International Credit Flows and Pecuniary Externalities

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Motivation

- Old "Washington consensus" in decline
  - Free trade: flow of goods/services intratemporal
  - Free finance: flow of capital intertemporal
- When does full capital account liberalization reduce (capital controls/macropru regulation improve) welfare?

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   - Market illiquidity: redeployability/specificity – not this paper

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   - Funding illiquidity: short-term debt, "hot money"
     - Type of capital flow matters: FDI, portfolio flows (equity), long-term debt

Asset side

Liability

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2. "Terms of trade hedge" (Cole-Obstfeld) can be undermined when
   - Industry's output is not easily substitutable.
     Consumers cannot easily find substitutes
   - No strong competitors in other countries
     - Natural resources: oil, copper for Chile,
     - Hard drives in Thailand, Bananas in Ecuador

Model setup - symmetric

- Preferences

$$E\left[\int_0^\infty e^{-rt}\frac{c_t^{1-\gamma}}{1-\gamma}dt\right]$$

  - Same preference discount rate r – "saving out of constraint"

- Two output goods y^a and y^b - imperfect substitutes

$$y_t=\left[\frac{1}{2}(y_t^a)^{\frac{s-1}{s}}+\frac{1}{2}\left(y_t^b\right)^{\frac{s-1}{s}}\right]^{s/(s-1)}$$

- (Comparative) advantages:

	Good $\boldsymbol{a}$	Good $\boldsymbol{b}$
Country A	$\bar{a}k_t$	$\underline{a}k_t$
Country B	$\underline{a}k_t$	$\bar{a}k_t$

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Two country/sector model

- World capital shares:

$$\psi_t^{Aa} + \psi_t^{Ab} + \psi_t^{Ba} + \psi_t^{Bb} = 1$$

- World supply of (output) goods:

$$Y_t^a = \left(\psi_t^{Aa}\overline{a} + \psi_t^{Ba}\underline{a}\right)K_t \qquad Y_t^b = \left(\psi_t^{Bb}\overline{a} + \psi_t^{Ab}\underline{a}\right)K_t$$

- Price of output goods a and b in terms of price of y

$$P_t^a = \frac{1}{2}\left(\frac{Y_t}{Y_t^a}\right)^{1/s} \text{ and } P_t^b = \frac{1}{2}\left(\frac{Y_t}{Y_t^b}\right)^{1/s}$$

  - Terms of trade P_t^a / P_t^b

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Two country/sector model

- Capital evolution for
  - $dk_t = (\Phi(\iota_t) - \delta)k_t dt + \sigma^A k_t dZ_t^A$ in country A
  - $dk_t = (\Phi(\iota_t) - \delta)k_t dt + \sigma^B k_t dZ_t^B$ in country B
    - Φ concavity – technological illiquidity
    - Single type of capital
    - Investment in composite good

- Shocks are
  - Two dimensional
    - Affect global capital stock $dZ_t^A + dZ_t^B$
    - Redistributive (initial shock + amplification) $\Rightarrow$ affects wealth share, η_t
      - Example: Apple vs. Samsung lawsuit

Market structures

	Trade		Finance	
Markets	Output y^a, y^b	Physical capital K	Debt	Equity
Complete Markets Full integration/First Best	X	X	X	X
Open credit account (equity home bias)	X	X	X	
Closed credit account	X	X		
	intratemporal		intertemporal	

Add taxes/capital controls

Returns on physical capital

- $dk_t/k_t = (\Phi(\iota_t) - \delta)dt + \sigma^A k_t dZ_t^A$

- Postulate
  - $dq_t/q_t = \mu_t^q dt + \sigma_t^{qA} dZ_t^A + \sigma_t^{qB} dZ_t^B$

Ito product rule:
$d(X_t Y_t) = dX_t Y_t + X_t dY_t + \sigma_X \sigma_Y dt$

- Returns from holding physical capital
  - $dr_t^{Aa} = \left(\frac{\overline{a} P_t^a - \iota_t}{q_t} + \mu_t^q + \Phi(\iota_t) - \delta + \sigma^A \sigma_t^{qA}\right) dt +$

    $+(\sigma^A + \sigma_t^{qA}) dZ_t^A + \sigma_t^{qB} dZ_t^B$

  - $dr_t^{Ab} = \left(\frac{\underline{a} P_t^b - \iota_t}{q_t} + \mu_t^q + \Phi(\iota_t) - \delta + \sigma^A \sigma_t^{qA}\right) dt +$

    $+(\sigma^A + \sigma_t^{qA}) dZ_t^A + \sigma_t^{qB} dZ_t^B$

The 3 step solution procedure

1. Derive equilibrium conditions
   - Optimality and asset pricing conditions (from postulated processes)
     - Consumption
       with log-utility: $c_t = rN_t$ (no precautionary savings)
     - Asset pricing (from above)
       with log-utility: Sharpe Ratio of asset = volatility of net worth
     - Internal investment rate ι_t: $q\Phi'(\iota_t) - 1 = 0$
   - Market clearing conditions
2. Derive evolution of state variable $\eta_t = \frac{N_t}{q_t K_t}$
3. Express in terms of ODE
   - All $\mu^{\text{postolated}}$ and $\sigma^{\text{postulated}}$ are expressed in terms of $q'(\eta), q''(\eta), \ldots$

For any market structure

market structure specific

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Market structures

1. Complete markets ⇒ First best
2. Incomplete markets (equity home bias)
   - Levered short-term debt financing
   - Sudden stops: (varying technological illiquidity)
     - Amplification
     - Runs due to sunspots
3. Closed capital account: capital controls (no equity, no debt)
4. Welfare analysis

1. Complete markets: First Best Remarks

- Perfect capital allocation + perfect risk sharing

- Prices are constant and independent of shocks
- Economy shrinks/expands with (multiplicative) shocks
- Elasticity of substitution, s, has no impact on prices

Market structures

1. Complete markets ⇒ First best
2. Incomplete markets (equity home bias)
   - Levered (short-term) debt financing
   - Sudden stops: (varying technological illiquidity, irreversibility)
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2. Equilibrium characterization: state variable

- Equilibrium is a map
  Histories of shocks $\{Z_s^A, Z_s^B, s \le t\}$ → prices allocation $q_t, \psi_t^{Aa} \ldots, \iota_t^A, \iota_t^B, \zeta_t^A, \zeta_t^B$

  wealth distribution

$$\eta_t = \frac{N_t}{q_t K_t} \in (0,1)$$

A's wealth share

- $\psi_t^{Aa} + \psi_t^{Ab} + \psi_t^{Ba} + \psi_t^{Bb} = 1$ and $C_t^A + C_t^B = Y_t - \iota_t K_t$
- Portfolio weights: $\frac{\psi_t^{Aa}}{\eta_t}, \frac{\psi_t^{Ab}}{\eta_t}, 1 - \frac{\psi_t^{Aa}+\psi_t^{Ab}}{\eta_t}$
- Consumption rates: $\zeta_t^A = C_t^A / N_t \quad \zeta_t^B = C_t^B / (q_t K_t - N_t)$

