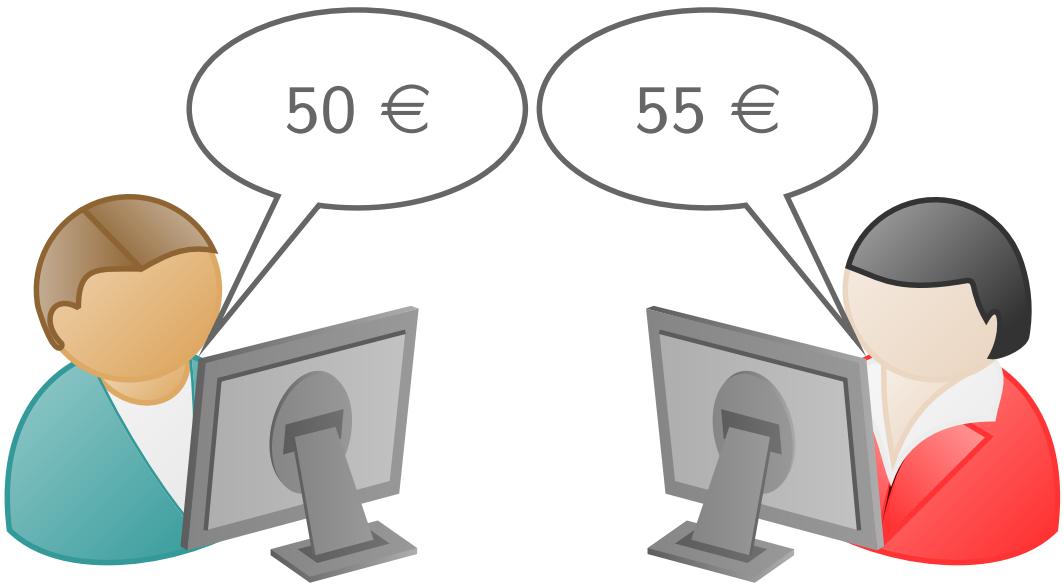
Feedback effects in the experimental double auction with private information



Barbara Ikica[1]

FMF, UL & IMFM

28 June 2019

[1] B. Ikica, H. H. Nax, D. G. Nuñez-Duran, B. S. R. Pradelski, Feedback effects in the experimental double auction with private information. *In progress.*

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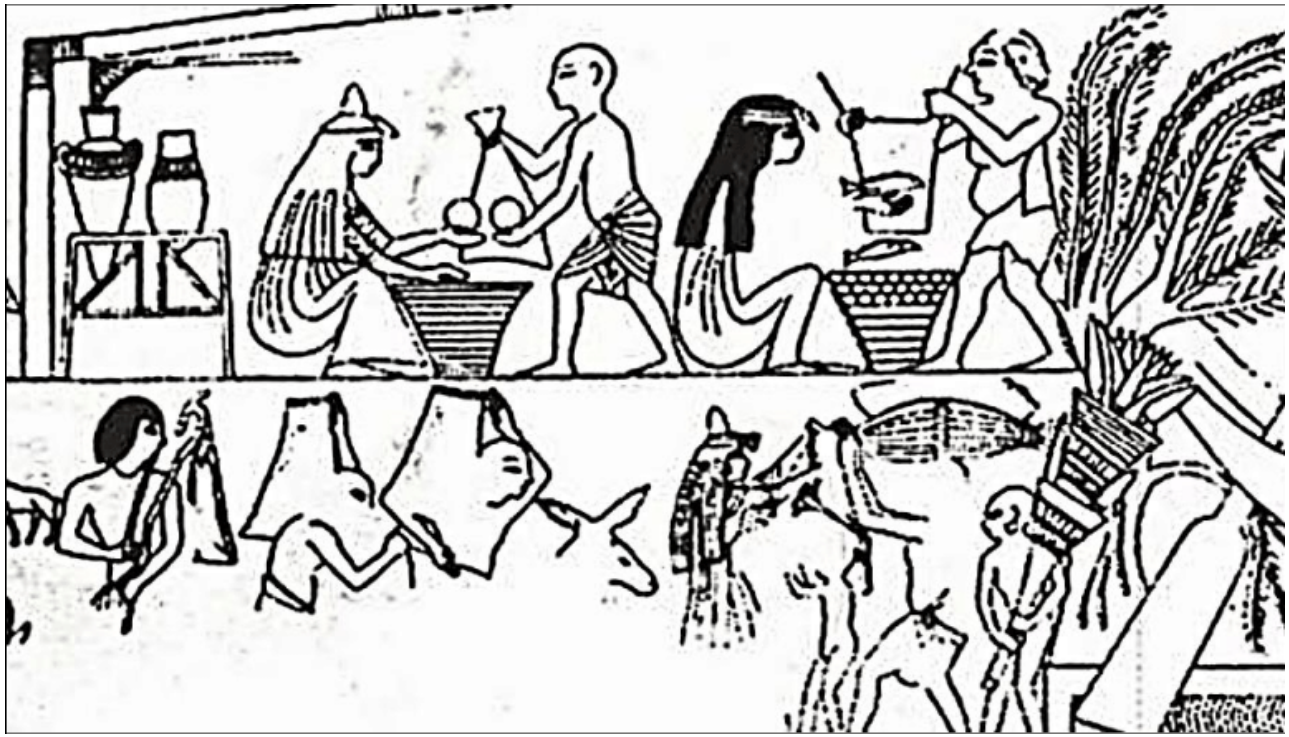
Two-sided markets



Market clearing

Market-clearing price

Can we find a price at which

Market clearing

Market-clearing price

Can we find a price at which

- the quantity demanded equals the quantity supplied

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Market clearing

Market-clearing price

Can we find a price at which

- the quantity demanded equals the quantity supplied
- and no surplus or shortage exists in the market?

Walrasian double auction

Walrasian double auction [Walras, 1883]

- Buyer $i \in \mathcal{B} \rightsquigarrow$ budget r_i^+, seller $j \in \mathcal{S} \rightsquigarrow$ production cost r_j^-

Walrasian double auction

Walrasian double auction [Walras, 1883]

- Buyer $i \in \mathcal{B} \rightsquigarrow$ budget r_i^+, seller $j \in \mathcal{S} \rightsquigarrow$ production cost r_j^-
- Buyers submit bids $\{b_i\}_{i \in \mathcal{B}}$, sellers submit asks $\{a_j\}_{j \in \mathcal{S}}$

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- Buyers submit bids $\{b_i\}_{i \in \mathcal{B}}$, sellers submit asks $\{a_j\}_{j \in \mathcal{S}}$
- An auctioneer matches them at a price π that clears the market

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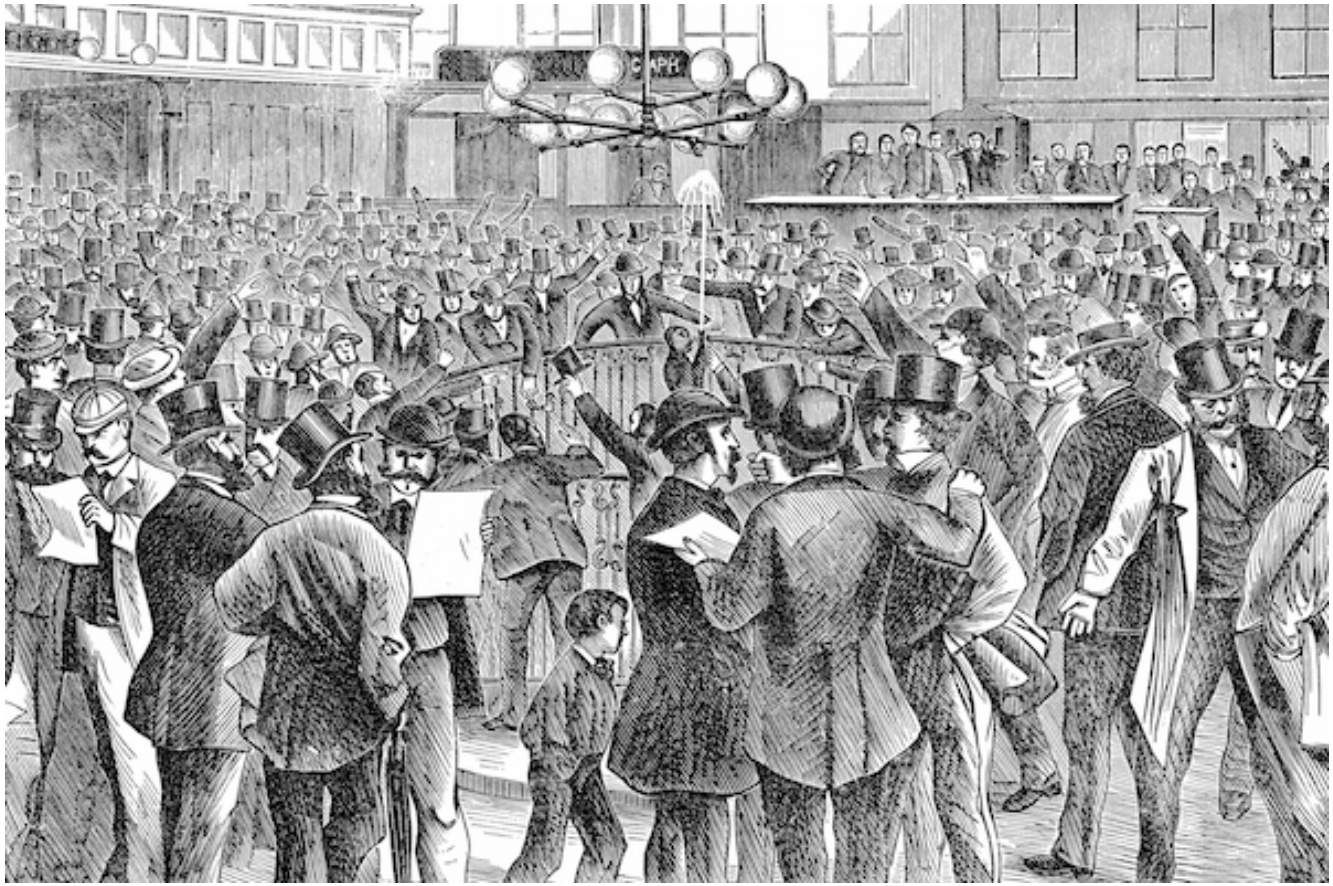
Walrasian double auction



Walrasian double auction

Competitive equilibrium

A market price π & a set of buyers and sellers involved in trade

Walrasian double auction

Competitive equilibrium

A market price π & a set of buyers and sellers involved in trade

- **Individual rationality** (every agent involved weakly prefers trading at π)

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Walrasian double auction

Competitive equilibrium

A market price π & a set of buyers and sellers involved in trade

- **Individual rationality** (every agent involved weakly prefers trading at π)
- **Envy-freenness** (every agent *not* involved weakly prefers *not* trading at π)

Walrasian double auction

Competitive equilibrium

A market price π & a set of buyers and sellers involved in trade

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- **Envy-freenness** (every agent *not* involved weakly prefers *not* trading at π)
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Walrasian double auction

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- **Market clearing** (supply equals demand)

Range of competitive equilibria: $[\underline{\pi}, \overline{\pi}]$

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Experimental economics

Central empirical question

Should competitive equilibria be expected in real-world markets?

Experimental economics

Central empirical question

Should competitive equilibria be expected in real-world markets?

1962 Vernon L. Smith $\rightsquigarrow$ 2002 Nobel Prize in economics

Experimental set-up

- Reservation prices: $\{r_i^+\}_{i\in\mathcal{B}}$, $\{r_j^-\}_{j\in\mathcal{S}}$.

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Experimental set-up

- Reservation prices: $\{r_i^+\}_{i\in\mathcal{B}}$, $\{r_j^-\}_{j\in\mathcal{S}}$.
- Bids $\{b_i^{t,T}\}_{i\in\mathcal{B}}$ and asks $\{a_j^{t,T}\}_{j\in\mathcal{S}}$ are placed for a single identical good, $T \in \mathbb{N}$.

