Benchmarks in Over-the-Counter Markets

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Common Over-the-Counter Market Benchmarks

- LIBOR, EURIBOR, TIBOR, ...
- SONIA, EONIA, ...
- WM/Reuters foreign exchange fixings.
- Gold, Silver, Palladium, Platinum, ...
- Oil (Brent, WTI), Natural Gas, Iron Ore (IODEX), ...
- Pharmaceuticals (Average Wholesale Price).

Key Benchmark Functions

1. Contractibility for price-contingent claims.
2. Monitoring agent-based trade execution.
3. Pre-trade price transparency: allowing easier comparison shopping in OTC markets.

Welfare Roles of Benchmarks in Search Markets

1. Increasing the volume of beneficial trade through:
    - Signaling when there are high gains from trade.
    - Improving the share of gains offered to traders.
2. Reducing total search costs.
3. Facilitating more efficient trade matching between dealers and customers, through:
    - Improving the ability of traders to detect when quotes are from high-cost dealers.
    - The use of benchmarks by low-cost dealers as a "price transparency weapon."

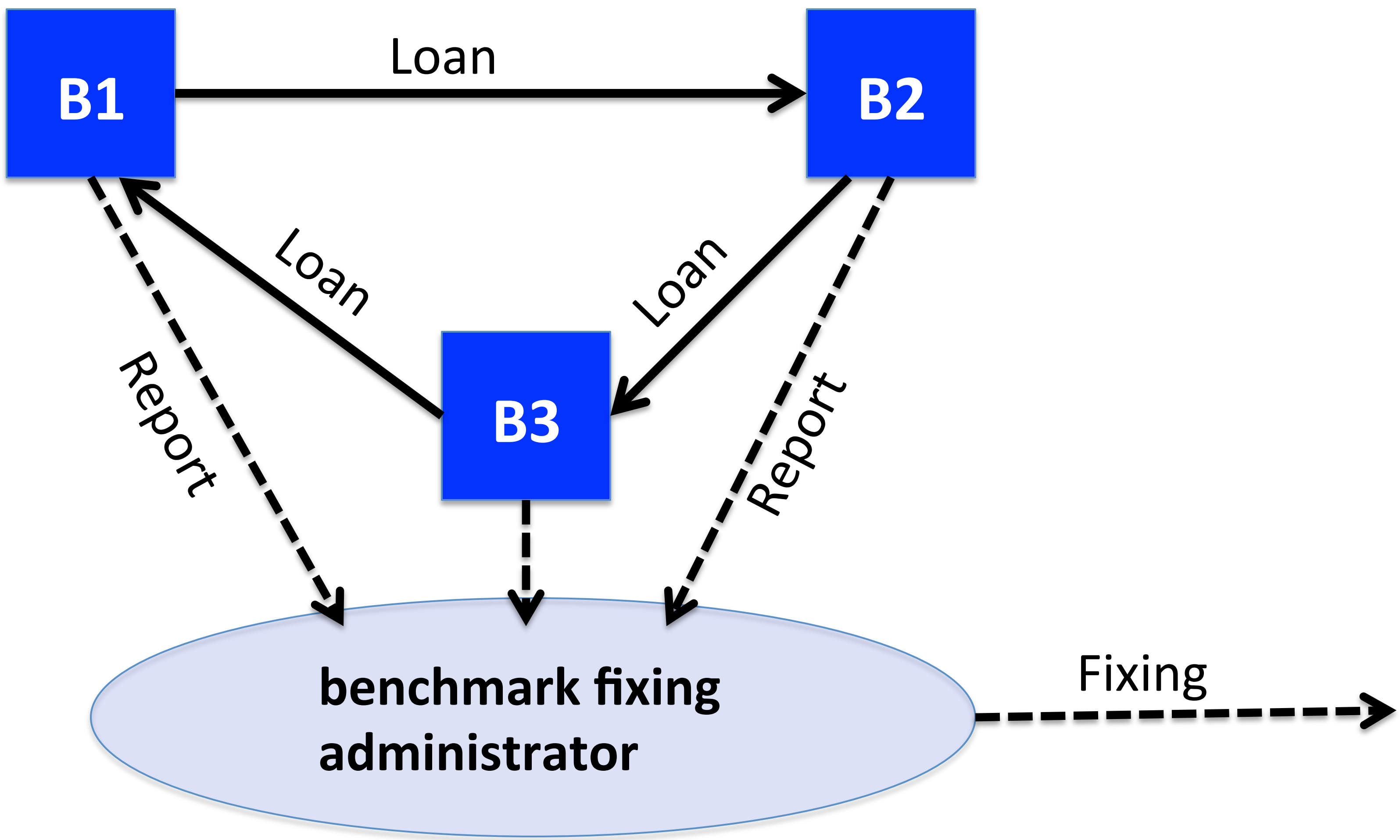
Selected LIBOR and EURIBOR Dependencies

(amounts in billions of USD equivalent notional)

