

Information and Liquidity

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Aringosa walked back to his black briefcase, opened it, and removed one of the bearer bonds. He handed it to the pilot.

“What’s this?” the pilot demanded.

“A ten-thousand-euro bearer bond drawn on the Vatican Bank.”

The pilot looked dubious.

“It’s the same as cash.”

“Only cash is cash,” the pilot said, handing the bond back.

The Da Vinci Code

Intro: Motivation

Venerable idea in monetary economics: media of exchange - or liquid assets more generally - tend to be (ought to be) portable, storable, divisible, and *recognizable*.

We formalize the relation between recognizability and liquidity in a game with information frictions.

Example: US dollars (other objects historically) are readily accepted while other currencies, stocks, bonds etc. are not.

...despite the alternatives having some good properties, in particular rate of return.

Maybe because these alternatives are less recognizable?

Intro: Literature

Monetary Economics

Classics: Menger, Jevons ... Brunner-Meltzer, Alchain

Modern: Freeman, Bannerjee-Maskin, Williamson-Wright,
Kim, Trejos, Berentsen-Rocheteau ...

Finance

Glosten and Milgrom, Kyle

Related work on multiple assets:

Tobin, Wallace ... Lagos, Lagos-Rocheteau, Geromichalos
et al, ...

Intro: An Issue

Std model *cannot* deliver what we want: it is *not* an equil for agents to always reject assets they don't recognize

- ◆ Asset can be good or a worthless lemon/counterfeit
- ◆ Buyers first choose to acquire good or bad assets
- ◆ Then meet sellers who recognize quality w/prob λ
- ◆ Suppose sellers reject assets they do not recognize
- ◆ Then no buyers bring bad assets

Hence always rejecting assets you cannot recognize is *not* an equilibrium.

Basic Model (1 of 2)

equal measure of buyers and sellers, b and s

s can produce good at cost k_g yielding u for b and 0 for s

b endowed with high-quality asset H yielding y_h to both

b can get low-quality asset L at cost k_l yielding y_l to both

for now goods and assets are indiv and b can only bring 1 asset to market (if he acquires L he eats H)

let l denote strategy of acquiring L , l' the opposite

let p_l be the prob b plays l

Basic Model (2 of 2)

s can distinguish H from L iff he pays ex ante cost k_i^s , with dist'n $F(k_i^s)$ across s

let i be strategy of acquiring info, p_i^s the prob s plays i

then $\lambda = \int p_i^s$ is fraction of informed sellers

after choosing p_b and p_s , each agent matched with prob α

let a be strategy of uninformed s to accept and p_a be the prob of playing a

(A1) $y_h > 0 \geq y_l - k_l$ (A2) $0 \leq y_l < k_g < y_h < u$

Model A: b chooses H or L before he sees if s played i or i'

Payoffs for b :

$$\pi_l = y_h - k_l + (1 - \alpha)y_l + \alpha\{\lambda y_l + (1 - \lambda)[p_a u + (1 - p_a)y_l]\}$$

$$\pi_{l'} = (1 - \alpha)y_h + \alpha\{\lambda u + (1 - \lambda)[p_a u + (1 - p_a)y_h]\}$$

Best response

$$p_l^*(p_a) = \begin{cases} 1 & p_a > \bar{p}_a \\ \Phi & p_a = \bar{p}_a \\ 0 & p_a < \bar{p}_a \end{cases}$$

where $\bar{p}_a = \frac{\alpha\lambda(u-y_h)+k_l-y_l}{\alpha(1-\lambda)(y_h-y_l)}$

Model A: taking p_i^s as given for now (exog info)

Payoffs for uninformed s :

$$\pi_a = -k_g + p_l y_l + (1 - p_l) y_h$$

$$\pi_{a'} = 0$$

So best response is

$$p_a^*(p_l) = \begin{cases} 1 & p_l < \bar{p}_l \\ \Phi & p_l = \bar{p}_l \\ 0 & p_l > \bar{p}_l \end{cases}$$