2. State variable: 3 regions

- Wealth share η
  - Three regions

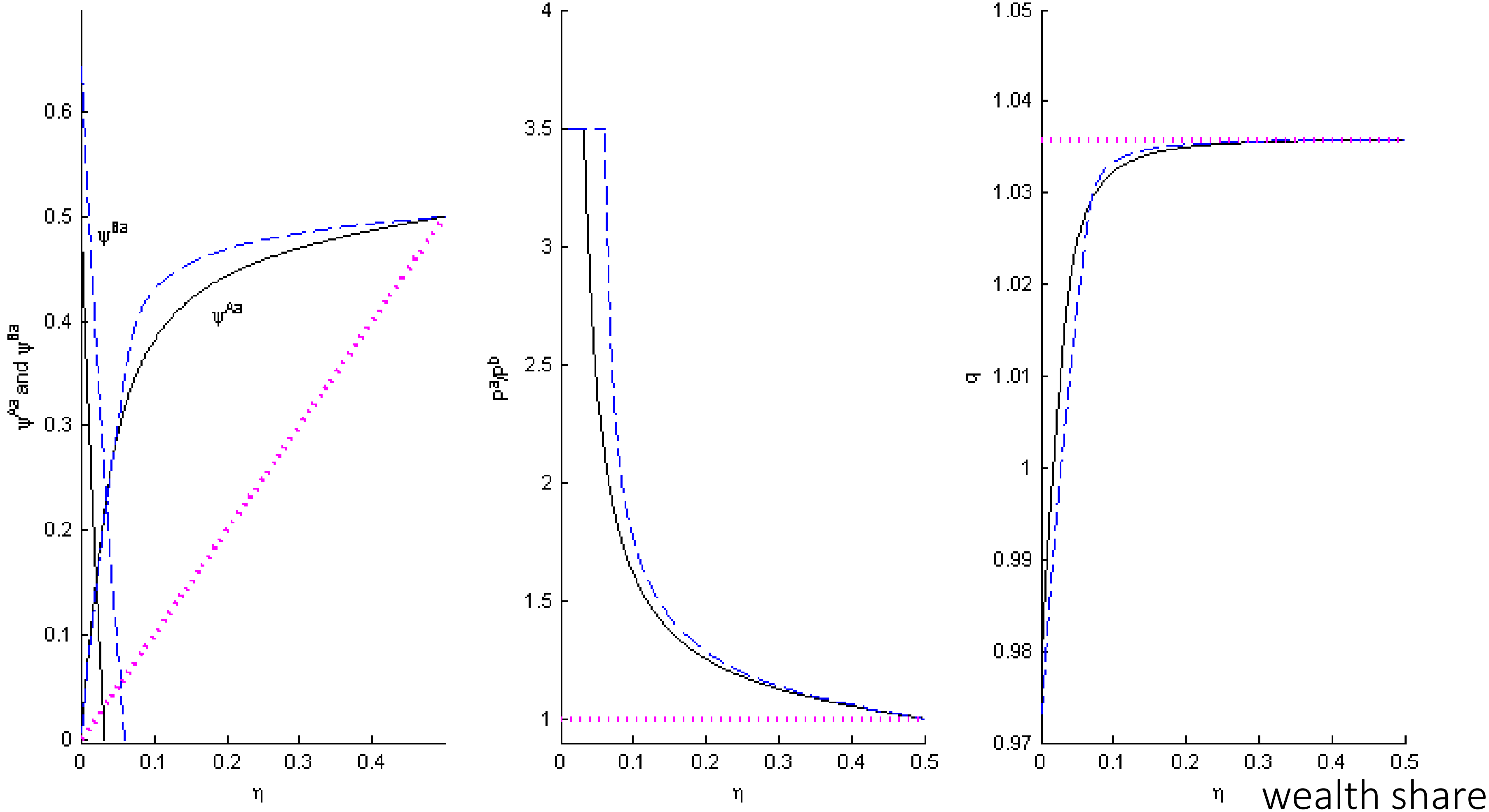
		Full specialization	
A produces	a	a	a, b
B produces	a, b	b	b

$$\psi_t^{Aa} = \eta_t$$
$$\psi_t^{Bb} = 1 - \eta_t$$
$$\psi_t^{Ba} = \psi_t^{Ab} = 0$$

  - Symmetric

2. Capital share, terms of trade, price of capital

- Numerical: $r = 5\%, \overline{a} = 14\%, \underline{a} = 4\%, \delta = 5\%, \kappa = 2, \sigma^A = \sigma^B = 10\%$



- Three different elasticities of substitution: $s = \{.5, 1, \infty\}$

TOT: Supply vs. demand shock

- Supply versus demand shock

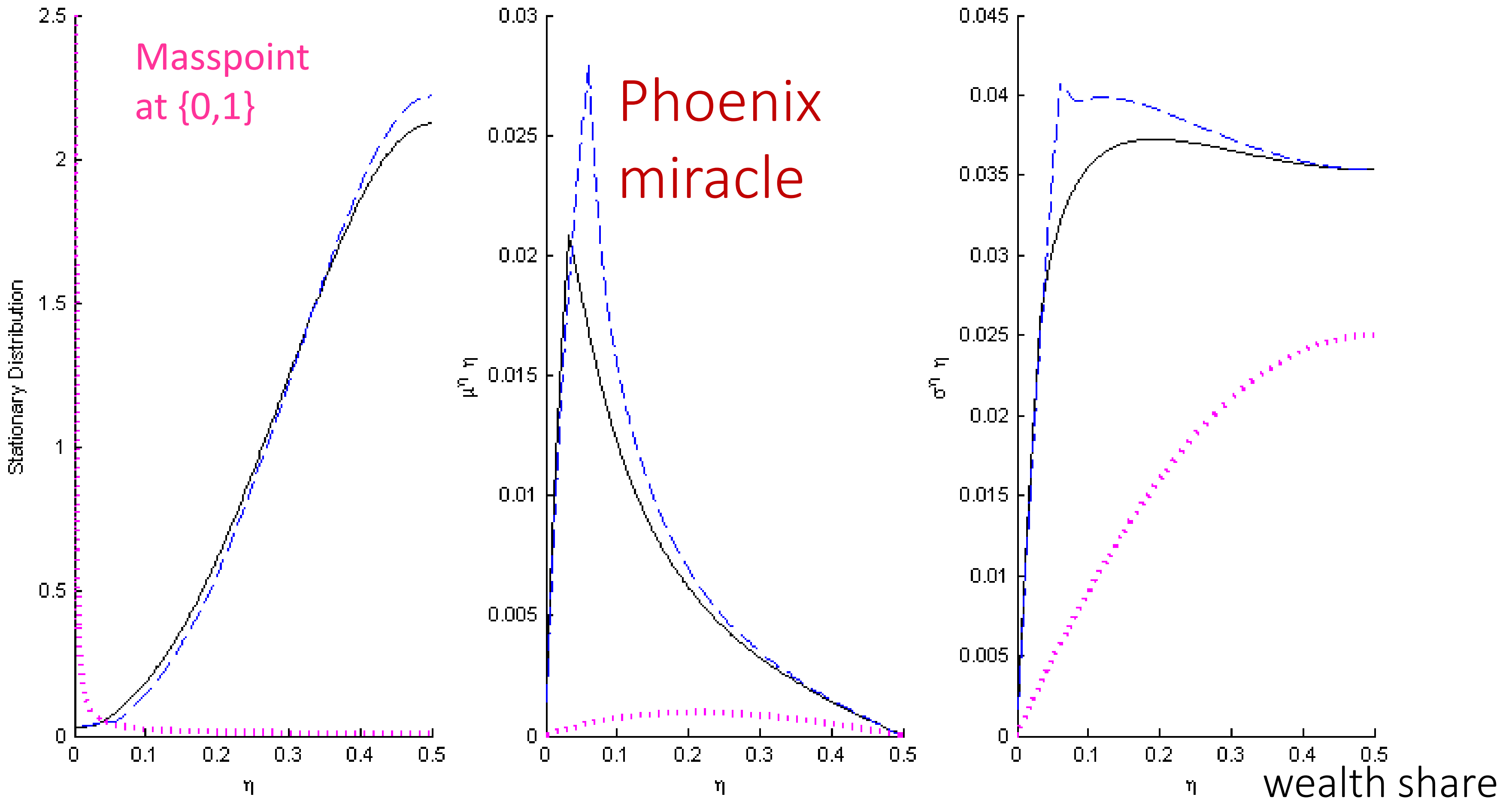
  TOT improve for A as η_t declines for $\eta_t \in [\overline{\eta}, .5)$ can be due to
  - $dZ^A < 0$: Negative supply shock — World recession
  - $dZ^B > 0$: Positive demand shock — World boom

