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Asset Markets with Heterogeneous Information

Pablo Kurlat (Stanford University)

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Asset Markets with Heterogeneous Information

Pablo Kurlat

Stanford University

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Abstract

I define a notion of competitive equilibrium for asset markets where assets are heterogeneous and traders have heterogeneous information about them. Markets are defined by a price and a procedure for clearing trades. Any asset can in principle be traded in any market but traders can use their information to impose acceptance rules which specify which goods they are willing to trade in each market. I then apply this notion to a model of distressed sales under asymmetric information and examine whether it can account for fire sales: sharp drops in prices when distressed agents need to sell assets. Standard models of asymmetric information with informed sellers, heterogeneous assets and identical uninformed buyers predict the opposite phenomenon, as more distressed sellers on average sell less-adversely-selected pools of assets. With heterogeneity among buyers in their ability to distinguish assets of different qualities, the possibility of fire sales depends on the joint distribution of wealth and ability.

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1 Introduction

In the last few years, the field of machine learning has seen a rapid increase in interest and research. This is due to the fact that machine learning has become a key technology in many industries, including healthcare, finance, and marketing. The field of machine learning is a branch of artificial intelligence that focuses on the development of algorithms that can learn from data and make predictions or decisions based on that data. There are many different types of machine learning algorithms, each with its own strengths and weaknesses. Some of the most common types of machine learning algorithms are supervised learning, unsupervised learning, and reinforcement learning. Supervised learning is a type of machine learning where the algorithm is trained on a dataset of labeled examples. The goal is to learn a model that can predict the label of new, unseen examples. Unsupervised learning is a type of machine learning where the algorithm is trained on a dataset of unlabeled examples. The goal is to learn a model that can find patterns or structure in the data. Reinforcement learning is a type of machine learning where the algorithm is trained on a dataset of examples that show the consequences of different actions. The goal is to learn a model that can choose the best action to take in a given situation. Machine learning has many applications in the real world. For example, it can be used to predict the outcome of a medical treatment, to detect fraud in financial transactions, or to recommend products to a customer. Machine learning is a rapidly growing field, and it is expected to continue to play a major role in the development of artificial intelligence in the years to come.

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2 The Economy

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Agents and preferences

Agents By definition
 $b \in B, P \in \mathcal{P}$

$$u(C_1; C_2) = C_1 + C_2$$

disposal

subfield

$v \in V, P \in \mathcal{P}$

$$u(C_1; C_2; v) = C_1 + (v) C_2$$

$\forall (v) \in V, (v) < 1$ before

the

Line 66: $\omega \in \mathcal{W}$

endowment

Endowment

Endowments and Assets

By definition $w(b) \in \mathcal{W}, t = 1$.
 By definition $i \in I, A \in \mathcal{A}, q(i) \in \mathcal{Q}, t = 2$.
 By definition $i \in I, A \in \mathcal{A}, q(i) \in \mathcal{Q}$.
 By definition $v \in V, e(i; v) \in \mathcal{E}$.

Information

By definition $i \in I, q(i) \in \mathcal{Q}$.
 By definition $x(i; b) \in \mathcal{X}$.
 By definition $i \in I, b \in B, q(i) \in \mathcal{Q}$.
 By definition $x(i; b) \in \mathcal{X}$.
 By definition $i \in I, b \in B, q(i) \in \mathcal{Q}$.
 By definition $x(i; b) \in \mathcal{X}$.

3 Equilibrium

Markets

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Seller's problem

[illegible]

5 v ~~110~~

$$\max_{C_1, C_2, S} u(C_1; C_2; v) \quad (1)$$

s.t:

$$C_1 = \int_{i \in I} p(m) (i; m) ds(m; i) \quad (2)$$

$$C_2 = \int_{i \in I} q(i) e(i; v) (i; m) ds(m; i) \quad (3)$$

$$s(m; i) e(i; v) \leq 8i; m \quad (4)$$

$$(i; m) ds(m; i) e(i; v) \leq 8i \quad (5)$$

C(2) ~~110~~

t = 1 ~~110~~

For i, m $s(m; i)$ in m , $ds(m; i)$ $p(m)$. ~~110~~

(2). C(3) ~~110~~

t = 2 ~~110~~

For i $q(i)$ ~~110~~

$e(i; v)$ ~~110~~

$q(i)$ ~~110~~

$ds(m; i)$ ~~110~~

For

$(i; m) < 1$. ~~110~~

For 30% ~~110~~

C(5) ~~110~~

$s(m; i)$ ~~110~~

$e(i; v)$ ~~110~~

For

not

$$s(M; i) e(i; v) \leq 8i \quad (6)$$

If $p(6)$ ~~110~~

on $ds(m; i)$ ~~110~~

(1992, 1996), G(2010), G(2012) ~~110~~

$p(6)$.

For $s(m; i)$ ~~110~~ $i; m$ ~~110~~ $(i; m) = 0$ ~~110~~

For 30% ~~110~~

For 1 ~~110~~

is a μ -robust

if $\mu^n(i; m) > 0$ implies $\mu^n(i; m) > 0$

Definition 1.

A μ is a μ -robust

if $\mu^n(i; m) > 0$ implies $\mu^n(i; m) > 0$

1. $\mu^n(i; m) > 0$

$$\max_{C_1, C_2, S} u(C_1, C_2; V)$$

s.t:

$$C_1 = \sum_{i=1}^M \int_0^1 p(m) \mu^n(i; m) ds^n(m; i)$$

$$C_2 = \sum_{i=1}^M \int_0^1 q(i) e(i; v) \mu^n(i; m) ds^n(m; i)$$

2. $\mu^n(i; m) > 0$

3. $\mu^n(i; m) > 0$ implies $\mu^n(i; m) > 0$

Buyer's orders

When a buyer

places an order

for a quantity q of a good, the seller's response is to supply the quantity q if $q \leq q^*$ and to supply the quantity q^* if $q > q^*$.

Definition 2.

An acceptance rule is a function μ from $[0, 1] \times [0, 1]$ to $[0, 1]$.

$\mu(i; b) = 1$ if $b \leq b^*$ and $\mu(i; b) = 0$ if $b > b^*$.

By a buyer's strategy

we mean a function

μ from $[0, 1] \times [0, 1]$ to $[0, 1]$.

Definition 3.

Definition 3. An allocation function $x(\cdot; b)$ is feasible for buyer i if

$$x(i; b) = x(i^0; b) \quad \text{or} \quad x(i; b) = x(i^0; b)$$

In addition, let

Allocation function

is

Allocation function

by b .

