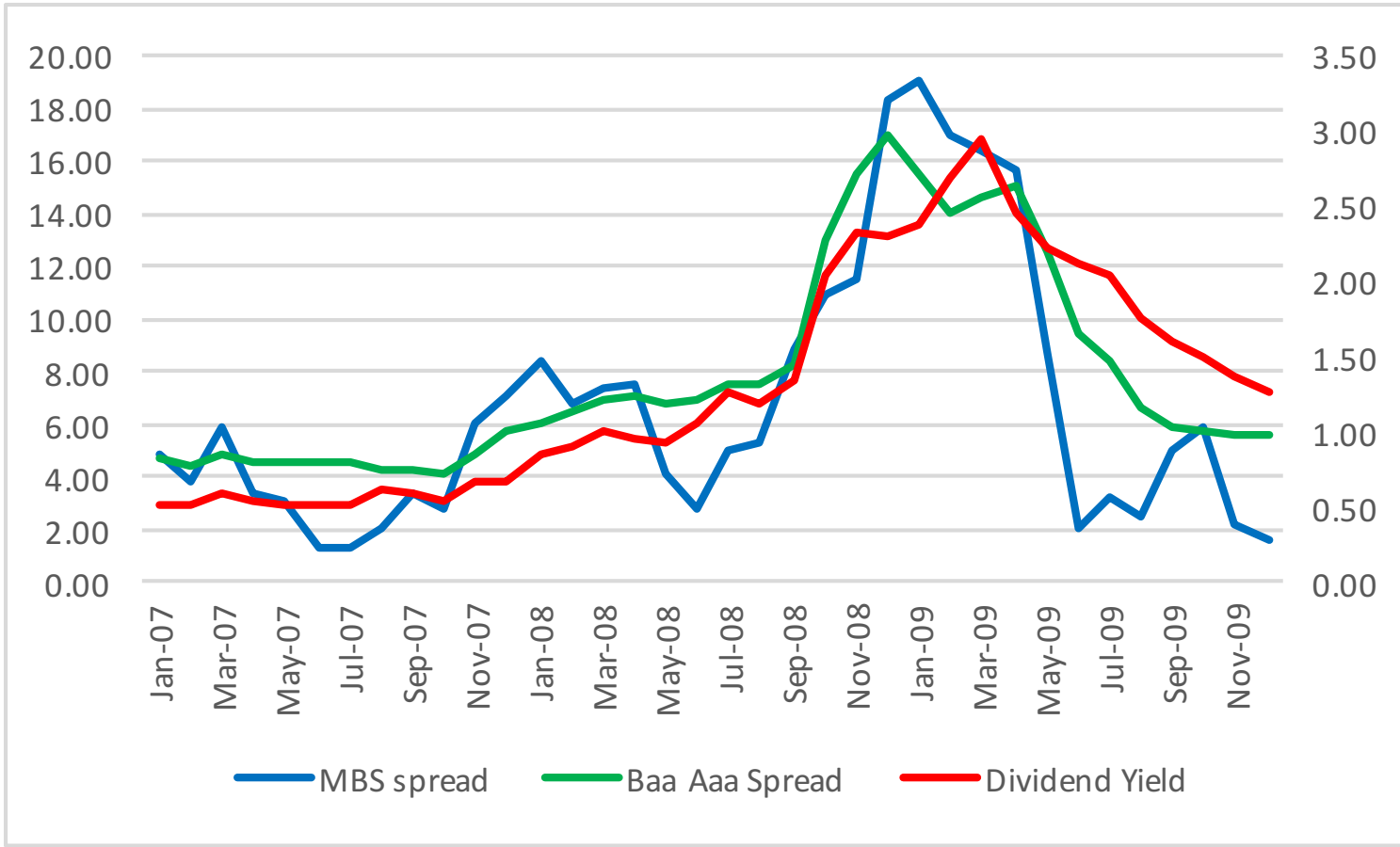
Example: 2008-09 Financial Crisis



- Intermediary risk-bearing capacity was impaired
- But aggregate risk aversion also likely moved
  - habits, sentiment, etc

What We Do

Intermediary risk appetite matters more for assets that are difficult to directly invest in, household risk appetite matters less

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1. Overcomes identification issue of positive correlation of intermediary and household risk aversion
2. Theoretically justified
   - A model that nests the simple version of two main views
   - Existing "intermediary tests" do not get at the question
3. Across asset classes, we find:
   - Measures of financial sector health predict returns more strongly in asset classes that are difficult to invest in
   - Household measures have opposite pattern
   - Unrelated to *observable* variation in risk (vol, skewness, or beta)

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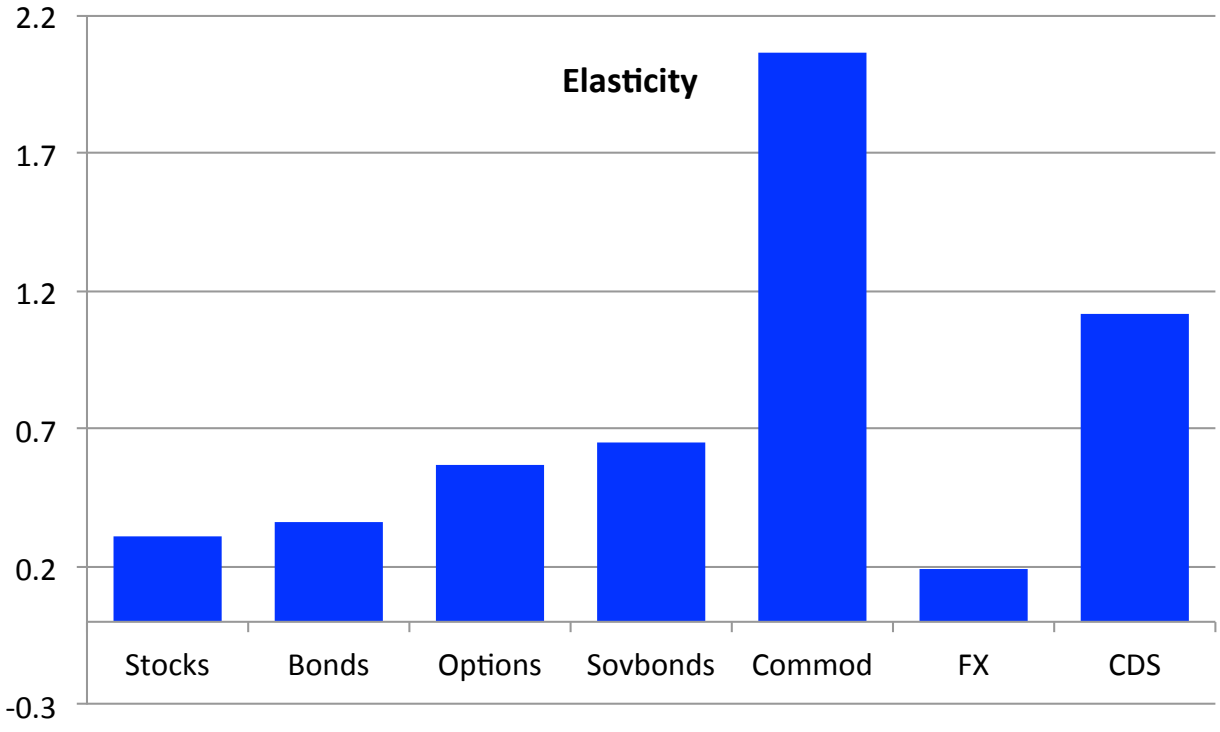
→ *Intermediaries and households have a distinct, but sizable effect on risk premia*