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$$\textit{payoff} \quad = \quad \begin{cases} r_i^+ - \pi, & i\in\mathcal{B} \\ \pi - r_j^-, & j\in\mathcal{S} \end{cases}$$

Experimental set-up

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$$\textit{payoff} = \begin{cases} r_i^+ - \pi, & i\in\mathcal{B} \\ \pi - r_j^-, & j\in\mathcal{S} \end{cases}$$

$$\textit{gain of trade} = r_i^+ - r_j^-$$

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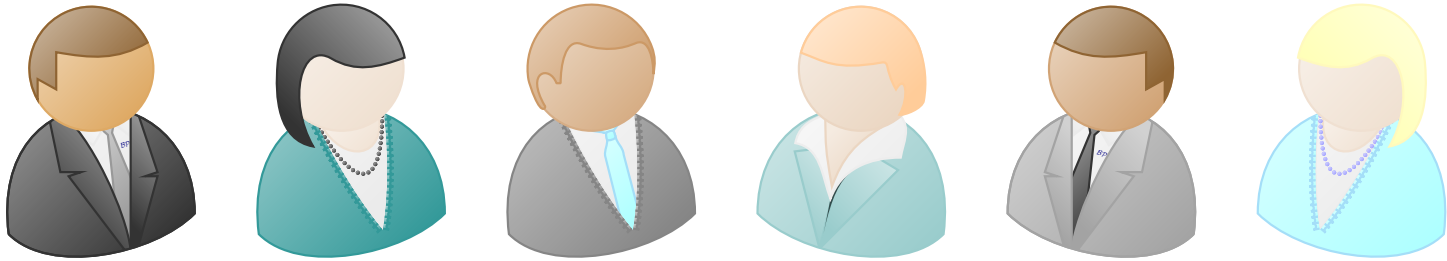
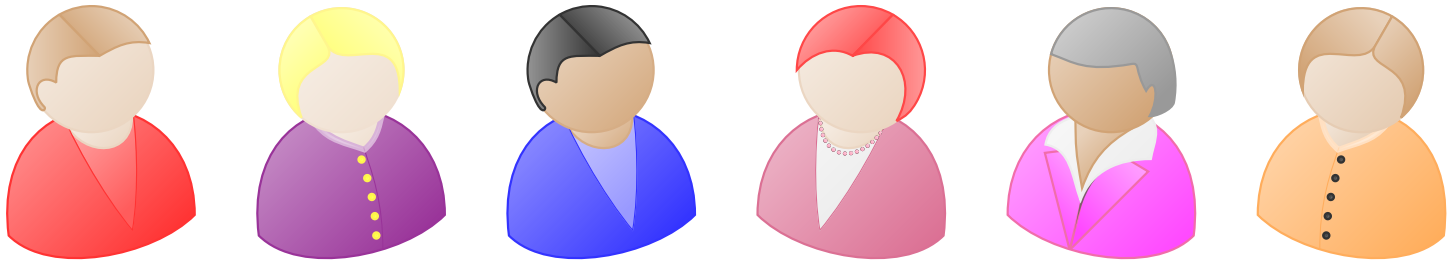
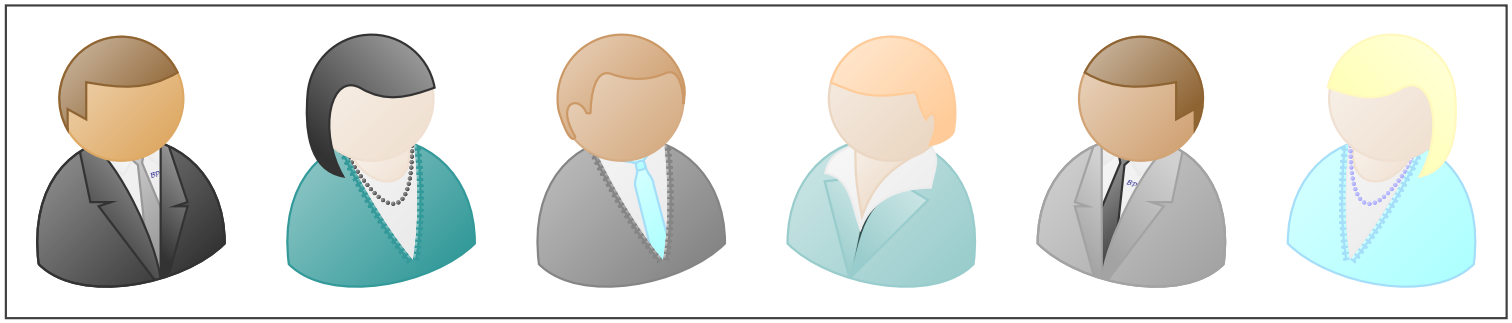
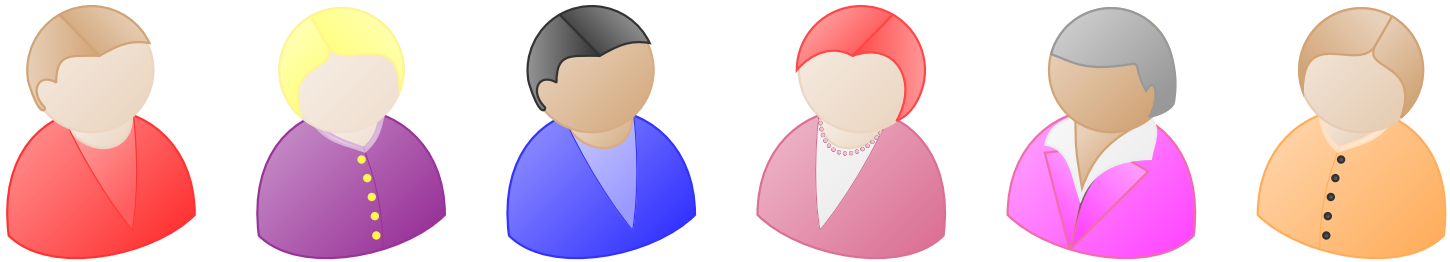
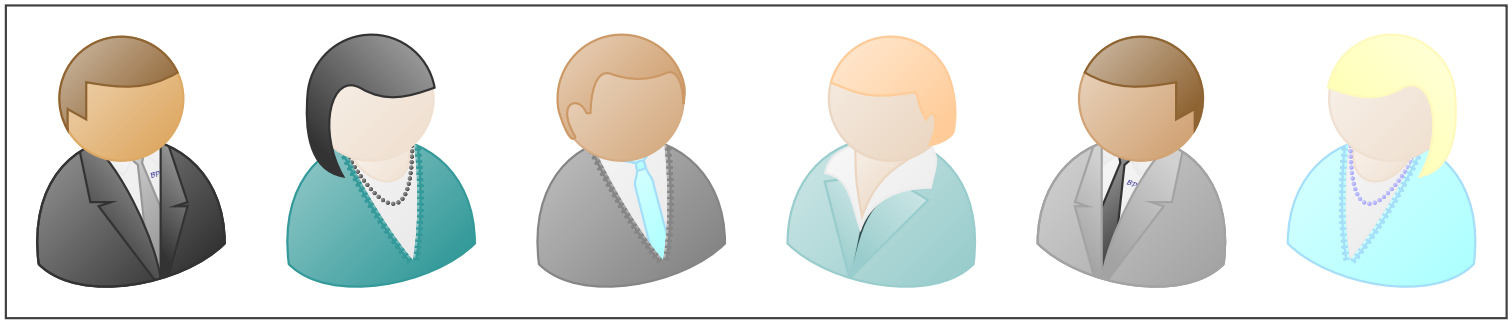




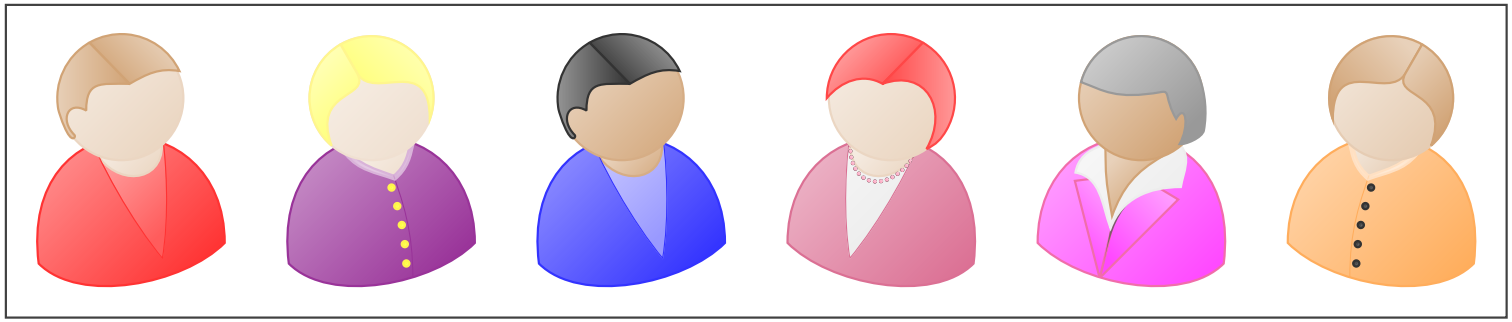


Sellers





Sellers



Buyers

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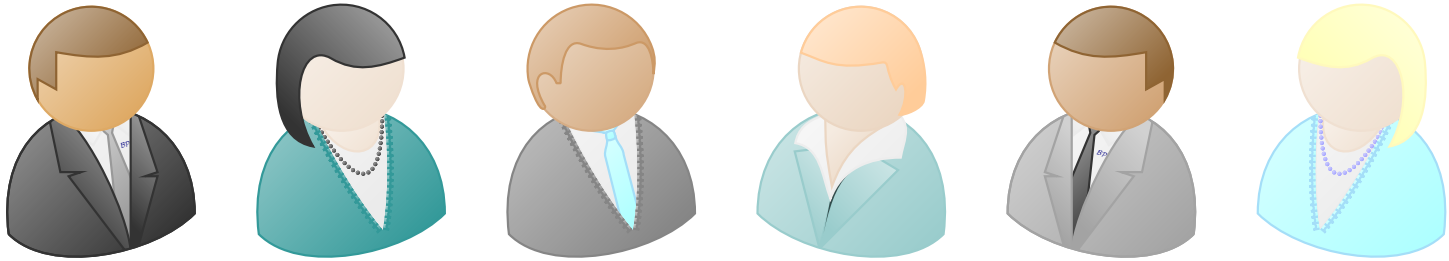
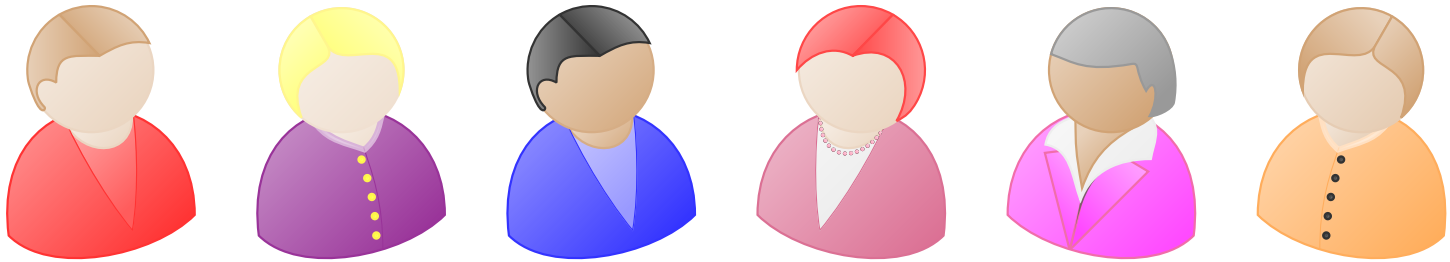
70 € 88 € 93 € 98 € 105 € 113 €