Allocation functions

Allocation function

is

Allocation function

is

Definition 4. An allocation function $A(\cdot; m)$ is

$A(\cdot; m) \in \mathcal{A}$

if

Allocation function

Allocation function

Allocation function

is

$A(\cdot; m)$

Allocation function

is

Allocation function

is $A(\cdot; m) \in \mathcal{A}$

$A(i; m) \in \mathcal{A}$

is

is $A(i; m) < 1$, Allocation function

is

Allocation function

is

Buyer's problem

Allocation function

Allocation function

Allocation function

i	q(i)	(i) b_1	(i) b_2	\bar{p}
1	0	0	0	1:5
2	0	1	0	1:5
3	1	1	1	1:5

$$d_{b_1} = 1$$

$$d_{b_2} = 1$$

Algorithm

By begin

$$\max_{c_1, c_2, d} u(c_1, c_2) \quad (7)$$

s.t:

$$c_1 = w(b) \quad p(m) A(l; m) d(d; m) \quad (8)$$

$$c_2 = \sum_{i=1}^M q(i) A(i; m) d(d; m) \quad (9)$$

$$d(b; M) = d(M) \quad (10)$$

$$c_1 \geq 0 \quad c_2 \geq 0 \quad (11)$$

Algorithm
 Step 1: $t = 1$
 Step 2: $m, p(m)$
 Step 3: $A(l; m)$
 Step 4: $p(m)$
 Step 5: C_1
 Step 6: C_2
 Step 7: $t = 2$
 Step 8: C_1
 Step 9: C_2

Clearing algorithms

Algorithm
 Step 1: $p(m)$
 Step 2: $A(l; m)$
 Step 3: $p(m)$
 Step 4: C_1
 Step 5: C_2

Algorithm

Step 1: A_1, A_2

Step 2: A_1, A_2

Step 3: A_1, A_2

Step 4: A_1, A_2

$t = 2$

m, p

b_1, d

b_2, \bar{p}

1. \bar{p}

b_2 is

2. \bar{p}

3. \bar{p}

4. \bar{p}

5. \bar{p}

b_1 is

6. \bar{p}

b_2 is

7. \bar{p}

$$A(i, j) = \begin{matrix} & \begin{matrix} 0 \\ 1 \end{matrix} \\ \begin{matrix} 0 \\ 1 \end{matrix} & \begin{matrix} 0 \\ 0.5 \end{matrix} \end{matrix}$$

$$(i) = \begin{matrix} 0 \\ 1 \end{matrix} \begin{matrix} f(i) = 1 \\ f(i) = 2 \\ f(i) = 3 \end{matrix} \quad (12)$$

8. \bar{p}

0.5 is

9. \bar{p}

10. \bar{p}

$\frac{1}{3}$ is

11. \bar{p}

12. \bar{p}

13. \bar{p}

b_2 is

14. \bar{p}

b_1 is

$$A(i, j) = \begin{matrix} & \begin{matrix} 0 \\ 1 \end{matrix} \\ \begin{matrix} 0 \\ 1 \end{matrix} & \begin{matrix} 0 \\ 0.75 \end{matrix} \end{matrix}$$

$$(i) = \begin{matrix} 0 \\ 1 \end{matrix} \begin{matrix} f(i) = 1 \\ f(i) = 2 \\ f(i) = 3 \end{matrix} \quad (13)$$

15. \bar{p}

b_1 is

16. \bar{p}

17. \bar{p}

18. \bar{p}

19. \bar{p}

20. \bar{p}

21. \bar{p}

22. \bar{p}

23. \bar{p}

24. \bar{p}

1. Determine the amount of asset i to be allocated to buyer b_k in round k as follows:

Let $S^k(i)$ be the residual supply of asset i at the start of round k .

$$A^k(i; \cdot) = \begin{cases} \frac{S^k(i)}{D(i)} & \text{if } \sum_{i \in I} S^k(i) > 0 \\ 0 & \text{otherwise} \end{cases} \quad (16)$$

For each asset i , the amount of asset i to be allocated to buyer b_k in round k is given by $A^k(i; \cdot)$.

¹Allocating this amount might not be feasible: For instance, suppose that in the example from Table 1 buyer b_2 demanded 2 units instead of 1 and the clearing algorithm prescribed the measures λ given by (14). In round 2, the algorithm would attempt to assign 2 units of asset 2 to buyer b_2 when only 1 remains.

To complete the description of the algorithm, it is necessary to describe what happens if this arises. Let

$$r(k; i) = \frac{S^k(i)}{A^k(i; \cdot) D(i)} \\ r(k) = \min_i r(k; i)$$

$r(k; i)$ is the ratio of the residual supply of asset i as of round k to the total demand that the algorithm attempts to allocate during round k . The amount the algorithm actually allocates per unit of demand is given by:

$$A^k(i; \cdot) r(k)$$

This means that if in some round there is insufficient supply to meet demand for some asset, the allocation received by all acceptance rules in that round is reduced in the same proportion. This could leave some acceptable assets un-allocated. Therefore if $r(k) < 1$ and there are any assets remaining such that $D(i) > 0$ for an acceptance rule λ such that round k is in the support of λ , then round k is repeated until this is no longer the case.

For example, suppose the assets and acceptance rules are as in Table 1, buyer b_1 demands 2 units and buyer b_2 demands 8 units. Suppose further that the allocation algorithm is $K = 3$ and the following measures:

$$\lambda(k; \cdot) = \begin{cases} \begin{matrix} \text{if } \lambda = f \text{ } 1; 1g & \text{if } \lambda = f \text{ } 0 \text{ } 0 \text{ } 1g & \text{any other} \\ 0 & 0.25 & 0 \\ 1 & 0.75 & 0 \\ 0 & 0 & 1 \end{matrix} & \begin{matrix} \text{if } k = 1 \\ \text{if } k = 2 \\ \text{if } k = 3 \end{matrix} \end{cases}$$

In the first round, the algorithm attempts to allocate the following amounts per unit demanded

$$A^k(i; \cdot) = \begin{cases} \begin{matrix} \text{if } \lambda = f \text{ } 1; 1g & \text{if } \lambda = f \text{ } 0 \text{ } 0 \text{ } 1g \\ 0 & 0 \\ 0.5 & 0 \\ 0.5 & 1 \end{matrix} & \begin{matrix} \text{if } i = 1 \\ \text{if } i = 2 \\ \text{if } i = 3 \end{matrix} \end{cases}$$

2. ~~Buyer~~ ~~pro~~ ~~k is~~

$$A(i; k) = \sum_{j=1}^{X^k} A^j(i; k) \cdot (j; k) \quad (17)$$

~~Buyer~~ ~~is~~

$$A(i; k) = \sum_{j=1}^{X^k} A^j(i; k) \cdot (j; k) \quad (18)$$

3. ~~Supply~~ ~~is~~

$$\begin{aligned} S^1(i) &= S(i) \\ S^k(i) &= S(i) - \sum_{j=1}^{X^k} A^j(i; k) \cdot (j; k) \end{aligned} \quad (19)$$

However, this results in

$$r(k=1; i=3) = \frac{1.5}{0.5 \cdot 1 + 2 + 1} = 0.5$$

and therefore pro-rated demand is

$$A^k(i; k) \cdot r(k) = \begin{cases} 0 & \text{if } i = 1 \\ 0.25 & \text{if } i = 2 \\ 0.25 & \text{if } i = 3 \end{cases}$$