	U.S.	LIBOR fraction	Eurozone	EURIBOR fraction
Syndicated loans	3400	97%	535	90%
Bilateral corporate loans	1650	$\simeq$40%	4322	60%
Retail mortgages	9608	15%	5073	28%
Floating rate notes	1470	84%	2645	70%
Interest rate swaps	106700	65%	137553	high
Exchange-traded derivatives	32900	93%	17300	100%

Source: Market Participant Group Report (2014)

Legacy IBOR fixing method

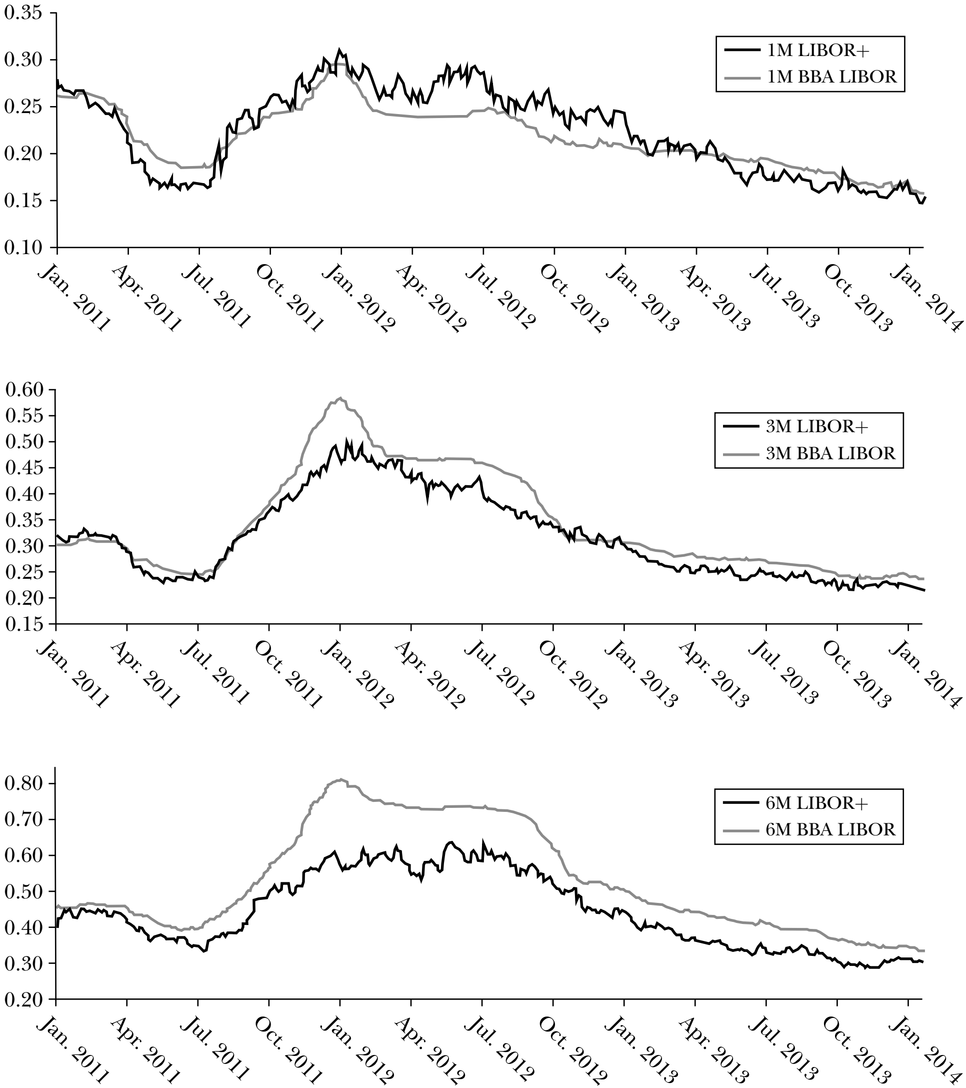


Transactions Data on Unsecured Bank Borrowing

		Number of Trades					Numbers of Issuers					Volume ($mn)				
		O/N	1W	1M	3M	6M	O/N	1W	1M	3M	6M	O/N	1W	1M	3M	6M
Daily Avg	2014	468	74	21	19	18	15	9	7	8	7	20,223	3,204	888	706	718
	2013	511	95	18	25	13	16	9	6	8	6	22,312	4,157	702	1,006	474
