

Incentive Auctions

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23 May 2011

* Special thanks to Larry Ausubel, Evan Kwerel, and Paul Milgrom for collaborating with me on this topic over the last dozen years. Thanks to the National Science Foundation for funding.

Incentive auctions

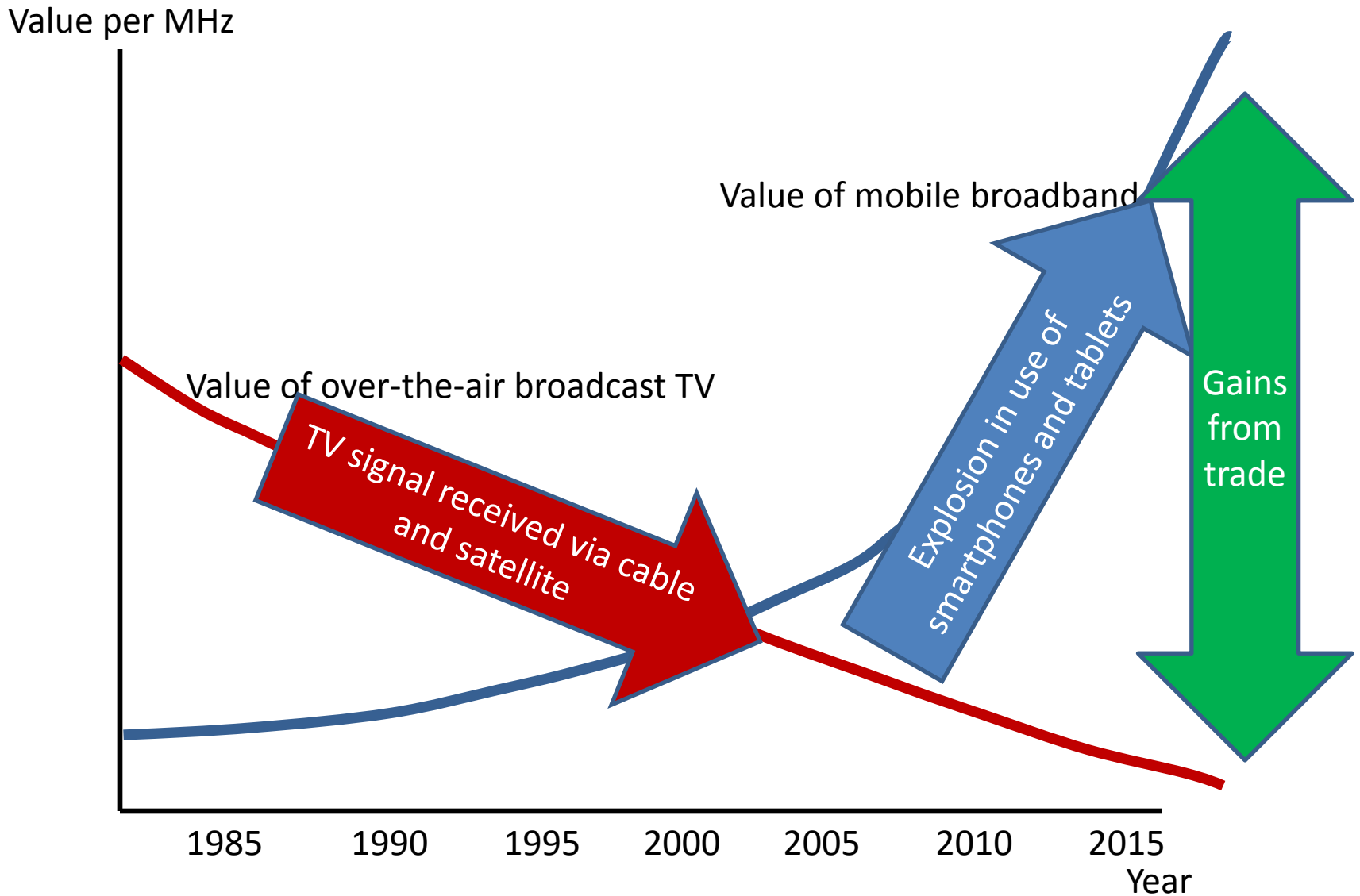


Auction includes essential regulatory steps to address market failures in the secondary market for spectrum

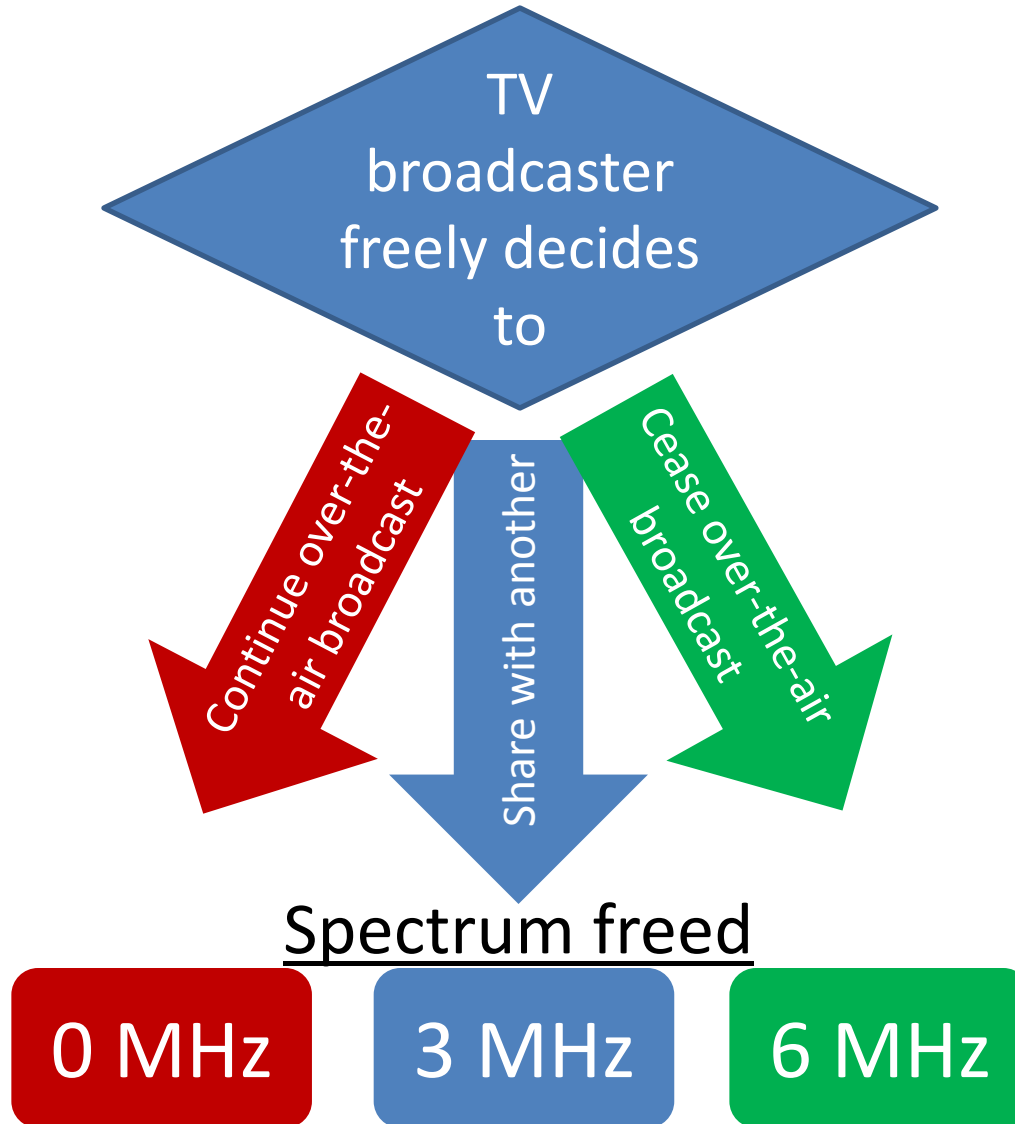
Letter from 112 economists, 6 April 2011



Motivation



Voluntary approach



Why voluntary?