- TOT: Output price

- …but fire-sale of (physical) capital stock k_t

2. Stability, Phoenix Miracle for different s

- Stationary distribution   drift   volatility



- Three different elasticities of substitution: $s = \{.5, 1, \infty\}$
- Difference to Cole & Obstfeld 1994: persistence of capital, $\delta < \infty$

Overview

1. Complete markets $\Rightarrow$ First best
2. Incomplete markets (equity home bias)
   - Levered short-term debt financing
   - Sudden stops: (varying technological illiquidity)
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2. Amplification

$$\sigma_t^{\eta A} = \frac{\frac{\psi_t^{Aa}}{\eta_t}(1-\eta_t)}{1 - [\psi_t^{Aa} - \eta_t]\frac{q'(\eta_t)}{q(\eta_t)}} \sigma^A$$

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2. Amplification

leverage

$$\sigma_t^{\eta A} = \frac{\frac{\psi_t^{Aa}}{\eta_t}(1-\eta_t)}{1 - [\psi_t^{Aa} - \eta_t]\frac{q'(\eta_t)}{q(\eta_t)}} \sigma^A$$

- Leverage effect ψ_t^{Aa}/η_t

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leverage

Market illiquidity (price impact)

- Leverage effect ψ_t^{Aa}/η_t
- Loss spiral $1/\{1 - [\psi_t^{Aa} - \eta_t]\frac{q'(\eta_t)}{q(\eta_t)}\}$ (infinite sum)

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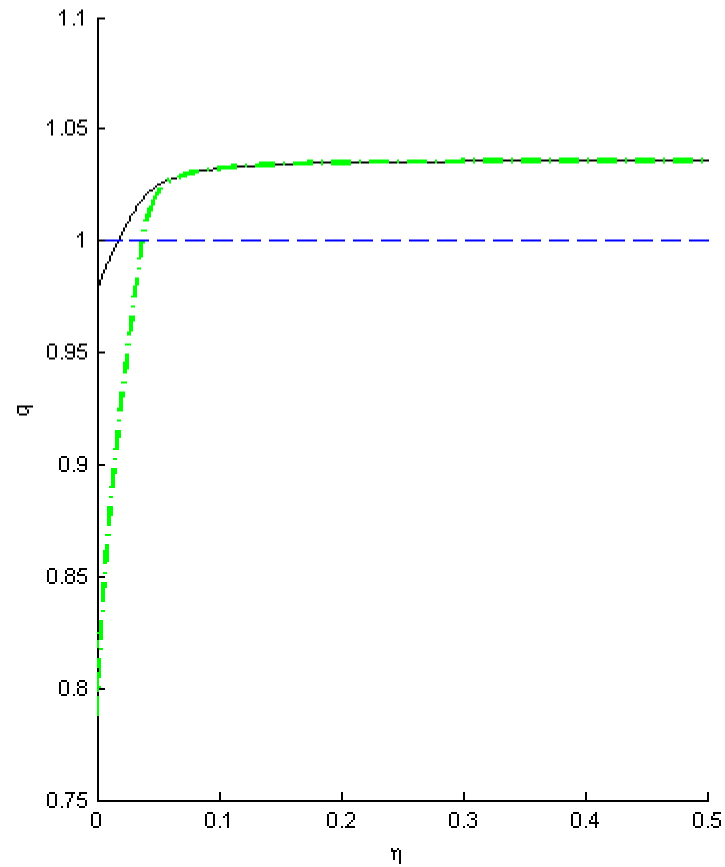
leverage: $\frac{\psi_t^{Aa}}{\eta_t}$

Market illiquidity (price impact): $\frac{q'(\eta_t)}{q(\eta_t)}$

- Leverage effect ψ_t^{Aa}/η_t
- Loss spiral $1/\{1-[\psi_t^{Aa}-\eta_t]\frac{q'(\eta_t)}{q(\eta_t)}\}$ (infinite sum)
- Technological illiquidity $(\kappa, \delta) \Rightarrow$ market illiquidity $q'(\eta)$
  - (dis)investment adjustment cost

2. Technological $(\kappa, \delta) \Rightarrow$ market illiquidity $q'(\eta)$

- Quadratic adjustment cost
- Investment rate of $\Phi + \frac{1}{\kappa}\Phi^2$ generates new capital at rate Φ
- $\Phi(\iota) = \frac{1}{\kappa}\left(\sqrt{1 + 2\kappa\iota} - 1\right)$
- Three cases
  - $\kappa = 0 \Rightarrow q = 1$
  - $\kappa = 2$
  - $\kappa_{\iota<0} = 100$ and $\kappa_{\iota>0} = 2$



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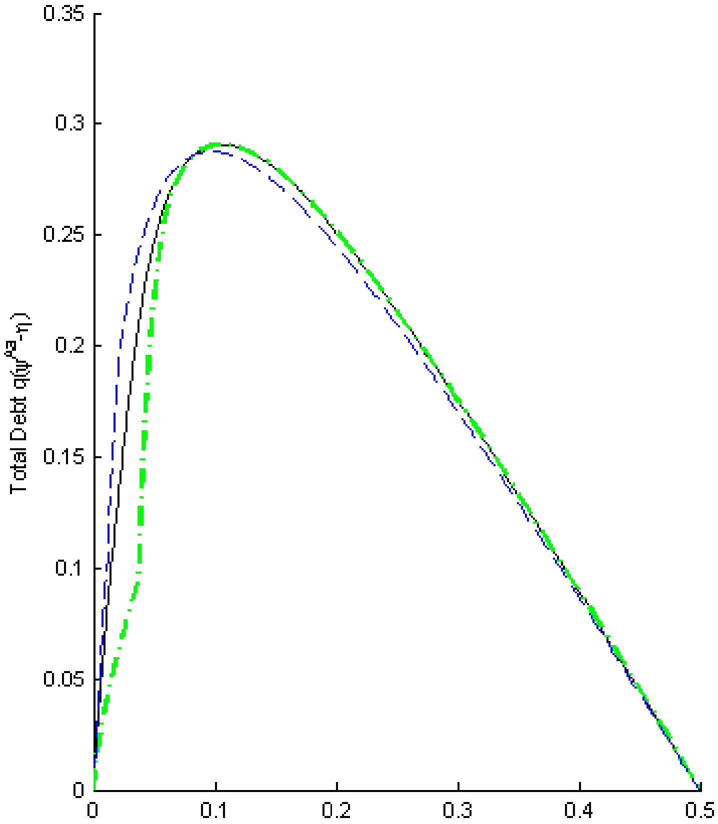
Sudden stops: amplification & runs