	2012	344	62	24	31	13	17	10	8	9	5	14,889	2,637	888	1,211	452
	2011	435	79	38	34	18	21	15	14	11	5	18,945	3,356	1,407	1,331	706
Daily Max	2014	538	127	42	45	40	17	13	10	12	11	23,853	5,460	1,869	1,903	1,861
	2013	878	280	78	126	76	20	18	13	17	15	39,722	13,043	3,479	5,904	2,892
	2012	521	225	80	112	55	24	20	19	19	13	22,985	10,007	3,613	4,539	2,140
	2011	666	263	113	107	112	27	25	32	24	15	30,015	11,686	4,982	4,642	4,985
Daily Min	2014	406	31	3	8	2	14	5	3	4	2	16,998	1,279	77	222	50
	2013	187	7	1	1	1	13	3	1	1	1	6,910	204	5	1	1
	2012	33	4	0	2	0	7	2	0	1	0	1,399	124	0	64	0
	2011	235	10	3	3	0	17	4	1	1	0	9,608	242	75	24	0

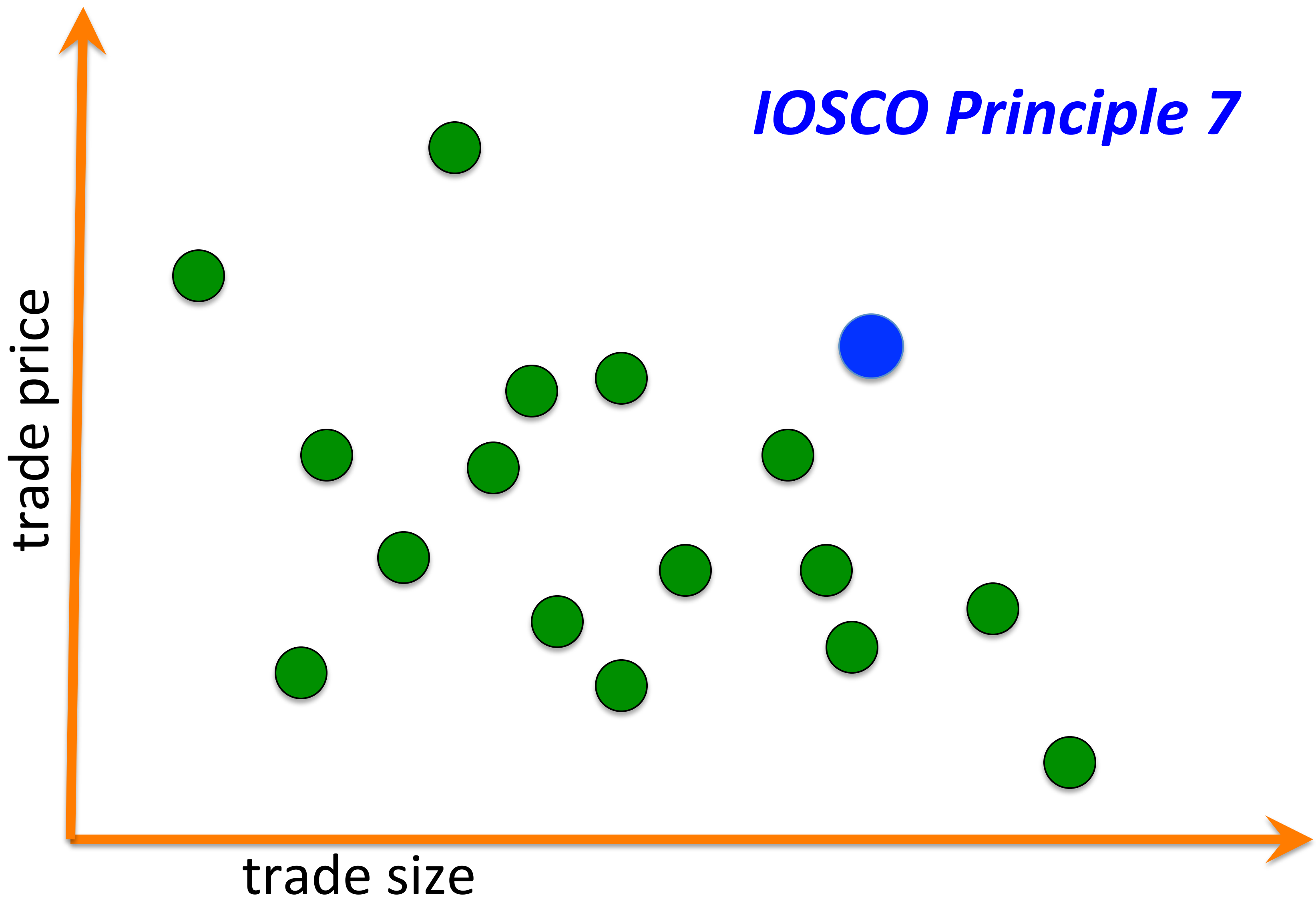
Source: Market Participants Group, *Final Report*, March 2014.