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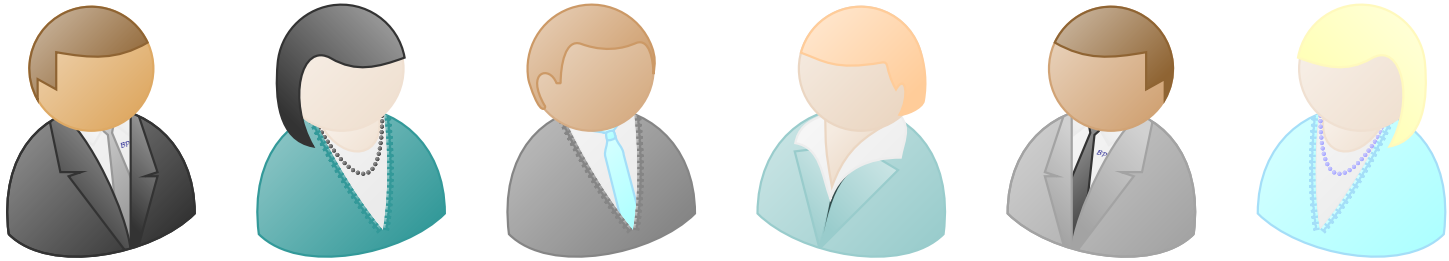
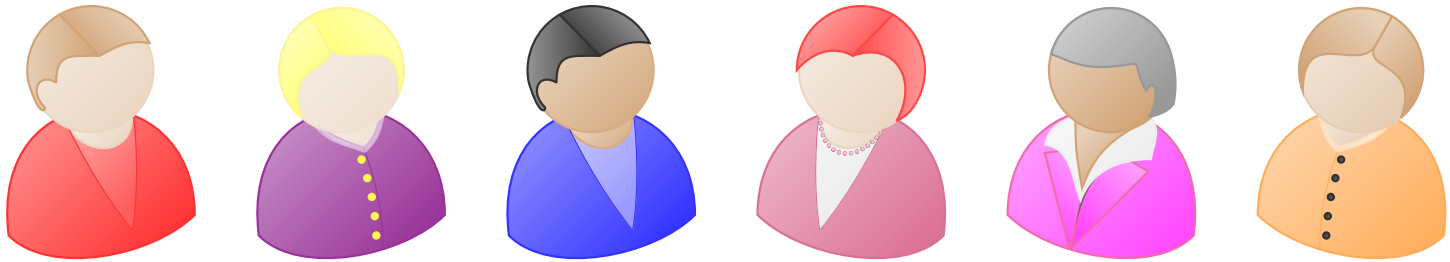
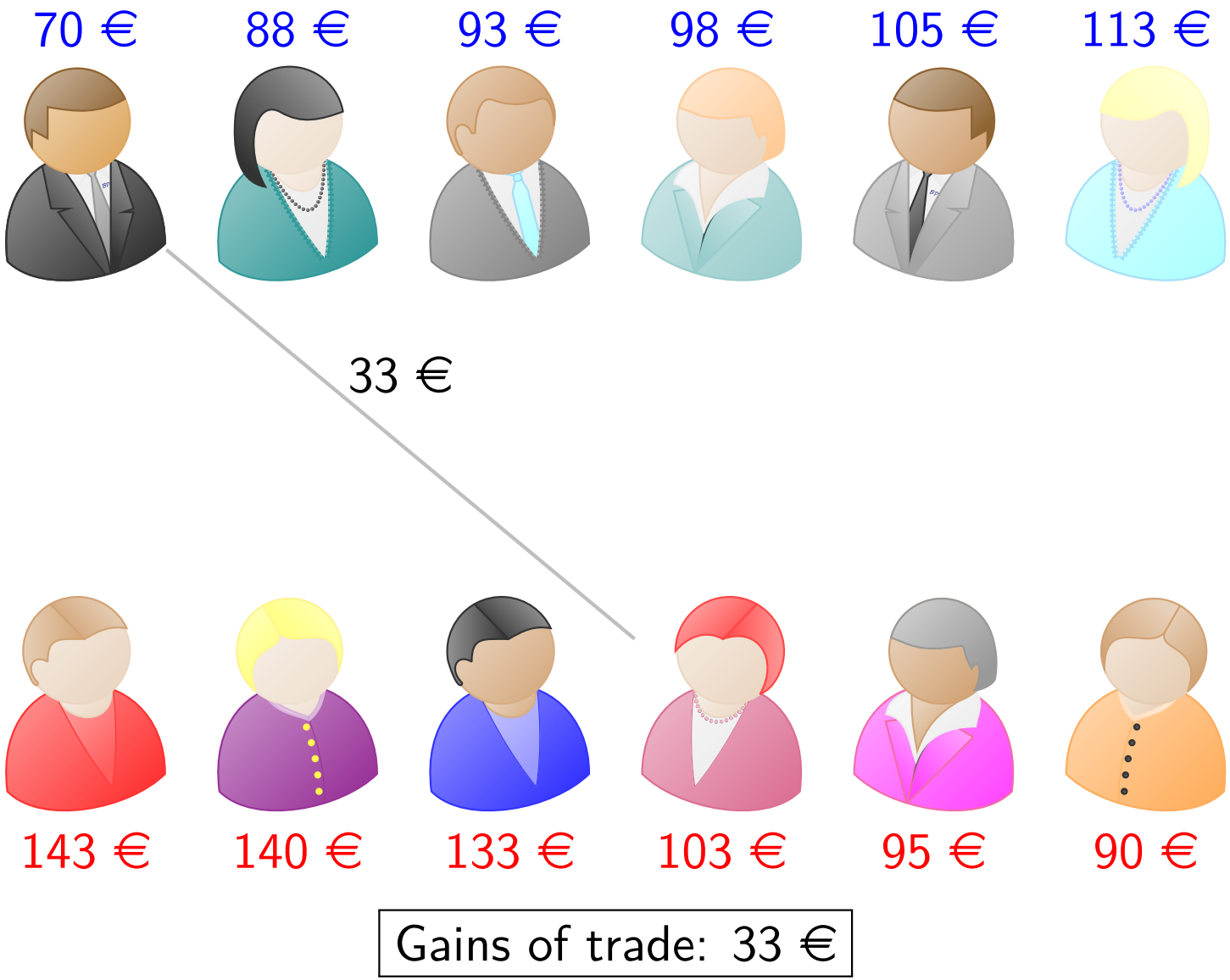
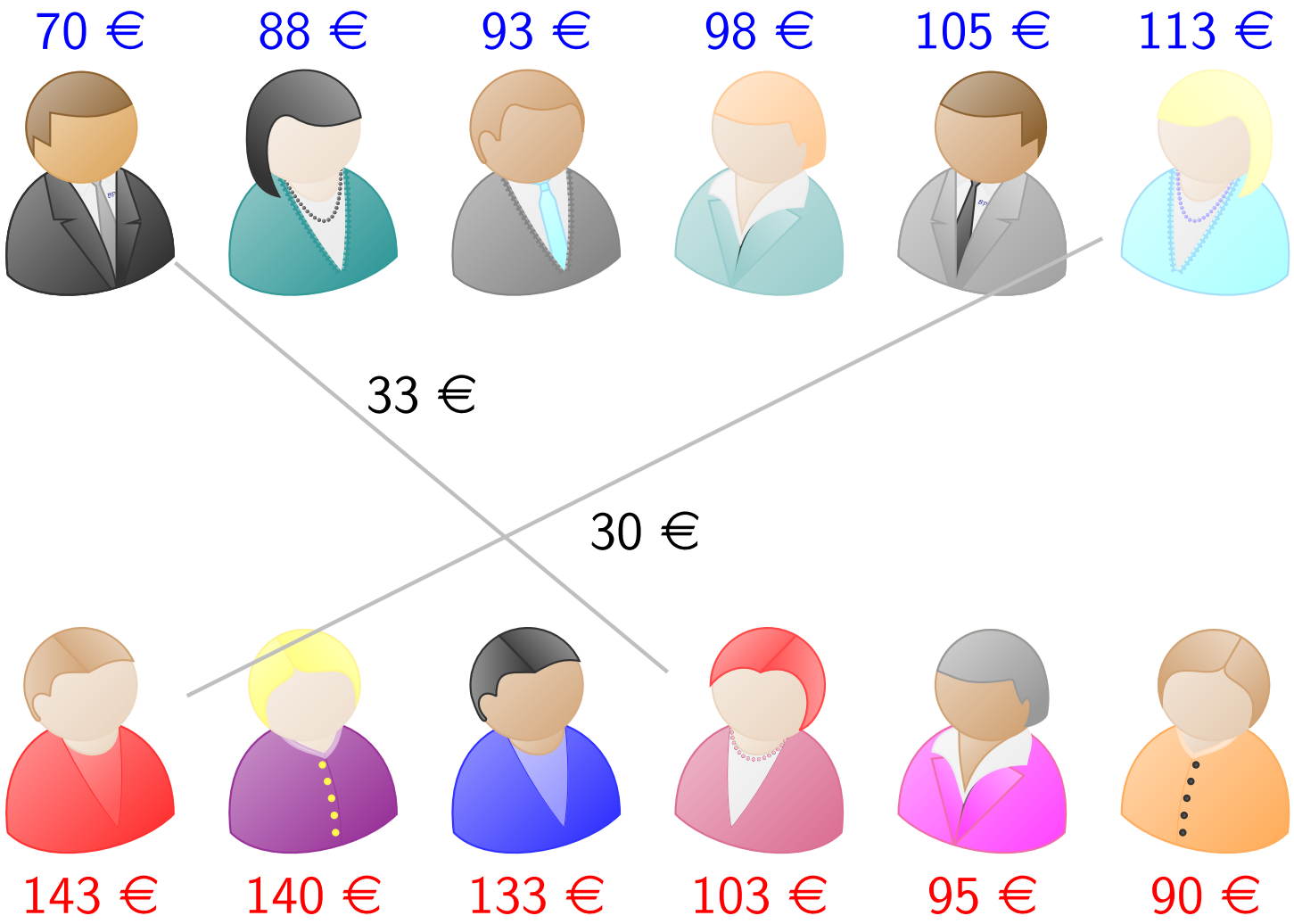