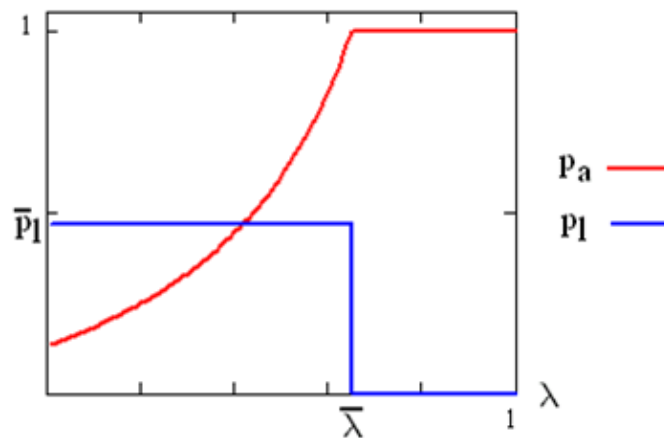
where $\bar{p}_l = \frac{y_h - k_g}{y_h - y_l}$.

Prop 1 (Model A, exog info): Let $\bar{\lambda} = \frac{\alpha(y_h - y_l) + y_l - k_l}{\alpha(u - y_l)}$.

If $\lambda > \bar{\lambda}$ then the unique equil is $p_a^* = 1$ and $p_l^* = 0$.

If $\lambda = \bar{\lambda}$ then $p_a^* = 1$ and p_l^* can take any value in $[0, \bar{p}_l]$.

If $\lambda < \bar{\lambda}$ then the unique equil is $p_a^* = \bar{p}_a(\lambda)$ and $p_l^* = \bar{p}_l$.



★ if λ is big b brings L to the market w/prob $p_l = 0$, so $p_a = 1$

★ if λ is small b brings L to the market w/prob $p_l > 0$ but uninformed s still accepts assets w/ prob

$$\bar{p}_a = \frac{\alpha\lambda(u - y_h) + k_l - y_l}{\alpha(1 - \lambda)(y_h - y_l)} > 0.$$

For $\bar{p}_a \approx 0$ we need $\lambda \approx 0$ and $k_l \approx y_l$.

Now $k_l \approx y_l$ is fine - counterfeiting is cheap - but how about $\lambda \approx 0$?

We need to endogenize information.

Model A: Endogenous Info

Payoffs to s from strategies i and i' are

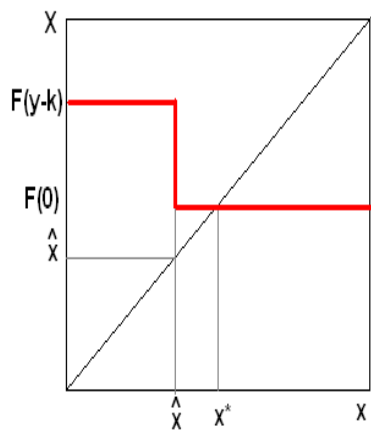
$$\pi_i^s = -k_i^s + \alpha(1 - p_l)(y_h - k_g)$$

$$\pi_{i'}^s = \alpha \{ p_a [-k_g + p_l y_l + (1 - p_l)(y_h)] \}$$

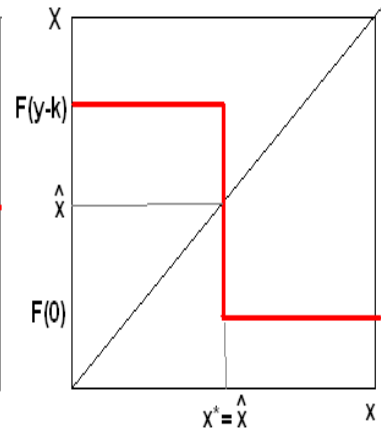
If $\lambda \in (\bar{\lambda}, 1]$, then $p_l^* = 0$ and BR is i' for all $k_i^s > 0$.

If $\lambda \in [0, \bar{\lambda})$, then $p_l^* = \bar{p}_l$ and BR is i iff $k_i^s \leq \bar{k} \equiv \frac{\alpha(k_g - y_l)(y_h - k_g)}{y_h - y_l}$.