This allocates a total of 0.5 units of each of assets 2 and 3 to buyer b_1 and 1 unit of asset 3 to buyer 2. This exhausts the supply of asset 3 but not of asset 2, which is acceptable to buyer b_1 . Therefore the first round is repeated on the remaining supply of $1.5 - 0.5 = 1$ and demands of 1 unit for buyer b_1 and 1 unit ($1 = 0.5 - 0.5$) for buyer b_2 , resulting in

$$A^k(i; k) = \begin{cases} 0 & \text{if } i = 1 \\ 1 & \text{if } i = 2 \\ 0 & \text{if } i = 3 \end{cases}$$

which requires no further pro-rating. Since the supply of acceptable assets has been exhausted, buyer b_2 receives nothing further in the second round. Overall, the allocation functions that result from this combination of supply, demand and clearing algorithm are:

$$A(i; k) = \begin{cases} 0 & \text{if } i = 1 \\ 0.75 & \text{if } i = 2 \\ 0.25 & \text{if } i = 3 \end{cases}$$

4. ~~Find~~ ~~the~~ ~~value~~ ~~of~~ ~~the~~ ~~function~~ ~~at~~ ~~the~~ ~~point~~ ~~(1, 1)~~

~~if~~ ~~the~~ ~~function~~ ~~is~~ ~~defined~~ ~~by~~ ~~the~~ ~~equation~~ ~~(1)~~

~~the~~ ~~value~~ ~~of~~ ~~the~~ ~~function~~ ~~at~~ ~~the~~ ~~point~~ ~~(1, 1)~~

$$f(x) = \begin{cases} \frac{1}{x^2} & \text{if } x > 0 \\ 0 & \text{if } x = 0 \\ x^2 & \text{if } x < 0 \end{cases} \quad (20)$$

~~Find~~ ~~the~~ ~~value~~ ~~of~~ ~~the~~ ~~function~~ ~~at~~ ~~the~~ ~~point~~ ~~(1, 1)~~

~~if~~ ~~the~~ ~~function~~ ~~is~~ ~~defined~~ ~~by~~ ~~the~~ ~~equation~~ ~~(1)~~

~~the~~ ~~value~~ ~~of~~ ~~the~~ ~~function~~ ~~at~~ ~~the~~ ~~point~~ ~~(1, 1)~~

~~if~~ ~~the~~ ~~function~~ ~~is~~ ~~defined~~ ~~by~~ ~~the~~ ~~equation~~ ~~(1)~~

~~the~~ ~~value~~ ~~of~~ ~~the~~ ~~function~~ ~~at~~ ~~the~~ ~~point~~ ~~(1, 1)~~

~~(1) = 1. If the function~~

~~is~~

~~if~~ ~~the~~ ~~function~~ ~~is~~ ~~defined~~ ~~by~~ ~~the~~ ~~equation~~ ~~(1)~~

~~if~~ ~~the~~ ~~function~~ ~~is~~ ~~defined~~ ~~by~~ ~~the~~ ~~equation~~ ~~(1)~~

~~Find~~ ~~the~~ ~~value~~ ~~of~~ ~~the~~ ~~function~~ ~~at~~ ~~the~~ ~~point~~ ~~(1, 1)~~

~~if~~

Definition of equilibrium

~~Find~~ ~~the~~ ~~value~~ ~~of~~ ~~the~~ ~~function~~ ~~at~~ ~~the~~ ~~point~~ ~~(1, 1)~~

1. ~~Find~~ ~~the~~ ~~value~~ ~~of~~ ~~the~~ ~~function~~ ~~at~~ ~~the~~ ~~point~~ ~~(1, 1)~~

~~if~~ ~~the~~ ~~function~~ ~~is~~ ~~defined~~ ~~by~~ ~~the~~ ~~equation~~ ~~(1)~~

2. ~~Find~~ ~~the~~ ~~value~~ ~~of~~ ~~the~~ ~~function~~ ~~at~~ ~~the~~ ~~point~~ ~~(1, 1)~~

~~if~~ ~~the~~ ~~function~~ ~~is~~ ~~defined~~ ~~by~~ ~~the~~ ~~equation~~ ~~(1)~~

3. ~~Find~~ ~~the~~ ~~value~~ ~~of~~ ~~the~~ ~~function~~ ~~at~~ ~~the~~ ~~point~~ ~~(1, 1)~~

~~if~~ ~~the~~ ~~function~~ ~~is~~ ~~defined~~ ~~by~~ ~~the~~ ~~equation~~ ~~(1)~~

4. ~~Find~~ ~~the~~ ~~value~~ ~~of~~ ~~the~~ ~~function~~ ~~at~~ ~~the~~ ~~point~~ ~~(1, 1)~~

~~if~~ ~~the~~ ~~function~~ ~~is~~ ~~defined~~ ~~by~~ ~~the~~ ~~equation~~ ~~(1)~~

5. ~~Find~~ ~~the~~ ~~value~~ ~~of~~ ~~the~~ ~~function~~ ~~at~~ ~~the~~ ~~point~~ ~~(1, 1)~~

~~if~~ ~~the~~ ~~function~~ ~~is~~ ~~defined~~ ~~by~~ ~~the~~ ~~equation~~ ~~(1)~~

6. ~~Find~~ ~~the~~ ~~value~~ ~~of~~ ~~the~~ ~~function~~ ~~at~~ ~~the~~ ~~point~~ ~~(1, 1)~~

~~if~~ ~~the~~ ~~function~~ ~~is~~ ~~defined~~ ~~by~~ ~~the~~ ~~equation~~ ~~(1)~~

~~Find~~ ~~the~~ ~~value~~ ~~of~~ ~~the~~ ~~function~~ ~~at~~ ~~the~~ ~~point~~ ~~(1, 1)~~

1. ~~Find~~ ~~the~~ ~~value~~ ~~of~~ ~~the~~ ~~function~~ ~~at~~ ~~the~~ ~~point~~ ~~(1, 1)~~

~~if~~ ~~the~~ ~~function~~ ~~is~~ ~~defined~~ ~~by~~ ~~the~~ ~~equation~~ ~~(1)~~

~~Find~~ ~~the~~ ~~value~~ ~~of~~ ~~the~~ ~~function~~ ~~at~~ ~~the~~ ~~point~~ ~~(1, 1)~~

2. $c_1, b; c_2, b; d, b$ (7) (10)

b, b $A(;;m)$ (9)

3. For m :

(a) S

$$S(i; m) = \sum_s s(m; i) \quad 8i$$

(b) D

$$D(i_0; m) = \sum_b d_b(i_0; m) \quad 8 i_0$$

d

(c) $A(;;m), (;;m), S(;;m)$ and $D(;;m)$ (18) and (20)