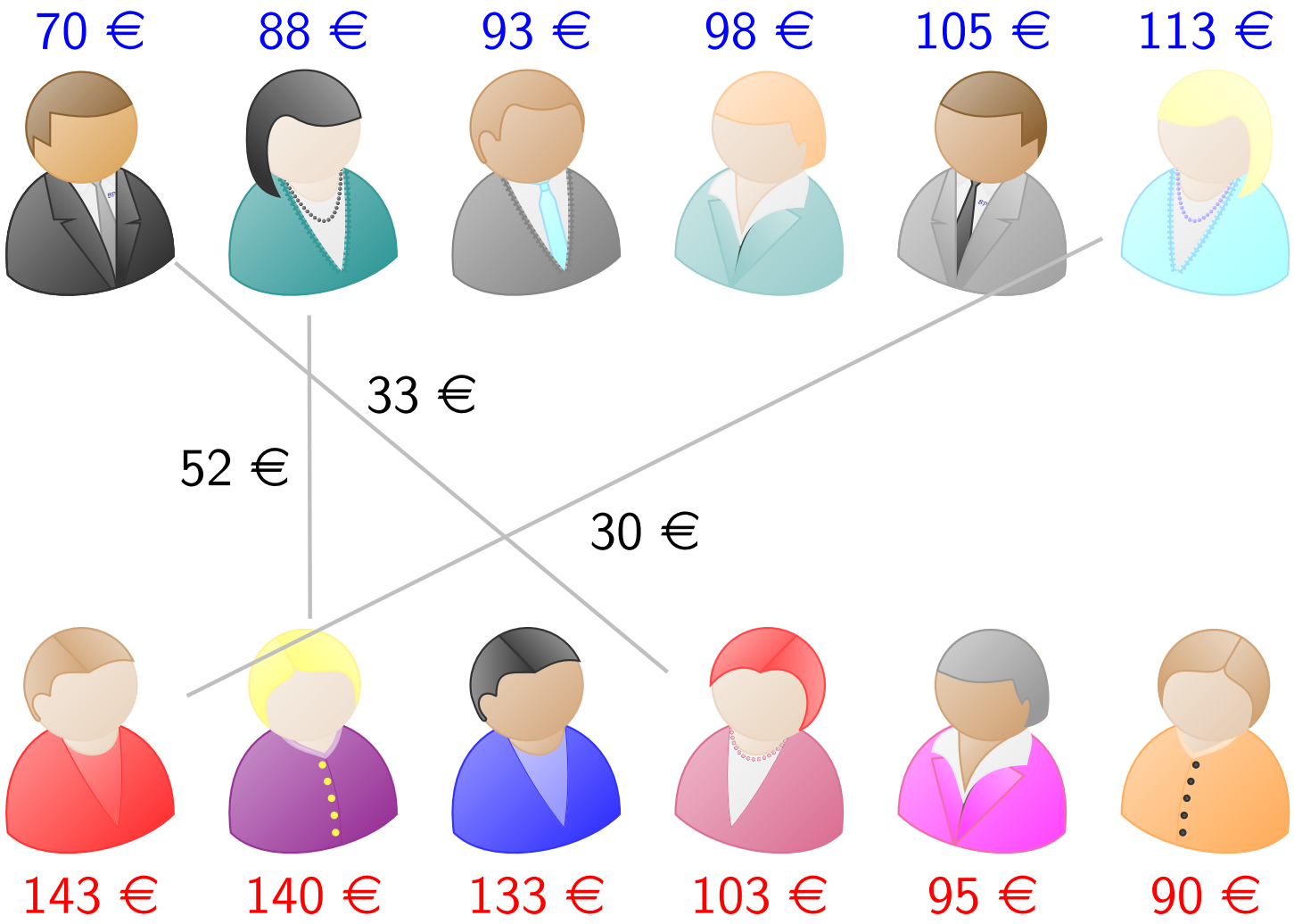
143 € 140 € 133 € 103 € 95 € 90 €



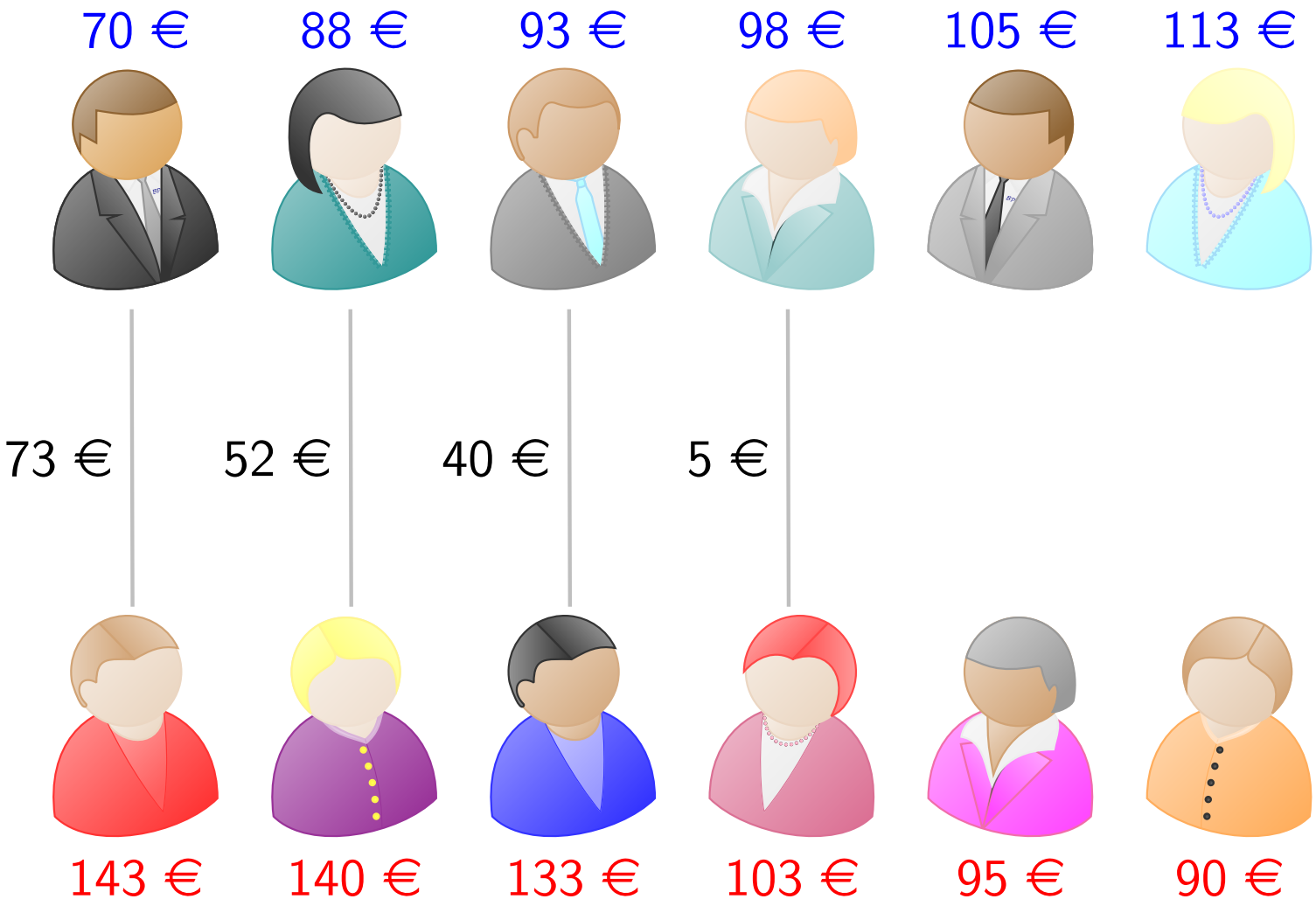
Gains of trade: 33 €



Gains of trade: 63 €



Gains of trade: 115 €



Gains of trade: 170 €

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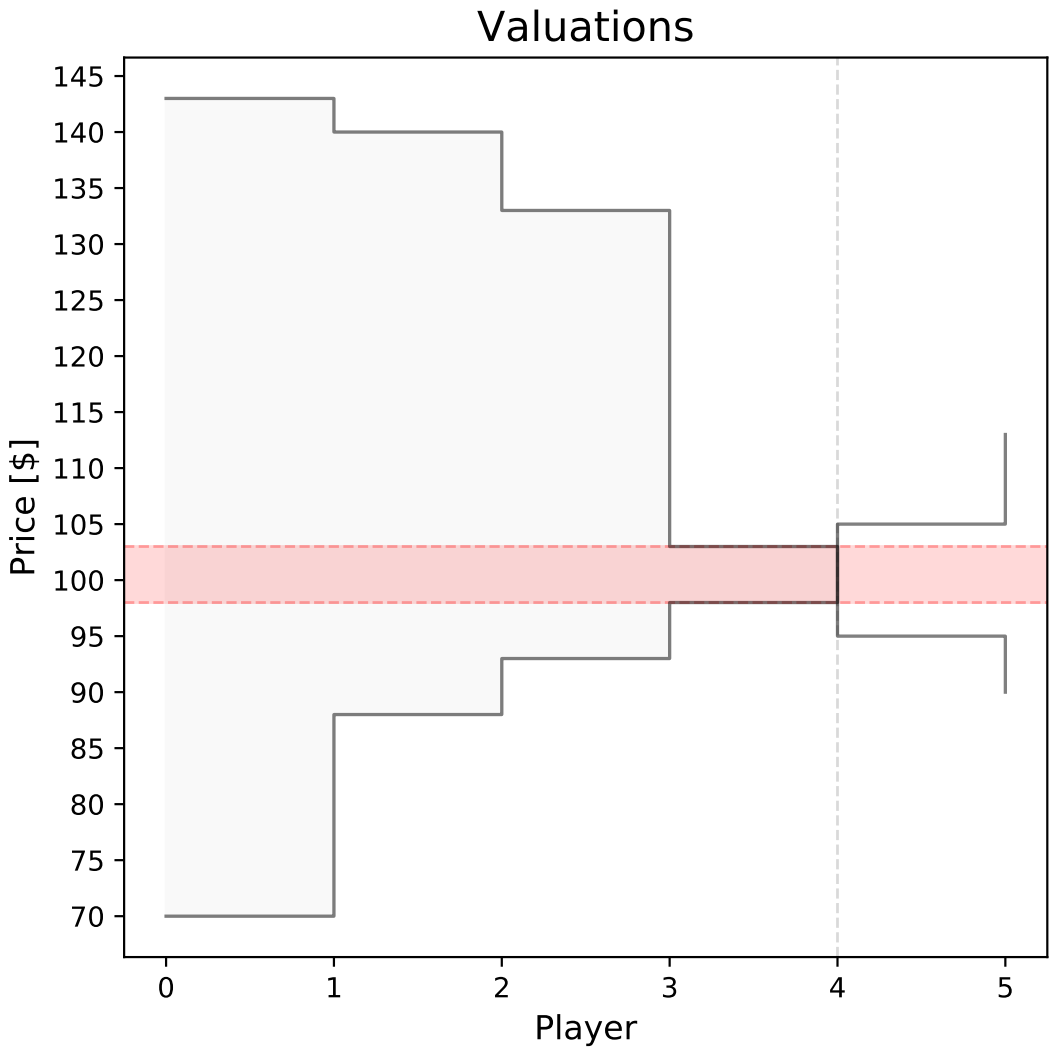
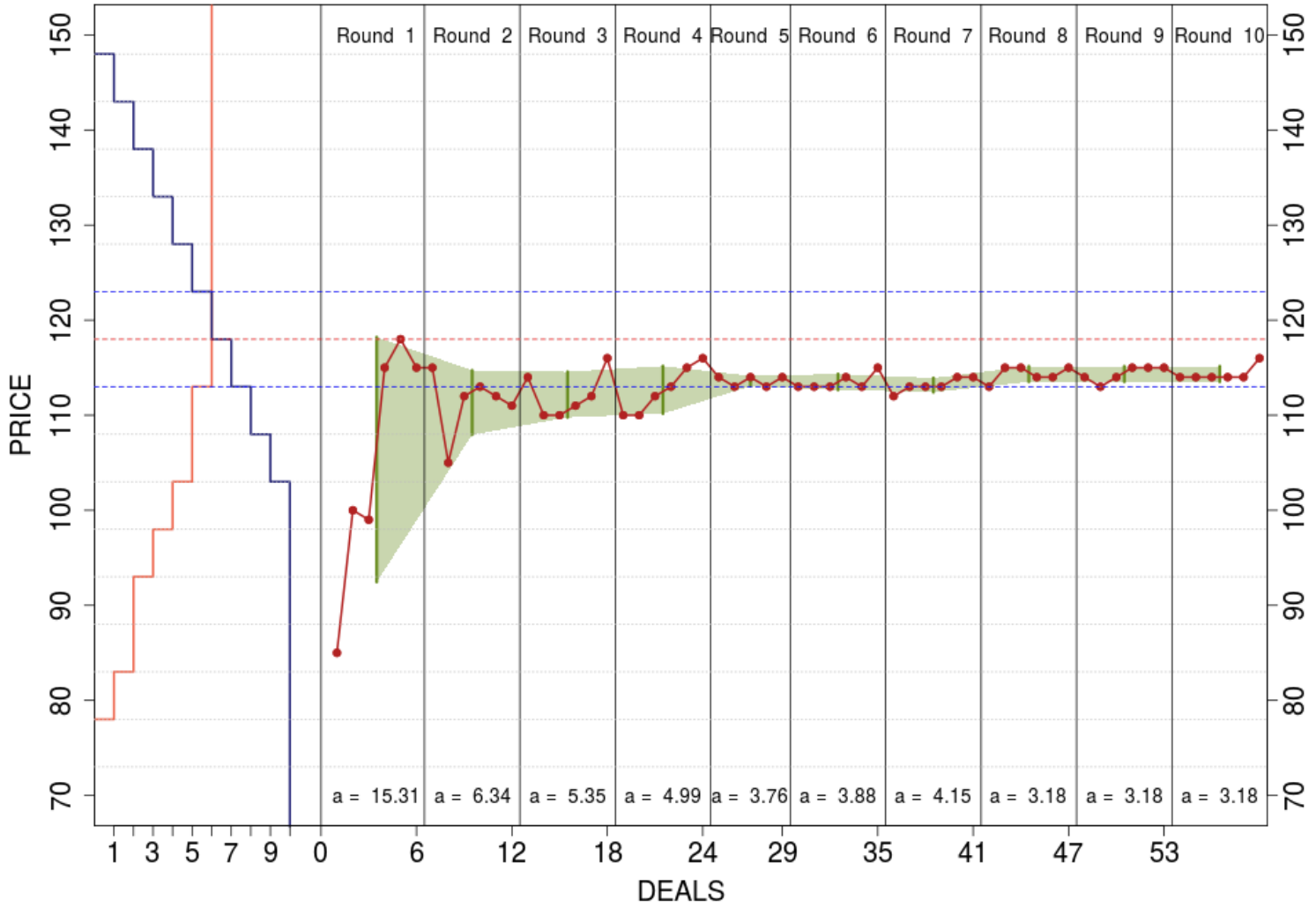


Equilibrium price range: $[98, 103]$, gains of trade: 170 €

Experimental market



Experimental market

	batch_name	game	period	time	id	side	valuation	bid_value	price
500	FullInfo	1	4	606	20	Buyer	108	102	nan
501	FullInfo	1	4	606	10	Buyer	133	102	nan
502	FullInfo	1	4	606	8	Buyer	138	115	115
503	FullInfo	1	4	606	14	Buyer	123	99	nan
504	FullInfo	1	4	607	18	Buyer	113	101	nan
505	FullInfo	1	4	609	17	Seller	108	120	nan
506	FullInfo	1	4	610	6	Buyer	143	102	nan
507	FullInfo	1	4	611	20	Buyer	108	103	nan
508	FullInfo	1	4	611	15	Seller	103	120	nan
509	FullInfo	1	4	611	16	Buyer	118	105	105
510	FullInfo	1	4	611	22	Buyer	103	90	nan

Treatments

- **Feedback**: black box, same, other, full.

Treatments

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- **Price mechanisms**: first price, random price, matchkeeper keeps.

Treatments

- **Feedback**: black box, same, other, full.
- **Price mechanisms**: first price, random price, matchkeeper keeps.
- **Market structures**: regular (10 buyers, 10 sellers, 10 rounds), asymmetric buy-side (20 buyers), asymmetric sell-side (20 sellers), long (50 rounds).

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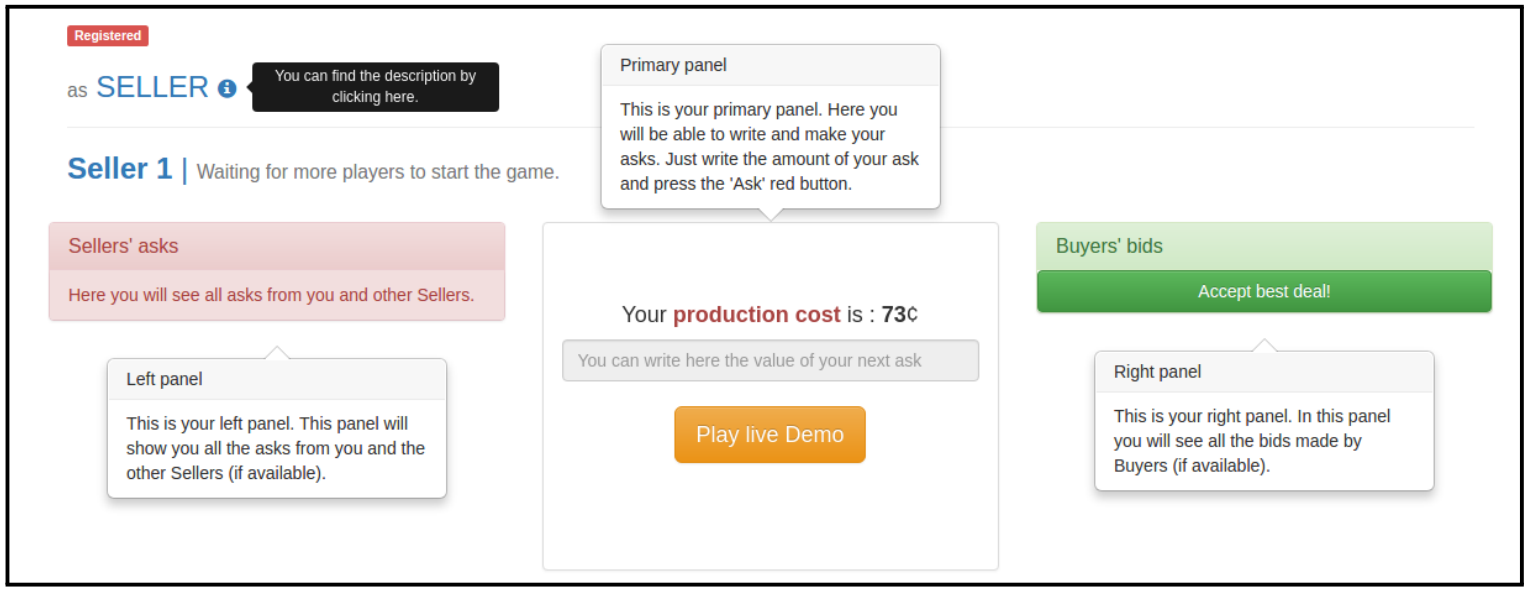