Main Result

$$\tilde{r}_{i,t+1} = a_i + b_i \hat{\gamma}_{I,t} + \varepsilon_{i,t+1}$$



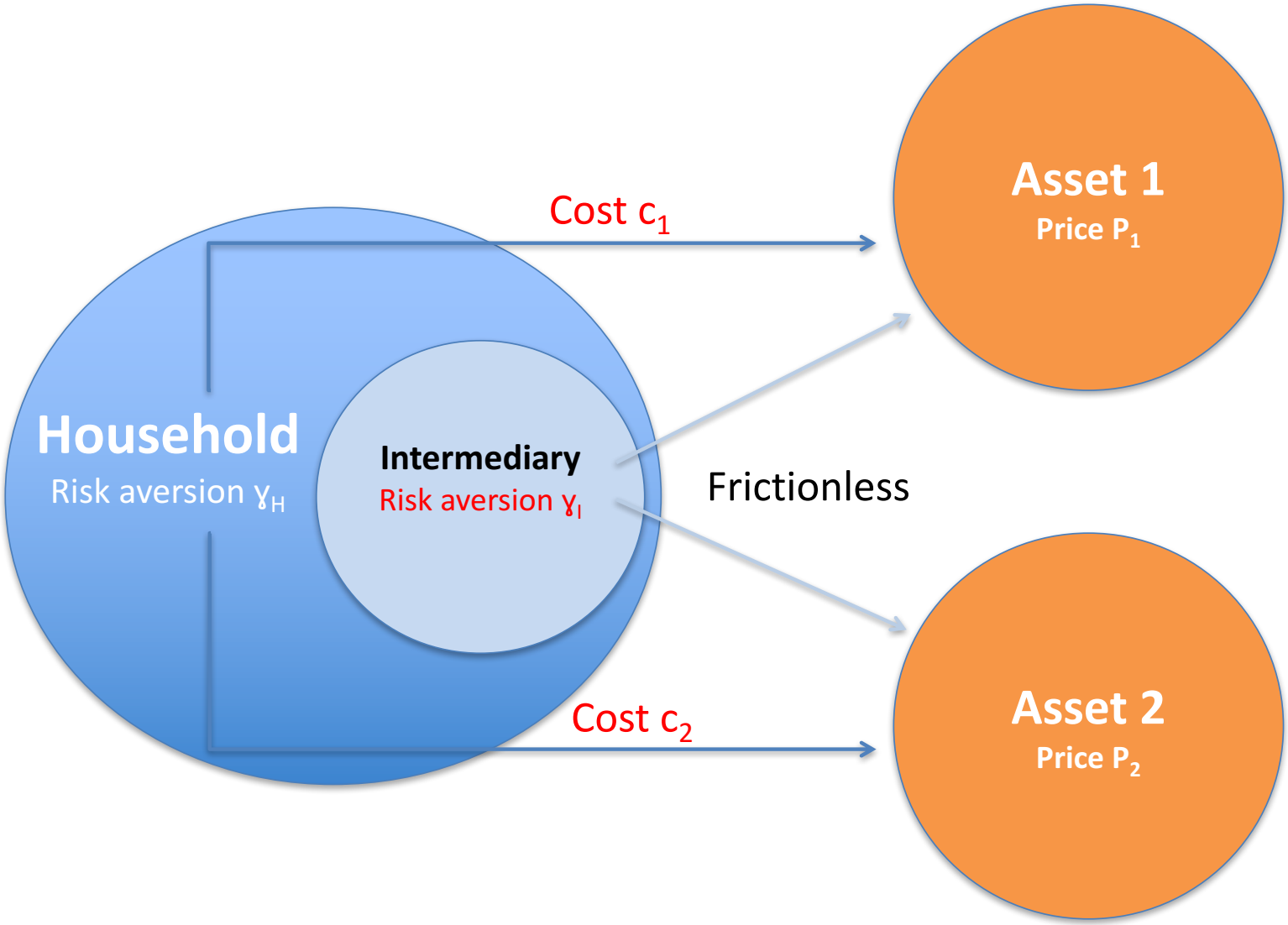
Literature

- Aggregate prices consistent with role of intermediaries: optimal decisions
  - Exposure to intermediary factor explains the cross-section of returns, e.g. Adrian Etula Muir (2014), He Kelly Manela (2017)
  - Intermediary balance sheet predicts future returns, e.g. Haddad Sraer (2016)
- Local evidence that intermediaries cause changes in prices
  - Arbitrage opportunities directly related to intermediation regulatory constraints, e.g. Du Tepper Verdelhan (2017), Lewis, Longstaff, Petrasek (2017)

Outline

Outline

Model



- Two periods, N assets with payoffs $\mathcal{N}(\mu, \Sigma)$

Setup

- **Household**: invest directly or through intermediary
  - CARA, risk aversion γ_H
  - Takes intermediary decisions as given
  - *Friction 1*: Assets differ in their ease of access for direct investment
  - quadratic cost of direct investment C

$$\max_{D_H} (D_H + D_I)' (\mu - p) - \frac{\gamma_H}{2} (D_H + D_I)' \Sigma (D_H + D_I) - \frac{1}{2} D_H' C D_H.$$

