

Price Discovery

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Trade and Investment Strategy

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Taking Stock

Auctions

- Loosely speaking the course thus far and the preceding lectures have been divided into two parts:
 - 1 auctions.
 - 2 limit order markets.
- Key words and phrases in our analysis of auctions include:
 - types of auctions (FPSB, SPSB, ascending, descending, . . .)
 - probability of winning with higher bid versus net gain conditional on winning with lower bid
 - bidding to beat (expected) highest losing valuation conditional on having highest valuation
 - strategic (same strategy space and payoffs) and revenue (same expected payoffs) equivalence
 - analytic solution in special cases (private value FPSB and SPSB)
 - compensating adjustments to allow for correlated signals about value
 - (dis)advantages from being differentially (un)informed

Taking Stock

Limit order markets

- Key words and phrases in our analysis of limit order markets include
 - the trading mechanism and the limit order book
 - limit orders (shrink the spread) versus market orders (shrink the book)
 - probability of trading versus net gain conditional on trading
 - picking off risk increases with inattention
 - the gains from trading on better (inside) information
 - front running by specialists
 - risk free trading
 - exploiting information about the future spread
 - APT links securities with the distribution over same payoff
 - inequalities rather than equalities when markets not perfectly liquid
 - APT specializes to EMH when traders are risk neutral
 - competitive equilibrium and perfectly illiquid markets

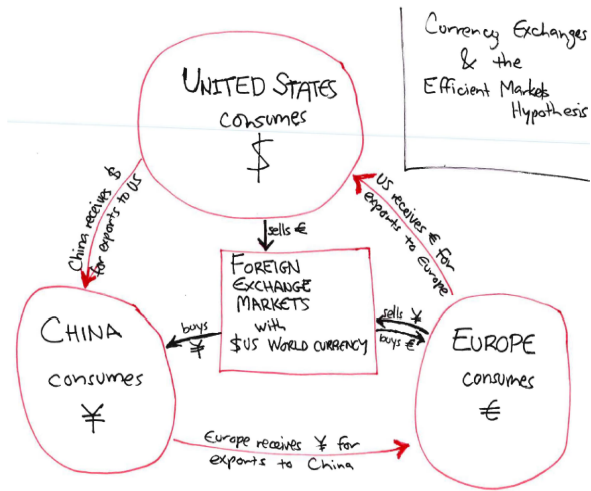
Currency Exchange

A hypothetical world

- Suppose US export companies sporadically receive euro injections from sales in the EU.
- Similarly European (Chinese) exporters earn yuan (dollars) for sales in China (the US).
- Export firms can also on the foreign exchange market between date 0 and T, but at date T all export companies are liquidated and no further value is placed on holding foreign currency.
- We assume the US dollar is a dominant currency, meaning all currency prices are quoted in dollars.
- We assume each export firm maximizes its expected accumulated domestic reserves before the liquidation date T.

Currency Exchange

A flow chart



Currency Exchange

Trading window

1. To trade in a specific market like "Euro", click on that market.
2. The selected market is highlighted in blue in "Summary data".
3. US export company's wealth is cash (i.e. US \$), for European company wealth is Euro, and for Chinese wealth is Yuan.

ComLabGames Username: Todd ID: 3 Identity: 1

History

Name	20:43:49			
wealth	0			

Limit order book

Price	Quant...	Cumulat...	Player...	Player ty...
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Cash 0 Duration 6000 Price 0 Quantity 1 Sell Buy

Summary data

Asset no.	Valuation	Endowment	Buy and...	Bid (Quant...	Ask (Quant...	Trading price (Quant...
Euro	100					
Yuan	50					

Subject's own limit orders

Price	Quant...	Revenue/C...	Duration
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Transaction history

Price	Quantity	Buyer	Seller	Seller	Time
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Player type: US export Company (1)

Round: 1

History shows US\$ amount for US company which is Cash. Currently ID= 3 has 0 cash and therefore 0 wealth.

Euro market is selected. Endowment is 100 Euros for US company. Type is shown

ComLabGames Username: Julia ID: 4 Identity: 2

History

Name	20:43:49			
wealth	0			

Limit order book

Price	Quant...	Cumulat...	Player...	Player L...
-------	----------	------------	-----------	-------------

Cash 100 Duration 6000 Price 0 Quantity 1 Sell Buy

Summary data

Asset no.	Valuation	Endowment	Buy and...	Bid (Quant...	Ask (Quant...	Trading price (Quant...
Euro	0					
Yuan	50					

Subject's own limit orders

Price	Quant...	Revenue/C...	Duration
-------	----------	--------------	----------

Transaction history

Price	Quantity	Buyer	Seller	Seller	Time
-------	----------	-------	--------	--------	------

Player type: European export Company (1)

Round: 1

History shows European company wealth is Euro endowment. Currently ID= 4 has 0 Euros and zero wealth

Assigned company is shown at the bottom.

Currency Exchange

Trading window

1. To trade in a specific market like "Euro", click on that market.
2. The selected market is highlighted in blue in "Summary data".
3. US export company's wealth is cash (i.e. US \$), for European company wealth is Euro, and for Chinese wealth is Yuan.