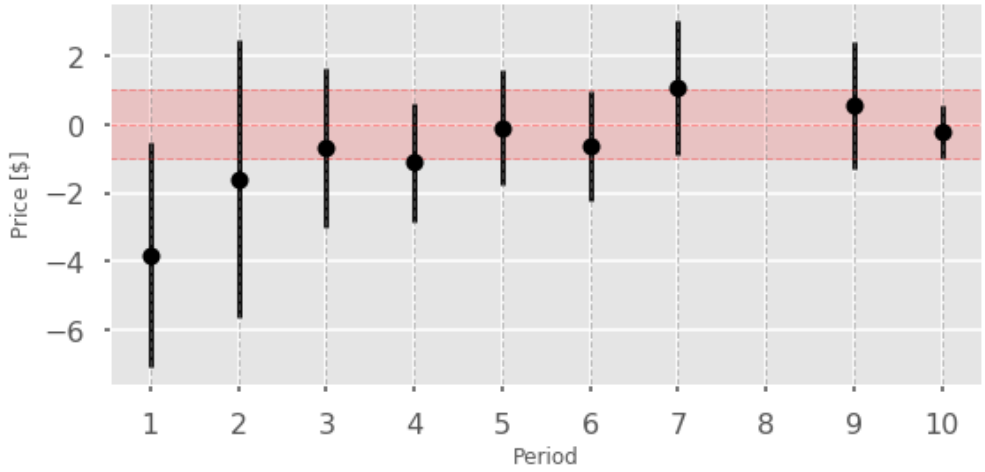
osf.io/gu62n

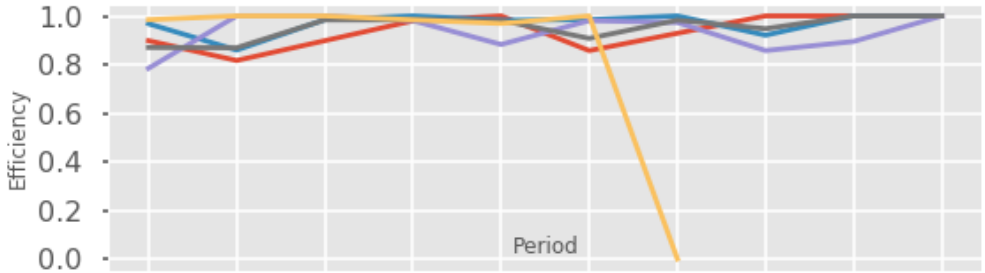
Overview of all treatments

Batch name	Feedback	Price rule	# Games
FullInfo	full	first	5
OwnInfo	same	first	5
OtherInfo	other	first	5
MatchmakerKeepsOwn	same	mmk_keeps	4
BlackBox	blackbox	first	5
MatchmakerRandomizes	blackbox	random	5
MatchmakerKeepsBlackBox	blackbox	mmk_keeps	5
AsymmetricFull	full	first	5
AsymmetricBlackBox	blackbox	first	5
AsymmetricReverseFull	full	first	5
AsymmetricReverseBlackBox	blackbox	first	5
MorePeriods	blackbox	first	5
LargeCore	full	first	8
LargeCoreBlackbox	blackbox	first	8
MarketShift	full	first	5
ChangingAsymmetry	full	first	5
ChangingAsymmetryInv	full	first	5

Convergence to competitive prices

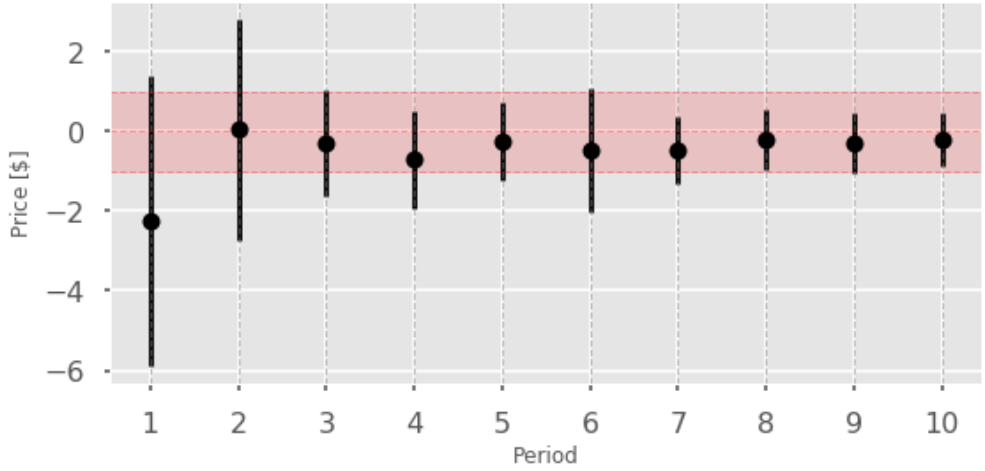
FullInfo: full feedback, first price

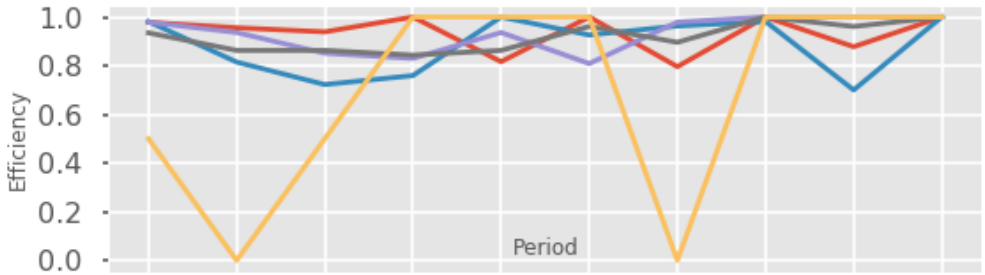




	1	2	3	4	5	6	7	8	9	10
B	10	10	10	10	10	10	9	10	10	10
S	8	8	8	8	8	8	8	7	8	8
B	9	9	9	9	8	9	9	9	9	9
S	9	10	10	9	10	10	9	9	9	10
B	8	7	7	8	8	8	7	7	6	7
S	10	10	9	9	9	9	8	9	9	9
B	10	10	10	10	9	9	10	10	10	10
S	7	8	8	8	8	8	7	7	7	7
B	9	9	9	9	9	9	0			
S	10	9	10	9	10	9	1			

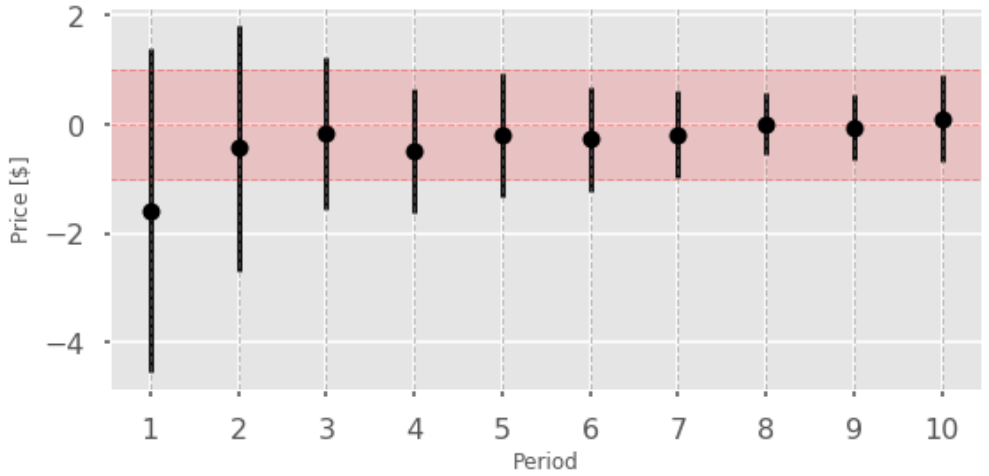
OwnInfo: same-side feedback, first price

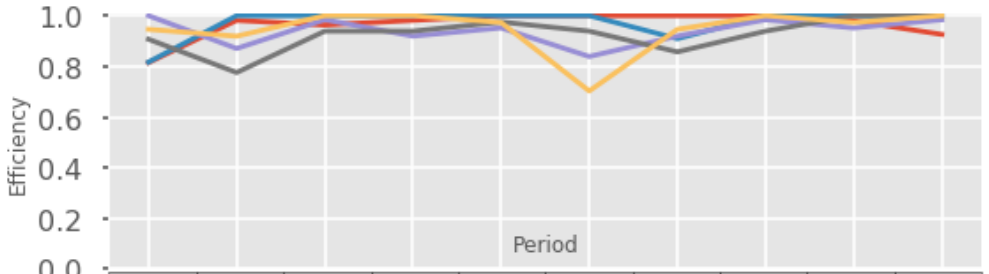




	1	2	3	4	5	6	7	8	9	10
B	9	9	10	10	10	10	10	10	10	10
S	6	6	6	6	6	6	6	6	6	6
B	7	8	8	8	8	8	8	8	7	8
S	9	8	8	8	8	8	8	8	8	7
B	7	7	7	7	7	7	7	7	7	7
S	9	9	9	9	9	9	9	9	9	9
B	9	10	10	10	10	10	10	10	10	10
S	7	7	6	6	6	6	5	6	6	6
B	2	2	2	1	1	1	2	1	1	1
S	3	3	3	2	2	2	2	2	2	2

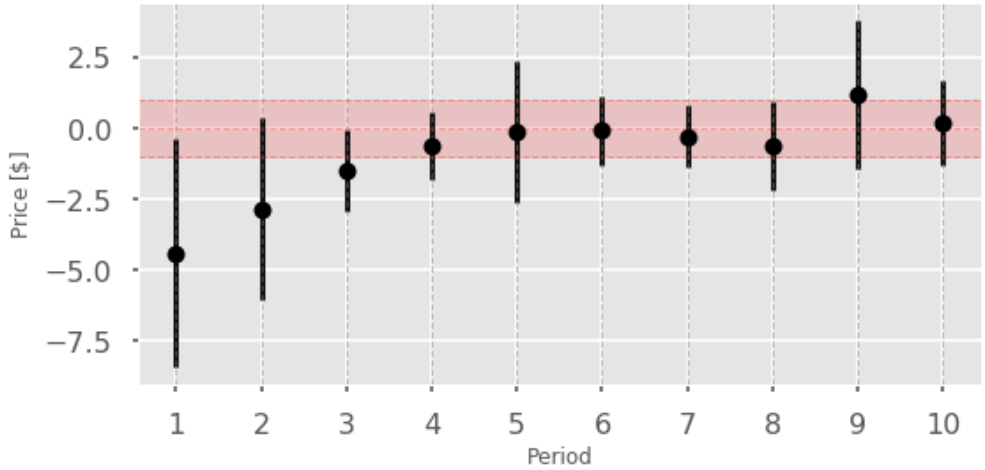
OtherInfo: other-side feedback, first price

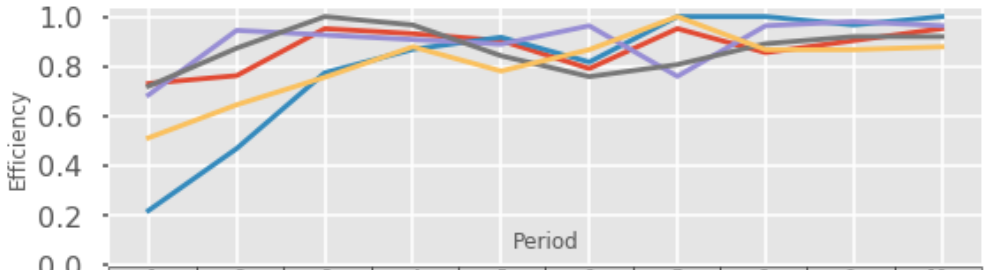




	1	2	3	4	5	6	7	8	9	10
B	8	8	8	8	8	8	6	6	7	7
S	9	9	9	9	9	9	9	9	9	10
B	6	6	6	6	6	6	5	5	6	6
S	6	5	6	5	6	6	6	6	6	6
B	9	9	9	9	9	9	9	9	9	9
S	8	8	9	9	9	9	9	9	9	9
B	8	9	9	9	8	8	8	8	9	9
S	6	6	6	6	5	6	6	6	6	6
B	4	4	4	4	4	4	4	4	4	4
S	3	3	3	3	3	3	3	3	3	3

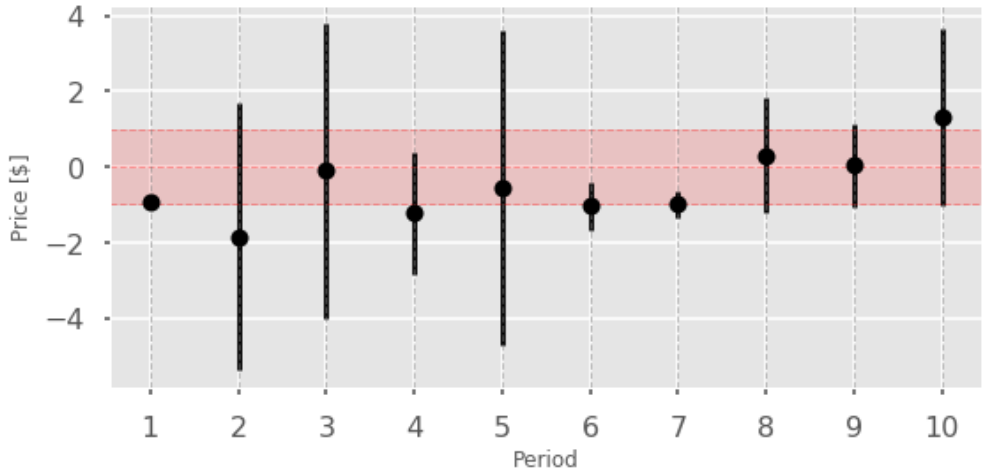
BlackBox: blackbox feedback, first price

