Leverage Cycles and the Anxious Economy

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Motivation

- Examine "closures" in Emerging Market dollar denominated Bonds (1997-2002)
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- Fact 3 - During market closures, higher-rated emerging market issuance falls by more (**Issuance Rationing**)

Focus

- "Anxious Economy" not a crisis
  - Bad news about US high-yield payoffs
  - No additional information about emerging market payoffs
  - If investors in emerging markets are liquidity constrained, may cut back their emerging market exposure to invest in US high-yield ("crossover" investors)

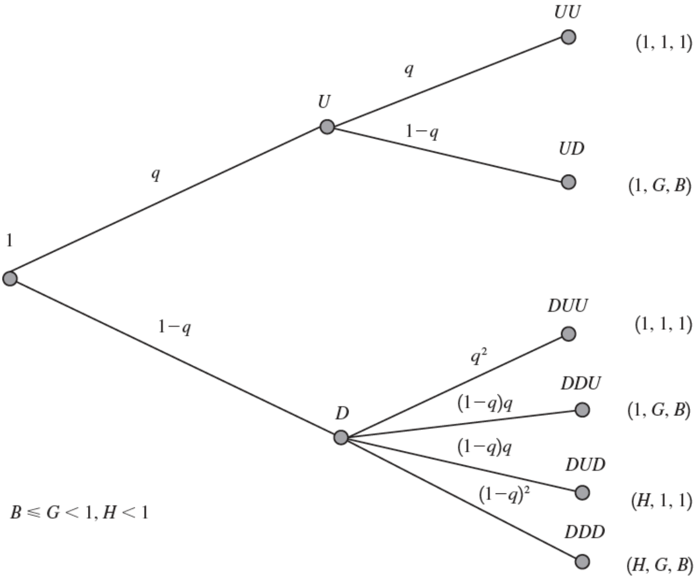
Model - Outline

- Construct heterogenous agent model (different beliefs and endowments) with incomplete markets capable of explaining Facts (1)-(3)
  - 1) Simple Benchmarks
    - Representative Agent (No contagion)
    - Complete Markets (Contagion quantitatively small)
    - Incomplete Markets (Contagion)
  - 2) Baseline Model With Leverage (Differential Contagion)
  - 3) Baseline Model With Adverse Selection (Differential Contagion and Issuance Rationing)

Model - Overview

- Finite Horizon
- Lucas tree of states $s \in S$
- Heterogenous Agents with different endowments and subjective probabilities over future states
- Log Utility

Model - Timing



$B \leqslant G < 1, H < 1$

Model - Representative Agent

- Consider only 1 Emerging Market asset (E), 1 High Yield asset (H)
- Endowments: $e = 2020$ in every node, 2 units of H and E in node 1
- Beliefs: q=0.9
- Terminal Payoffs in bad state: E=0.1, H=0.2
- No contagion: at node D future marginal utility is higher than at node U - higher prices for E

Asset	p_1	p_u	p_D	$(p_1 - p_D)/p_1$ %
E	.9082	.9082	.9083	-.01
H	.9901	.9981	.9183	7.25

Model - Complete Markets

- 2 Agents: Optimists (q = 0.9) and Pessimists (q=0.5)
- Endowments: $e^P = 2000, e^O = 20$ in every node, 1 Unit of each asset (H & E) in node 1
- Agents can trade Arrow securities, High-yield, and Emerging Economy assets
- Contagion Small: Pessimists much wealthier, especially at node D - prices reflect pessimists beliefs more strongly

Asset	p_1	p_u	p_D	$(p_1 - p_D)/p_1$ %
E	.5527	.5554	.5499	0.5
H	.8007	.9985	.5998	25.1

Model - Incomplete Markets

- Same endowments, beliefs, eliminate Arrow securities
- Contagion present
- Key mechanism: Increasing dispersion of beliefs - (optimists,pessimists) believe US High-yield asset will payout fully with probability (.99,.75) in initial state vs (.9,.5) in anxious state
  - Portfolio Effect - At node D optimists buy all of H, have less to spend on E

Asset	p_1	p_u	p_D	$(p_1 - p_D)/p_1$ %
E	.7954	.8630	.7273	8.56
H	.9097	.9986	.7364	19.05

Model - Collateral General Equilibrium

- Introduce non-contingent bond promising ϕ_s units consumption at each potential node next period
  - Cannot default
  - Collateral capacity of asset j: $\phi_s^j \leq \min_{t \in S(s)}[p_{tj} + D_{tj}]$
  - Cannot use endowment as collateral
- $\forall s \in S$, let s^* denotes node prior to state s
- x - consumption, y - asset holdings, r_s - risk free rate

Agents Problem

- max $U^i = \sum_{s \in S} \bar{q}_s^i \, (\delta^i)^{t(s)-1} \, u^i(x_s)$

  s.t. $B^i(p, r) = \{(\mathbf{x}, \mathbf{y}, \phi) \in \mathbb{R}_+^S \times \mathbb{R}_+^{SJ} \times \mathbb{R}^S : \forall s,$

  $(x_s - e_s^i) + \sum_{j \in J} p_{sj}(y_{sj} - y_{s^*j}) \leq \frac{1}{1+r_s}\phi_s - \phi_{s^*} + \sum_{j \in J} y_{s^*j} D_{sj},$