- *More likely to quickly clear spectrum*
 - Broadcasters benefit from cooperating
- *Lower economic cost of clearing*
 - Spectrum given up only by broadcasters who put smallest value on over-the-air signal
- *Market pricing for clearing*
 - Avoids costly administrative process
- *Efficient clearing*
 - Clear only when
value to mobile operator > value to TV broadcaster

Two approaches



Too complex due to repacking



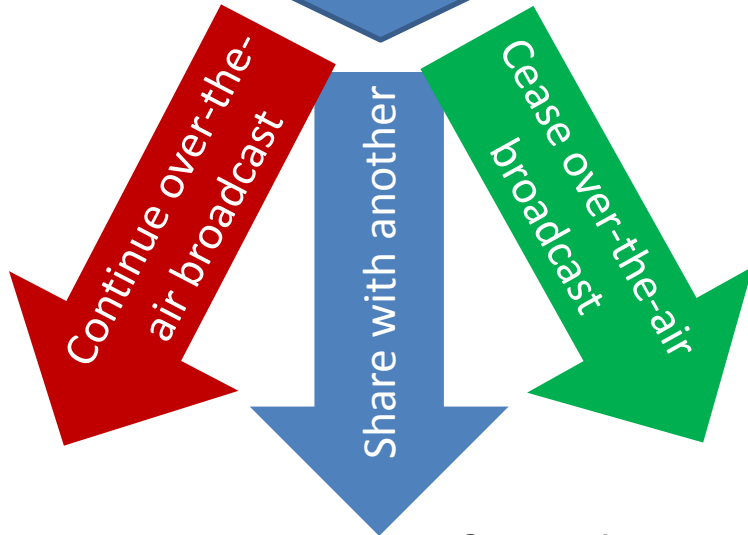
Reverse
auction to
determine
supply

TV
broadcaster
freely decides
to

- Mostly single channel
- Price discovery not important

=>

- Sealed-bid auction
 - Price to cease
 - Price to share



0 MHz

3 MHz

6 MHz

Washington DC

0 MHz

3 MHz

6 MHz

$P = \$30$

Reverse
auction to
determine
supply

$S = 48$

7

Price = $\$30/\text{MHzPop}$

13

9

26

22

31

18

41

37

47

44

35

Washington DC

0 MHz

3 MHz

6 MHz

$P = \$20$

Reverse
auction to
determine
supply

$S = 36$

7

Price = \$20/MHzPop

13

9

26

22

31

18

41

37

47

44

35

Washington DC

0 MHz

3 MHz

6 MHz

$P = \$10$

Reverse
auction to
determine
supply

$S = 24$

7

Price = \$10/MHzPop

13

9

26

22

31

18

41

37

47

44

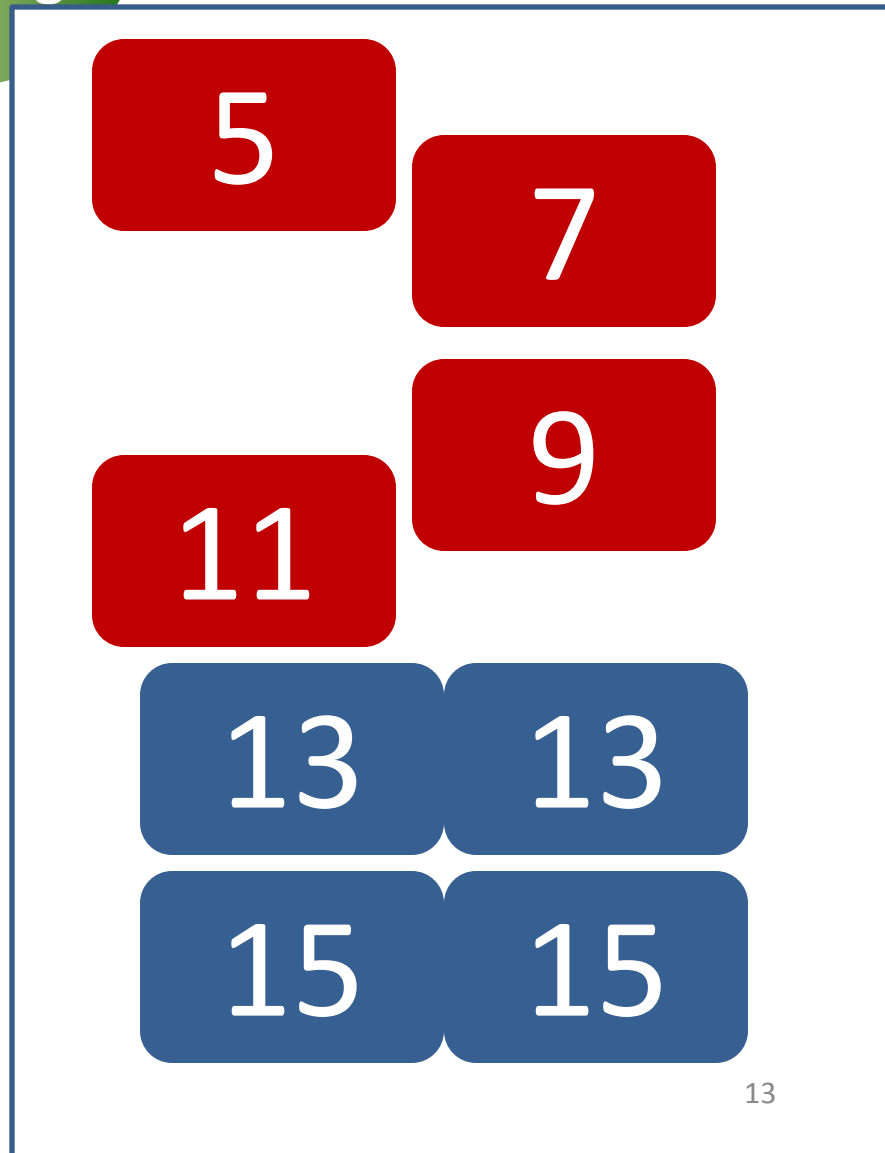
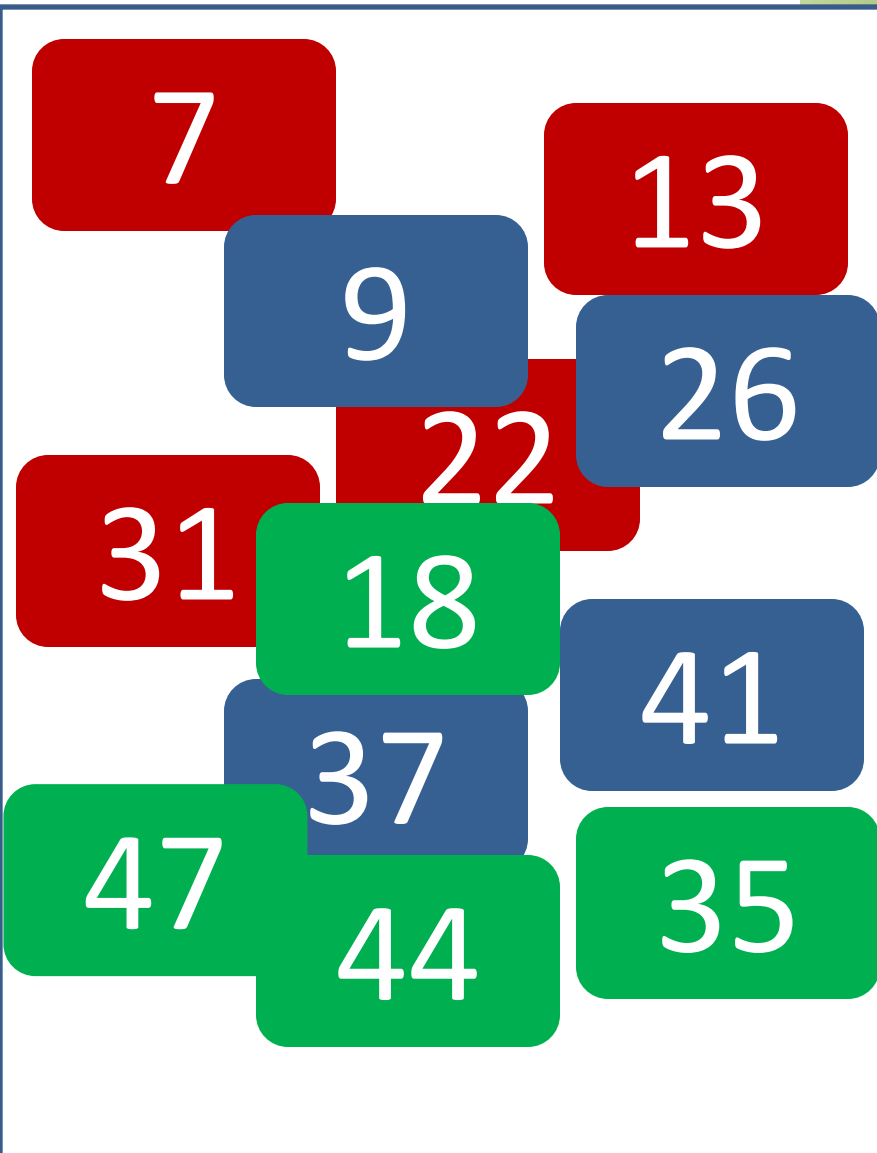
35