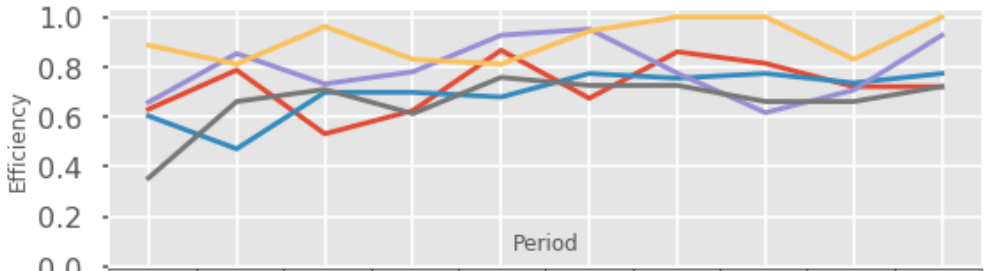




	1	2	3	4	5	6	7	8	9	10
B	9	9	9	8	9	9	9	9	9	9
S	10	10	9	8	8	8	8	8	8	8
B	7	8	7	7	7	7	7	7	7	7
S	7	5	6	6	7	7	7	7	7	7
B	9	8	8	8	8	8	8	8	8	8
S	9	9	9	9	9	8	8	8	8	8
B	8	9	8	9	8	9	9	10	9	9
S	10	9	10	10	10	10	10	10	10	10
B	6	5	5	4	4	5	5	5	5	4
S	5	5	6	6	6	6	4	5	5	5

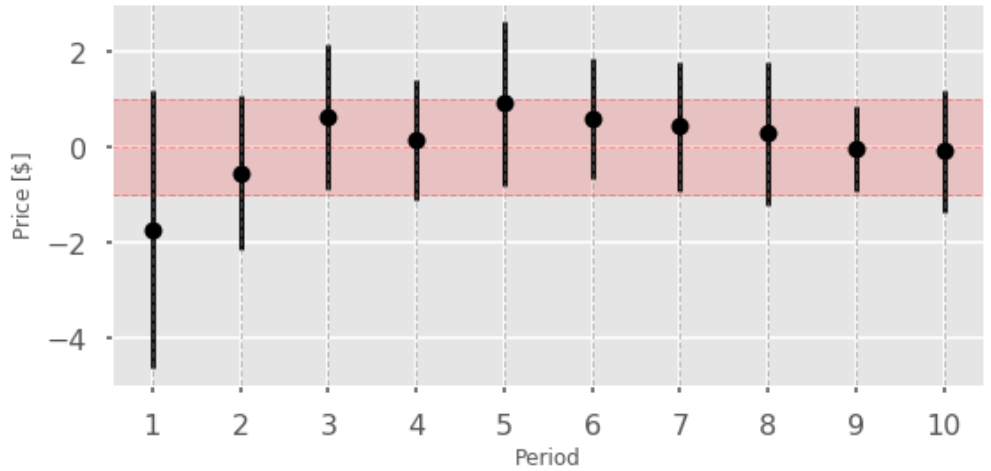
MatchmakerRandomizes: blackbox feedback, random price

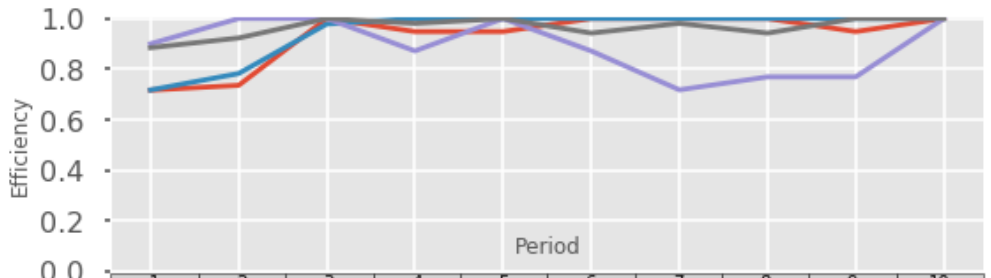




	1	2	3	4	5	6	7	8	9	10
B	8	8	8	9	8	7	7	7	7	7
S	7	8	8	7	8	8	8	7	8	8
B	10	9	10	10	10	10	10	10	10	10
S	7	7	7	7	7	7	7	7	7	7
B	7	7	7	6	6	6	6	6	6	6
S	6	6	6	6	6	6	6	7	6	6
B	9	9	9	9	9	9	9	9	9	8
S	9	10	10	10	10	10	10	9	9	9
B	5	5	5	5	5	5	5	5	5	5
S	6	6	6	6	6	6	6	6	6	6

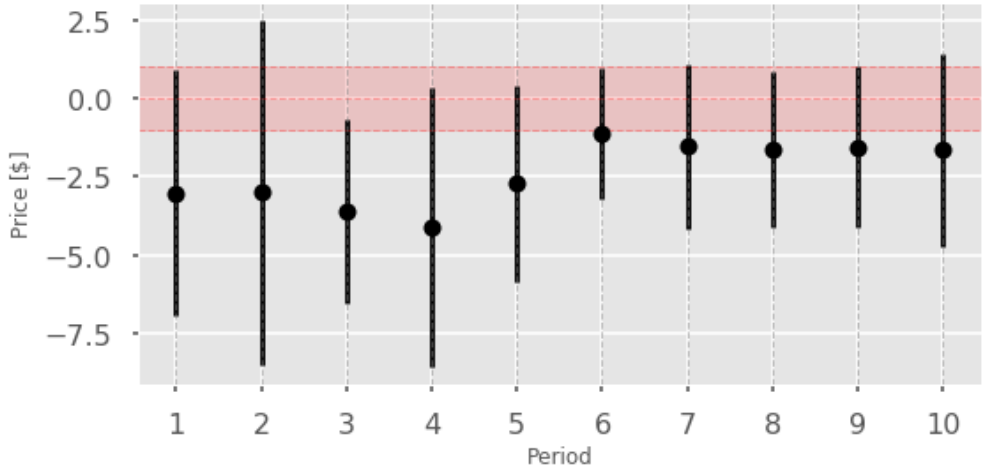
MatchmakerKeepsOwn: same feedback, matchmaker-keeps price

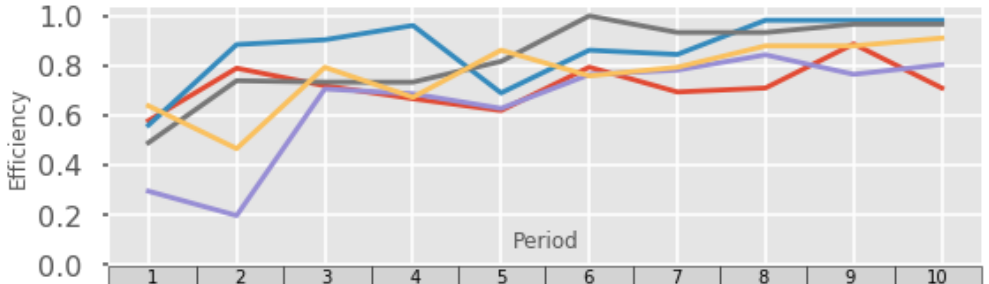




	1	2	3	4	5	6	7	8	9	10
B	8	8	8	8	8	8	8	8	8	8
S	7	7	8	9	9	9	9	9	9	9
B	9	8	9	9	9	9	9	9	9	9
S	7	7	7	7	7	7	7	7	7	7
B	5	5	6	6	6	6	6	6	6	5
S	7	7	7	7	7	7	7	7	7	7
B	9	9	9	9	9	9	8	9	8	8
S	9	9	9	9	9	9	9	9	8	8

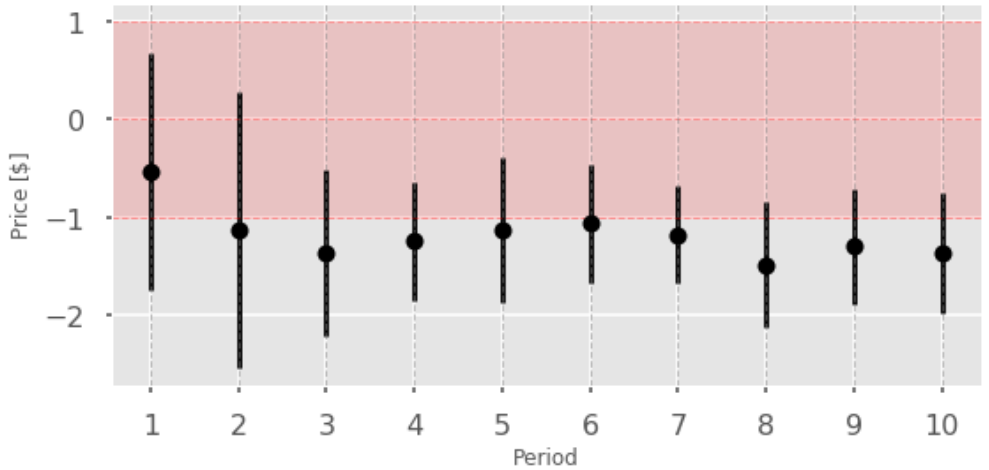
MatchmakerKeepsBlackBox: blackbox feedback, matchmaker-keeps price

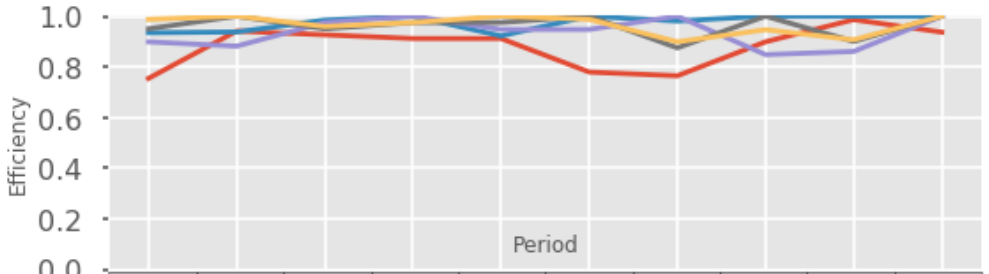




	1	2	3	4	5	6	7	8	9	10
B	10	9	10	9	9	9	9	9	9	9
S	10	10	10	10	10	10	9	9	9	9
B	8	8	8	8	9	9	9	8	9	9
S	8	9	9	9	9	9	9	9	9	9
B	8	8	8	8	8	8	8	8	8	8
S	9	9	9	9	9	10	10	9	9	9
B	9	9	9	9	9	9	9	10	10	10
S	8	7	8	8	8	8	8	8	8	8
B	6	6	6	6	6	6	6	6	6	6
S	7	7	7	7	7	7	7	7	7	6

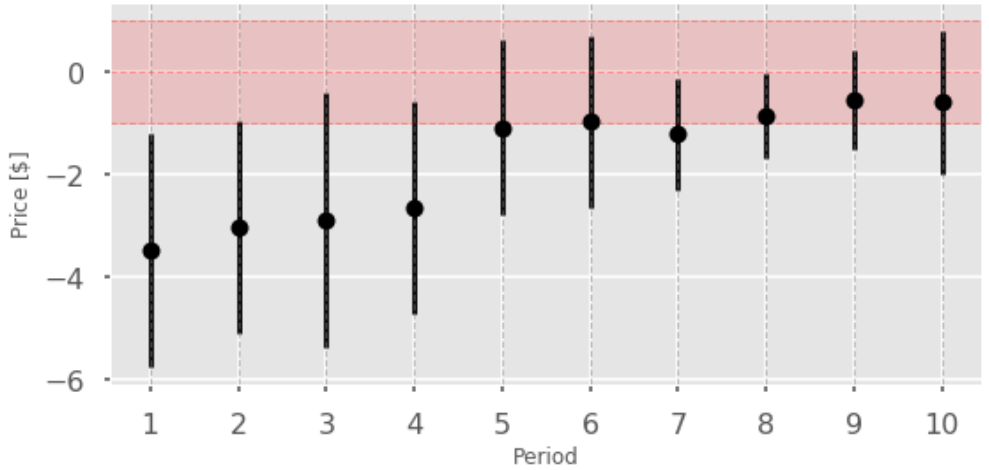
AsymmetricFull: full feedback, first price

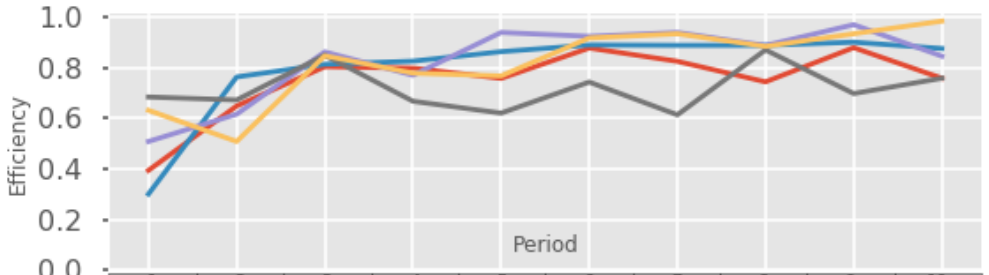




	1	2	3	4	5	6	7	8	9	10
B	7	8	8	8	8	8	8	9	8	9
S	20	20	20	20	20	19	20	20	20	20
B	7	7	7	7	7	7	6	7	7	7
S	19	20	20	20	20	20	19	20	19	19
B	9	8	9	9	8	8	9	9	9	9
S	18	18	18	19	19	18	18	18	18	18
B	9	9	9	9	9	9	9	9	9	9
S	19	19	20	19	20	20	18	18	18	18
B	9	9	9	9	9	9	9	9	9	9
S	18	17	17	18	18	18	18	16	17	17