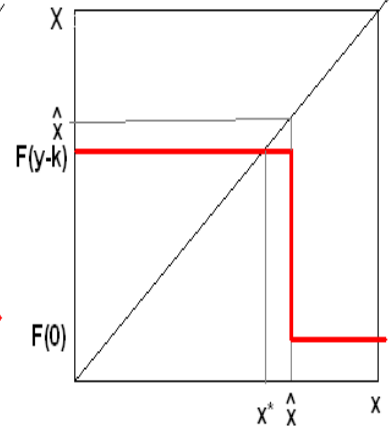
If $\lambda = \bar{\lambda}$ and we select $p_l \in [0, \bar{p}_l]$ as equil, BR is i iff k_i^s below some cutoff in $[0, \bar{k}]$.



$\hat{x} < F(0) \Rightarrow$
 only S with $k = 0$ invests
 $pc = 0$ and $pa = 1$



$F(0) < \hat{x} < F(y-k) \Rightarrow$
 $x^* = \hat{x}$ $pa = 1$ and $pc = ???$



$F(y-k) < \hat{x} \Rightarrow$
 S with $k < y-k$ invest
 $pa = \dots$ $pc = \dots < 1$

Prop 2 (Model A, endog info): There exists a unique equil.

info costly: $\lambda^* = F(\bar{k})$, $p_l^* = \bar{p}_l$, and $p_a^* = \frac{\alpha F(\bar{k})(u-y_h)+k_l-y_l}{\alpha[1-F(\bar{k})](y_h-y_l)}$.

info not so costly: $\lambda^* = \bar{\lambda}$, $p_l^* = \frac{F^{-1}(\bar{\lambda})}{\alpha(k_g-y_l)}$, and $p_a^* = 1$.

info cheap: $\lambda^* = F(0)$ and $p_l^* = 0$ and $p_a^* = 1$.

even if info is costly, so that λ^* is low and $p_l^* > 0$, we still tend to get $p_a^* > 0$.

issue: *if λ is low then p_l^* is high and this makes info very valuable.*

so it is hard to get $\lambda \approx 0$ and $p_a \approx 0$.

Model B: b chooses H or L *after* he sees if s played i or i' (like bringing both H and L to market).

Prop 3 (Model B, exog info):

If $\lambda > \hat{\lambda}$ then the unique equil is $p_a^* = 1$ and $p_l^* = 0$.

If $\lambda = \hat{\lambda}$ then $p_a^* = 1$ and p_l^* can take any value in $[0, \bar{p}_l]$.

If $\lambda < \hat{\lambda}$ then the unique equil is $p_a^* = \hat{p}_a$ and $p_l^* = \bar{p}_l$.

Remark: if $k_l \approx y_l$ then equil implies $p_a^* \approx 0$.

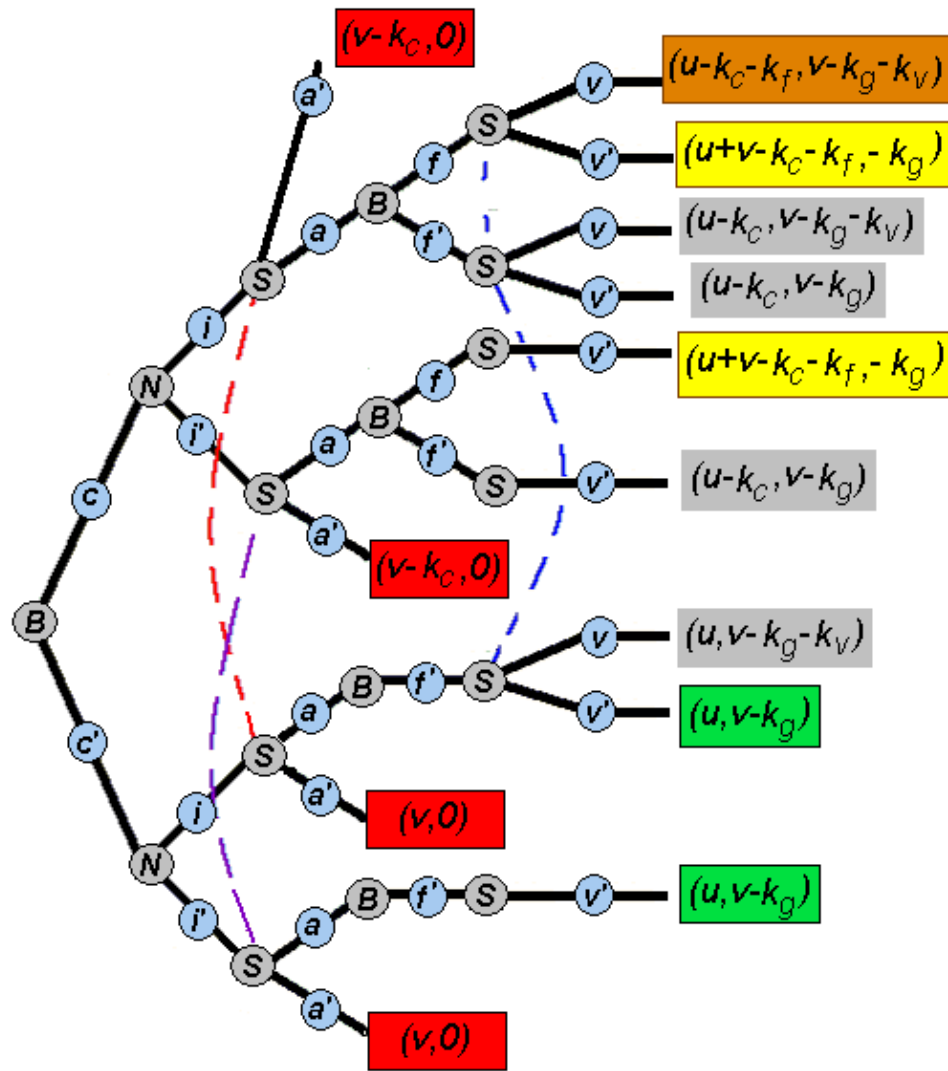
When cost of counterfeiting is not too high s will *never* accept something he cannot recognize.