- Sudden stop
  - Adverse fundamental triggers %-decline in debt that exceeds %-decline in net worth; $\frac{\partial(\psi^{Aa}-\eta)}{\partial\eta}\frac{\eta}{\psi^{Aa}-\eta} > 1 \Leftrightarrow \frac{\partial\psi^{Aa}}{\partial\eta} > \frac{\psi^{Aa}}{\eta}$ $\Leftrightarrow$ pro-cyclical leverage



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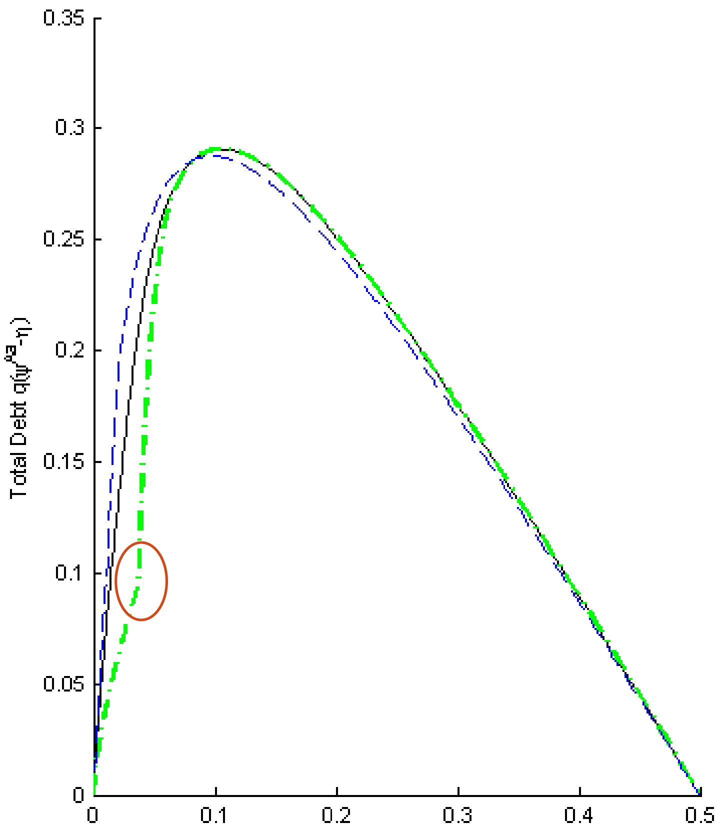
Slope of tangent vs. secant



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  - An unanticipated sunspot triggers a sudden capital price drop from q to $\tilde{q}$, accompanied by a drop in η to $\tilde{\eta}$.

$$\tilde{q}\tilde{\eta} = \max\{\eta q + \psi^{Aa}(\tilde{q} - q), 0\}$$

Sudden stops: amplification & runs

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  $\Leftrightarrow$ pro-cyclical leverage

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hyperbola

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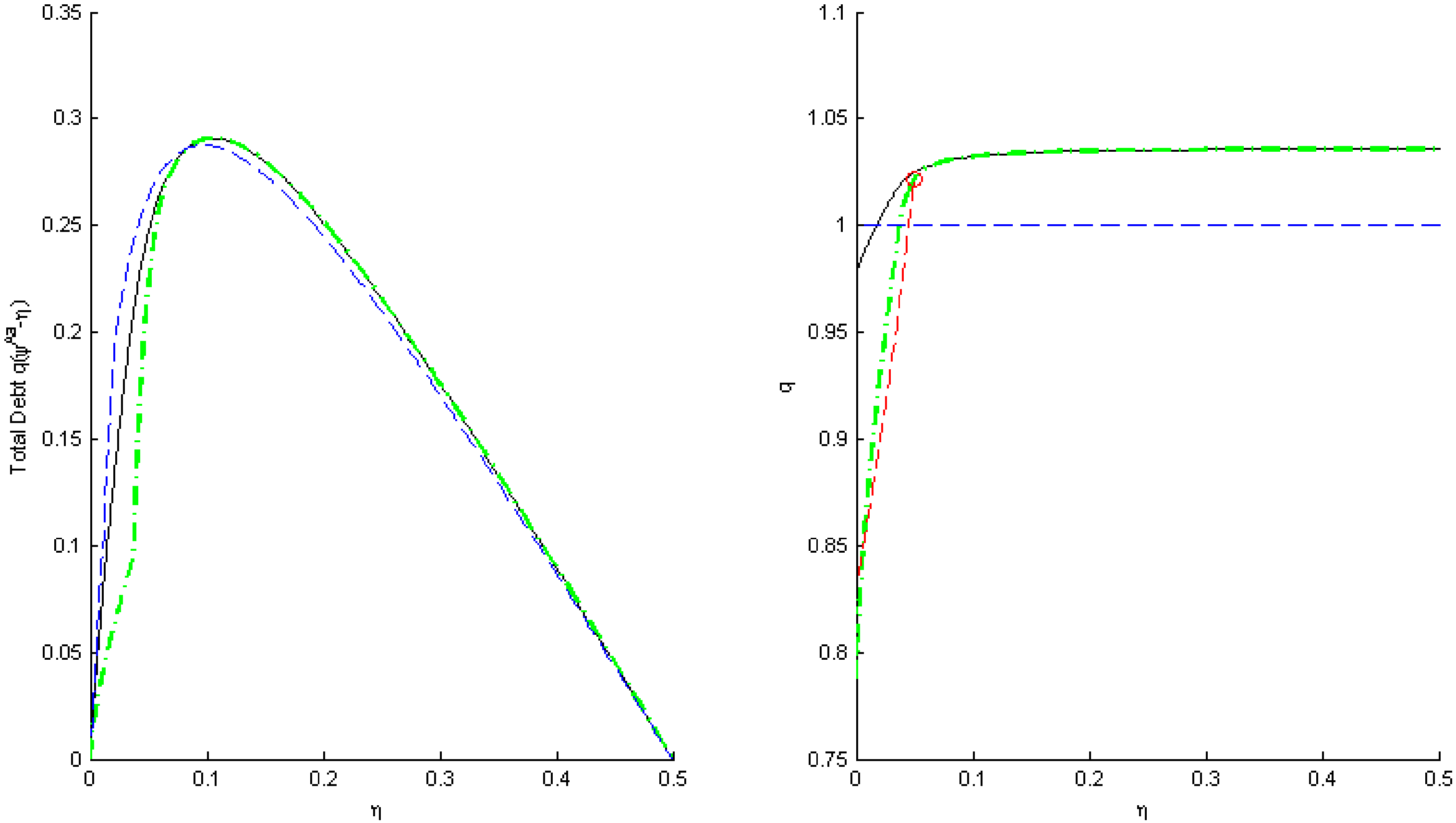
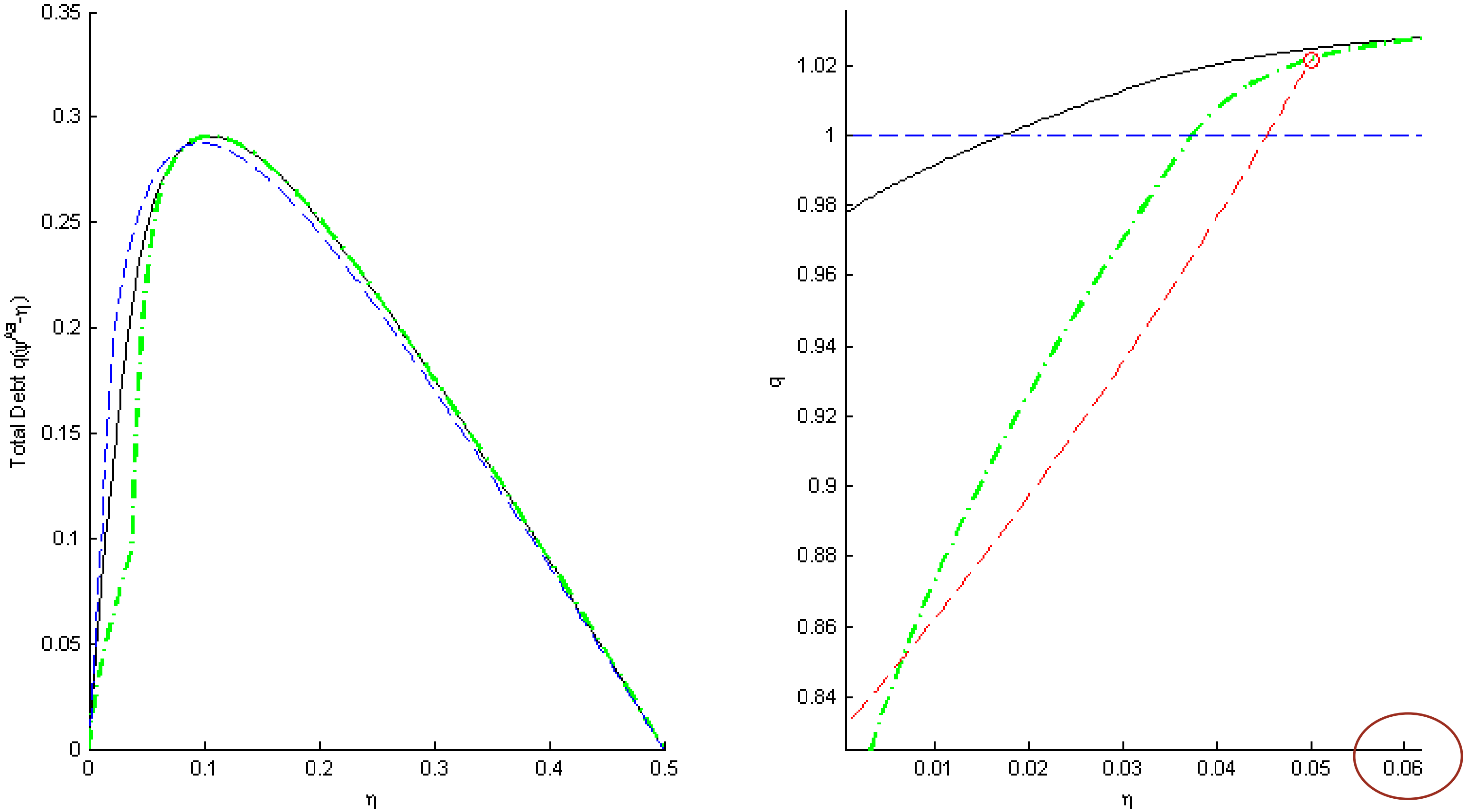
Sudden stop due to sunspot