P = \$20

S = 36

Mandatory
repacking

Supply =
160 MHz

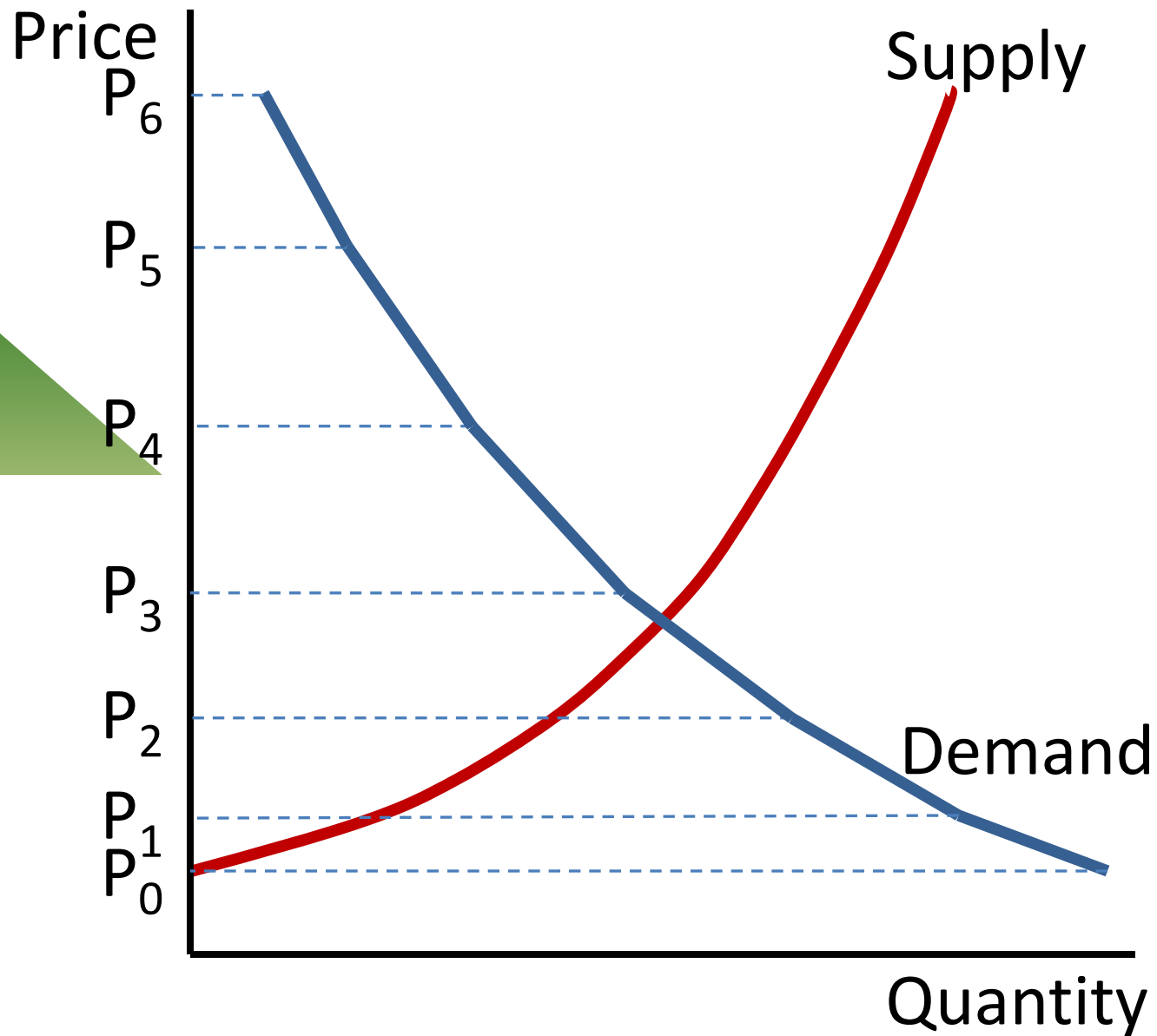




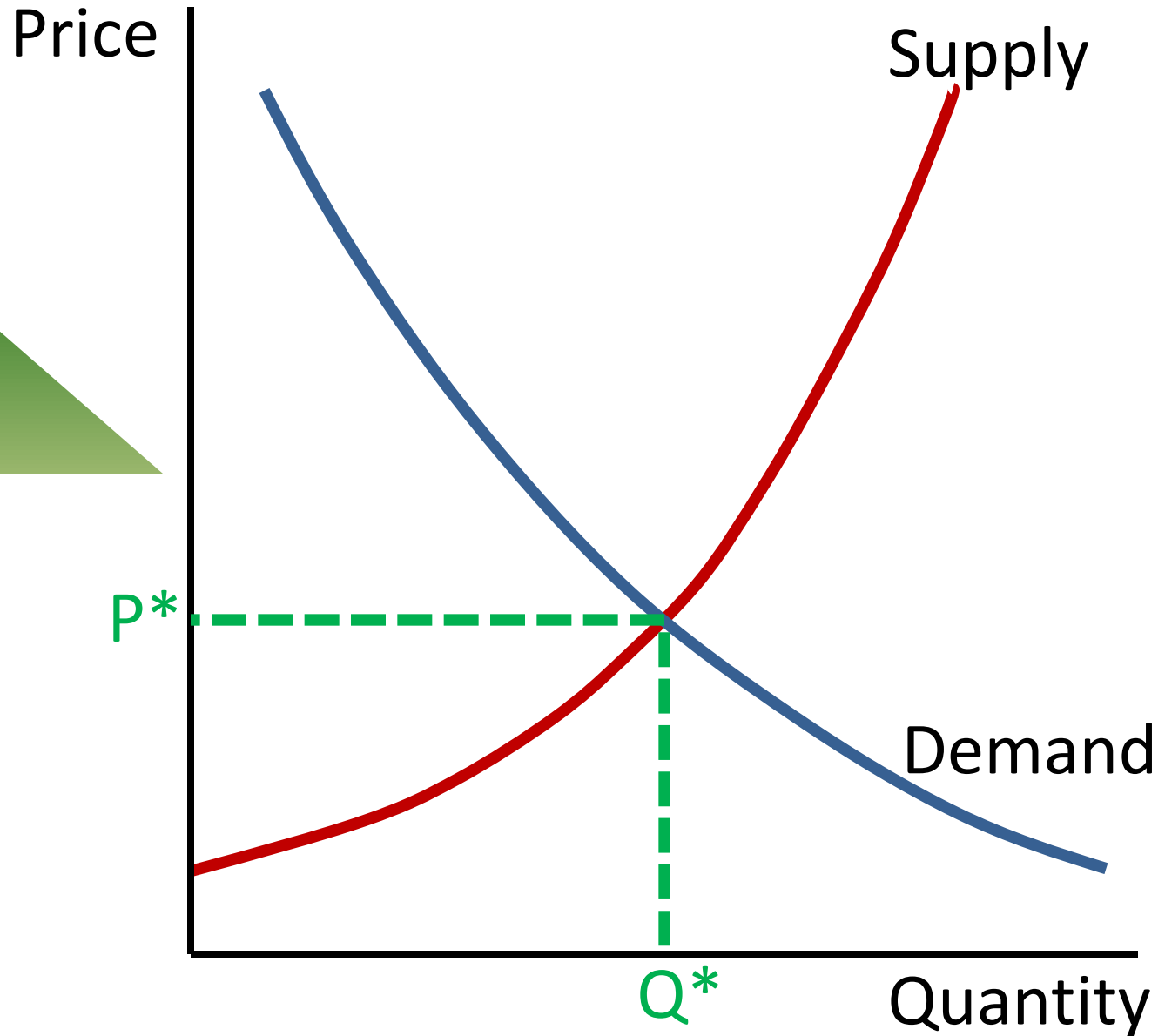
Forward
auction to
determine
demand

- Mobile operators want large blocks of contiguous paired spectrum for LTE (4G)
 - One to four 2×5 MHz lots
- Complementarities strong both within and across regions
- Package clock auction ideal
 - Within region complementarities guaranteed with generic lots
 - Across region complementarities achieved through optimization of specific assignments