Prop 4 (Model B, endog info): same

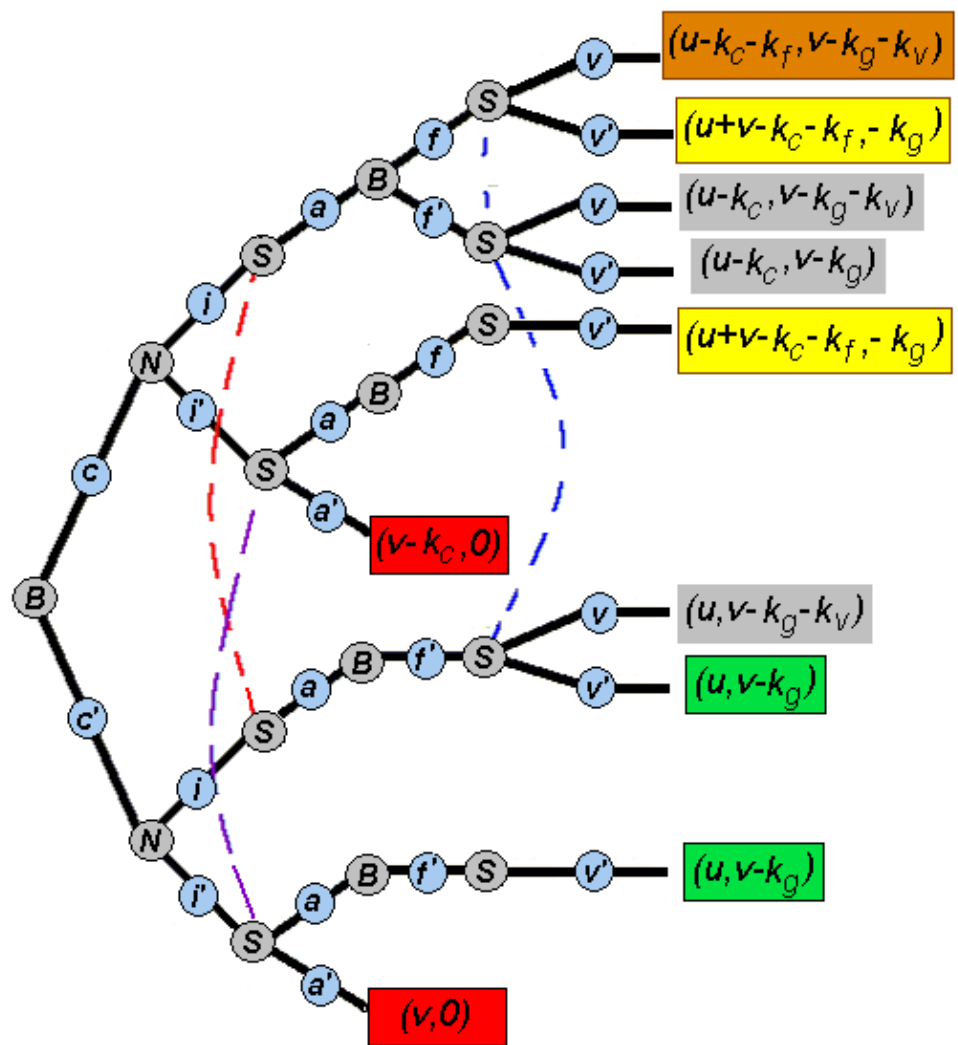
Extensions

Costly State Verification/Falsification: it all works

Divisible goods/assets: it all works (we think).

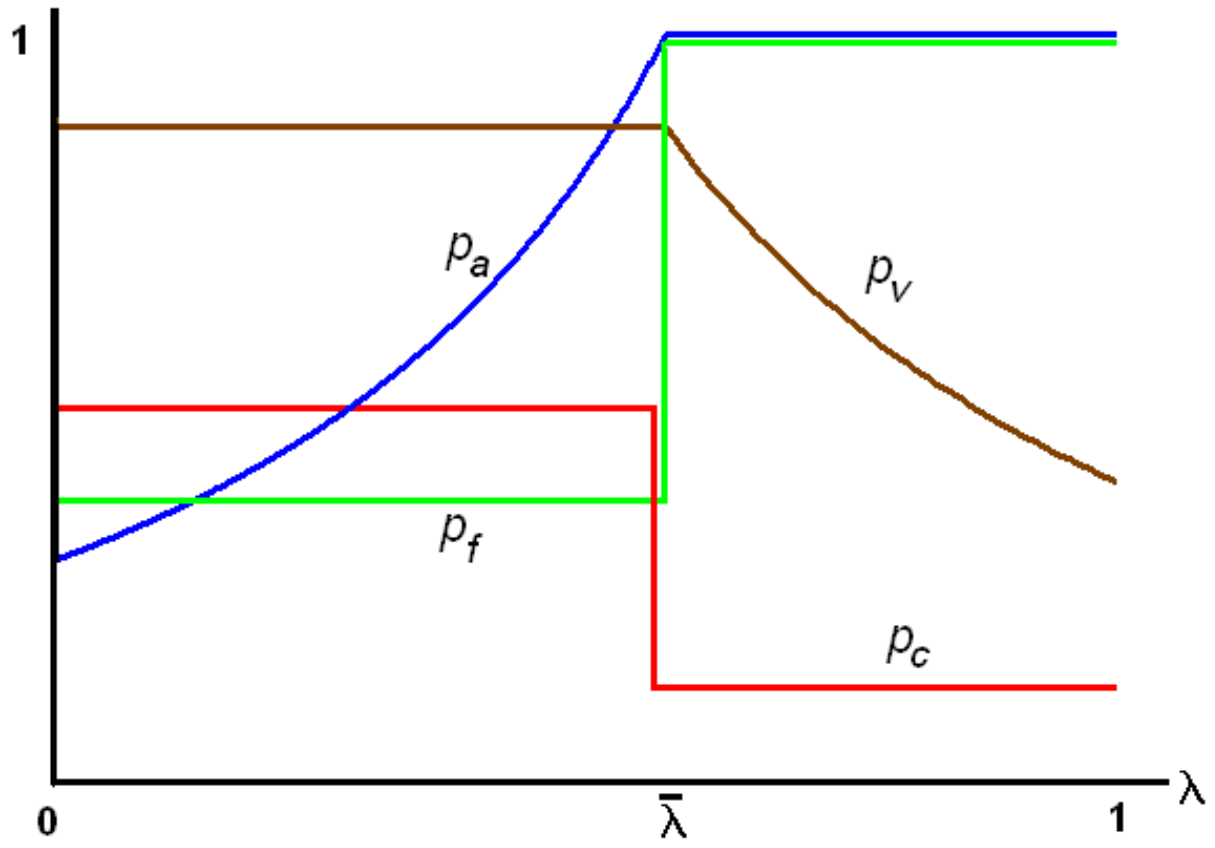


no trade
 S catches B
 efficient trade



no trade
 S catches B
 efficient trade

Results



Application: LPW

Consider LW with two assets: money M and Lucas tree A

Trees not perfectly recognizable - may be *lemon trees*

Show how monetary policy affects all asset prices and returns

Show even transactions, markets, or agents that never use M are affected by inflation

As long as someone is holding M , its return has GE effects on all asset prices, portfolios, liquidity, etc.