Sudden stop due to sunspot: Zoomed in



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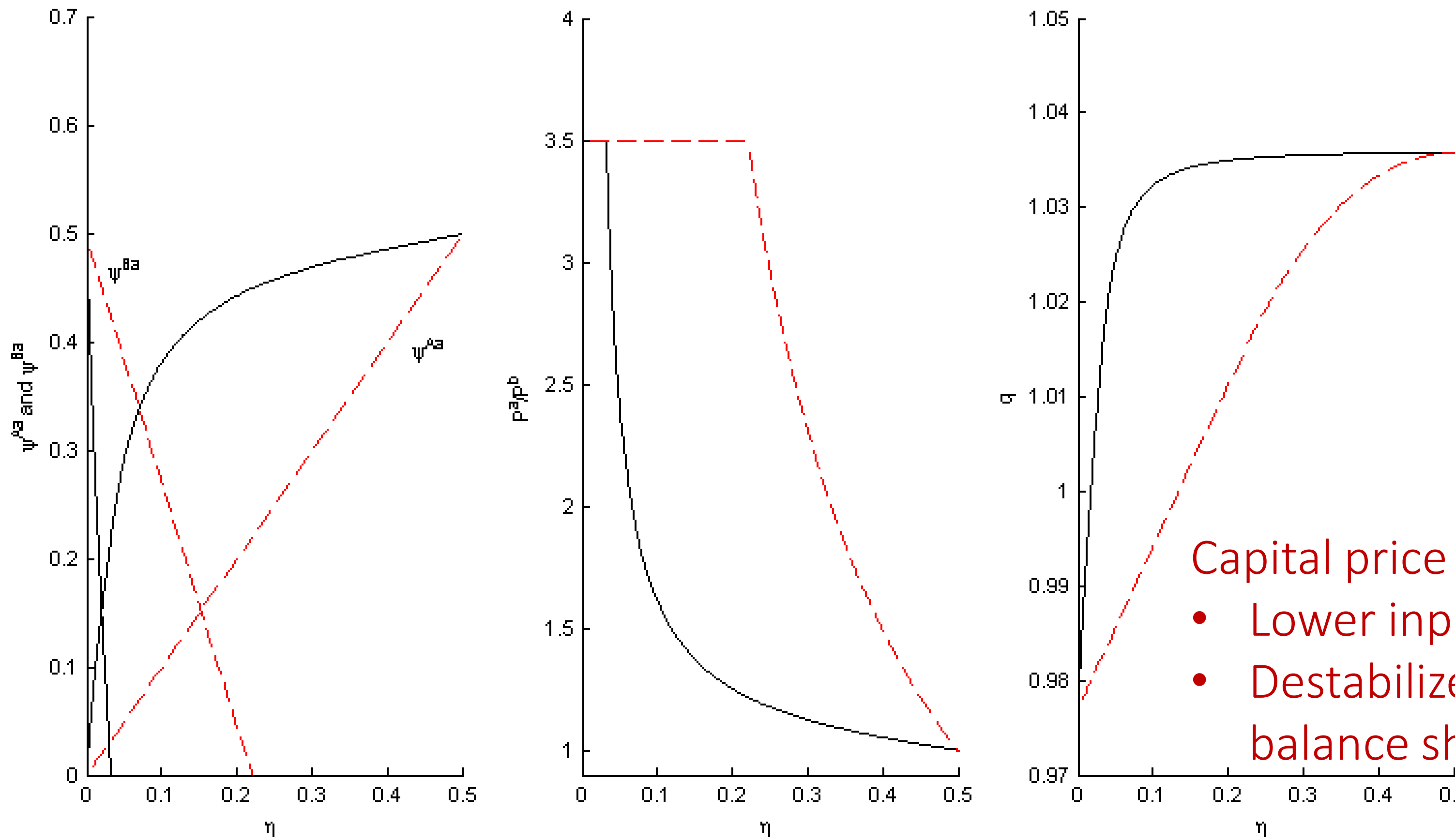