Forward
auction to
determine
demand

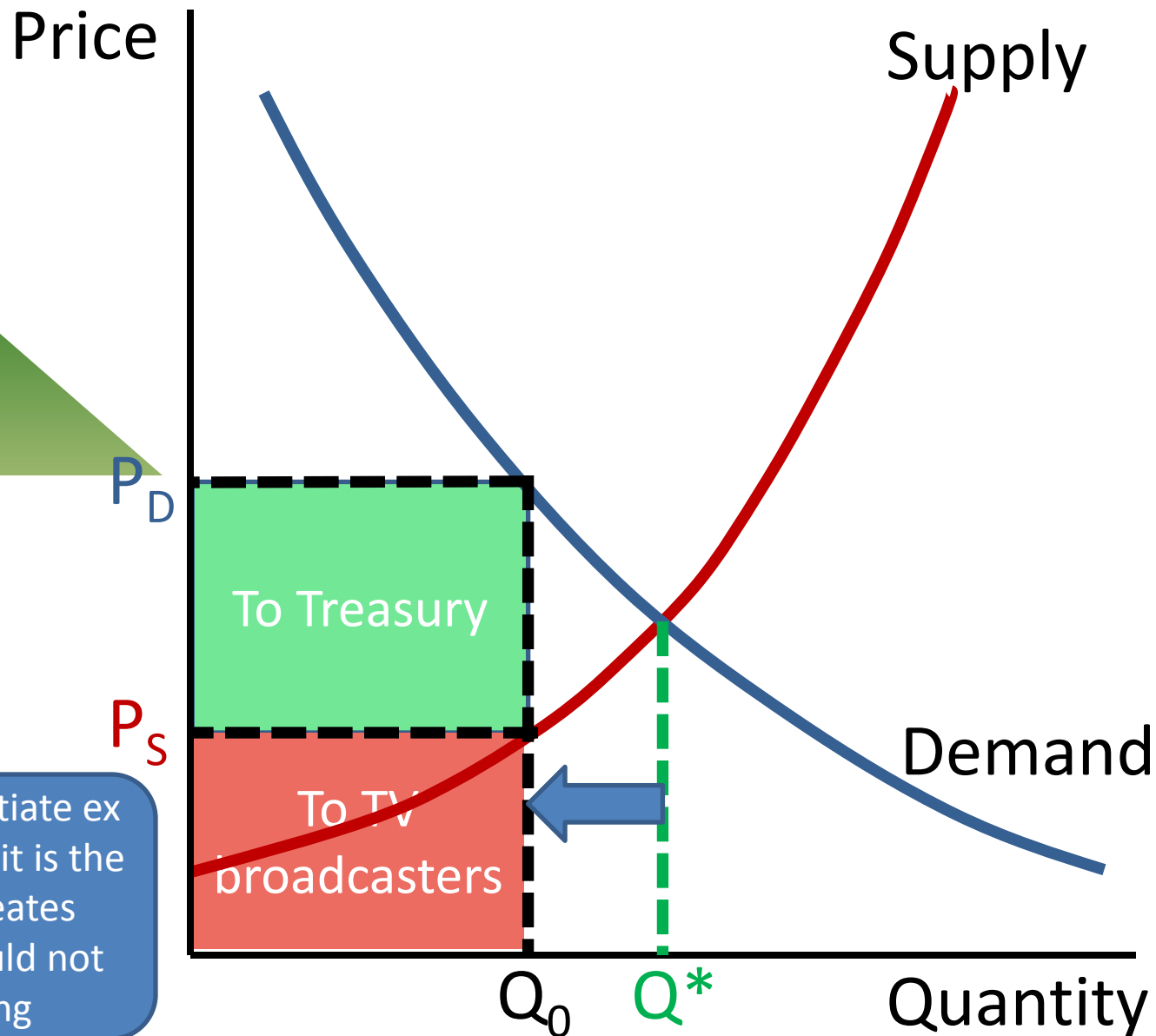


Forward
auction to
determine
demand



Forward auction to determine demand

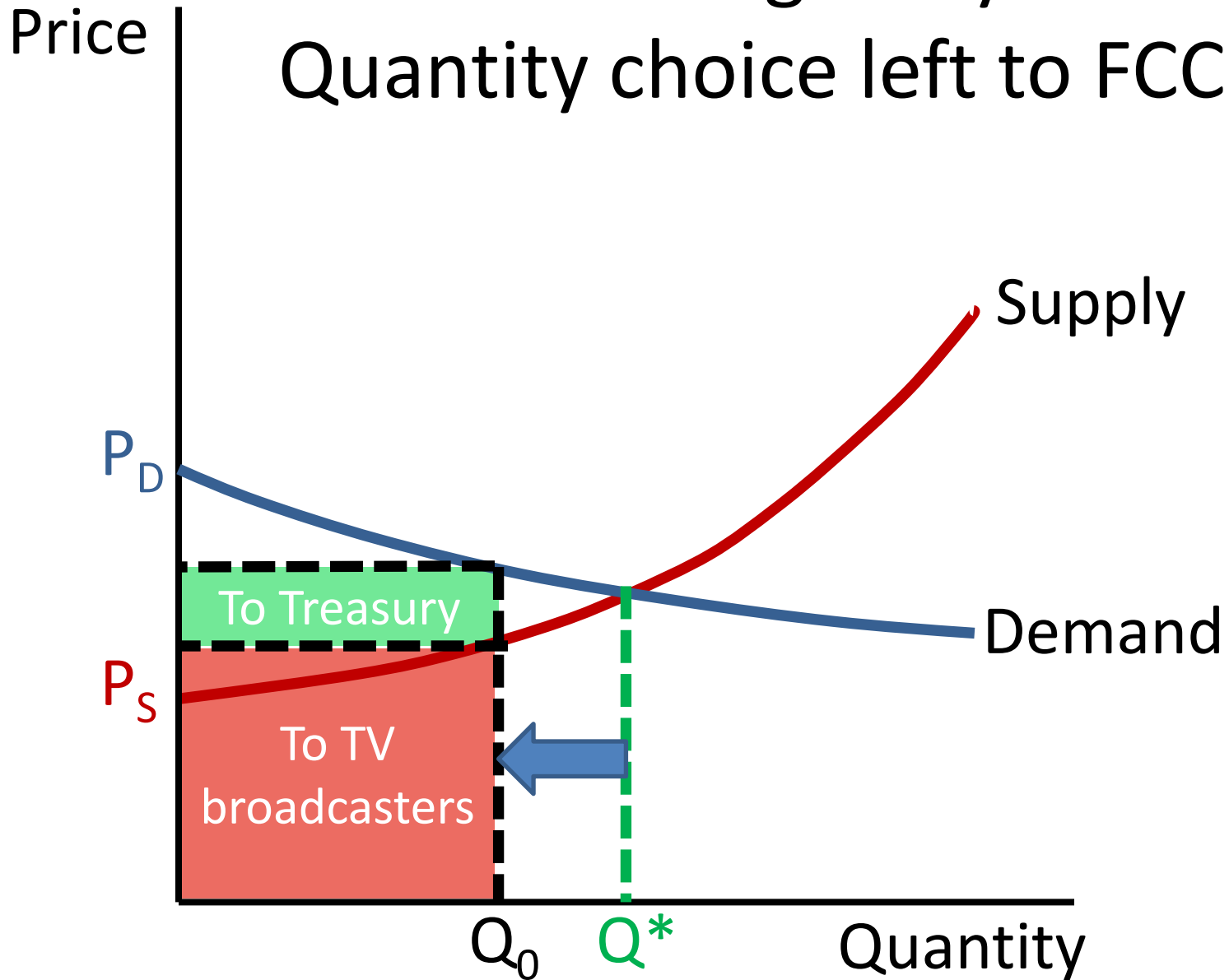
Broadcasters cannot negotiate ex post with operators, since it is the FCC's repacking that creates value; ex post trades would not benefit from repacking