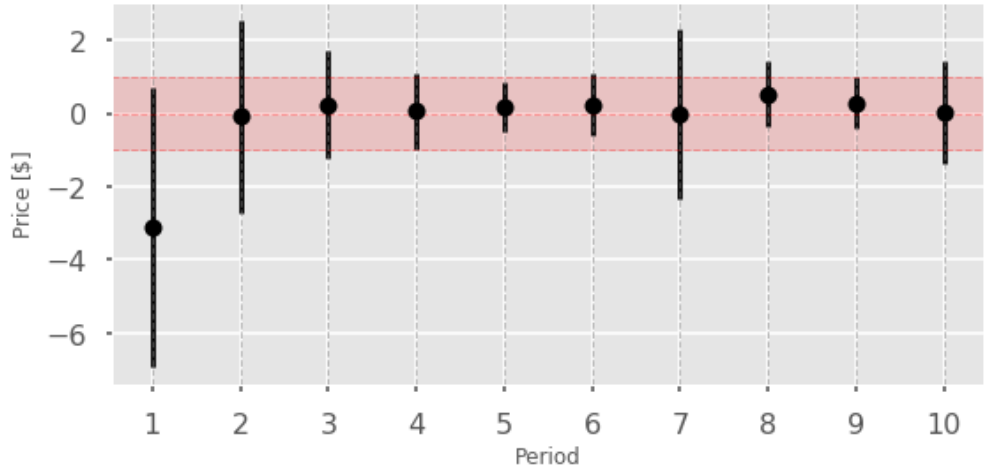
AsymmetricBlackBox: blackbox feedback, first price

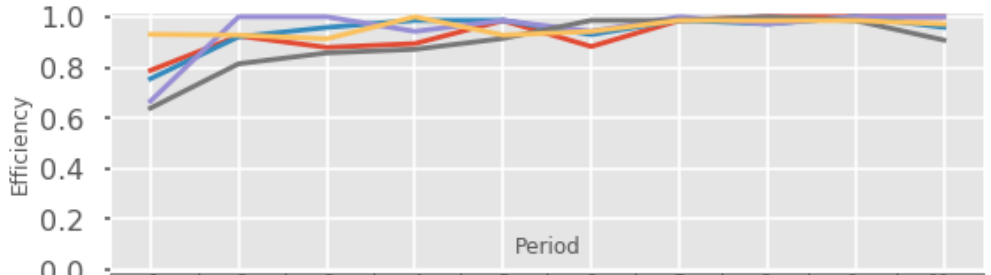




	1	2	3	4	5	6	7	8	9	10
B	7	8	8	9	9	8	9	9	9	8
S	17	17	18	17	16	17	17	17	18	17
B	10	10	10	10	10	9	10	10	10	10
S	18	18	19	19	19	19	19	19	19	19
B	8	8	8	8	8	8	8	7	8	7
S	17	17	17	17	17	17	17	16	17	17
B	8	9	8	8	8	8	8	8	8	8
S	10	10	10	10	11	10	9	9	9	10
B	8	8	8	8	8	8	8	8	8	8
S	13	14	14	11	12	12	12	12	12	12

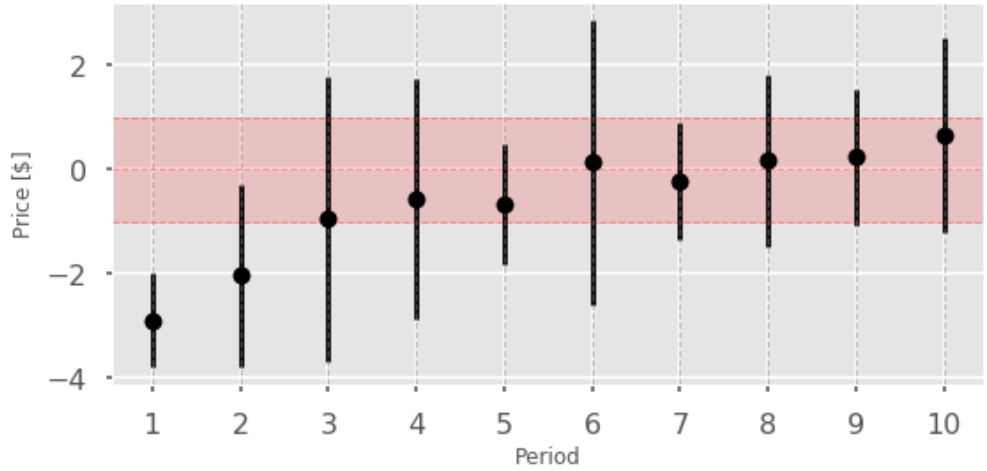
AsymmetricReverseFull: full feedback, first price

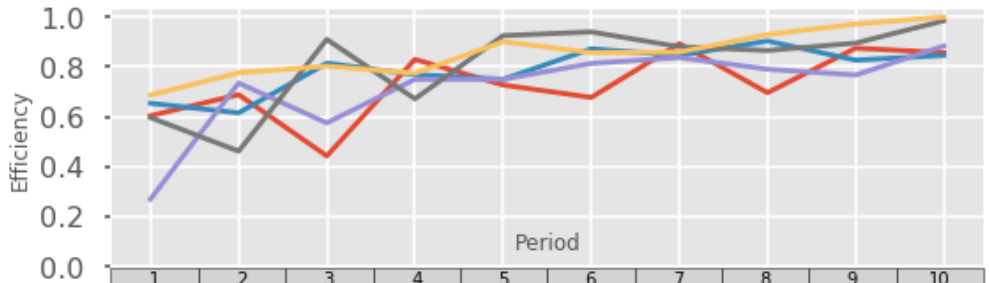




	1	2	3	4	5	6	7	8	9	10
B	17	17	17	18	17	18	19	19	19	18
S	8	8	8	8	8	8	8	8	8	8
B	17	16	16	17	17	17	17	17	17	16
S	5	9	8	8	8	8	9	8	9	9
B	14	14	17	16	16	16	16	17	16	17
S	7	6	7	7	7	7	7	7	7	7
B	16	15	15	15	15	15	14	15	15	15
S	9	9	9	9	9	9	9	9	8	8
B	19	17	17	16	17	17	16	15	17	16
S	8	8	8	8	8	8	8	8	8	8

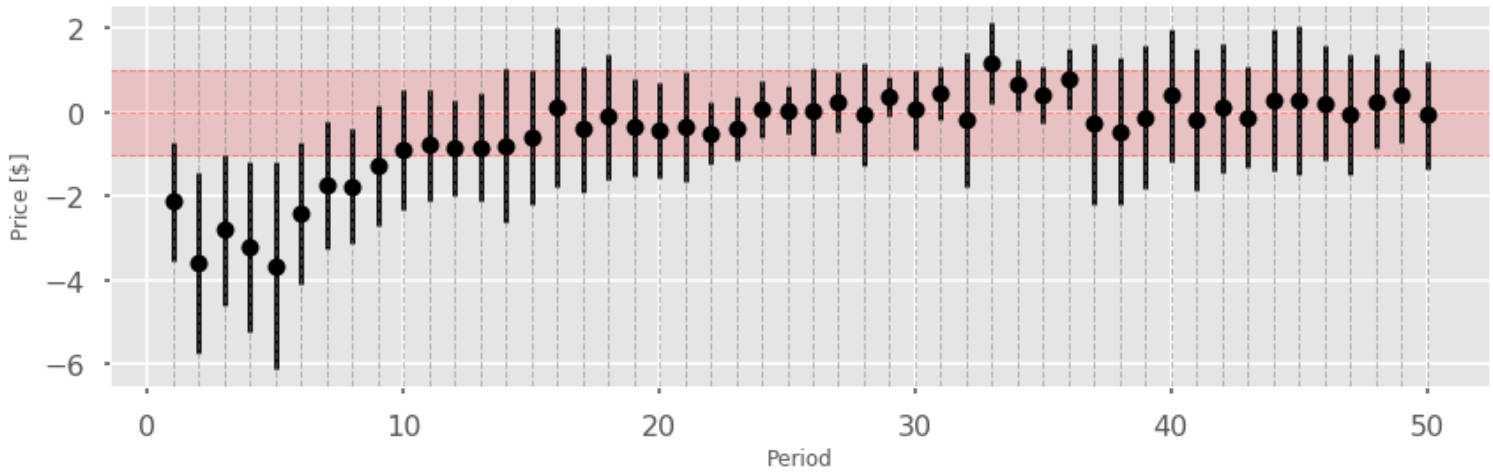
AsymmetricReverseBlackBox: blackbox feedback, first price

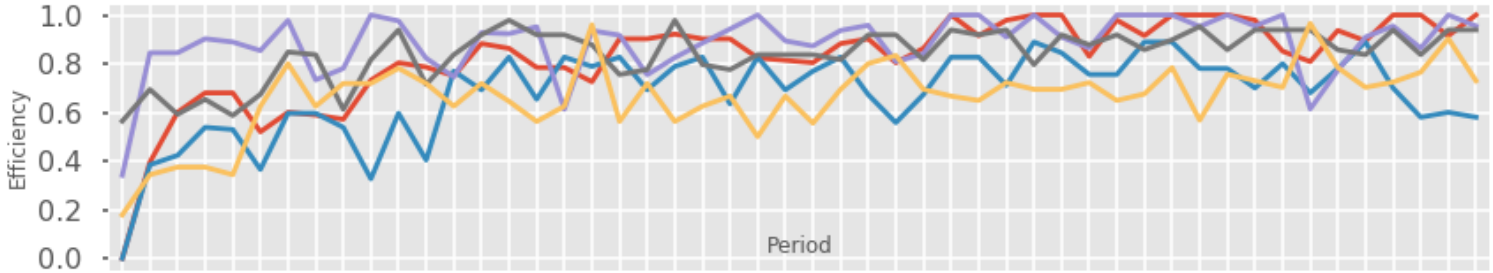




	1	2	3	4	5	6	7	8	9	10
B	13	13	13	13	15	14	15	14	15	15
S	6	7	7	7	8	8	7	7	7	7
B	13	14	15	14	14	14	13	14	14	14
S	8	8	8	8	8	7	8	8	8	8
B	10	12	12	11	11	11	11	10	10	10
S	4	5	6	6	6	7	7	7	7	7
B	13	14	16	15	14	14	14	14	14	14
S	6	7	7	7	7	7	7	7	7	7
B	12	15	16	16	16	15	16	16	16	16
S	9	9	9	9	9	8	9	9	9	9

MorePeriods: blackbox feedback, first price





	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
B	9	9	9	9	9	9	9	10	10	10	10	10	10	9	9	8	8	8	8	8	8	8	8	8	7	8	8	8	8	7	7	6	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	
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B	7	7	7	7	6	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	6	7	7	7	7	7	7	7	6	5	6	5	
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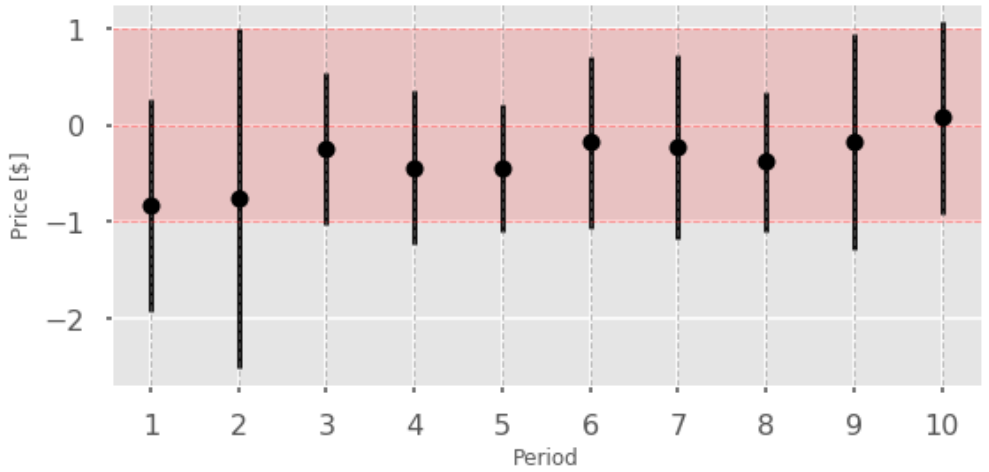
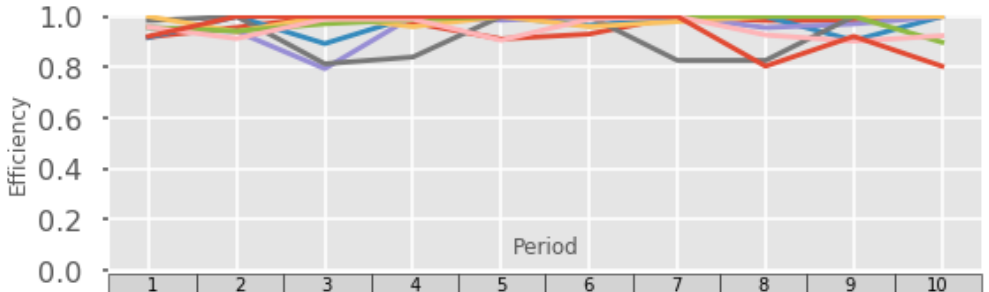
B	5	6	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	6	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	4	5	5	5	5	5	5	5	5	5			
S	5	5	5	4	5	4	5	5	4	5	4	5	6	6	5	7	7	7	6	6	7	7	7	5	5	6	6	6	6	5	5	5	5	6	5	5	5	5	5	5	5	4	5	5	5	5	5			
B	8	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	8	8	8	8	8	8	7	8	8	8	8	8	8	8	8	8			
S	7	8	8	7	6	6	6	7	7	7	7	7	7	6	7	7	7	7	7	6	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7			
B	4	5	5	5	5	5	4	5	5	5	5	5	5	5	5	5	4	5	5	5	5	6	6	6	6	6	5	6	6	6	7	6	6	6	6	7	7	7	7	7	7	7	6	7	7	6	7	6	7	
S	7	7	6	7	7	7	7	7	7	7	7	7	7	7	6	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	6	6	6	6	6	6	6	6	6	6	6	5	6	6	5	5	6	6		