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- **Intermediary**
  - *Friction 2*: Intermediaries invest on behalf of household, but with different investment policies
  - CARA, risk aversion γ_I

$$\max_{D_I} D_I' (\mu - p) - \frac{\gamma_I}{2} D_I' \Sigma D_I.$$

Intermediary and Asset Prices

$$\mu - p = \gamma_H \Sigma \left(\Sigma + \frac{1}{\gamma_I} C \right)^{-1} \left(\Sigma + \frac{1}{\gamma_H} C \right) S$$

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$$\mu - p = \gamma_H \Sigma \left(\Sigma + \frac{1}{\gamma_I} C\right)^{-1} \left(\Sigma + \frac{1}{\gamma_H} C\right) S$$

Proposition: The intermediary matters for asset prices, that is $\partial(\mu - p)/\partial\gamma_I \neq 0$, if and only if

$$\gamma_I \neq \gamma_H \quad \textbf{and} \quad C \neq 0$$

1. Imperfect substitution
   - $C > 0 \Leftrightarrow \frac{\partial D_H}{\partial D_I} \neq -1$: Household doesn't undo intermediary decision.
2. Preference (mis)alignment
   - $\gamma_I \neq \gamma_H$: Intermediary isn't a veil who acts perfectly on behalf of household

Outline

Our Approach

$$\frac{1}{\mu_i - p_i} \frac{\partial(\mu_i - p_i)}{\partial \log(\gamma_I)} = \frac{c_i}{\gamma_I \sigma_i^2 + c_i} \geq 0$$

$$\frac{1}{\mu_i - p_i} \frac{\partial(\mu_i - p_i)}{\partial \log(\gamma_H)} = \frac{\gamma_H \sigma_i^2}{\gamma_H \sigma_i^2 + c_i} > 0$$

Our Approach

$$\frac{1}{\mu_i - p_i}\frac{\partial(\mu_i - p_i)}{\partial \log(\gamma_I)} = \frac{c_i}{\gamma_I \sigma_i^2 + c_i} \geq 0, \uparrow c_i$$

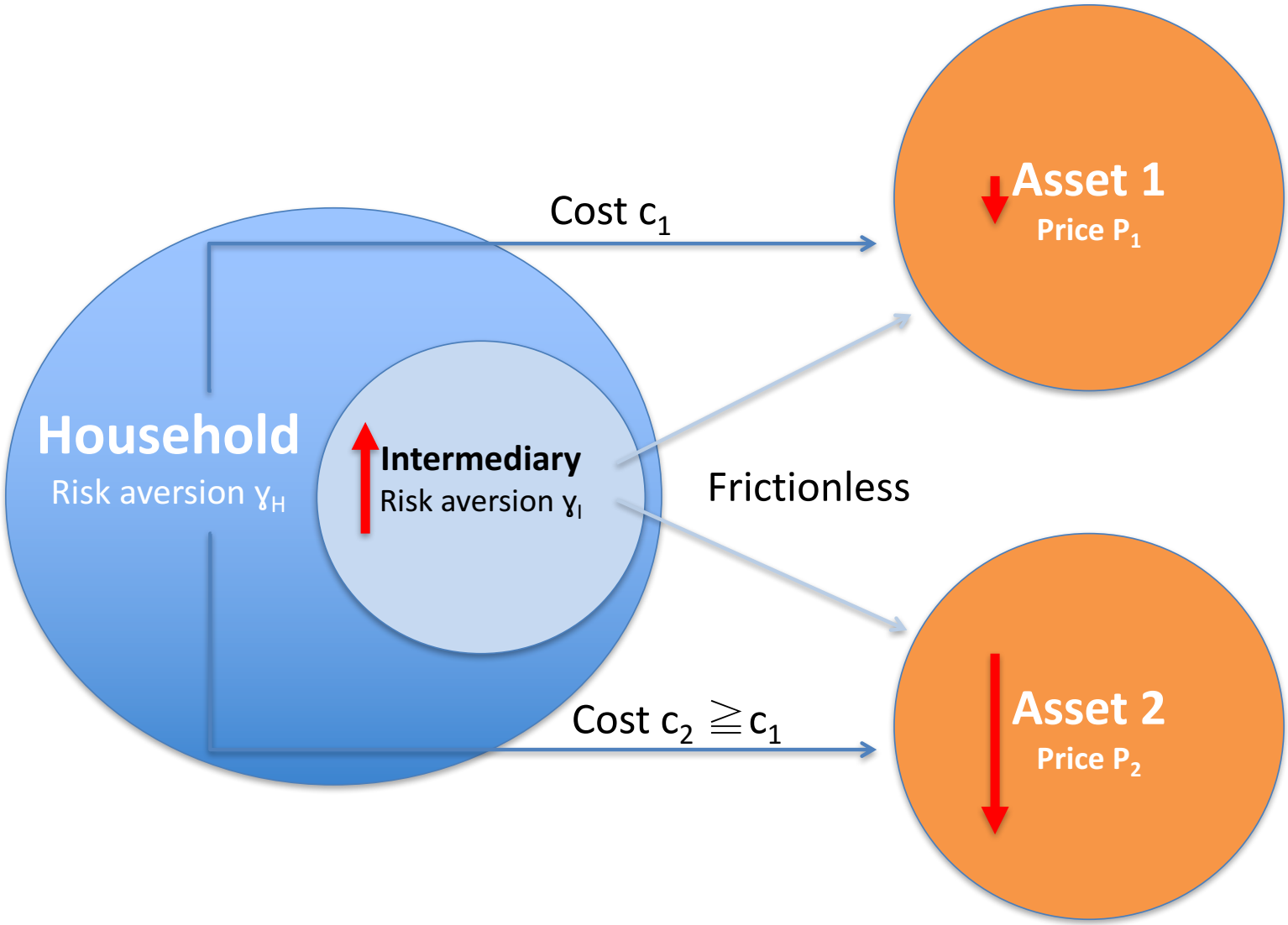
$$\frac{1}{\mu_i - p_i}\frac{\partial(\mu_i - p_i)}{\partial \log(\gamma_H)} = \frac{\gamma_H \sigma_i^2}{\gamma_H \sigma_i^2 + c_i} > 0, \downarrow c_i$$

Our approach: Relative predictability

1. The elasticity of risk premium to intermediary risk aversion γ_I is increasing in the cost of direct holding c_i, strictly if the intermediary matters for asset prices.