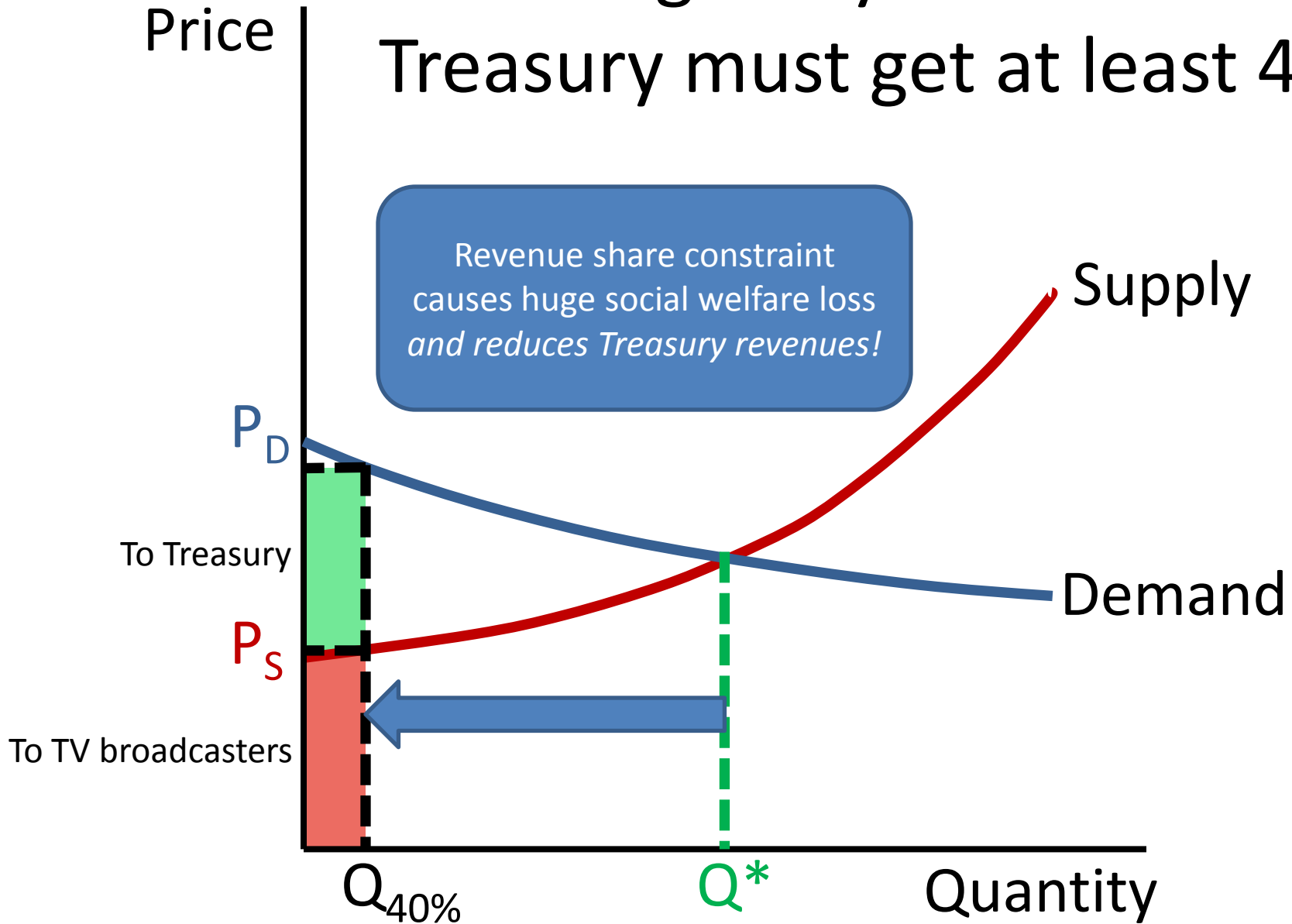
Ways Congress can screw up

- Impose restrictions on which broadcasters can participate in the auction
 - Destroys competition in reverse auction
- Make repacking purely voluntary
 - Reverses status quo—FCC can relocate stations
 - Creates holdout problem in reverse auction
- Too greedy
 - Impose specific requirement on government revenue share (e.g., Treasury gets 40% of revenue)

Not too greedy: Quantity choice left to FCC



Too greedy constraint: Treasury must get at least 40%



Ways FCC can screw up

- Impose restrictions on which broadcasters can participate in the auction
 - Destroys competition in reverse auction
- Make repacking purely voluntary
 - Reverses status quo—FCC can relocate stations
 - Creates holdout problem in reverse auction
- Adopt poor auction design
- Fail to address competition concerns

Background

Package Clock Auction

Package clock auction: Overview

- A package bid is an all-or-nothing bid for a portfolio of products
- When bidding on individual lots, a bidder is exposed to the risk of winning only some of a complementary set of products
- Package bidding eliminates the exposure problem by allowing bidders to bid on packages of products