ComLabGames Username: Todd ID: 3 Identity: 1

History

Name	20:43:49		
wealth	0		

Limit order book

Price	Quan...	Cumulati...	Player...	Player ty...
-------	---------	-------------	-----------	--------------

Cash 0 Duration: 6000 Price: 0 Quantity: 1 Sell Buy

Summary data

Asset na...	Valued	Endow...	St...	Buy ord...	Bid (Quant...	Ask (Quant...	Trading price (Quant...
Euro	100	6					
Yuan	50						

Subject's own limit orders

Price	Quant...	Revenue	C...	Duration
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Transaction history

Price	Quantity	Buyer	Buyer	Seller	Seller	Time
-------	----------	-------	-------	--------	--------	------

Player type: US export Company (1)

Round: 1

History shows US\$ amount for US company which is Cash. Currently ID= 3 has 0 cash and therefore 0 wealth.

Euro market is selected. Endowment is 100 Euros for US company. Type is shown

ComLabGames Username: Julie ID: 4 Identity: 2

History

Name	20:43:49		
wealth	0		

Limit order book

Price	Quan...	Cumulati...	Player...	Player ty...
-------	---------	-------------	-----------	--------------

Cash 100 Duration: 6000 Price: 0 Quantity: 1 Sell Buy

Summary data

Asset na...	Valued	Endow...	St...	Buy ord...	Bid (Quant...	Ask (Quant...	Trading price (Quant...
Euro	6	6					
Yuan	350						

Subject's own limit orders

Price	Quant...	Revenue	C...	Duration
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Transaction history

Price	Quantity	Buyer	Buyer	Seller	Seller	Time
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Player type: European export Company (1)

Round: 1

History shows European company wealth is Euro endowment. Currently ID= 4 has 0 Euros and zero wealth

Assigned company is shown at the bottom.

Currency Exchange

Submitting a price & quantity in a specific market

1. Select the market you want to trade in.
2. Type a price and quantity, and then click **Sell** to sell and **Buy** to buy.
3. The limit order book shows outstanding limit orders for a specific market

At the beginning US company can only submit sell orders in Euro and Yuan markets (i.e. no cash/wealth available)

Submitted buy order in Euro market

European company can buy Euros with Cash available and sell Yuan

Player type: US export Company (1)

Player type: European export Company (1)

Round: 1

Name	07.45.03 (L...	Price	Quantity	Cumulative	Player Id	Player type
wealth	0	30	30	0	3	US export...

Name	07.45.03 ...	Price	Quantity	Cumulative	Player Id	Player type
wealth	0	90	10	0	3	US export...
		10	5	0	4	European...

Asset name	Valuation	Endowment	Sell orders	Buy orders	Bid (Quantity)	Ask (Quantity)	Trading price (Quantity)
Euro	50	10 (6000)			60 (20)		
Yuan		30 (6000)				30 (20)	

Asset name	Valuation	Endowment	Sell orders	Buy orders	Bid (Quantity)	Ask (Quantity)	Trading price (Quantity)
Euro	0 (0)	5 (50)			30 (10)		
Yuan	250	0 (0)				30 (20)	

Currency Exchange

Transactions

1. To buy/sell directly select the best order by clicking on the price of the order and click **Buy** / **Sell**.
2. Summary data and Transaction history show the executed order.

Two units of Euros at price 60 was sold and US wealth increased to 120.

Name	Price	Quantity	Cumulative	Player id	Player type
wealth	120	0			
	60	2	0	3	US export...
	10	5	0	4	European...

Asset name	Valuation	Endowment	Sell orders	Buy orders	Bid (Quantity)	Ask (Quantity)	Trading price (Quantity)
Euro	0	0 (480)	9 (0)	16 (5)	00 (0)	60 (2)	
Yuan	30	29 (90)					

Price	Quantity	Revenue/Cost	Duration	Time
60	2	120	4840	09:48:53

Chinese company bought two Euros for at price = 60. Cash decreased to 30. Wealth stayed at 0. Endowment of Euros increased to 102

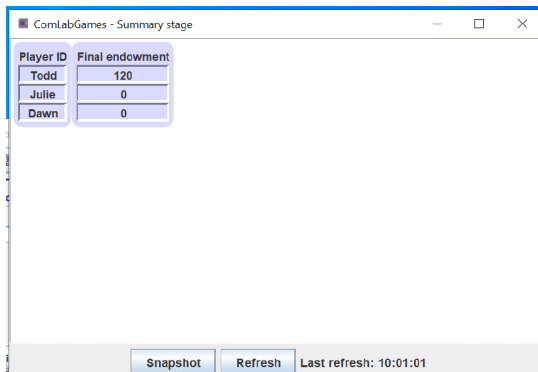
Name	Price	Quantity	Cumulative	Player id	Player type
wealth	0	0			
	60	2	0	3	US export...
	10	5	0	4	European...