2. The elasticity to household risk aversion γ_H is decreasing in the cost of direct holding.

Intermediary Risk Aversion



Outline

Risk Appetite Proxies

- Measures of intermediary risk aversion $\hat{\gamma}_{I,t}$:
  - Adrian Etula Muir (2014), He Kelly Manela (2016) factors
    - ⋆ Shown to proxy for health of financial sector
  - Take log annual change in variables as return predictors, standardize and average them together

- Measures of household risk aversion $\hat{\gamma}_{H,t}$
  - Habit: surplus consumption ratio from Cochrane (2017)
  - cay from Lettau Ludvigson (2001)
  - Consumer sentiment from Michigan Survey

Returns

Returns $r_{i,t+1}$:

- Stocks, Treasury bonds, Sovereign bonds, Options on stocks (straddle), Commodities, FX (carry trade), CDS

- Also look at returns to convertible bond arb, fixed income arb, other hedge fund strategies

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Normalization: different assets have different level of risk

- $r_{i,t+1}/E[r_i]$

- $r_{i,t+1}/\sigma[r_i]$

Cost Rankings

- Create a ranking of direct investment costs c_i (low to high):

Stocks	Bonds	Options	Sov.	Com.	FX	CDS

Cost Rankings

- Create a ranking of direct investment costs c_i (low to high):

	Stocks	**Bonds**	**Options**	**Sov.**	**Com.**	**FX**	**CDS**
FoF	Stocks	Bonds		Sov Bonds			
VaR	Stocks	Bonds			Comm	FX	
BIS		Bonds	Options		Comm	FX	CDS

- Confirm using multiple sources
  - *Flow of funds*: HH holdings / Total assets compared to broker dealers and other fin institutions
  - *Value-at-Risk*: Take VaR for primary dealers (10K), normalize by asset class std dev, compare to size of each market
  - *BIS* data on derivatives: Gross value, totals as well as accounted by fin institutions

