External Equity Financing Shocks, Financial Flows, and Asset Prices

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Macro Finance Society Workshop

May 31, 2014

Overview

Study the impact of aggregate financial shocks on asset prices and financing flows in the cross section

Motivation

Firms' ability to raise equity varies over time

- Issuing equity is costly, e.g., asymmetric information, agency frictions, etc. (Myers and Majluf 1984; Jensen and Meckling 1976)
- These costs are *time-varying:* higher in contractions and lower in expansions (Choe, Masulis, and Nanda 1993; Bolton, Chen, and Wang 2011,2013; Eisfeldt and Muir 2013; Mclean and Zhao 2013)
- Times of unusually high marginal issuance cost $\Leftrightarrow$ negative (financial) shocks to the availability of external equity
- *Question:* What's the impact of this shock on the cross sectional risk premiums?

Main findings

Empirical:

- Measure aggregate equity issuance cost shocks (ICS) using XS data
- ICS is a source of systematic risk
  - Exposure to ICS helps price the cross sectional returns (BM, IK, Size, Issuance)

Theoretical:

- Corporate finance meets asset pricing
- Incorporate ICS into an investment-based asset pricing model with costly external equity finance and collateral constraint on debt
- *Mechanism*: Inflexible substitution between two marginal sources of external financing $\Rightarrow$ risk dispersion

$\Rightarrow$ Time variation in the availability of external funds can have a significant impact on risk premiums in the cross section

Outline

1. **Empirical evidence**
2. **Model setup/results**
3. **Model mechanism**
4. **Conclusion**

Outline

1. **Empirical evidence**

Empirical: proxy for equity issuance cost shocks

- Equity issuance costs include direct and indirect costs
  - Direct costs are observable but relatively small (Altinkilic and Hansen 2000)
- Indirect costs are unobservable, but can be substantial, and vary over time (Choe et al 1993; Hennessy and Whited 2007; Bolton, Chen, and Wang 2013; Bustamante 2013)

Our approach:

- Construct an empirical proxy of equity issuance cost shocks (ICS) by exploring **cross sectional data**

Basic idea:

- Controlling for aggregate investment opportunities, e.g., aggregate TFP, when relatively more firms are issuing equity in the cross section, that signals lower (aggregate) marginal cost of issuance

Empirical: proxy for equity issuance cost shocks

Data: CRSP/Compustat annual industry files (1971-2011)

Firm i is a (net) equity issuer if (Eisfeldt and Muir 2013):

$$\overbrace{\text{Net equity issuance}_{i,t}}^{(\text{SSTK}_{it}\text{-PRSTKC}_{it}\text{-DV}_{it})} > 0$$

Construct time series of the **fraction** of firms issuing equity in the cross section:

$$\text{Fraction}_t = \frac{\sum_{i=1}^{N_t} \mathbf{1}_i(\text{Net issuance} > 0)}{N_t}$$

Extract ICS from this fraction

Note: Captures extensive not the intensive margin ($ amount of aggregate issuance)
Why? Covas and Den Haan 2013, AER.

Empirical: proxy for equity issuance cost shocks

Extract equity issuance cost shock (ICS) using a rolling VAR

1. Apply one-sided HP filter to TFP (x_{t+1}) and issuance fraction (s_{t+1}).
2. Estimate:

$$\begin{pmatrix} x_{t+1} \\ s_{t+1} \end{pmatrix} = A \begin{pmatrix} x_t \\ s_t \end{pmatrix} + \begin{pmatrix} u_{t+1} \\ v_{t+1} \end{pmatrix},$$

⇒ Interpret v_{t+1} as an aggregate shock to the cost of issuing equity

⇒ When v_{t+1} **positive**, fraction unusually high, **marginal issuing cost low**

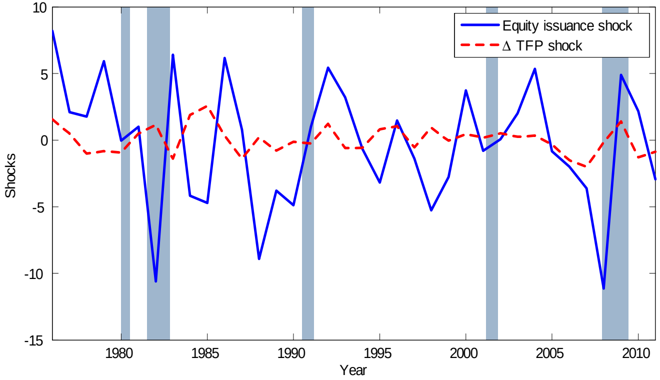
⇒ Broadly, v_{t+1} captures the time-varying *wedge* between the valuations of managers and investors