- At the same time, package bidding can help to alleviate the demand reduction problem in which larger bidders inefficiently reduce demand in order to win spectrum at lower prices

Package clock auction: Overview

- Auctioneer names prices; bidder names package
 - Price increased if there is excess demand
 - Process repeated until no excess demand
- Supplementary bids
 - Improve clock bids
 - Bid on other relevant packages
- Optimization to determine assignment/prices
- No exposure problem (package auction)
- Second pricing to encourage truthful bidding
- Activity rule to promote price discovery

Package clock auction adopted for several recent and upcoming auctions

- UK 10-40GHz spectrum
 - February 2008, 27 rounds, £16 million
- UK L-band spectrum
 - May 2008, 33 rounds, £8.3 million
- UK 800MHz and 2.6GHz
 - First-quarter 2012
- Netherlands 2.6GHz spectrum
- Belgium 2.6GHz spectrum
- Austria 2.6GHz spectrum

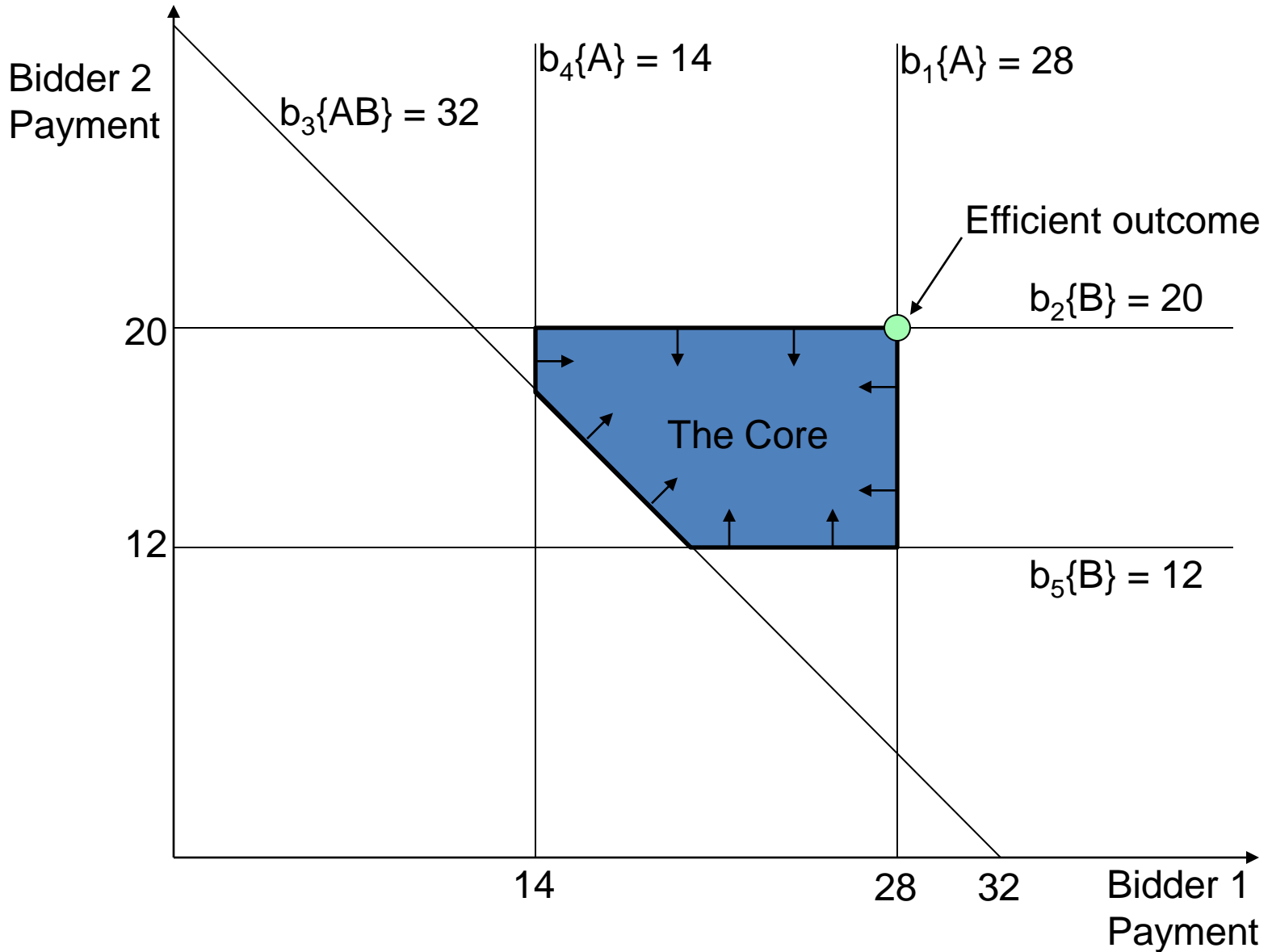
Bidder-optimal core pricing

- Minimize payments subject to core constraints
- Core = assignment and payments such that
 - Efficient: Value maximizing assignment
 - Unblocked: No subset of bidders offered seller a better deal