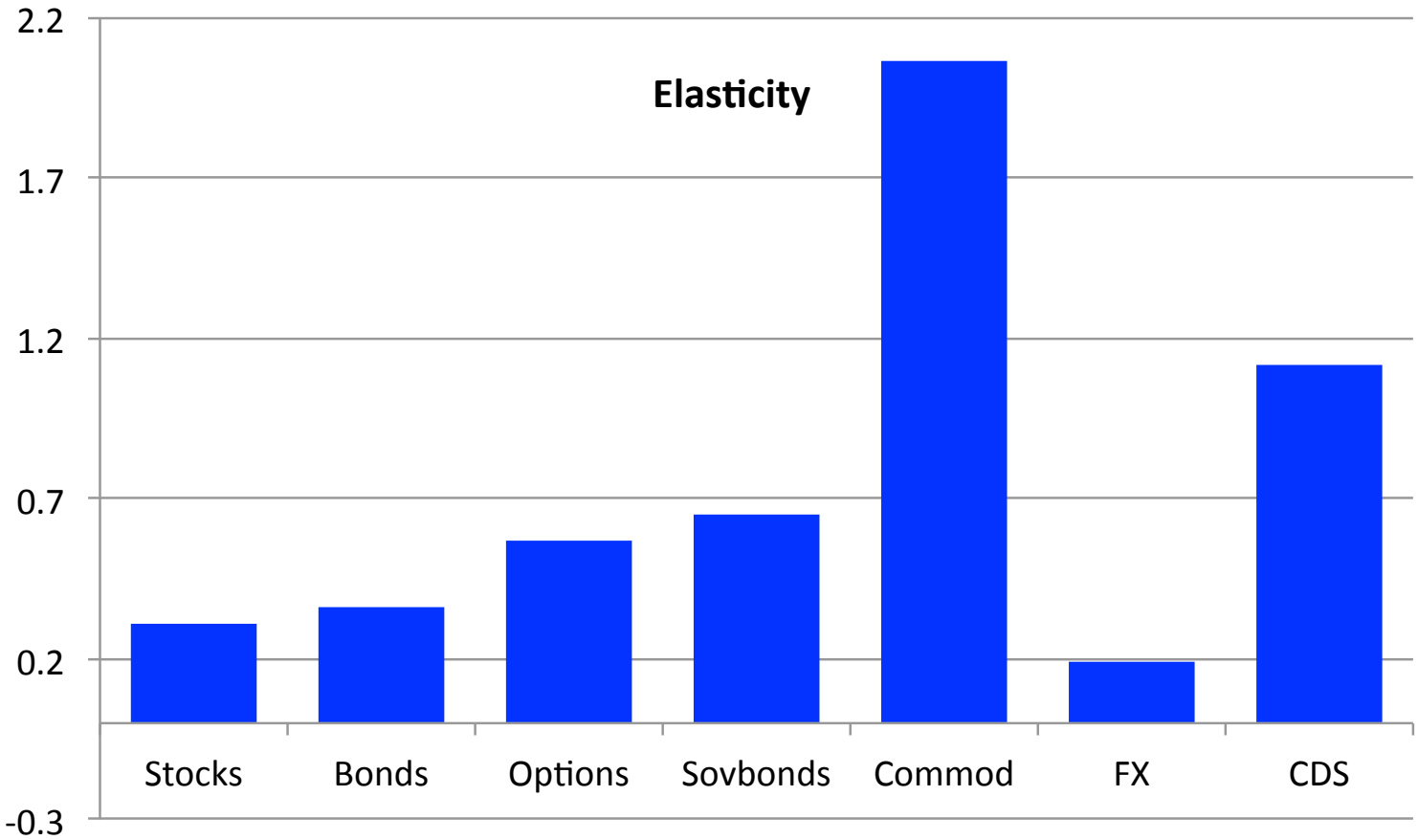
Intermediaries and Risk Premium

$$r_{i,t+1}/E[r_i] = a_i + b_i \hat{\gamma}_{I,t} + \varepsilon_{i,t+1}$$

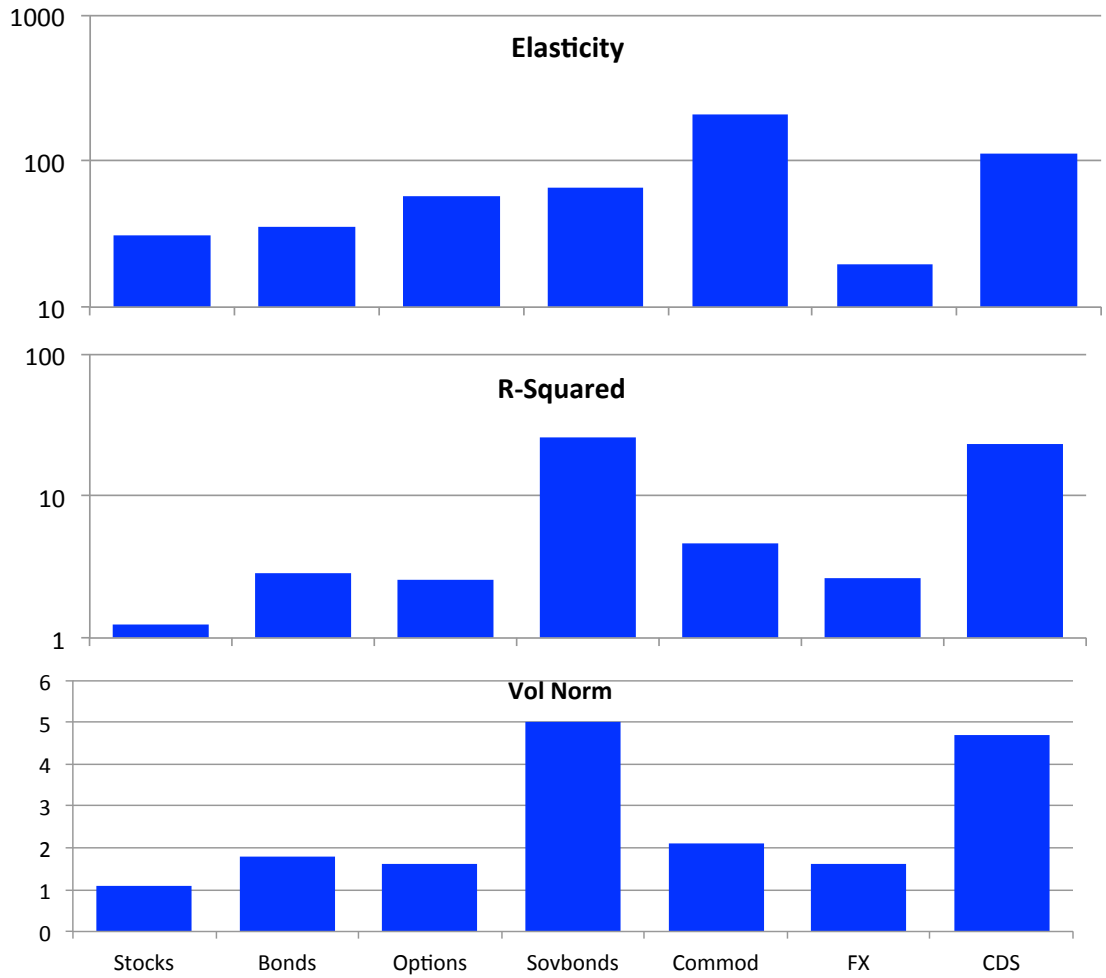
	Stocks	Bonds	Options	Sovereign	Commod	FX	CDS
γ_I	0.33	0.35	0.68	0.64	2.52	0.22	1.08
	(0.27)	(0.15)	(0.30)	(0.16)	(0.78)	(0.09)	(0.44)
N	164	145	100	62	102	113	44
R^2	1.5%	2.7%	3.8%	26.2%	7.1%	3.4%	23.1%

Intermediaries and Risk Premia

Elasticity of risk premia to intermediary state variable



Alternative Scalings ($\times 100$, log scale)

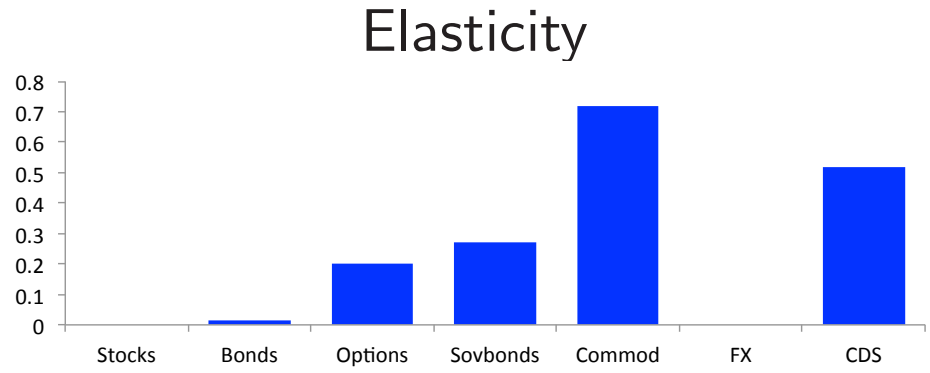


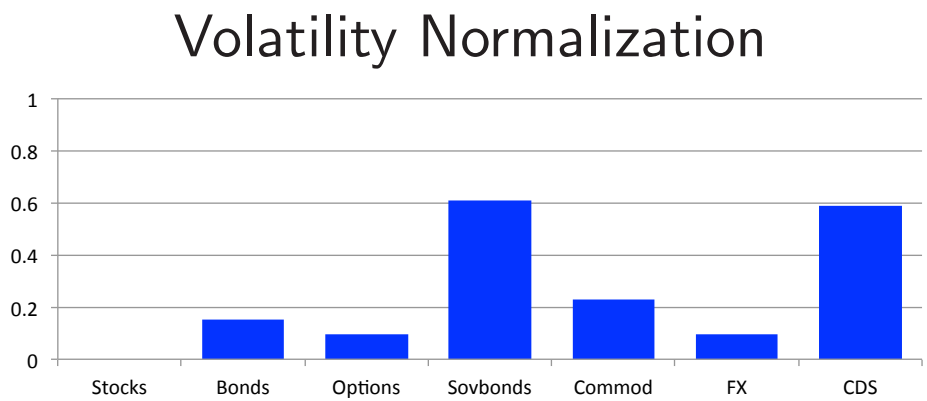
Vol norm: $r_{i,t+1}/\hat{\sigma}(r_{i,t+1}) = a_i + b_i \gamma_{I,t} + \varepsilon_{i,t+1}$