Robustness checks

Simple approach but robust to alternative procedures

Measurement	
Gross issuance	Compustat
Net issuance w/ alternative cutoffs	Compustat
the chg. in log split-adj. shares	Fama and French (2008)
Monthly adjusted CRSP shares	Boudoukh et al (2007)
Number of SEOs	Loughran and Ritter (1995)
Number of IPOs	Ibbotson et al (1994)
Controls	
Investment shocks	Papanikolaou (2011)
Liquidity shocks	Pastor and Stambaugh (2003)
Collateral constraint shocks	Jermann and Quadrini (2012)
Uncertainty shocks	Bansal et al (2013)
Leverage ratio of securities broker-dealers	Adrian, Etula, and Muir (2013)
Market returns	CRSP
Price to dividend ratio	CRSP
Chg. in aggregate cash holding	Compustat
Size, age, industry	Compustat

Empirical: properties of ICS



- ICS shocks more volatile than TFP shocks.
- Low correlation between ICS and TFP shocks (≈ 0).

Empirical: properties of ICS

	ΔGDP	ΔC	ISTS	ICS
ΔC	0.75			
ISTS	0.44	0.14		
ICS	0.08	0.17	0.06	
TFP	0.25	0.37	0.18	-0.14

- ICS positively correlated with GDP and consumption (**marginal equity issuance costs countercyclical**)
- Weak correlation with investment-specific shocks.

Empirical: ICS and systematic risk

Question: does exposure to ICS helps understand cross sectional expected returns?

Standard time series and cross sectional regressions:

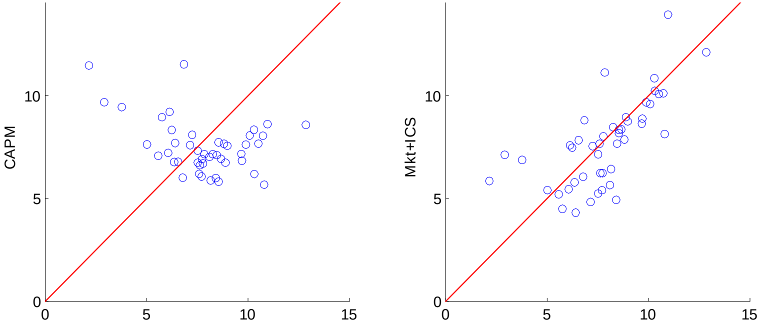
$$r_{it}^{e} = a_i + \beta_i^{\mathrm{M}} \times \mathrm{MKT}_t + \beta_i^{\mathrm{ICS}} \times \mathrm{ICS}_t + e_{it},$$

$$E_T\left[r_{it}^{e} \overbrace{(1 - b_{\mathrm{M}} \times \mathrm{MKT}_t - b_{\mathrm{ICS}} \times \mathrm{ICS}_t)}^{M_t \,:\, \mathrm{SDF}} \right] = 0.$$

Test assets: 10 investment rate, 10 book-to-market, 10 size, 10 debt growth, and 6 equity issuance portfolios.

Empirical: pricing performance of ICS

Predicted vs realized average returns: CAPM vs MKT + ICS two-factor model



Empirical: ICS and investment portfolios

	Low IK	High IK	L-H
$E(r^e)$	7.99	2.79	5.20
[t]	3.40	0.87	1.88
α	1.17	-8.17	9.34
[t]	0.57	-2.62	2.48
MKT	0.94	1.52	-0.57
[t]	9.59	4.96	-1.67
R^2	0.68	0.61	0.15
MKT	0.87	1.54	-0.67
[t]	13.78	4.76	-1.98
ICS	1.30	-0.36	1.67
[t]	4.37	-0.75	3.14
R^2	0.78	0.61	0.25

- Low investment firms have **high** exposure to ICS.
- Do poorly when it is more costly to issue equity