4 Two examples

Example 4.1

Let T be a

$v \in [0, 1]$ type

is

$b \in [0, 1]$ type

$$(v) = \begin{pmatrix} 1 & \text{if } v \\ 0 & \text{if } v < \end{pmatrix}$$

is a

is a

$t = 1$ (p

is a

is a

$q(i) = 1(i >)$ for $2(0; 1)$. is a

1 (is

$i >)$ type

is a

(is i) is a

is a

$e(i; v) = 1$ type

w (b)

is a

is a

is a

$x(i; b) = 1(i > b)$. is a

is a

$x(i; b) = 1$. is a

is a

$x(i; b) = 1$, is a

is a

$b > 1/2$ is a

is a

b is

is a

problem

$$(i) = I(i, g) \text{ and}$$

$$! (K_o) = \begin{pmatrix} 1 & f & 1 & 2 & K_o \\ 0 & 1 & 0 & 0 & 0 \end{pmatrix}$$

graph

3. The non-restrictive- first-then-more-restrictive- test

[0 1] 16

graph

$$! (K_o) = \begin{pmatrix} 1 & f & 0 & 2 & K_o \\ 0 & 1 & 0 & 0 & 0 \end{pmatrix}$$

graph

$$(i) = 18i; \text{ and}$$

$$! (K_o) = \begin{pmatrix} 1 & f & 1 & g & 2 & K_o \\ 0 & 1 & 0 & 0 & 0 & 0 \end{pmatrix}$$

problem

$$(i) = I(i, g) \text{ if } g > 0, \text{ and}$$

$$! (K_o) = \begin{pmatrix} 1 & f & 1 & 2 & K_o \\ 0 & 1 & 0 & 0 & 0 \end{pmatrix}$$

graph

First-Come-First-Served
 First-In-First-Out
 (to be used for the
 graph of the
 is a first-come-first-served
 graph)

False Positives Case

Is a graph a tree?

m

Is a graph a tree?

(if $v < 0$)

graph

is a tree if $i > d$ and $i < d$. Is a graph a tree?

$b < b$ $b > b$ $x(i; b) = 1, b$
 $[b; 1], b$ $b < b$ b
 b d p

$$\frac{1}{(1-b) + (1-p)} \frac{w(b)}{p} db = 1 \quad (21)$$

$$p = \frac{(1-b)}{(1-b) + (1-p)} \quad (22)$$

For

1. p

$$s_v(m; i) = \begin{matrix} 8 \\ \text{wavy} \\ 1 \end{matrix} \begin{matrix} 8 \\ \text{wavy} \\ p(m) \end{matrix} \begin{matrix} i \\ p \\ d \\ v < \end{matrix} \quad (23)$$

and

$$\begin{aligned} c_{1,v} &= \begin{pmatrix} p \\ 1 \end{pmatrix} \begin{pmatrix} i; m \end{pmatrix} di \quad f \quad v < \\ c_{2,v} &= \begin{pmatrix} p \\ 0 \end{pmatrix} \begin{pmatrix} i; m \end{pmatrix} di \quad f \quad v \\ &= \begin{pmatrix} 0 \\ 1 \end{pmatrix} \begin{pmatrix} f \quad v < \end{pmatrix} \end{aligned} \quad (24)$$

2. p

$$S(i; m) = \begin{matrix} 8 \\ \text{wavy} \\ 1 \end{matrix} \begin{matrix} 1 \\ f \quad i > \end{matrix} \begin{matrix} p(m) \\ 1 \end{matrix} \quad (25)$$

3. Def

$$d_b(i; m) = \begin{cases} \frac{w(b)}{p} & \text{if } m = m_i, \quad (i) = x(i; b) \text{ and } b > b_i \\ 0 & \text{otherwise} \end{cases} \quad (26)$$

Def

$$c_1(b) = \begin{cases} w(b) & \text{if } b < b_i \\ 0 & \text{if } b = b_i \end{cases}$$

$$c_2(b) = \begin{cases} 0 & \text{if } b < b_i \\ \frac{w(b)}{p} \frac{(1 - b_i)}{(1 - b) + (1 - b_i)} & \text{if } b = b_i \end{cases} \quad (27)$$

4. Def

$$D(i; m) = \sum_{b=1}^8 \frac{1}{p} w(b) d_b(i; m) \quad (28)$$

5. A Def

$$A(i; m) = \begin{cases} \frac{i2I_0}{i2I} \frac{(i)I(i)}{(i)I(i)} & \text{if } p(m) < p \text{ and } (i)I(i) > 0 \\ 0 & \text{if } p(m) < p \text{ and } (i)I(i) = 0 \\ \frac{i2I_0}{i2I} \frac{(i)[I(i) + I(i>)]}{(i)[I(i) + I(i>)]} & \text{if } p(m) \geq [p; 1] \text{ and } (i)[I(i) + I(i>)] > 0 \\ \frac{i2I_0}{i2I} \frac{(i)di}{(i)di} & \text{if } p(m) = 1 \text{ and } (i)di > 0 \\ 0 & \text{if } p(m) = p \text{ and } (i)di = 0 \end{cases} \quad (29)$$

6. Def

$$(i; m) = \begin{cases} \frac{1}{b} \frac{1}{(1 - b) + (1 - b_i)} \frac{w(b)}{p} db & \text{if } m = m_i \text{ and } i > b_i \\ 0 & \text{if } m = m_i \text{ and } i \leq b_i \\ 0 & \text{if } m \neq m_i \end{cases} \quad (30)$$

In mathematics, a **group** is a set G equipped with a binary operation \cdot that combines any two elements a and b of the set to form a third element $a \cdot b$, also in G . The set G and the operation \cdot must satisfy four properties that are grouped into four axioms. These are:

- Closure:** For all $a, b \in G$, the result of the operation $a \cdot b$ is also in G .
- Associativity:** For all $a, b, c \in G$, the equation $(a \cdot b) \cdot c = a \cdot (b \cdot c)$ holds.
- Identity:** There exists an element $e \in G$, called the identity element, such that for every element $a \in G$, the equations $a \cdot e = a$ and $e \cdot a = a$ hold.
- Inverse:** For every element $a \in G$, there exists an element $a^{-1} \in G$, called the inverse of a , such that $a \cdot a^{-1} = e$ and $a^{-1} \cdot a = e$.

Groups are fundamental in many areas of mathematics, including algebra, geometry, and physics. They provide a framework for understanding symmetry and the structure of mathematical objects.

[illegible]
$$(b) = \frac{1}{p} \frac{(1)}{(1-b) + (1)}$$

20

is $(1 - b) \frac{w(b)}{p} \frac{1}{(1 - b)^+ (1 - b)}$ is strictly

decreasing in b . From

the above, in

the above

initially,

For

$i \in \{1, \dots, m\}$, let

b

$\frac{w(b)}{p} \frac{1}{(1 - b)^+ (1 - b)}$ is

$b \geq b^*$; if

is strictly decreasing in b . From

the above,

the above

is strictly decreasing in

the above

the above

Proposition 2. In any equilibrium, the price and allocations are those of the equilibrium described by equations (21)-(30).