Predictability Due to Intermediary

Lower bound on the % of R^2 which we can attribute to intermediary:

$$\left(\frac{(b_i - b_{stock})^2 var(x)}{var(r_i)}\right) / \left(\frac{b_i^2 var(x)}{var(r_i)}\right)$$





→ **Impact of intermediaries on predicting returns for an equal-weighted portfolio: 4.4% R^2**

Panel Regressions

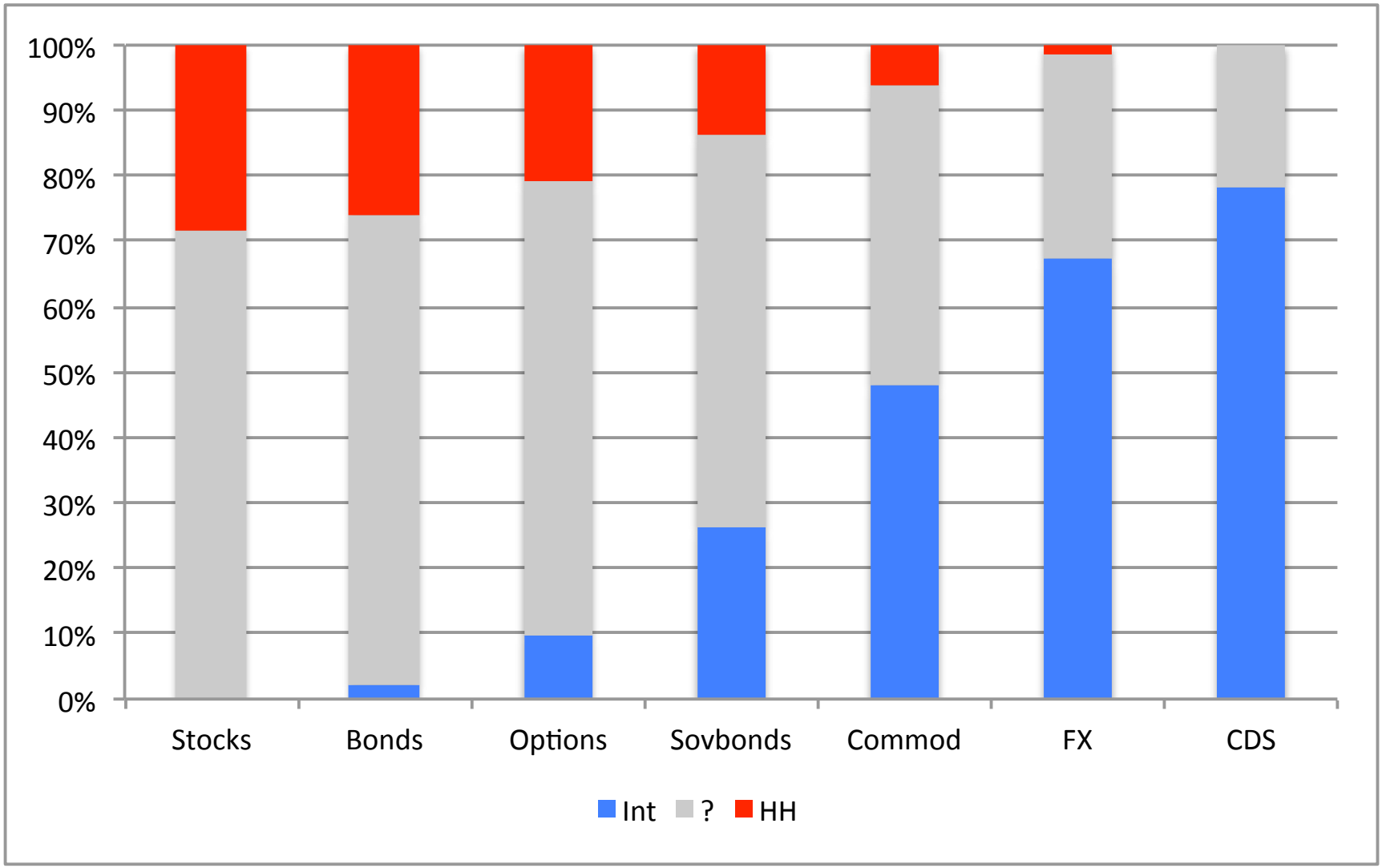
$$r_{i,t+1}/s_i = a_i + b_1^I \gamma_{I,t} + 1_{INT} b_2^I \gamma_{I,t} + b_1^H \gamma_{H,t} + 1_{INT} b_2^H \gamma_{H,t} + \varepsilon_{i,t}$$

- Panel regression with INT dummies for more intermediated assets (test if coeffs different)
- Add Campbell Cochrane habit (similar using other HH risk aversion proxies)

Two Risk Premium Cycles

$INT =$	$1_{\neq Stock/Bond}$		$1_{\neq Stock/Bond/Opt}$		Rank $\in$ [0,1]	
γ_I	0.33*	0.20	0.39**	0.31	0.36*	0.23
	(0.18)	(0.18)	(0.20)	(0.19)	(0.21)	(0.21)
$INT \times \gamma_I$	0.56**	0.76***	0.61**	0.77**	0.75**	1.04**
	(0.27)	(0.28)	(0.30)	(0.34)	(0.37)	(0.41)
γ_H		0.41**		0.29		0.40*
		(0.19)		(0.21)		(0.22)
$INT \times \gamma_H$		-0.61*		-0.53		-0.85*
		(0.36)		(0.37)		(0.45)
N	730	730	730	730	730	730
R^2	0.0288	0.0335	0.0296	0.0330	0.0280	0.0320

Lower Bounds of Variation in Risk Premia



Use panel to provide lower bound of variance due to each

Robustness

- Different samples: Table 8
  - Exclude crisis
  - More balanced panel: start post 1990
- Alternative measures of intermediary risk aversion: Tables 5-6
  - Use two measures separately
  - Use long-term changes in AEM/HKM or levels
  - Use Gilchrist Zachrajsek (2010) spread, health of intermediaries

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Next:

- Time-varying risk

Time-varying risk

- Third main view: changes in risk drive changes in risk premium
- **Main concern**:
  - More intermediated assets become more risky exactly when intermediary health is poor ...
  - but this has nothing to do with intermediaries
- Measure and control for *observable* variation in risk