Key result: endogenize info and hence acceptability

⇒ CIA constraint endog and depends on policy

⇒ dollarization and hysteresis.

Wallace (1980)

Of course, in general, fiat money issue is not a tax on all saving. It is a tax on saving in the form of money. But it is important to emphasize that the equilibrium rate-of-return distribution on the equilibrium portfolio does depend on the magnitude of the fiat money financed deficit. ... In [OLG] models, the real rate-of-return distribution faced by individuals in equilibrium is less favorable the greater the fiat money financed deficit. Many economists seem to ignore this aspect of inflation because of their unfounded attachment to Irving Fisher's theory of nominal interest rates. (According to this theory, (most?) real rates of return do not depend on the magnitude of anticipated inflation.)

The attachment to Fisher's theory of nominal interest rates accounts for why economists seem to have a hard time describing the distortions created by anticipated inflation. The models under consideration here imply that the higher the fiat money-financed deficit, the less favorable the terms of trade – in general, a distribution – at which present income can be converted into future income. This seems to be what most citizens perceive to be the cost of anticipated inflation.

But the OLG models Wallace refers to do *not* generate a liquidity premium (only a risk premium).

Here is where (more) modern monetary theory comes in.

Model

DM mtg w/ prob α , equal prob of being b or s

w/prob λ , s can recognize if a is good or bad

if s cannot recognize a he does not accept it, so b wants to hold some m

note how we finesse private information & bargaining

one can use alternatives (VG) but bargaining is natural

let q_1 and q_2 be quantities traded in type 1 and type 2 mtgs

CM problem

$$W^i(y) = \max_{x, h, \hat{m}, \hat{a}_1, \hat{a}_2} \{U(x) - h + \beta V^i(\hat{m}, \hat{a}_1, \hat{a}_2)\}$$

$$\text{st } x = h + y - \phi \hat{m} - \psi(\hat{a}_1 + \hat{a}_2) + T$$

$$y = \phi m + (\psi + \delta)(a_1 + a_2)$$

$$\begin{aligned} V^i(m, a_1, a_2) = & W^i(y) + \lambda_1 [u(q_1) + W^i(y - p_1) - W^i(y)] \\ & + \lambda_2 [u(q_2) + W^i(y - p_2) - W^i(y)] \\ & + \text{prob}(\text{sale}) S^i(q) \end{aligned}$$

$$\Rightarrow \text{FOC} \left\{ \begin{array}{l} U'(x) = 1 \\ \psi \geq \beta V_2^i(\hat{m}, \hat{a}_1, \hat{a}_2), = \text{ if } \hat{a}_1 > 0 \\ \psi \geq \beta V_3^i(\hat{m}, \hat{a}_1, \hat{a}_2), = \text{ if } \hat{a}_2 > 0 \\ \phi \geq \beta V_1^i(\hat{m}, \hat{a}_1, \hat{a}_2), = \text{ if } \hat{m} > 0. \end{array} \right.$$

Key results: linearity and history independence, $\partial W^i / \partial y = 1$ and $(x, \hat{m}, \hat{a}_1, \hat{a}_2) \perp y$.

Results with exog info

There exists a unique ss monetary equil

1. $A > \bar{A} \Rightarrow a$ priced fundamentally: $\psi = \delta/r \perp \pi$.