False Negatives Case

In the above case

$$s_v(m; i) = \begin{matrix} 8 \\ \text{wavy line} \\ 1 \\ \text{wavy line} \\ 0 \end{matrix} \quad \begin{matrix} 8 \\ \text{wavy line} \\ p(m) \\ \text{wavy line} \\ 0 \end{matrix} \quad \begin{matrix} i \\ p(i) \\ 0 \\ p(m) \\ 1 \end{matrix} \quad \begin{matrix} v < \\ \\ \\ \end{matrix} \quad (31)$$

From (23), the above

is strictly decreasing in

the above $p(i)$ is

As a result, the above

the above

p, b

$$E(i; p) = \begin{matrix} i \\ p(j) \end{matrix} \quad (32)$$

$E(i; p)$ is

$t = 1$ is

(i)

define

$p(i)$. Also

$$W(i) = \frac{1}{w(b)} db \quad (33)$$

$$\hat{b}(i) = \frac{1}{1-i}$$

$\hat{b}(i)$ such

$x(i; b) = 1$, i.e. $b =$

be i such

$W(i)$ such

$t = 1$ such

above

i such that

substitution

of

$$E(i; p) = W(i) \quad (34)$$

By (32) and (33), this (34) is

$$p^E(i) = \frac{1}{(1-i)^w} \frac{1}{1-i} \quad (35)$$

Indefinite

p^E such

(i) $p(i)$ in

1 such (i) p

substitution

Monotonicity

Let $i < i^0$. By

id i^0 such

i^0 such

(i.e. p)

$x(i; b) = 1$ b

$x(i^0; b) = 1$ b. It

be

i such

i^0 such

i such that

i^0 b

define

$p(i)$ such

Define p^M such

M such p

to p^E . In

M , if 2 , b

p^E b

substitution

1. $E(i; p^M) = W(i)$. This

$p^M(i)$, b

substitution

2. p^M such

$(i; i^0)$ b $E(i; p^M) < W(i)$. This

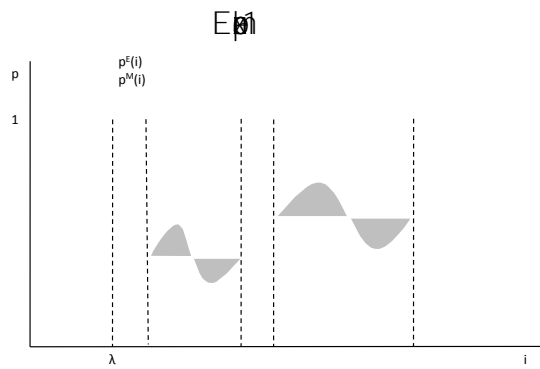
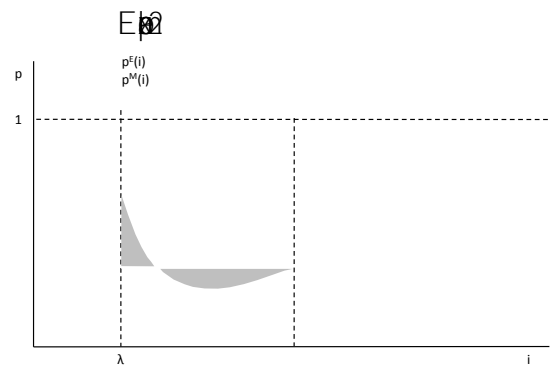


Fig. 2: M



p^E

Upper bound

$p^M(i)$ is the probability

that

$$p^M(i) = \min(p^E(i), 1)$$

where

$$p^E(i) > 1.$$

Non-selective buyers

Step

in the market

is the probability

$$p^E(i) = 1$$

(ie the probability

$$p^E(i) = 1$$

of the

probability

$$p^E(i) = 1$$

is the probability

$$p^N(i) = \frac{p^E(i)}{p^E(i) + 1} \quad (36)$$

where

$$p^E(i) < p^N(i).$$

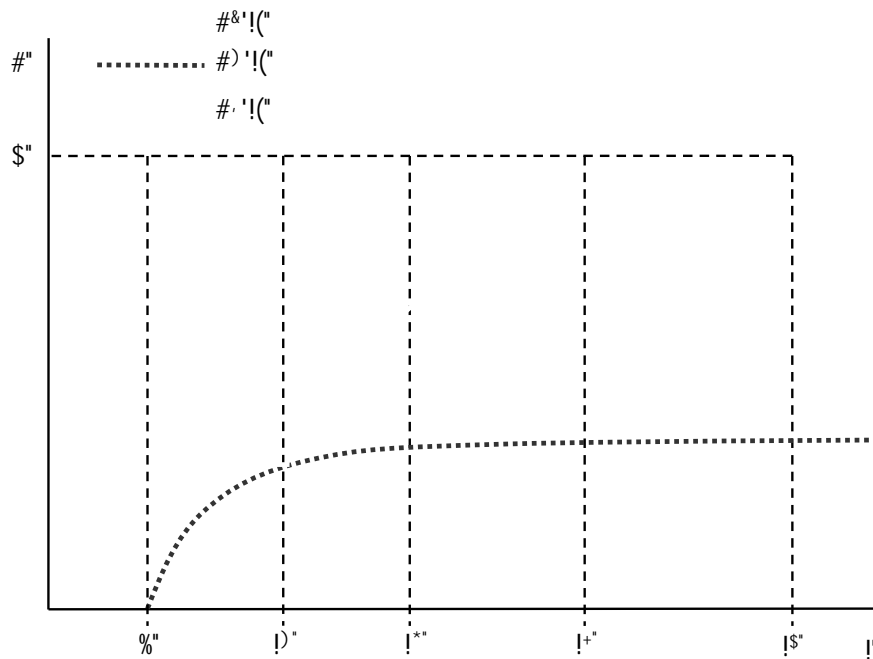
where

$$t = 1$$

in

$$p^N(i) = \frac{p^E(i)}{p^E(i) + 1}$$

$$p^N(i) = \frac{p^E(i)}{p^E(i) + 1}$$



g i familie

$$i^N \left(\max_{i: p^N(i) \neq p^M(i)} \text{fluctuation} \right)$$

On the other hand, p (i) is

$$p^N(i) = \frac{p^N(i) f(i)}{p^M(i)} \quad (37)$$

Fig. 3.

Breeding site

1. Edge is defined as the boundary between two adjacent pixels. It is identified by the gradient magnitude $d = \frac{w(b)}{p(m)}$.

b $\frac{1-i^N}{1-i}$. ~~Equal to~~ Equal to

Fig. 3. 9

$p^N \quad i^N \quad \text{dlog}$

(i) =

$$I(i > 1 - b(1 - \epsilon)).$$

$$2. \text{ If } b < \frac{1 - i^1}{1} ; \frac{1 - i^N}{1} , \text{ then } i^1 \text{ is } 0$$

$$\left(\min_{i^1} f(i) : p(i) = 1 \right) \text{ is } 0$$

Figure 3

1. If $b < \frac{1 - i^1}{1} ; \frac{1 - i^N}{1}$ then

$$d = \frac{w(b)}{p(m)} \text{ is } 0$$

$$i^N ; i^1 \text{ is } 0$$

$$3. \text{ If } b < \frac{1 - i^1}{1} \text{ then } i^1 \text{ is } 0$$

is 1. If $b < \frac{1 - i^1}{1}$

$$(a) \text{ If } b < \frac{1 - i^1}{1} \text{ then } p(m) = 1 \text{ and } (i) = I(i > 1 - b(1 - \epsilon))$$

$$(b) \text{ If } b < \frac{1 - i^1}{1} \text{ then } p(m) = p^N i^N \text{ and } (i) = 1$$