Empirical: ICS and book-to-market portfolios

	Growth	Value	V-G
$E(r^e)$	5.76	12.85	7.09
[t]	1.89	4.98	2.05
α	-2.49	4.94	7.43
[t]	-1.63	2.05	1.97
MKT	1.14	1.09	-0.05
[t]	17.79	6.22	-0.22
R^2	0.81	0.58	0.00
MKT	1.18	1.01	-0.17
[t]	17.70	9.33	-1.13
ICS	-0.67	1.34	2.01
[t]	-1.97	2.12	2.17
R^2	0.83	0.65	0.17

- Value firms have **high** exposure to ICS
- Do poorly when it is more costly to issue equity

Empirical: price of risk of ICS in XS regressions

	All portfolios	
	CAPM	2F
b_M	2.83	1.12
[t]	1.04	0.55
b_{ICS}		19.18
[t]		2.70
MAE	2.24	1.27

Empirical: ICS and aggregate economic activity

Plausible source of systematic risk? High ICS forecasts high consumption growth

$$\Delta \mathrm{C}_{t+1} = a + \underset{(1.91)}{0.07} \times \mathrm{ICS}_t + \underset{(2.66)}{0.87} \times \mathrm{TFPS}_t + e_{it}, \ R^2 = 30.1\%$$

Outline

2. **Model setup/results**

Model

A dynamic capital structure model with

1. A large cross section of heterogenous, but ex ante identical, firms
2. Firms choose investment (equity) and debt to maximize firm value
3. Equity issuing cost is time-varying due to an *aggregate* shock (ICS).
4. Collateral constraint on debt
5. Exogenous SDF with two aggregate shocks

Technology

Output

$$Y_t = Z_t X_t^{1-\theta} K_t^{\theta}$$

Aggregate productivity $\log X_t$

$$\Delta x_{t+1} = \mu_x + \sigma_x \varepsilon_{t+1}^x$$

Firm-specific productivity $\log Z_t$ (source of heterogeneity)

$$z_{t+1} = \bar{z}(1 - \rho_z) + \rho_z z_t + \sigma_z \varepsilon_{t+1}^z$$

Capital accumulation

$$K_{t+1} = (1 - \delta) K_t + I_t$$

Capital adjustment costs

$$G_t = \begin{cases} \frac{c_k^+}{2} \left(\frac{I_t}{K_t} \right)^2 K_t, & I_t \geq 0 \\ \frac{c_k^-}{2} \left(\frac{I_t}{K_t} \right)^2 K_t, & I_t < 0. \end{cases}$$

Debt financing

Debt collateral constraint (debt payment$\leq$liquidation value of capital)

$$B_{t+1} \leq \varphi K_{t+1}$$

$\varphi < 1$ controls tightness of the collateral constraint (hence, borrowing capacity)

Firms' budget constraint (E_t firm's payout)

$$E_t = (1-\tau)(Y_t - F_t) + \tau\delta K_t + \tau r_f B_t - I_t - G_t + B_{t+1} - (1+r_f)B_t - \Phi_t$$

Debt adjustment cost

$$\Phi_t = \frac{c_b}{2}\left(\frac{\Delta B_t}{B_t}\right)^2 B_t$$

Equity financing

External equity H_t :

$$H_t = \max(-E_t, 0)$$

Equity issuance cost

$$\Psi(H_t) = (\eta_0 X_t + \eta_1 H_t) \exp[-\eta_2 \xi_t] \mathbf{1}_{\{H_t > 0\}}$$

Stochastic disturbance in issuance cost follows an AR(1):

$$\xi_{t+1} = \rho_\xi \xi_t + \sigma_\xi \underbrace{\varepsilon^\xi_{t+1}}_{\text{Exogenous ICS}}$$

Firms' maximization problem

Effective cash flow

$$D_t = E_t - \Psi_t$$

Stochastic discount factor

$$M_{t,t+1} = \frac{1}{1+r_f} \frac{e^{-\gamma_x \Delta x_{t+1} - \gamma_\xi \Delta \xi_{t+1}}}{\mathbb{E}_t \left[e^{-\gamma_x \Delta x_{t+1} - \gamma_\xi \Delta \xi_{t+1}} \right]}$$

Value maximization

$$V_t = \max_{I_t, B_{t+1}, K_{t+1}} D_t + \mathbb{E}_t [M_{t,t+1} V_{t+1}]$$

Optimality conditions

The first-order condition with respect to I_t

$$\underbrace{q_t}_{\text{Marginal } q} = \underbrace{\left(1 + \Psi'(H_t)\mathbf{1}_{\{H_t > 0\}}\right)}_{\text{Marginal issuance cost}} \underbrace{\left[1 + \frac{\partial G_t}{\partial I_t}\right]}_{\text{Marginal inv. adj. cost}}$$

Marginal benefit of investing = marginal cost of investing

Note: q_t is the Lagrangian multiplier associated with the LOM of capital.