Asset name	Valuation	Endowment	Sell orders	Buy orders	Bid (Quantity)	Ask (Quantity)	Trading price (Quantity)
Euro	102	0 (0)	9 (0)	16 (5)	00 (0)	60 (2)	
Yuan	0	0 (0)					
Cash	30	600					

Price	Quantity	Revenue/Cost	Duration	Time
60	2	120	4840	09:48:53

Currency Exchange

Summary page



Player ID	Final endowment
Todd	120
Julie	0
Dawn	0

Snapshot Refresh Last refresh: 10:01:01

Currency Exchange

Competitive equilibrium as a tool for price discovery

- In a multimarket setting, it is quite problematic to intuit where prices will settle.
- The concept of *competitive equilibrium* is a useful tool for predicting what prices will emerge.
- From your courses in microeconomics, a competitive equilibrium (CE):
 - is a *price vector*, one for every market but one (the numeraire)
 - where *suppliers and demanders optimally* pick quantities to trade given the price vector
 - so that *markets clear*.
- That is aggregate supply equals aggregate demand in each market:
 - There are no unanticipated *orders* unfilled or unwanted *inventory*
- In a CE all potential gains from trade are realized:
 - a CE allocates resources efficiently.

Currency Exchange

Competitive equilibrium defined for this game

- In this model of international trade there are technically six markets
 - three export commodities plus three currencies.
- However matching supply to demand in this CE is trivial because:
 - aggregate demand for each export commodity comes from just one currency area.
 - each exporting firm only values its own currency.
- It follows that in CE:
 - US buys all of the 300 dollars supplied
 - EU buys all the 200 Euros supplied
 - China buys all the 400 yen supplied
- Therefore solving for the CE amounts to finding an US dollar exchange rate for both Euros and Yen to equate the supply and demand in the currency markets.

Currency Exchange

Supply of foreign exchange

	\$	€	¥
US	-	100	50
CHINA	200	100	-
EUROPE	100	-	350
TOTAL	300	200	400

Currency Exchange

Competitive equilibrium

Using competitive equilibrium analysis:

$$D_{US} = P_{¥} 50 + P_{€} 100 = 300$$

$$P_{¥} D_C = 200 + P_{€} 100 = P_{¥} 400$$

$$P_{€} D_E = 100 + P_{¥} 350 = P_{€} 200$$

$$\textcircled{1} D_{US} - P_{¥} D_C =$$

$$P_{¥} 50 - 200 = 300 - P_{¥} 400$$

$$\Rightarrow P_{¥} = \frac{500}{450} = \frac{10}{9} \approx 1.1$$

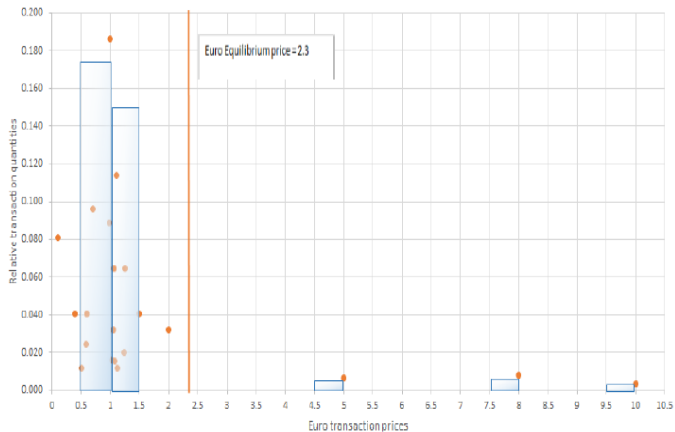
Using $\textcircled{1}$ and $P_{€} D_E =$

$$P_{€} = \frac{100 + P_{¥} 350}{200}$$

$$= \frac{1}{2} + \frac{7}{4} \cdot \frac{10}{9} \approx 2.3$$

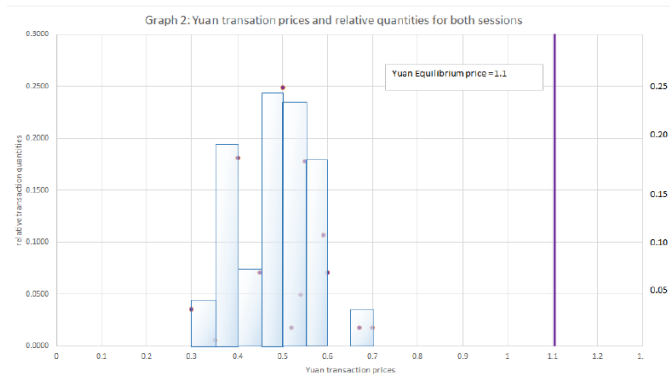
Currency Exchange

Transaction prices in Euro market



Currency Exchange

Transaction prices in Yuan market



Currency Exchange

Efficiency of Limit Order Markets

	US \$	EU	Yuan
US Export company	0.30	0.11	0.04
European Export Company	0.39	0.55	0.28
Chinese export company	0.31	0.34	0.68
	1	1	1