(c) Not both

Figure 4

1. If

$$(a) \text{ If } b < \frac{1 - i^1}{1} , \text{ then } b^1 \text{ is } 0$$

$$\frac{1 - i^1}{1}$$

$$w(b) \text{ db} = 1 - i^1$$

$$b^1$$

$$\text{then } d = w(b) \text{ and } p(m) = 1 \text{ and } (i) = x(i; b).$$

$$\text{If } b < \frac{1 - i^1}{1} \text{ then } (i^1; 1) \text{ is } 0$$

$$(b) \text{ If } b < b^1 \text{ then } b < b^1$$

$$\frac{h}{i^N} \frac{w^0}{p(i^N)} i^N +$$

for

W_0

$w(b) \text{ db}$

$$f \text{ bp } (1 - b(1 - \dots)) = p^N (i^N) g$$

for

$$p(m) = p \cdot i^N \text{ and}$$

first it is in

$$(i) = 1. \text{ In by}$$

probability of

i^N

for

$$b = \frac{1 - i^N}{1} \text{ and}$$

Model with

For the first

being

$$i^N, i^A; i^B \text{ and } [i^1; 1] \text{ in Fig 3. It is}$$

the

more likely

only if it is

but for the

for the first

model in the

model in the

model in the

for

At

1. For

$$p(m) < p \cdot i^N :$$

$$A(I_0; m) = \frac{8}{i_2 I_0} \frac{(i) I (i) di}{(i) I (i) di} \text{ if } i_2 I (i) I (i) di > 0$$

2. For

$$p(m) \geq p \cdot i^N ; 1, \text{ then it is}$$

the

the

$$p(i) = p(m), \text{ then}$$

the

$$i^A; i^B \text{ in Fig 3. It is}$$

(a) For

$$() = I (i - g) \text{ if } g > , \text{ then}$$

is

(

$$A(I_0; m) = \frac{1 - f g^2 I_0}{0} \text{ if}$$

(b) ~~FOIA~~

$$A(l_0; m) = \frac{\int_{l_0}^{\infty} \frac{(i)!(i-1)!}{(i-1)!(i-2)!} di}{\int_{l_0}^{\infty} \frac{(i)!(i-1)!}{(i-1)!(i-2)!} di} \quad \text{for } l_0 \geq 0$$

3. ~~Faktor~~

Definieren wir

$$i(m) = \max_i \{ p(i) - p(m)g \}$$

b

$$A(l_0; m) = \frac{\int_{l_0}^{\infty} \frac{(i) [l(i) + l(i)] (i - i(m)) di}{(i) [l(i) + l(i)] (i - i(m)) di} f_{l_0}(i) [l(i) + l(i)] (i - i(m)) di}{0} > 0 \quad (38)$$

Plg

1. Intro

$$p(m) = p(i) \text{ for } i > i^N \text{ and } i \leq i^N$$

b6
b7C
b7D

$$(j) = \begin{pmatrix} 1 & f_j & i \\ 0 & 1 & 0 \end{pmatrix}$$

2. Introduction

$$i > i^N \text{ da } p(i) = p(m) \text{ da}$$

Benefits

$$j) = \begin{pmatrix} 1 & f_j \\ 0 & \min_{i \in I} f_i : p(i) = p(m) \end{pmatrix} g$$

3. Interview

$$p(m) = p \cdot i^N \text{ degrees}$$

~~benefits~~

$$(j) = \frac{1}{1 + \frac{W_0}{p(i^N)} \frac{1}{(i^N)}} \frac{f_j}{W}$$

~~T66~~ ~~Legebölg~~ F's sind ~~81~~

Monday 16 September

being a good person

Abstract

Identification

4691

En(21) a(22) eam

$$\frac{dp}{d} = \frac{(p)^2}{2(1)} \frac{2}{41} \frac{b}{b} \frac{\frac{(1-b)}{2(1)}p + \frac{1}{p} \frac{1}{b} \frac{(1-w(b))}{[(1-b)+(1)]^2} db}{\frac{(1)}{(1)}p + \frac{1}{p} \frac{w(b)}{(1-b)+(1)}} \frac{3}{5} \quad (39)$$

findings

ed ididididididid

~~Other information~~

Human Est. 444 (2010) 0

aussetzen die Götter

responsibility is shared

Estimation of the self-interest bias

11361 • J. Neurosci., September 24, 2008 • 28(39):11356–11361

b/

Prüfungstermin: 11.05.2017

~~Problem 1~~ If

Abstract

Integrating the above information

to (b) is a \mathbb{Z} -module

is a \mathbb{Z} -module

is a \mathbb{Z} -module

is a \mathbb{Z} -module

, so it

to

is a \mathbb{Z} -module

is a \mathbb{Z} -module (see [1992, 1997, K1992])

is a \mathbb{Z} -module (see [1997])

is a \mathbb{Z} -module

is a \mathbb{Z} -module

is a \mathbb{Z} -module (see [1998])

is a \mathbb{Z} -module

is a \mathbb{Z} -module

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is a \mathbb{Z} -module

is a \mathbb{Z} -module (see [1994, 1998, A1998])

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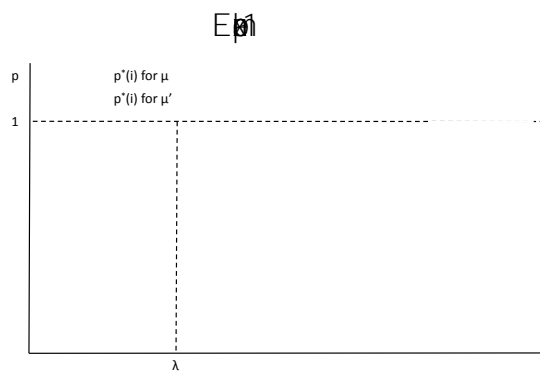


Fig. 4

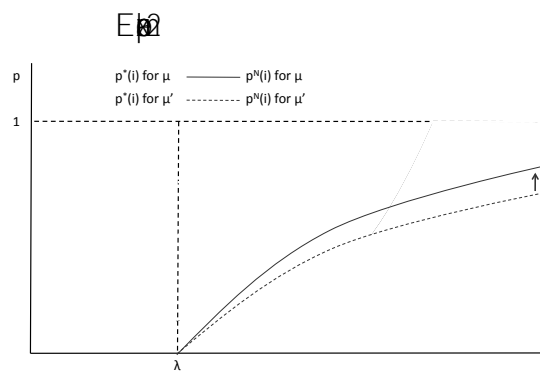


Fig. 5

Figure 4 shows the relationship between p^N and λ . The vertical axis is labeled p and has a tick mark at 1. The horizontal axis is labeled λ . A horizontal dashed line is drawn at $p=1$. A vertical dashed line is drawn at λ . The region to the left of the vertical line and below the horizontal line is shaded. The legend indicates: $p^*(i)$ for μ (solid line) and $p^*(i)$ for μ' (dashed line).