Capital price lower
- Lower input price
- Destabilizes balance sheet

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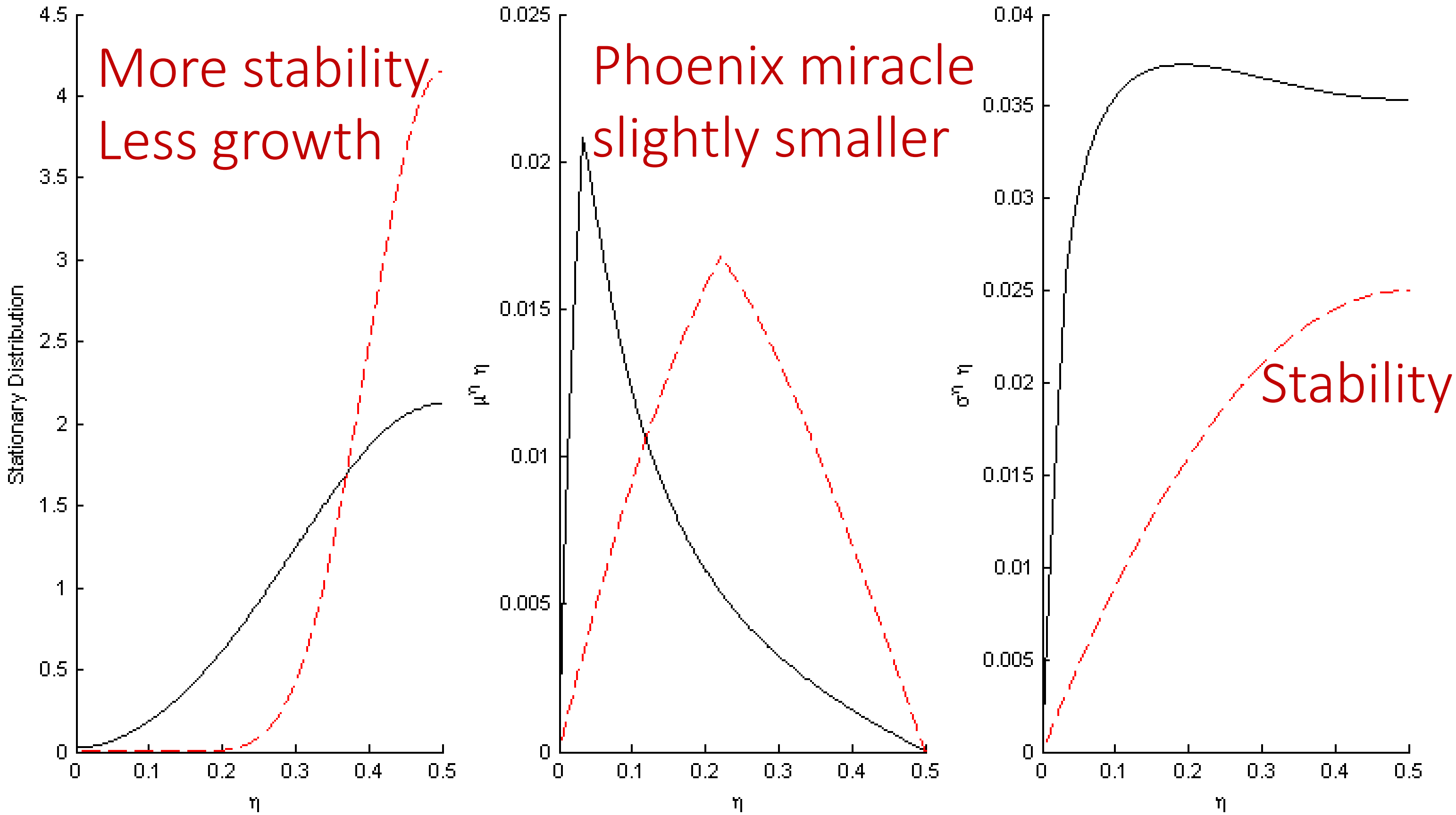

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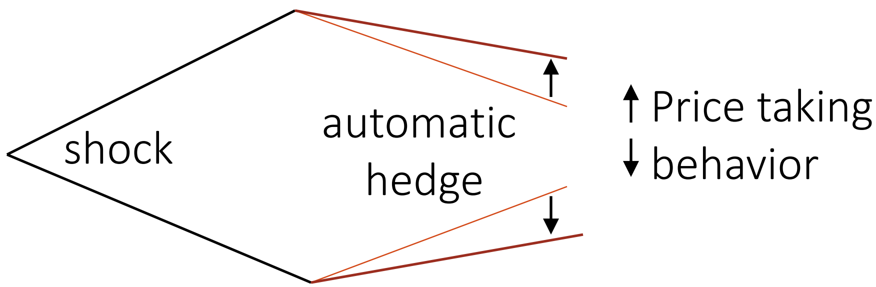
   - Pecuniary externalities
   - Welfare calculations + Pareto improving redistributions

4. When are credit flows excessive?

- Constrained inefficiency (in incomplete market setting) due to pecuniary externalities
  - Price of capital: fire sale externality if leverage is high
  - Price of output good: "terms of trade hedge" restrained competition
    - Price taking behavior undermined this hedge