2. $A \leq \bar{A} \Rightarrow \psi > \delta/r$ depends on π

Increase in $\pi \Rightarrow q_1$ and q_2 both fall

As $\pi \uparrow$ agents move out of m into a , so $\phi \downarrow$ and $\psi \uparrow$

$\Rightarrow a$'s (accounting) return $1 + \delta/\psi$ falls with i

Inflation affects real asset prices and returns – *Fisher's theory does not hold* – and trade in *all* mtgs

Results with endog info

Value of information:

$$\Pi^i(\lambda) \equiv \beta\alpha S^i[q_2(\lambda)] - \beta\alpha S^i[q_1(\lambda)]$$

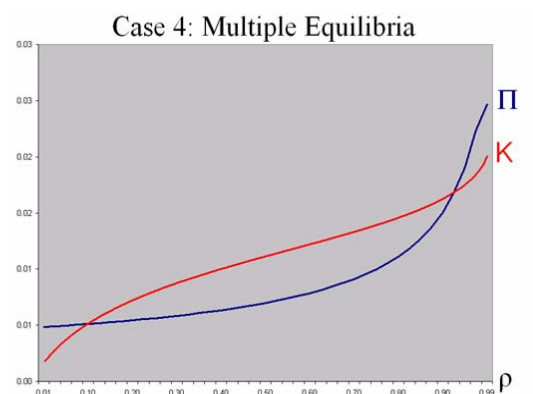
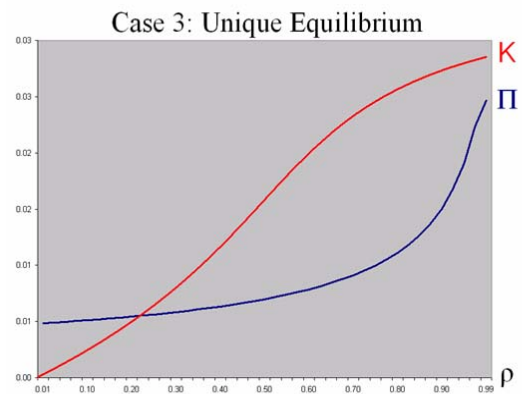
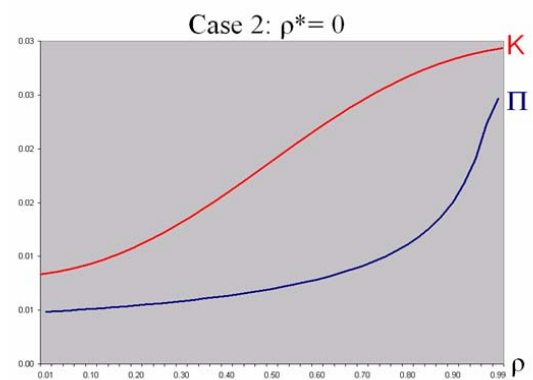
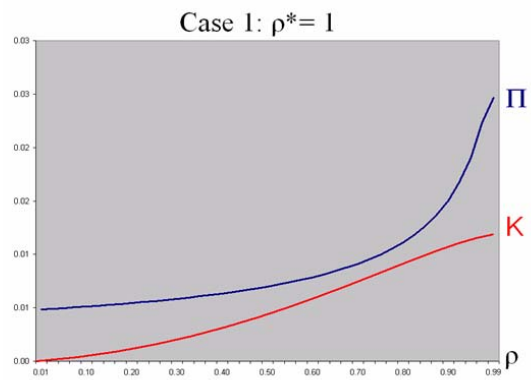
where $S^i(q)$ is i 's surplus from sales and $q_1(\lambda)$ and $q_2(\lambda)$ are equil q

Best response for agent j : pay $\kappa = \kappa(j)$ iff $\Pi(\lambda) \geq \kappa(j)$

Equilibrium is a fixed point of $T(\lambda) = F[\Pi(\lambda)]$

Existence is automatic; and easy to make $0 < \lambda^* < 1$

And multiplicity ... *due to GE effects.*



Key Results:

Assume $\exists!$ equil $\lambda^* \in (0, 1)$. Then $\partial \lambda^* / \partial \pi > 0$.

Hence higher inflation leads to other assets being more liquid – it is as if inflation endogenously relaxes the CIA constraint.

Intuition: if $\pi \uparrow$ agents move out of m into a , so $\psi \uparrow$ and more sellers are willing to pay verification cost.

Implication: hysteresis

Once you dollarize, you don't go back!

Conclusion:

Information is interesting for monetary theory and policy