Calibration

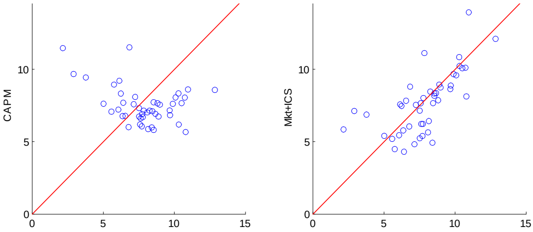
Technology		
Returns to scale	θ	0.75
Corporate tax rate	τ	0.35
Rate of depreciation for capital	δ	.01
Fixed operating cost	f	.04
Adj. cost parameters in capital	c_k^+/c_k^-	0/39
Adj. cost parameters in debt	c_b	2.8
Resale value of capital	φ	0.75
Fixed/linear issuance costs	η_0/η_1	.002/0.1
Parameter of time-varying issuance cost	η_2	10
Stochastic processes		
Growth/volatility/persistence of agg. productivity	μ/σ_x	.001/.055
Mean/persistence/volatility of firm productivity	$\bar{z}/\rho_z/\sigma_z$	−3.4/.97/.15
Persistence of issuance disturbance	ρ_ξ	.98
Conditional volatility of issuance disturbance	σ_ξ	.035
Loading of the SDF on agg. prod. shock	γ_x	9.25
Loading of the SDF on the issuance shock	γ_ξ	7

Targeted moments

Moment	Data	Model
Asset prices		
Agg. excess stock market returns	5.71	5.88
Real risk-free rate	1.65	1.65
Avg. book-to-market ratio	0.67	0.68
Real quantities: Aggregate-level		
Std. dev. of aggregate profits	0.14	0.12
Std. dev. of agg. net issuance-to-book-equity ratio	0.04	0.05
Std. dev. of aggregate debt growth rate	0.08	0.08
Average frequency of net issuance	0.37	0.34
Marginal issuance cost	.084 – .12	0.10
Real quantities: Firm-level		
Std. dev. of IK	0.19	0.17
Std. dev. of net issuance-to-book-equity ratio	0.35	0.32
Autocorrelation of investment rate	0.29	0.39
Financial leverage ratio	0.38	0.38
Std. dev. of financial leverage ratio	0.14	0.08
Autocorrelation of financial leverage ratio	0.65	0.62

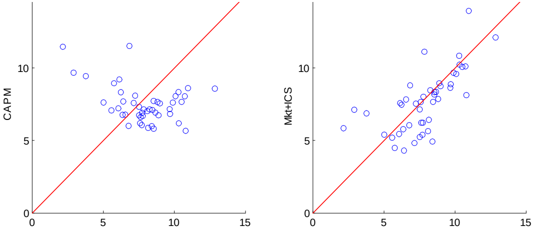
Model: asset pricing performance

- Data

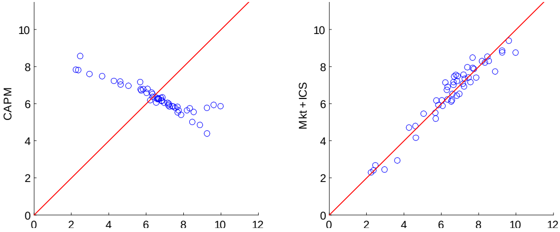


Model: asset pricing performance

- Data



- Model: Replicate the failure of CAPM



Model: asset pricing tests of investment portfolios

Note: ICS constructed as in the real data, from issuing fraction, it's not ξ_t

	Low IK	High IK	L-H	Data
$E(r^e)$	9.03	2.23	6.80	5.20
[t]	5.42	1.40	7.90	1.88
α	3.62	-4.02	7.64	9.34
[t]	7.38	-8.65	8.84	2.48
MKT	0.96	1.14	-0.18	-0.57
[t]	37.04	42.87	-2.63	-1.67
R^2	0.93	0.96	0.15	0.15
MKT	0.85	1.04	-0.31	-0.67
[t]	14.17	14.68	-2.97	-1.98
ICS	0.10	-0.09	0.22	1.67
[t]	1.88	-1.33	2.92	3.14
R^2	0.79	0.82	0.35	0.25