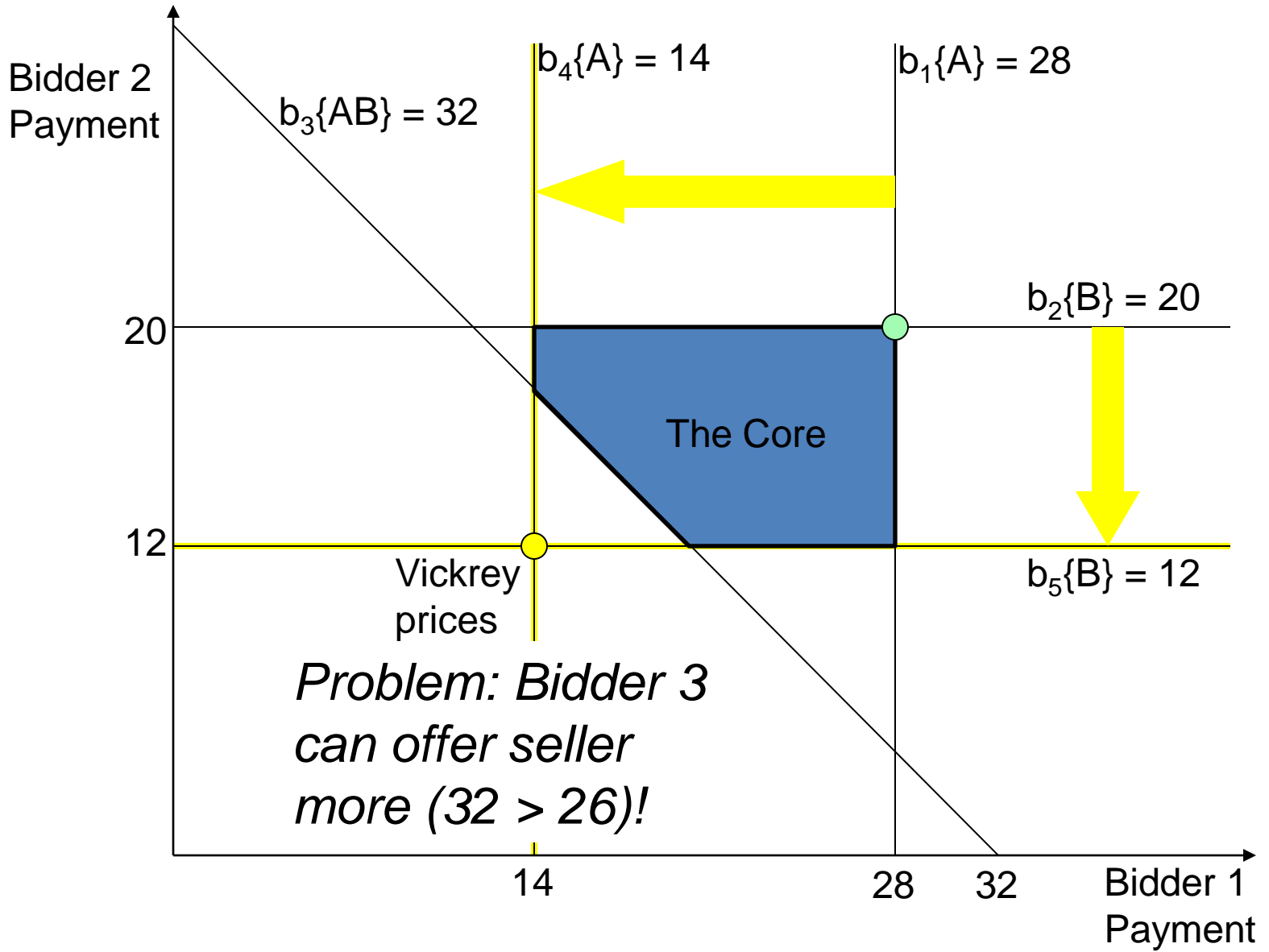
Five-bidder example with bids on {A,B}

- $b_1\{A\} = 28$
 - $b_2\{B\} = 20$
 - $b_3\{AB\} = 32$ Vickrey prices:
 - $b_4\{A\} = 14$ $p_1 = 14$
 - $b_5\{B\} = 12$ $p_2 = 12$
- Winners
-