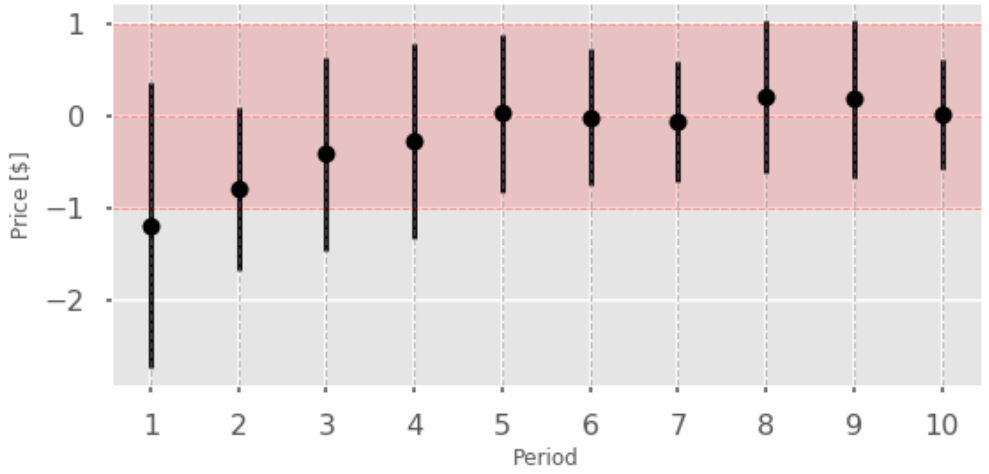
LargeCore: full feedback, first price

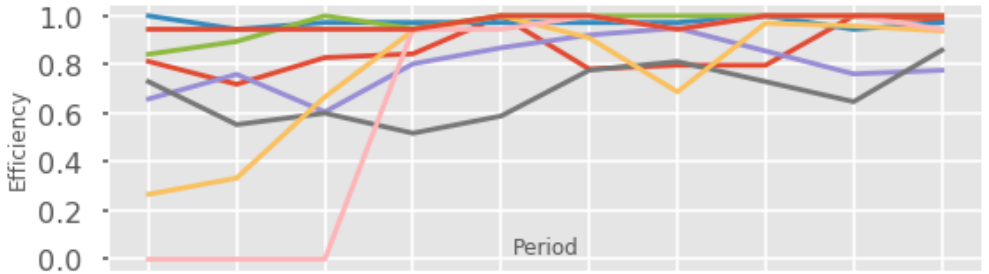




	1	2	3	4	5	6	7	8	9	10
B	9	8	8	8	8	7	7	7	7	7
S	6	6	6	7	7	7	7	6	6	6
B	7	7	7	7	7	7	7	7	7	7
S	9	9	9	9	9	9	9	9	9	9
B	5	5	5	5	5	5	5	5	5	5
S	7	7	7	7	7	7	7	7	7	7
B	4	4	5	5	5	5	5	5	5	
S	5	5	5	5	5	5	5	5	5	
B	4	4	4	4	4	4	4	4	4	4
S	4	3	3	3	4	3	3	3	3	3
B	5	5	5	6	6	5	6	6	6	5
S	7	7	7	7	7	6	6	6	6	6
B	10	10	10	10	10	10	9	9	8	8
S	10	9	10	10	10	10	10	10	10	10
B	4	4	4	4	4	4	4	4	4	4
S	5	5	5	4	4	5	5	5	5	5

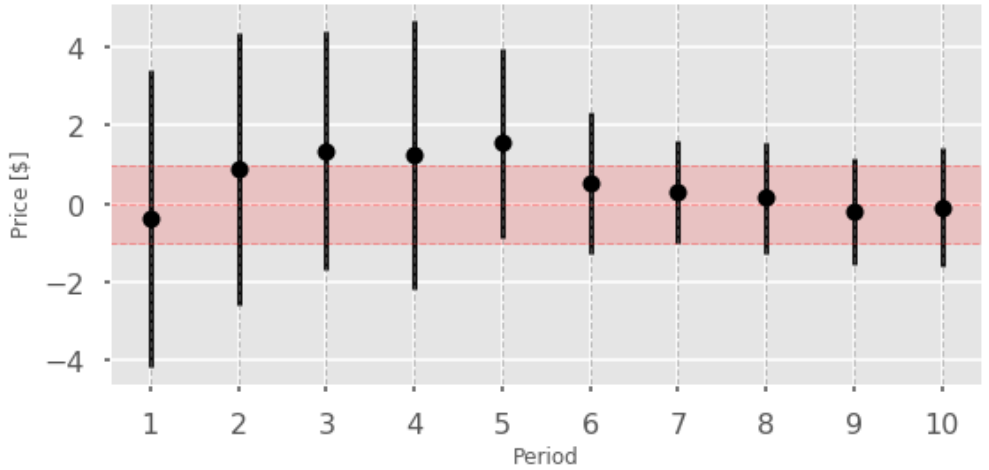
LargeCoreBlackbox: blackbox feedback, first price

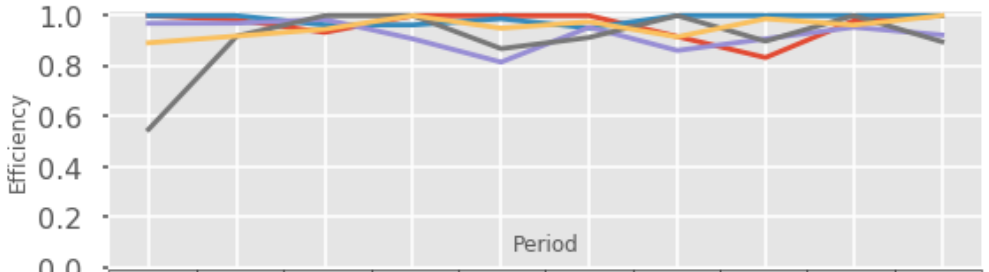




	1	2	3	4	5	6	7	8	9	10
B	9	9	9	10	10	10	10	10	9	9
S	5	5	5	5	5	5	5	5	5	5
B	2	2	2	2	2	2	2	2	2	2
S	3	3	3	3	3	3	3	3	3	3
B	10	9	8	8	8	8	9	8	8	8
S	7	7	7	7	7	7	7	7	6	6
B	9	9	9	9	9	9	9	9	9	9
S	9	9	9	9	9	9	9	9	9	9
B	4	3	3	2	2	2	3	2	3	3
S	4	3	3	4	3	4	4	4	4	4
B	1	1	1	1	1	1	1	1	1	1
S	4	4	4	4	4	4	4	4	4	4
B	1	1	1	1	1	1	1	1	1	1
S	2	2	2	2	2	2	2	2	2	2
B	1	1	1	1	1	1	1	1	1	1
S	2	2	2	2	2	2	2	2	2	2

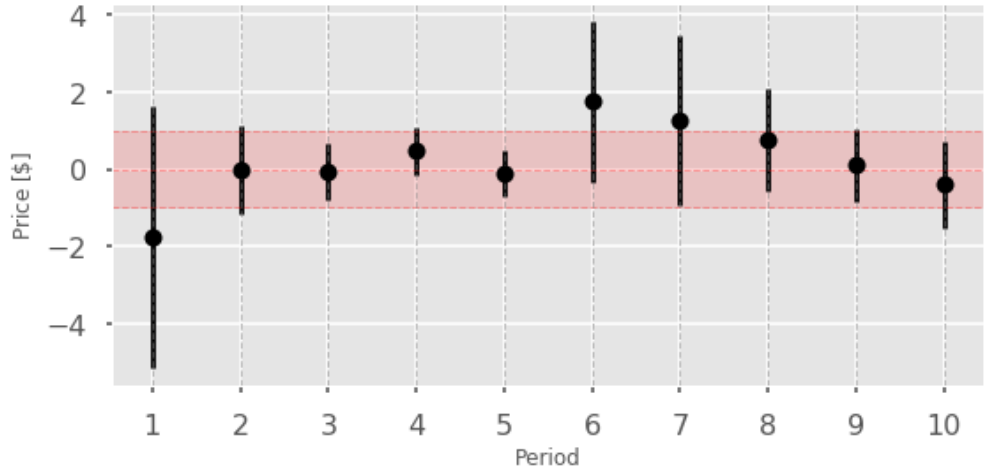
MarketShift: full feedback, first price

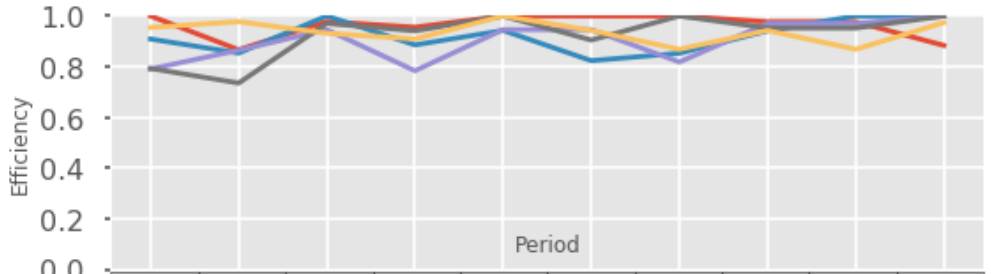




	1	2	3	4	5	6	7	8	9	10
B	5	5	5	5	5	4	4	4	4	4
S	7	7	7	7	7	7	7	7	7	6
B	9	9	9	9	9	9	9	9	9	9
S	9	9	9	9	9	9	9	9	9	9
B	9	8	9	9	9	9	9	9	9	9
S	6	7	6	6	6	6	6	6	6	6
B	8	7	7	7	7	7	7	7	7	6
S	8	8	8	8	8	9	8	8	9	9
B	8	8	8	8	8	8	7	8	8	8
S	8	8	8	9	9	9	9	9	9	9

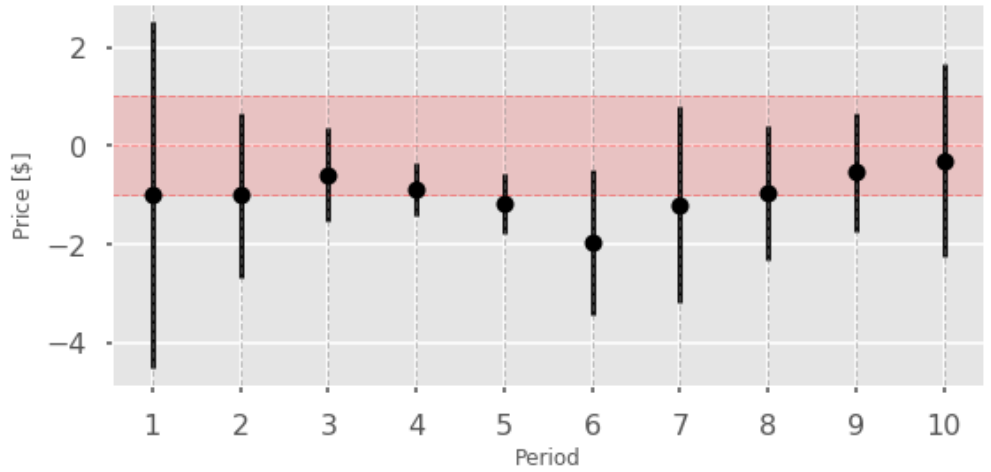
ChangingAsymmetry: full feedback, first price

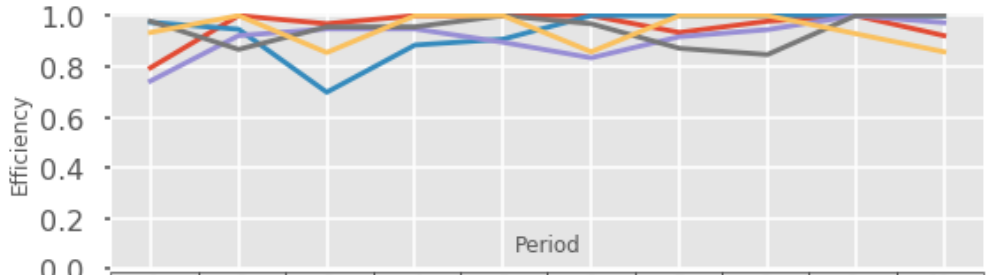




	1	2	3	4	5	6	7	8	9	10
B	6	7	8	8	8	6	6	6	6	6
S	7	7	7	7	7	9	9	9	9	9
B	6	7	7	7	7	5	5	5	5	5
S	4	5	4	4	4	5	5	5	6	6
B	9	8	8	8	8	7	5	6	6	6
S	7	7	7	7	7	8	8	8	8	8
B	5	5	5	5	5	3	3	3	3	3
S	3	4	4	4	4	4	4	4	4	4
B	7	7	6	7	6	4	5	4	5	5
S	8	8	8	8	8	10	10	10	10	10

ChangingAsymmetryInv: full feedback, first price





	1	2	3	4	5	6	7	8	9	10
B	5	4	4	4	5	7	7	7	6	6
S	8	9	9	9	9	7	7	7	7	7
B	5	5	5	5	5	6	6	6	6	6
S	8	8	9	10	10	7	8	8	8	7
B	7	7	7	7	7	9	8	9	8	9
S	6	7	7	7	7	5	5	5	5	5
B	8	8	8	8	7	7	7	6	6	7
S	9	9	9	9	9	7	7	7	7	7
B	5	6	6	6	6	7	7	7	7	7
S	8	8	8	8	8	6	6	6	6	6