Model: asset pricing tests of BM portfolios

Note: ICS constructed as in the real data, from issuing fraction, it's not ξ_t

	Growth	Value	V-G	Data
$E(r^e)$	2.84	9.56	6.72	7.09
[t]	1.69	5.80	7.76	2.05
α	-3.35	4.26	7.61	7.43
[t]	-7.63	8.19	8.89	1.97
MKT	1.13	0.94	-0.18	-0.05
[t]	46.79	33.09	-2.82	-0.22
R^2	0.96	0.92	0.15	0.00
MKT	1.03	0.83	-0.30	-0.17
[t]	14.71	13.83	-3.16	-1.13
ICS	-0.07	0.11	0.21	2.01
[t]	-1.15	1.99	2.71	2.17
R^2	0.82	0.78	0.33	0.17

Model: asset pricing tests in the simulated data

Note: ICS constructed as in the real data, from issuing fraction, it's not ξ_t

	All-Data		All-Model	
	CAPM	2F	CAPM	2F
b_M	2.83	1.12	4.17	4.12
[t]	1.04	0.55	2.97	2.55
b_{ICS}		19.18		22.74
[t]		2.70		5.15
MAE	2.24	1.27	1.95	0.38

Model: investment portfolio characteristics data/model

	L IK	H IK	H-L	Data
IK	-5.84	51.81	57.65	74.57
Equity/BE	-9.76	30.55	40.31	2.32
EquityFreq	13.47	72.27	58.80	26.62
ΔDebt	-18.15	35.68	53.83	43.17
DebtFreq	3.89	98.88	94.99	25.39
Lev	48.93	31.72	-17.21	-31.06
Prod	0.83	1.56	0.73	0.17

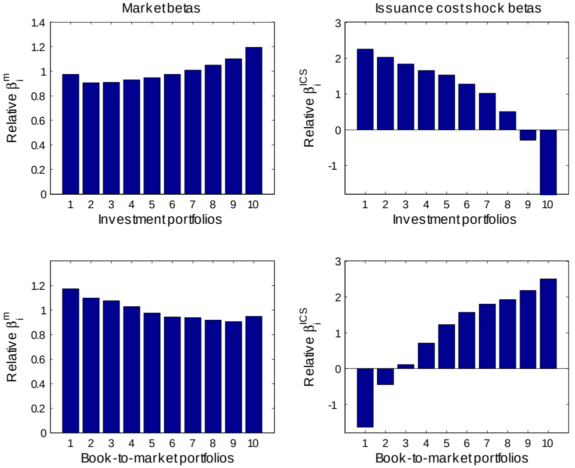
Low investment: invest less, issue less equity, have higher leverage and are less productive than high IK (low risk) firms

Outline

3. **Model mechanism**

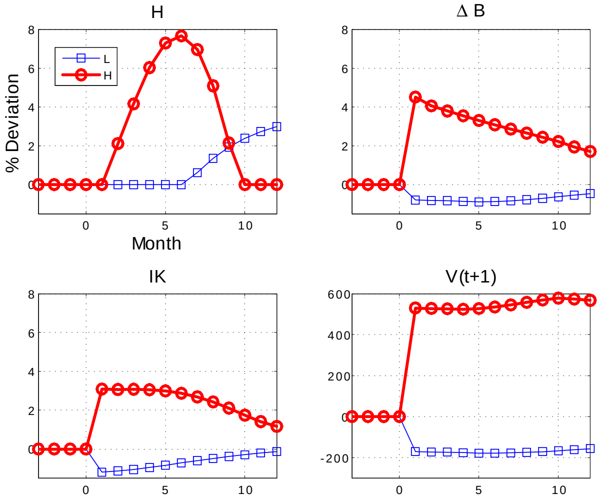
Mechanism: market and ICS betas

$$r_{it}^e = a_i + \beta_i^m \times r_t^m + \beta_i^{ICS} \times ICS_t + e_{it}$$



- High IK and growth firms are an hedge against ICS.
- Cross sectional risk driven by ICS betas: the CAPM fails in our setup.

Mechanism: IRF to negative ICS (*higher* mg. cost)



Flexibility in the marginal sources of financing of high productivity firms makes them operationally more flexible and hence less risky

Mechanism: comparative statics of quantities

Validation: under which conditions is the VAR shock a good proxy for the true ICS?