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Discus-

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Appendix

No formal proof

Proof of Proposition 1

1. In

Eq.(30) $\frac{q(i)}{p(m)} \frac{a(i; m; b; m)}{A(i; m; b; m)} < 1$ for $i \in [1; m]$, $b \in [1; m]$, $d \in [1; m]$.
 A good labeling(1) is in m $\frac{q(i)}{p(m)} \frac{a(i; m; b; m)}{A(i; m; b; m)} < 1$ for $i \in [1; m]$, $b \in [1; m]$, $d \in [1; m]$.
 of $i \in [1; m]$, $b \in [1; m]$, $d \in [1; m]$.
 (24) $\frac{q(i)}{p(m)} \frac{a(i; m; b; m)}{A(i; m; b; m)} < 1$ for $i \in [1; m]$, $b \in [1; m]$, $d \in [1; m]$.

2. In

(25) $\frac{q(i)}{p(m)} \frac{a(i; m; b; m)}{A(i; m; b; m)} < 1$ for $i \in [1; m]$, $b \in [1; m]$, $d \in [1; m]$.

3. By

Eq.(30) $\frac{q(i)}{p(m)} \frac{a(i; m; b; m)}{A(i; m; b; m)} < 1$ for $i \in [1; m]$, $b \in [1; m]$, $d \in [1; m]$.

$$\frac{q(i)}{p(m)} \frac{a(i; m; b; m)}{A(i; m; b; m)} < 1 \text{ for } i \in [1; m], b \in [1; m], d \in [1; m] \quad (40)$$

at

$$M^{\max}(b) = \max_m (m; b) = \arg \max_m (m; b)$$

By (1)

$$(a) \text{ If } f^{\max}(b) < 1, \text{ then}$$

$$d(m; b) = 0 \quad \forall m$$

$$(b) \text{ If } f^{\max}(b) > 1, \text{ then}$$

$$\int_{M^{\max}(b)}^{\infty} \frac{d(m; b)}{p(m)} dm = w(b)$$

at

$$d(m; b) = 0 \quad \forall m \geq M^{\max}(b)$$

By (29),

$$(m; b) = \begin{cases} \frac{1}{p(m)} \frac{(1-b)^m}{(1-b)^{M^{\max}(b)} + (1-b)^{m-M^{\max}(b)}} & \text{if } p(m) > 0 \\ 0 & \text{otherwise} \end{cases}$$

By (30)

$$f^{\max}(b) = \frac{1}{p} \frac{(1-b)^{M^{\max}(b)}}{(1-b)^{M^{\max}(b)} + (1-b)^{M^{\max}(b)-1}}$$

at

$$M^{\max}(b) = \min_{m \in M} \{m : p(m) = p^g\}$$

By (22), if

$$b < b^* \text{ then } f^{\max}(b) < 1 \text{ so}$$

$$d(m; b) = 0 \quad \forall m$$

$$b > b^* \text{ then}$$

$$p(m) = p^g; \text{ then}$$

$$m = M^{\max}(b). \text{ By (27) it}$$

By (31)

4. Den

$$(28) \text{ By (26) it}$$

5. And

Lemma 1. Consider an arbitrary market and suppose $i < j$. Then in any equilibrium the residual supplies after n rounds of clearing in market i satisfy

$$S^n(i; m) = S^{n-1}(i; m) \quad \forall i; n; m \in m$$

Proof. By (19)

$$a^n(i; m) = a^1(i; m) \quad \forall i; n; m \in m$$

if

$$a(i; m) = a^1(i; m) = \begin{cases} \frac{(i)S(i)}{(i)S(i)di} & \text{if } (i)S(i)di > 0 \\ 0 & \text{otherwise} \end{cases} \quad \forall i; m \in m \quad (41)$$

Lemma 1. Consider an arbitrary market and suppose $i < j$. Then in any equilibrium the residual supplies after n rounds of clearing in market i satisfy

6. By

$$(30) \text{ and } (20).$$

Proof of Proposition 2

Lemma 1.

Consider an arbitrary market and suppose $i < j$. Then in any equilibrium the residual supplies after n rounds of clearing in market i satisfy

$$\frac{S^n(j)}{S^{n-1}(j)} = \frac{S^n(i)}{S^{n-1}(i)}$$

Proof. By (19) and (16)

$$\begin{aligned} \frac{S^n(i)}{S^{n-1}(i)} &= 1 - \frac{\frac{(i)S^{n-1}(i)}{(i)S^{n-1}(i)di} \int (i; n) dD(i)}{S^{n-1}(i)} \\ &= 1 - \frac{(i)}{(i)S^{n-1}(i)di} \int (i; n) dD(i) \end{aligned}$$

if

$$\frac{S^n(j)}{S^{n-1}(j)} = \frac{S^n(i)}{S^{n-1}(i)} = \frac{(i)}{(k)S^{n-1}(k)dk} \int (j; n) dD(j) \quad (42)$$

Given μ

$$(i) = x(i; b)$$

$$(i) = 1$$

$$(i) = 1 - x(i; b)$$

Let μ be a probability measure on \mathcal{F} such that $\mu(\mathcal{F}) = 1$.

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Let μ be a probability measure on \mathcal{F} such that $\mu(\mathcal{F}) = 1$.

$$x = 1. \text{ Let } \mu$$

$$(i) \quad (j), \text{ or}$$

□

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Lemma 2. Let

$$\begin{aligned} & \left(\frac{q(i)a(i; m)}{p(m)A(i; m)} \right) \text{ if } A(i; m) > 0 \\ & 0 \text{ otherwise} \\ \max & \left(\frac{1}{p(m)} \frac{q(i) - (i)S(i; m)}{p(m)} \right) \end{aligned}$$

For n ,

$$A^n(l; m) = \int_0^1 \sum_{i=1}^n S^{n-1}(i; m) di > 0$$

Let $n \rightarrow \infty$ then $A^n(l; m) = 1$, (43)

$$\begin{aligned} (i; m) &= \frac{1}{p(m)} \sum_{n=1}^{\infty} q(i) \frac{p^n(i; n)}{n!} a^n(i; m) \\ &= \frac{1}{p(m)} \sum_{n=1}^{\infty} \frac{p^n(i; n)}{n!} a^n(i; m) \\ &= \frac{1}{p(m)} \sum_{n=1}^{\infty} \frac{p^n(i; n)}{n!} \frac{\int_0^1 S^{n-1}(i; m) di}{\int_0^1 S^{n-1}(i; m) di} \end{aligned}$$

Let $n \rightarrow \infty$

$$\frac{\int_0^1 S^{n-1}(i; m) di}{\int_0^1 S^{n-1}(i; m) di}$$

is $\lim_{n \rightarrow \infty} (i; m) = \max (i; m)$. $\int_0^1 S^{n-1}(i; m) di = 1$, \square

Let p be a probability
on Ω . Its support is
the set

Lemma 3. Let

$$(b; m) = \max_{\text{feasible for } b} (b; m)$$

In any equilibrium

$$(b; m) = \max (b; m)$$

where b is defined by equation(?)