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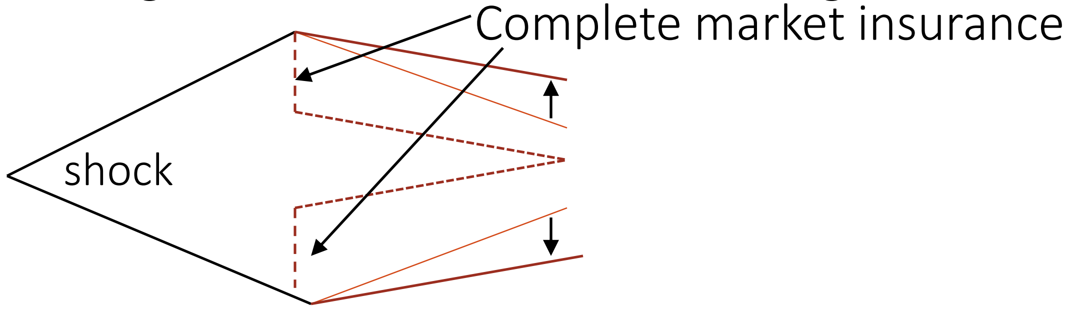
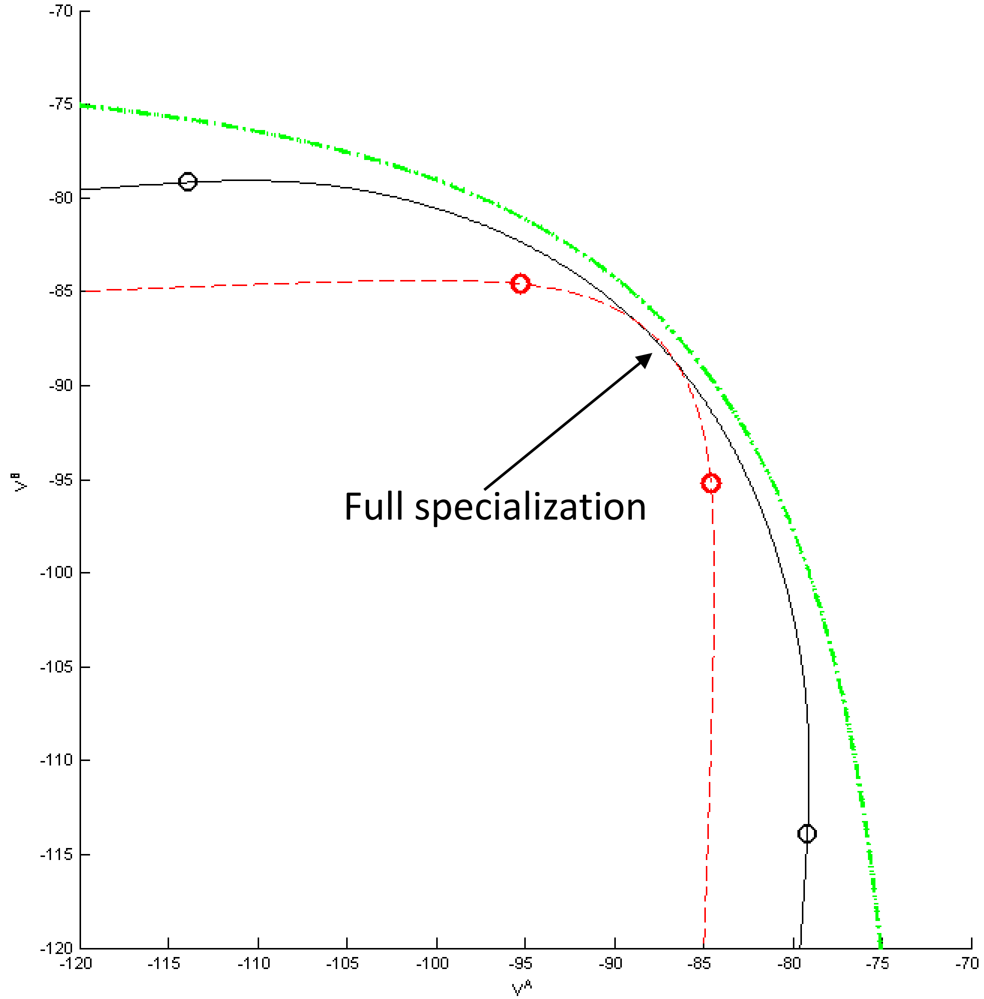


4. Welfare comparison

- $r = 5\%, \overline{a} = 14\%, a = 4\%, \delta = 5\%, \kappa = 2, \sigma^A = \sigma^B = 10\%,$



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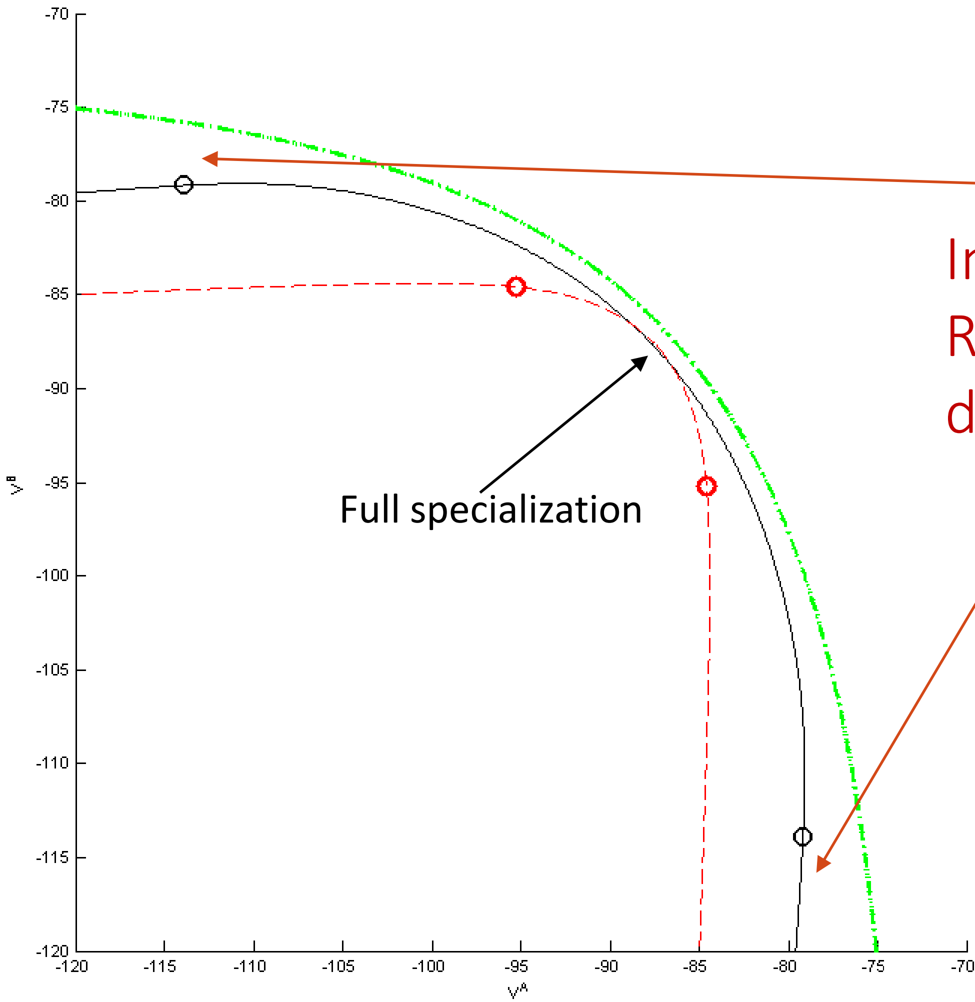

Inefficiency at the extremes:
Role for redistributive Policy
default/bail-out/debt-relief