Time-varying risk

$$ln(\sigma^2_{i,t+1}) = a_i + b_i \gamma_{I,t} + \varepsilon_{i,t+1}$$

	Mkt	Bonds	Options	Sovereigns	Commodities	FX	CDS
γ_I	0.30***	0.05	0.23***	0.20	0.35***	0.06	0.13
	(0.09)	(0.10)	(0.09)	(0.14)	(0.10)	(0.11)	(0.21)
γ_H	0.12	0.50***	-0.02	0.27	0.20	-0.05	1.02***
	(0.07)	(0.12)	(0.11)	(0.16)	(0.13)	(0.07)	(0.23)
N	164	145	100	62	102	113	44
R^2	0.139	0.145	0.0441	0.123	0.141	0.00818	0.431

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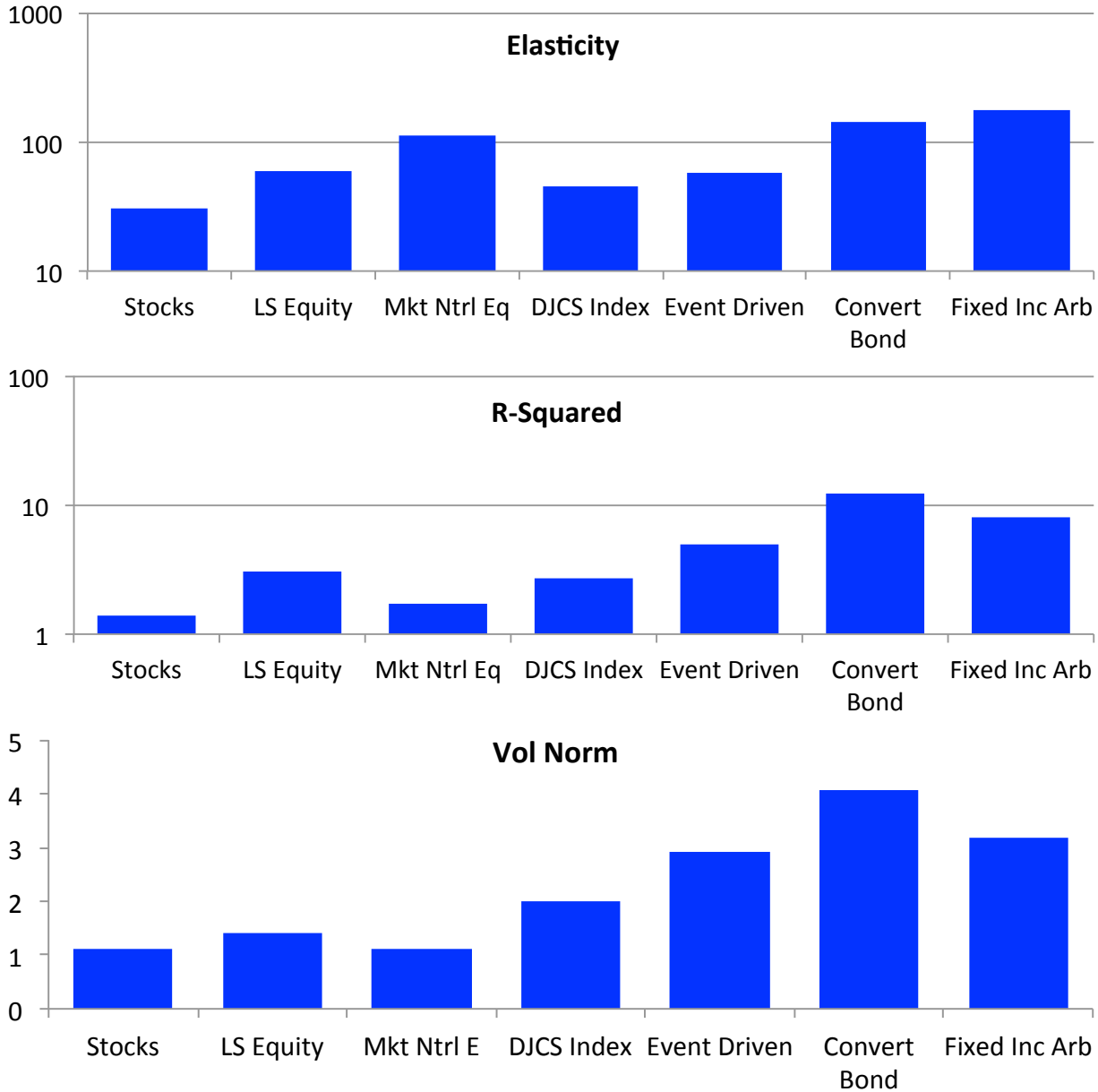
	Mkt	Bonds	Options	Sovereigns	Commodities	FX	CDS
γ_I	0.30***	0.05	0.23***	0.20	0.35***	0.06	0.13
	(0.09)	(0.10)	(0.09)	(0.14)	(0.10)	(0.11)	(0.21)
γ_H	0.12	0.50***	-0.02	0.27	0.20	-0.05	1.02***
	(0.07)	(0.12)	(0.11)	(0.16)	(0.13)	(0.07)	(0.23)
N	164	145	100	62	102	113	44
R^2	0.139	0.145	0.0441	0.123	0.141	0.00818	0.431

- In addition: no differential effect for skewness, no difference when we control for time-varying betas or other risk meausres

Complex Strategies: Hedge Fund returns

- Convert bond arb and Merger arb (Mitchell and Pulvino (2001, 2012)): disruptions linked to capital scarcity, HF own 40+% of convertible bonds
- Fixed income arbitrage: Hu Pan Wang (2013)
- HF returns from DJCS: Equity LS, Mkt Neutral, Event Driven, Convert Bond, Fixed Income Arb, Total Index

Hedge Fund Returns: Intermediary ($\hat{\gamma}_I$)



Note: pattern *not* there for γ_H

Conclusion

Do intermediaries matter for aggregate asset prices?

Yes, a lot. Households too.

- Intermediary risk appetite matters more for assets that are difficult to directly invest in
- Household appetite matters less
- Both results are specific signature of models with financial frictions.