The Core

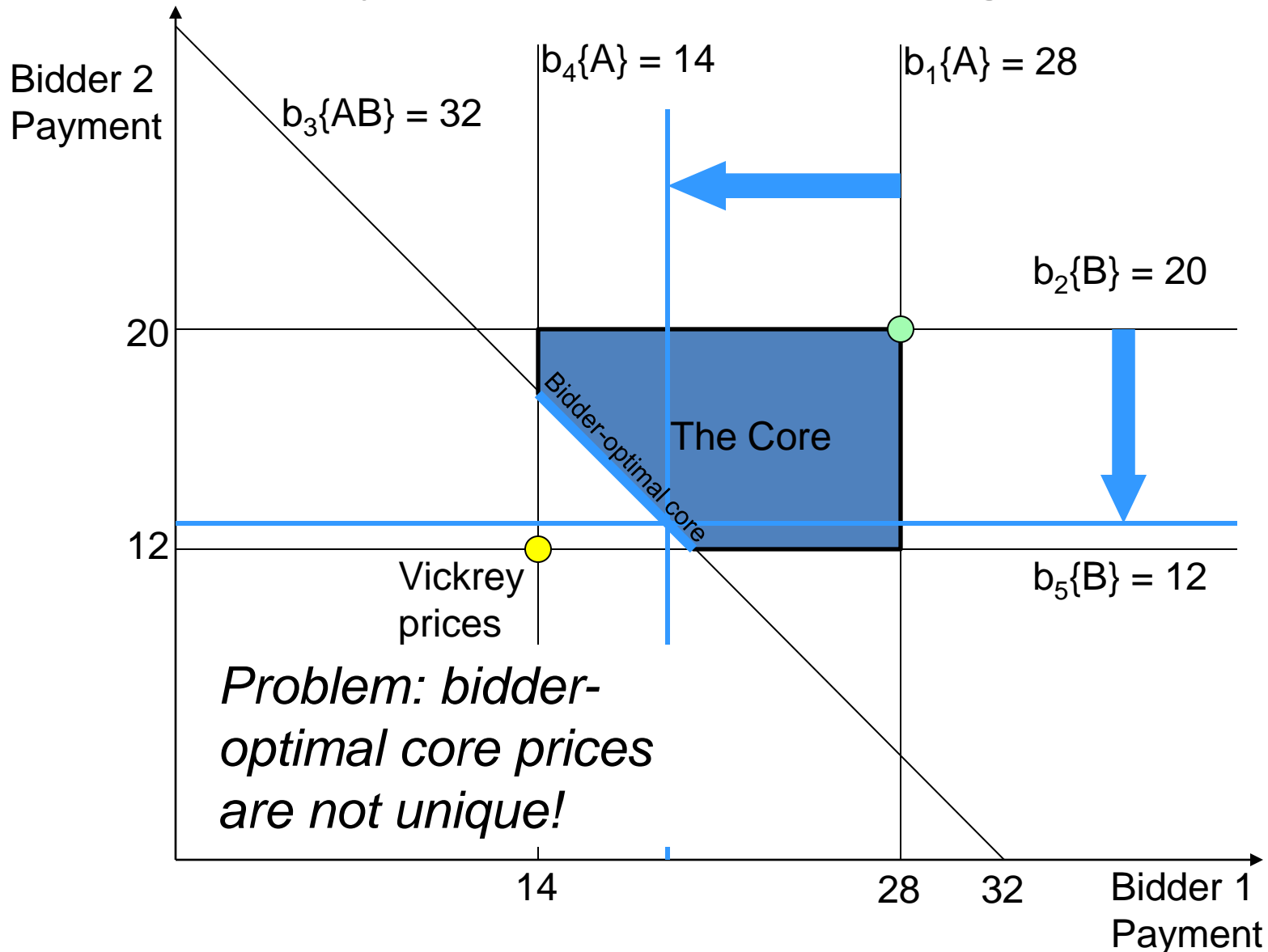


Vickrey prices: How much can each winner's bid be reduced (while holding others fixed)?

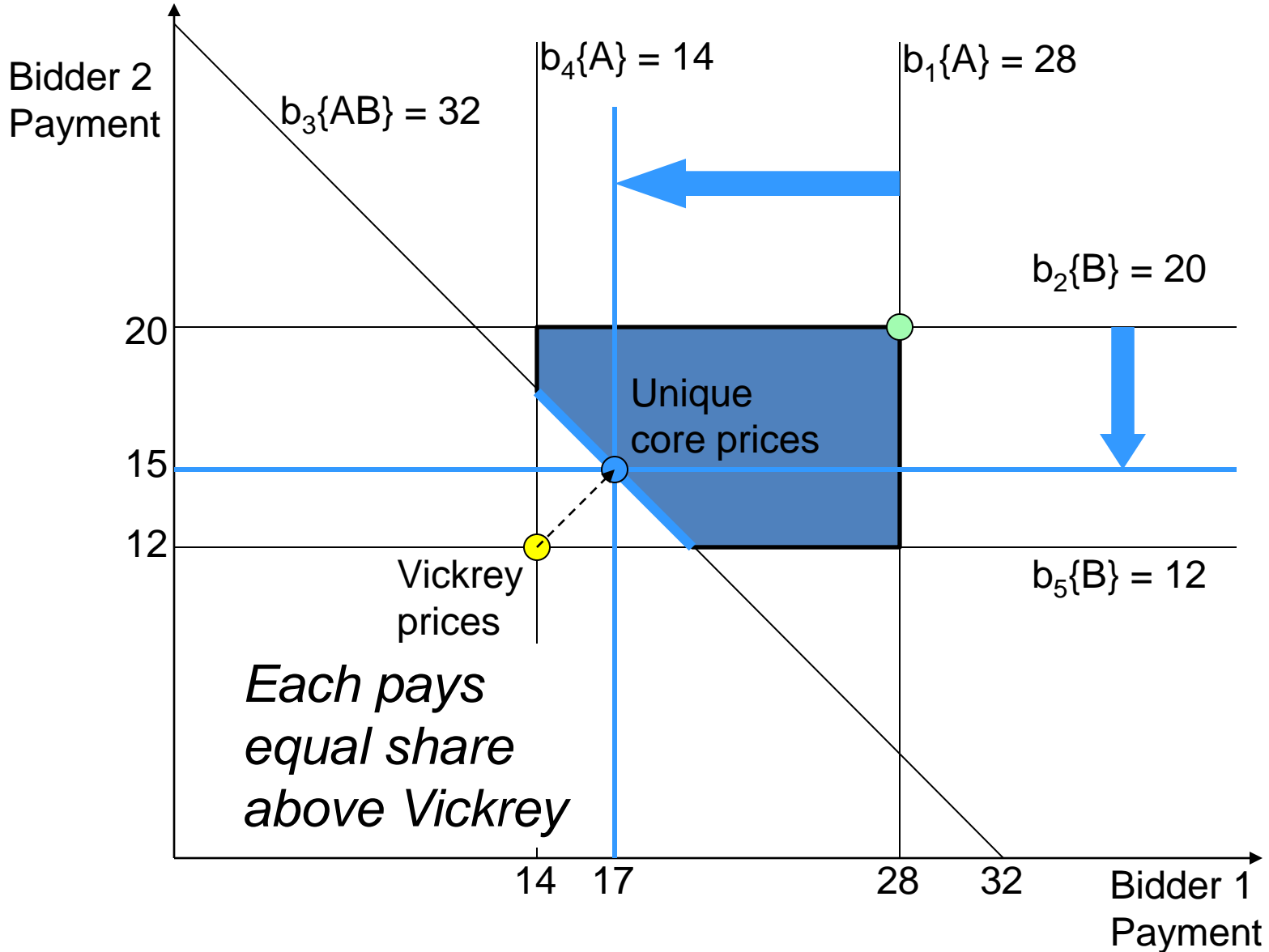


Problem: Bidder 3 can offer seller more ($32 > 26$)!

Bidder-optimal core prices: *Jointly* reduce winning bids as much as possible (while remaining within core)



Core point closest to Vickrey prices (Alternative: core point closest to linear prices)



Package clock auctions: Activity rule

- Activity rule based on revealed preference:
Bidders can only move toward packages that become better values
 - At time $t' > t$, package $q_{t'}$ has become relatively cheaper than q_t
(P')
$$q_{t'} \cdot (p_{t'} - p_t) \leq q_t \cdot (p_{t'} - p_t)$$
 - Supplementary bid $b(q)$ must be less profitable than revised package bid at t
(S')
$$b(q) \leq b(q_t) + (q - q_t) \cdot p_t$$

Properties with substitutes

- Bidding on most profitable package is best
- Clock yields competitive equilibrium with efficient assignment and supporting prices
- Final assignment = clock assignment

Properties in general

- Supplementary bids needed if excess supply
- Bidder can guarantee winning its final package by raising bid by final price of unsold lots