Pareto improving

Intuition:
Other country's output price is high

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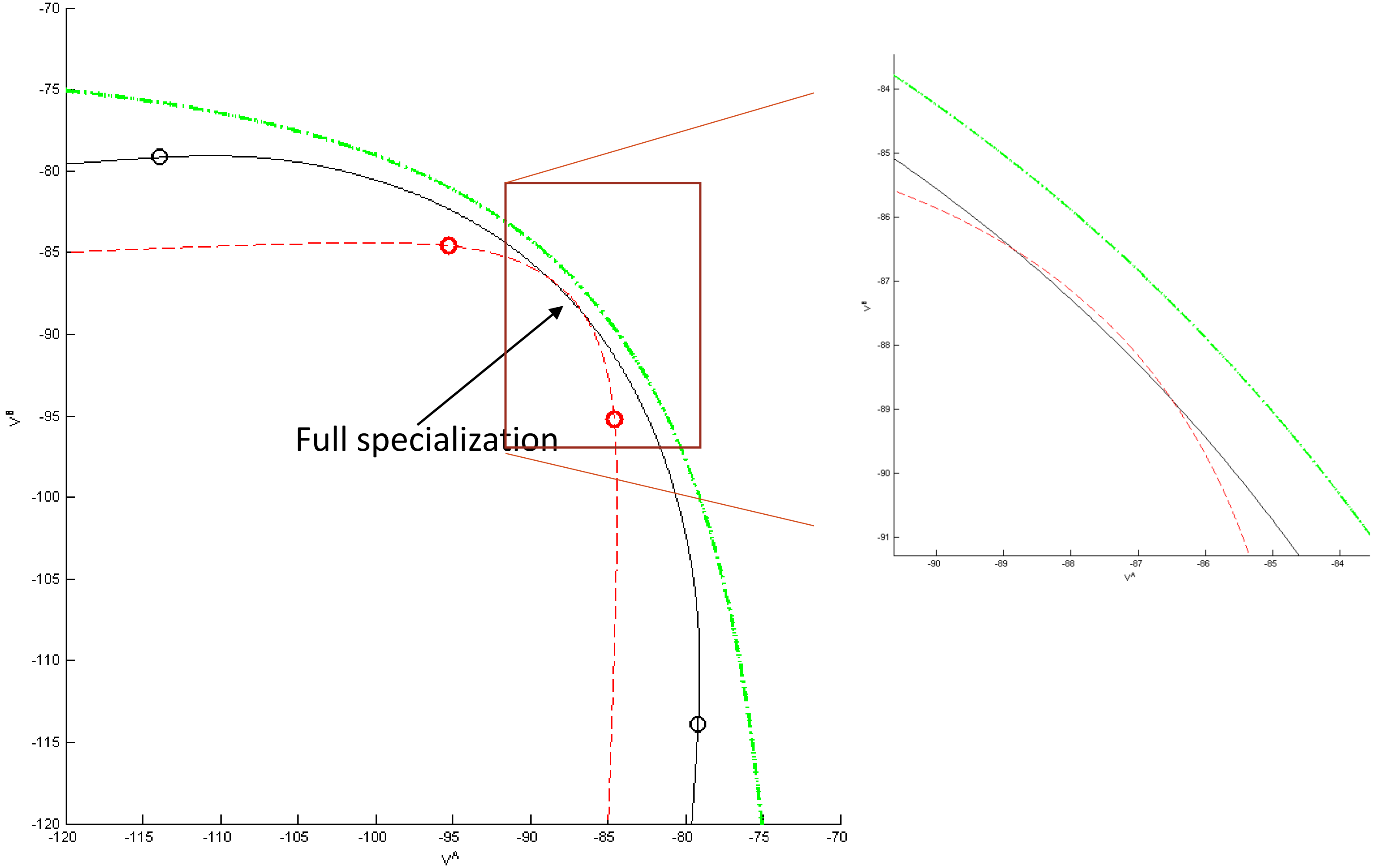
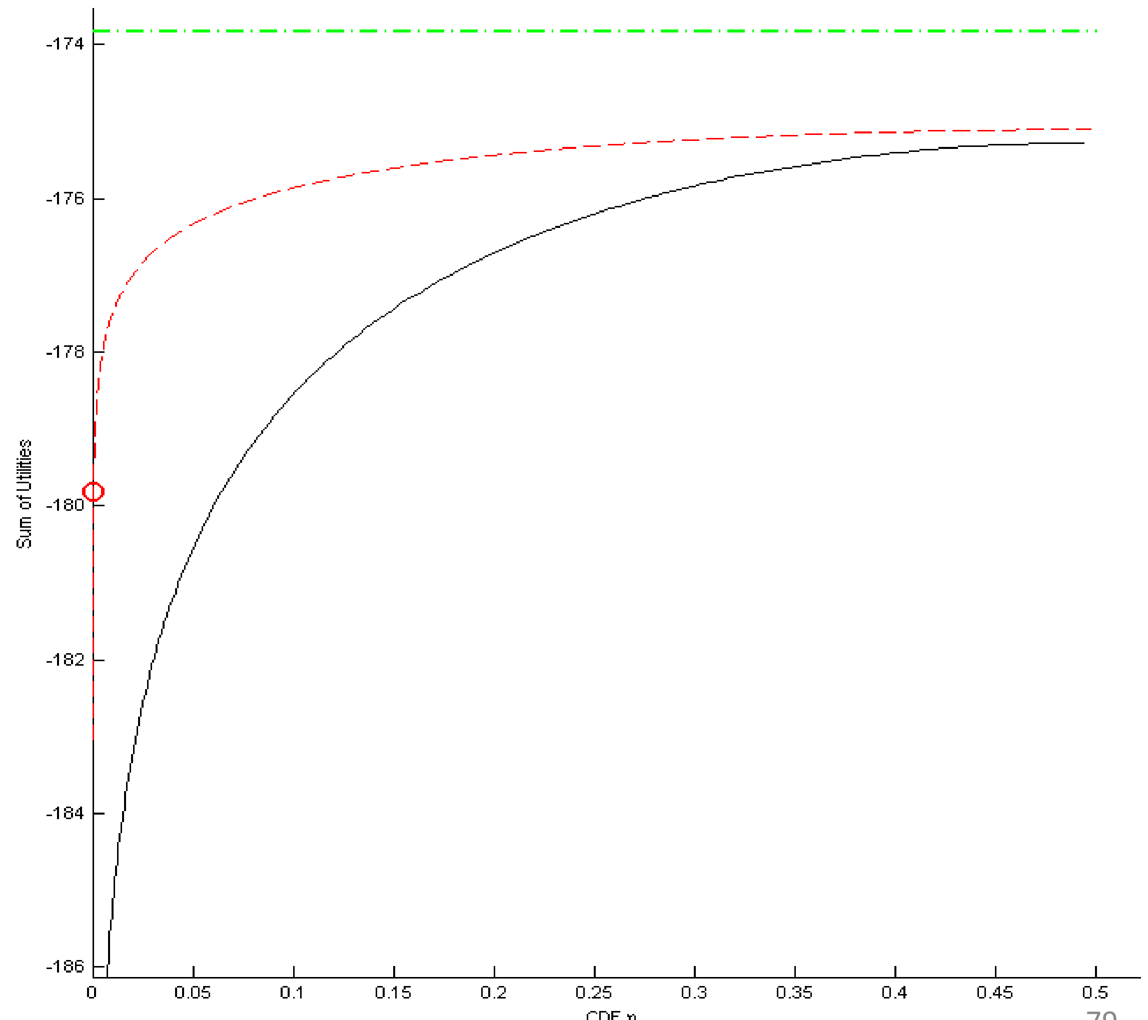


4. Welfare comparison

- Any monotone transformation of η would be equally good state variable
- Normalization: take CDF of η
  - Uniform stationary distribution!



Conclusion

- Sudden stops
  - Amplification of fundamental shock
  - Runs due to sunspots – vulnerability region
- Phoenix miracle
- Tradeoff between capital allocation & risk sharing
  - "Terms of trade hedge"
- When are short-term credit flows excessive?
  - When can capital controls (financial liberalization) be welfare enhancing (reducing)?
  - Pecuniary externality
    - Price of physical capital fire-sales externality – technological illiquidity
    - Price of output goods: "terms of trade hedge" externality
- Bailout/Restructuring
  Redistributive policy can be Pareto improving if one country is sufficiently balance sheet impaired
  - Reduces output good price

positive

normative