APPENDIX

Statistical Properties

Test if elasticity different?

$$r_{i,t+1}/\overline{(r_{i,t+1})} - r_{stock,t+1}/\overline{(r_{stock,t+1})} = a_i + b_i\gamma_{I,t} + \varepsilon_{i,t+1}$$

	Elasticity Difference					
	Bonds	Options	Sovereign	Commodity	FX	CDS
γ_I	0.26	-0.06	-0.01	-1.40	0.09	-0.08
	(0.20)	(0.15)	(0.36)	(0.85)	(0.28)	(0.36)
N	145	100	62	102	113	44
R^2	0.016	0.003	0.002	0.028	0.050	0.002

- Instability of estimate in smaller sample: $\overline{r_{i,t+1}}$ hard to estimate, blows up std errors
- Elasticity "ideal" from theory,difficult test with smaller samples

Variance Normalization

Variance norm more stable (easier to estimate than $E[r]$ in small sample)

$$r_{i,t+1}/\hat{\sigma}^2(r_{i,t+1}) - r_{stock,t+1}/\hat{\sigma}^2(r_{stock,t+1}) = a_i + b_i\gamma_{I,t} + \varepsilon_{i,t+1}$$

Variance Normalization Difference						
	Bonds	Options	Sovereign	Commodity	FX	CDS
γ_I	-2.22*	-0.14	-3.11***	-0.87	-1.79**	-14.88**
	(1.21)	(0.20)	(1.13)	(0.68)	(0.76)	(6.66)
N	145	100	62	102	113	44
R^2	0.013	0.004	0.191	0.011	0.139	0.238

- Variance normalization less pure from theory (e.g., need to assume diagonal Σ) but more stable empirically in subsamples

Intermediary Risk Aversion: HKM and AEM

Rather than combine HKM AEM measures, here split separately

	Stocks	Bonds	Options	Sovereign	Commod	FX	CDS
				Annual Changes			
γ_I^{AEM}	-0.42	-0.22*	-0.90***	-0.50***	-3.44***	-0.26***	-0.79**
	(0.26)	(0.12)	(0.26)	(0.15)	(0.58)	(0.08)	(0.38)
γ_I^{HKM}	-0.04	-0.27	0.25	-0.39**	1.12	0.01	-0.71*
	(0.27)	(0.18)	(0.37)	(0.16)	(0.93)	(0.10)	(0.39)
N	164	145	100	62	102	113	44
R^2	0.020	0.029	0.094	0.262	0.201	0.056	0.234

▸ Back

Intermediary Risk Aversion: HKM and AEM

Rather than combine HKM AEM measures, here split separately

	Stocks	Bonds	Options	Sovereign	Commod	FX	CDS
				Levels			
γ_I^{AEM}	-0.01	0.31	-1.00**	-0.75*	-1.75	-0.22*	-0.80
	(0.39)	(0.20)	(0.49)	(0.39)	(1.49)	(0.12)	(0.76)
γ_I^{HKM}	-0.59	-0.32	-0.45	-0.63***	-0.23	0.42***	-0.78
	(0.37)	(0.22)	(0.54)	(0.20)	(1.52)	(0.16)	(0.49)
N	168	145	100	62	102	113	44
R^2	0.041	0.020	0.117	0.214	0.035	0.095	0.137

▸ Back

Intermediary Risk Aversion: Levels

- Replace changes in log AEM / HKM with levels to proxy for γ_I
  - Most theories: level matters, but there are large trends
  - Follow Adrian Moench Shin (2010), Schularick Taylor (2012), Baron Xiong (2016) using 1-3 year changes

	Stocks	Bonds	Options	Sovereign	Commodities	FX	CDS
γ_I	-0.53**	-0.01	-1.29***	-1.16***	-1.72*	0.18	-1.40**
	(0.22)	(0.18)	(0.34)	(0.28)	(0.89)	(0.13)	(0.58)
N	168	145	100	62	102	113	44
R^2	0.033	0.000	0.110	0.212	0.027	0.020	0.137

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Intermediary Risk Aversion: GZ Spread

- Replace AEM / HKM with Gilchrist Zakrajsek (2012) excess bond premium spread
  - GZ argue this captures health of intermediaries

	Stocks	Bonds	Options	Sovereign	Commodities	FX	CDS
GZ	-0.01	-6.14***	0.86	-3.10***	0.83	-0.38	-12.35*
	(0.28)	(1.09)	(0.84)	(1.01)	(1.05)	(0.98)	(4.09)
N	156	145	100	62	102	113	44
R^2	0.000	0.129	0.024	0.204	0.016	0.002	0.253

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Subsample: Exclude Crisis

Dropping the crisis (Panel A), Post 1990 only (Panel B)

	Dropping 2007-2009						
	Stocks	Bonds	Options	Sovereign	Commodities	FX	CDS
γ_I	-0.22	-0.26	-0.49*	-0.73***	-2.74***	-0.25**	-0.90***
	(0.30)	(0.17)	(0.27)	(0.18)	(0.75)	(0.11)	(0.15)
N	141	126	81	46	79	90	21
R^2	0.007	0.010	0.037	0.354	0.170	0.057	0.628

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Subsample: Post 1990

	Post 1990						
	(1) Stocks	(2) Bonds	(3) Options	(4) Sovereign	(5) Commodities	(6) FX	(7) CDS
γ_I	-0.42	-0.41***	-0.42	-0.64***	-4.25**	-0.23**	-1.07***
	(0.30)	(0.10)	(0.50)	(0.17)	(1.98)	(0.11)	(0.38)
N	84	80	80	62	84	84	44
R^2	0.025	0.163	0.008	0.254	0.038	0.035	0.231

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Household Risk Aversion: Consumer Sentiment

Proxy for $\gamma_{H,t}$ using consumer sentiment from Michigan survey

	Stocks	Bonds	Options	Sovereign	Commodity	FX	CDS
γ_I	-0.65	-0.51*	-1.32*	-1.17**	-3.86**	-0.55**	-3.04***
	(0.57)	(0.29)	(0.73)	(0.51)	(1.92)	(0.22)	(0.98)
γ_H	0.16	-0.10	-0.06	-0.26	-1.39	-0.47	-0.89
	(0.55)	(0.41)	(0.84)	(0.35)	(2.59)	(0.29)	(1.03)
N	167	148	103	65	105	116	47
R^2	0.015	0.015	0.036	0.147	0.047	0.060	0.355