  $\phi_s \leq \sum_{j \in J^c} y_{sj} \min_{t \in S(s)}[p_{tj} + D_{tj}]\}$

Collateral Equilibrium

- A collateral equilibrium is a set of prices and allocations such that:
$(\mathbf{p}, \mathbf{r}), (\mathbf{x}^i, \mathbf{y}^i, \phi^i)_{i \in I} \in \mathbb{R}_+^{SJ} \times \mathbb{R}_+^S \times (\mathbb{R}_+^S \times \mathbb{R}_+^{SJ} \times \mathbb{R}^S) : \forall s,$
$\sum_{i \in I}(x_s^i - e_s^i) = \sum_{i \in I} \sum_{j \in J} y_{s^*j}^i D_{sj},$
$\sum_{i \in I}(y_{sj}^i - y_{s^*j}^i) = 0, \forall j,$
$\sum_{i \in I} \phi_s^i = 0,$
$(x^i, y^i, \phi^i) \in B^i(p, r), \forall i,$
$(x, y, \phi) \in B^i(p, r) \implies U^i(x) \leq U^i(x^i), \forall i.$

Asset Pricing I

- Liquidity Wedge ω_s^i :
  - $\frac{1}{1+\omega_s^i}\frac{1}{1+r_s} = \frac{\sum_{\sigma \in B(s)} \delta^i q^i_{s\sigma} MU^i(x^i_{s\sigma})}{MU^i(x^i_s)} = \sum_{\sigma \in B(s)} sdf^i_{s\sigma} q^i_{s\sigma}$
  - Measures wedge between rates borrowers willing to pay and lenders willing to take (given that payment is guaranteed)
- Effective collateral capacity:
  $\phi^i_{sj} = \mathbf{1}\{\text{Collateral Constraint Binds}\} \min_{t \in S(s)}[p_{tj} + D_{tj}]$

Asset Pricing II

- Decompose Asset price into payoff value and collateral value:
- Payoff Value: $PV^i_{sj} = \sum_{\sigma \in B(s)} sdf^i_{s\sigma}[p_{s\sigma j} + D_{s\sigma j}]q^i_{s\sigma}$
- Collateral Value $CV^i_{sj} = [\frac{1}{1+r_s} - \frac{1}{1+\omega^i_s}\frac{1}{1+r_s}]\phi^i_{sj}$
- $p_{sj} = PV^i_{sj} + CV^i_{sj}$ if agent i holds asset j
- Higher ω increases collateral value, decreases payoff value

Simulation Results - Collateral Equilibrium

Asset	p_1	p_u	p_D	$(p_1 - p_D)/p_1$ %
E	.8511	.8695	.7416	12.9
H	.9316	.9985	.7306	21.6

Asset		p_1	p_u	p_D	$\frac{U-D}{p_U}$%	$\frac{1-D}{p_1}$ %
E	PV	.8223	.8655	.7251	16.6	11.8
	CV	.0287	.0043	.0201	-1.8	1.1
	Margin	.1286	.8852	.8651		
H	PV	.9316	.9985	.7306	26.8	21.6
	CV	0	0	0		
	Margin	1	1	1		

The Leverage Cycle

- During good times next periods price volatility low - enables high leverage and lowers liquidity wedge - asset prices rise
- Leverage does not cause lower absolute prices in anxious economy
  - Collateral Value makes emerging economy asset more valuable in economy with leverage
- Leverage causes larger price drop from 1 to D (due to higher asset prices in period 1, not lower period 2 asset prices)

Differential Contagion

- Extend previous model to include 2 emerging market assets (G,B) with payoffs (.2, .05)
- 2 Emerging Market Asset model without leverage exhibits contagion but not differential contagion
- Leverage allows for differential contagion through "flight to collateral"
  - Alternative explanation to "flight to quality"
  - In anxious economy liquidity wedge high, and dispersion of margins between assets high

Asset	p_1	p_u	p_D	$(p_1 - p_D)/p_1$ %
G	.8699	.8864	.7726	11.2
B	.8458	.8654	.7298	13.7
H	.9311	.9985	.7332	21.2

Extension - Adverse Selection

- Extend model to include issuance choice by emerging market
- 2 country types (G, B), private information
- Governments issue assets promising fraction z of next periods dividend to finance current-period consumption
- Price Schedule: $\vec{p_s} = \{(z_s, p_s(z_s)) : z_s \in (0,1], p_s \in \mathbb{R}_+\}$
- Country i's budget set: $B^{ks}(\vec{p_s}) = \{(\mathbf{x}, z) \in \mathbb{R}_+^{1+S_T(s)} \times \mathbb{R}_+ : x_s \leq \vec{p_s}(z)z,\ z \leq 1, \forall a \in S_T(s) : x_\alpha = e_\alpha^{ks} + (1-z)D_{\alpha k}\}$.

Issuance Rationing

- A separating equilibrium exists: good government signals type by issuing less assets
- Anxious economy exhibits issuance rationing - larger price spread for good/bad types increases incentive for bad type to mimic good type - good types issuance must drop

Asset	p_1	p_u	p_D	$\frac{p_1 - p_D}{p_1}$ %	$\frac{z_1 - z_D}{z_1}$ %
G	.8149	.8409	.6957	14.6	89.9
B	.7807	.8117	.6385	18.2	25
H	.8849	.9967	.6326	28.5	