Spec.	Correl. $r(ICS, \xi)$
0-Data	
1-Benchmark	0.31
2-No ICS	0.01
3-Tighter collateral const.	0.28
4-High debt adj. cost	0.42

Mechanism: comparative statics of asset pricing

	IK		BM	
Spec.	r^e	α	r^e	α
0-Data	5.99	9.06	7.07	7.46
1-Benchmark	6.8	7.64	6.72	7.61
2-No ICS	-0.81	-1.89	-1.92	-1.99
3-Tighter collateral const.	-3.43	-2.37	-4.2	-2.82
4-High debt adj. cost	-1.59	0.4	-2.59	0.71

Conclusion

- Time variation in the availability of external funds can have a significant impact on risk premiums in the cross section
- *Empirical approach*: measure external equity issuance cost shocks (ICS) using cross sectional data
- Exposure to ICS helps price the cross section of stock returns (BM, IK, Size, Issuance, etc.)
- *Theoretical insight*: Inflexible substitution between two marginal sources of external financing generates cross sectional dispersion in firms' risk

Optimality conditions

The first-order condition with respect to K_{t+1}

$$\underbrace{q_t - \mu_t \varphi}_{\text{Marginal price of capital}}$$

$$= \mathbb{E}_t M_{t,t+1} \left\{ \underbrace{\left((1 + \Psi'(H_{t+1})\, \mathbf{1}_{\{H_{t+1}>0\}}\right)}_{\text{Marginal benefit of iss. cost reduction}} \underbrace{\left[\frac{\partial E_{t+1}}{\partial K_{t+1}} + (1-\delta)\left(1 + \frac{\partial G_{t+1}}{\partial I_{t+1}}\right)\right]}_{\text{Marginal benefit of real investment}} \right\}$$

Note: μ_t is the Lagrangian multiplier associated with the collateral constraint.

Optimality conditions

The first-order condition with respect to B_{t+1}

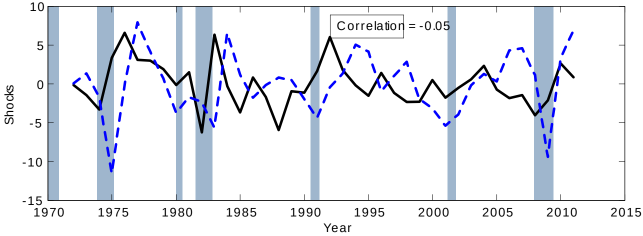
$$\underbrace{\mu_t}_{\text{shadow value of collateral constraint}} \underbrace{-\mathbb{E}_t \left[M_{t,t+1} \left(1 + \Psi'(H_{t+1}) \mathbf{1}_{\{H_{t+1}>0\}}\right) \frac{\partial E_{t+1}}{\partial B_{t+1}} \right]}_{\text{marginal cost of debt}}$$

$$= \underbrace{\left(1 + \Psi'(H_t) \mathbf{1}_{\{H_t>0\}}\right) \frac{\partial E_t}{\partial B_{t+1}}}_{\text{Marginal benefit of debt}}$$

Robustness checks

Validation: Capturing variation in the cost of external **equity** financing? or **debt** financing?

1. Redo previous analysis using the shocks to the fraction of firms issuing debt (blue line) and compare to our ICS (black line).

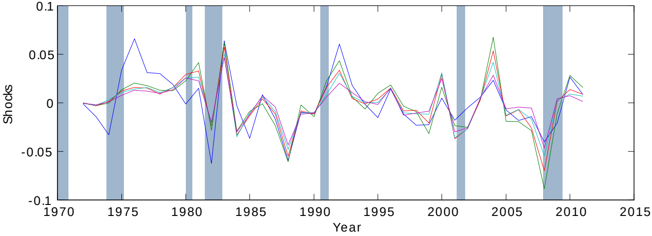


- Low correlation between the two measures
- Asset pricing tests using shocks to debt fraction are weak.

Robustness checks (cont.)

2. ICS also helps pricing other portfolios: earnings to price, cash flow to price, leverage, etc.

3. Several issuance events due to exercise of employee stock options. Re-define issuance as $> 1\%$ to 5% of assets.



$\Rightarrow$ These alternative shocks are **highly correlated** with baseline shocks