Proof. By (1) and (2) b is the best response to b

in

$$(b; m) = \max_{b_i} (b_i; m)$$

Lemma 2. Let

$$\frac{q(i)}{(i)S(i; m)di} \geq \frac{q(i)}{(i)S(i; m)di}$$

in

□

Lemma 3. Let

is a

m^0 is

in $(b; m)$, then

by

m.

Lemma 4.

In equilibrium there is trade at only one price

Proof. Assume

$p_H \neq p_L$. If

then $m \neq p = p_L$, then

if $i > p_L$, then $p(1) = 1$, then

$v < i > , b \quad s(i; m; v) = 1$, ie

for $i > p_L$, then $p > p_L$. Then

m

$p(m) \in (p_L; p_H]$.

(

$$S(i; m) = \frac{f(i)}{1 - f(i)}$$

Fig. 1. Let

m

b

$p(m) \in (p_L; p_H)$. Then

$$(b; m) = \max_{b_i} (b_i; m)$$

$$> (b; m^0) \quad m^0 \quad p(m^0) = p_H$$

Lemma 2. Let

then

m

$p(m) < p_H$. If

by

p_H .

b, then

then

p_H .

□

Lemma 3. Let

p, then

then

Lemma 5. De ne

$$(i; p) = \int_0^1 (i; m) dm$$

$$m: p(m) = p$$

In any equilibrium where there is trade at $(i; p) = 1$ for all $i > \bar{i}$.

Proof. Assume to the contrary

that there exists $i > \bar{i}$ such that $(i; p) < 1$ for all p . Then $(i; p) < 1$ for

$i > \bar{i}$. By Lemma 4, it follows that

$(i; p) < 1$ for all

p . (1) Also, $s(i; m; v) = 1$ for all $m \leq i > \bar{i}$, so

$S(i; m) = \int_0^1 s(i; m; v) dv = 1$ for all $m \leq i > \bar{i}$. Now, by Lemma 3, it follows that

$p(m^0) < p$ for all $m^0 \leq i > \bar{i}$.

Let

$$\begin{aligned} (b; m^0) &= \frac{1}{p(m^0)} \frac{\int_0^1 (1 - m^0) dm}{\int_0^1 S(i; m^0) di + \int_0^1 (1 - m^0) dm} \\ &= \frac{1}{p(m^0)} \frac{\int_0^1 (1 - m) dm}{\int_0^1 S(i; m) di + \int_0^1 (1 - m) dm} \\ &> \frac{1}{p} \frac{\int_0^1 (1 - m) dm}{\int_0^1 S(i; m) di + \int_0^1 (1 - m) dm} \\ &= \max_{m \leq i} (b; m) \end{aligned}$$

By (1) in

$S(i; m) = S(i; m^0)$ if $p(m) < p(m^0)$, for all i . Then $p(m^0) < p$ for all

$m^0 \leq i > \bar{i}$.

Let $p(m) = p$. Then

$p = p$. □

Lemma (1)-(5) Part 2

Let p be a price such that (21) and (22).

Standardize

in m so that $p = p_H$, for all $S(i; m) = 1$ for all i and $S(i; m) = 0$ for all $i > \bar{i}$.

Then

$$(b; m) = \frac{1}{p_H} \frac{\int_0^1 (1 - m) dm}{\int_0^1 (1 - m) dm + \int_0^1 (1 - m) dm}$$

the b by b_H , find

$$\frac{1}{p_H} \frac{(1 - b_H)}{(1 - b_H) + (1 - b_H)} = 1$$

Eq(22) in $b_H > b$.
The b by

$$\frac{(1 - b_H)}{(1 - b_H) + (1 - b_H)} \frac{w(b)}{p_H}$$

the b by

$$\frac{1}{b_H} \frac{1}{(1 - b_H) + (1 - b_H)} \frac{w(b)}{p_H} db$$

the $p_H > p$ d $b_H > b$, Eq(21) with 1, the
La(5).

the b by $p_L < p$. For
in m by $p(m) \geq (p_L; 1)$, the $S(i; m) = 1$ if i d $S(i; m) = 0$
 $i > 1$. For the b by
d by $p \geq (p_L; 1)$, b by

$$= \frac{1}{p} \frac{(1 - b_H)}{(1 - b_H) + (1 - b_H)}$$

the b by p_L , the b by $b > b$
the b by

$$\frac{1}{p_L} \frac{(1 - b_H)}{(1 - b_H) + (1 - b_H)}$$

the $p = p_L$, b by b_L find

$$\frac{1}{p_L} \frac{(1 - b_L)}{(1 - b_L) + (1 - b_L)} = 1$$

For the b by $b > b_L$ the b by

find b_L

$$b_L = \frac{1}{(1-b) + (1-b)^{\frac{w(b)}{p_L}}} db$$

if $b_L < b$, then $p_L < p_d$ and $b_L < b$, a contradiction.

if $b_L = b$, then $p_L = p_d$.

find

find p_d

$$p = p_d$$

add to p_d

Monotonicity transformation

For $p(i) : [a; 1] \rightarrow \mathbb{R}^+$, find M , m

if $p(i) > p^M$, then $p(i) > p^M$

1. For $i \in [a; 1]$

$$\begin{aligned} (i) \quad & \max_{i^0} [p(i) - p(j)] dj \\ & s.t.: i - i^0 \end{aligned}$$

Not

(a) $(i) = 0$ if $i^0 = i$

if $p(i) > p^M$

if $p(i) = 0$

if $p(i) < p^M$

2. Define

$$P = \{i \in [a; 1] : (i) > 0\}$$

3. Choose $k \in P$ such that k is the smallest element of P

if $k = a$, then $i_k = a$

4. For

$$(a) \quad (i_k) = 0$$

$$(b) \quad (i_k) > 0. \text{ If } i_k = a_i \text{ for } i \in I_k, \text{ then } i_k \text{ is a constant function.}$$

5. For i_k de

$$(a) \text{ If } (i_k) = 0:$$

$$p_k = p(i_k)$$

$$d \quad i_k^0 \text{ and } i^0$$

$$i^0$$

$$(p_k - p(i)) di = 0$$

$$i_k$$

$$\text{Then } i^0 = i_k \text{ is a constant function.}$$

$$\text{If } i_k \text{ is not a constant function, then}$$

$$i_k \text{ is a constant function. If } (i) > 0, \text{ then } i_k \text{ is a constant function.}$$

$$i_k \text{ and } (i) \text{ is}$$

$$i$$

$$(b) \text{ If } (i_k) > 0:$$

$$i \text{ is a constant function.}$$

$$p_k; i^0 \text{ and } i$$

$$i^0$$

$$(p_k - p(i)) di = 0$$

$$i_k$$

$$p_k = p(i^0)$$

$$\text{If } p_k; i_k^0 \text{ and } i$$

$$i \text{ is a constant function. If } i_k^0 = 1 \text{ and } p_k \text{ is a constant function, then}$$

$$1$$

$$(p_k - p(i)) di = 0$$

$$i_k$$

6. p^M is a function of $p(i)$ in

$$p^M(i) = p_k \text{ for } i \in [i_k; i_k^0]; \text{ for } k$$