Comparison of Transactions-Based LIBOR+ to Actual British Banker's Association (BBA) LIBOR

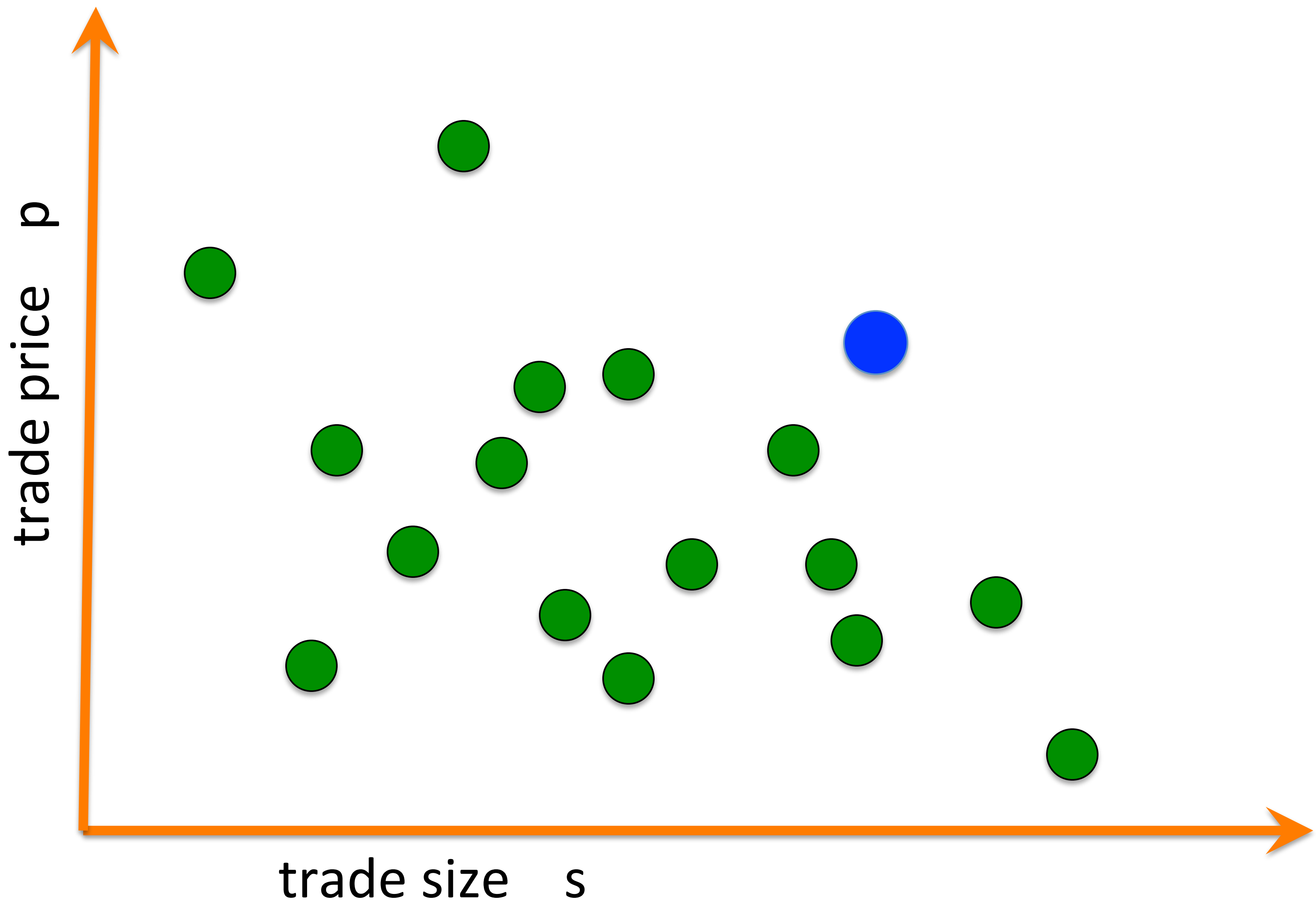


Source: Market Participants Group (2014).

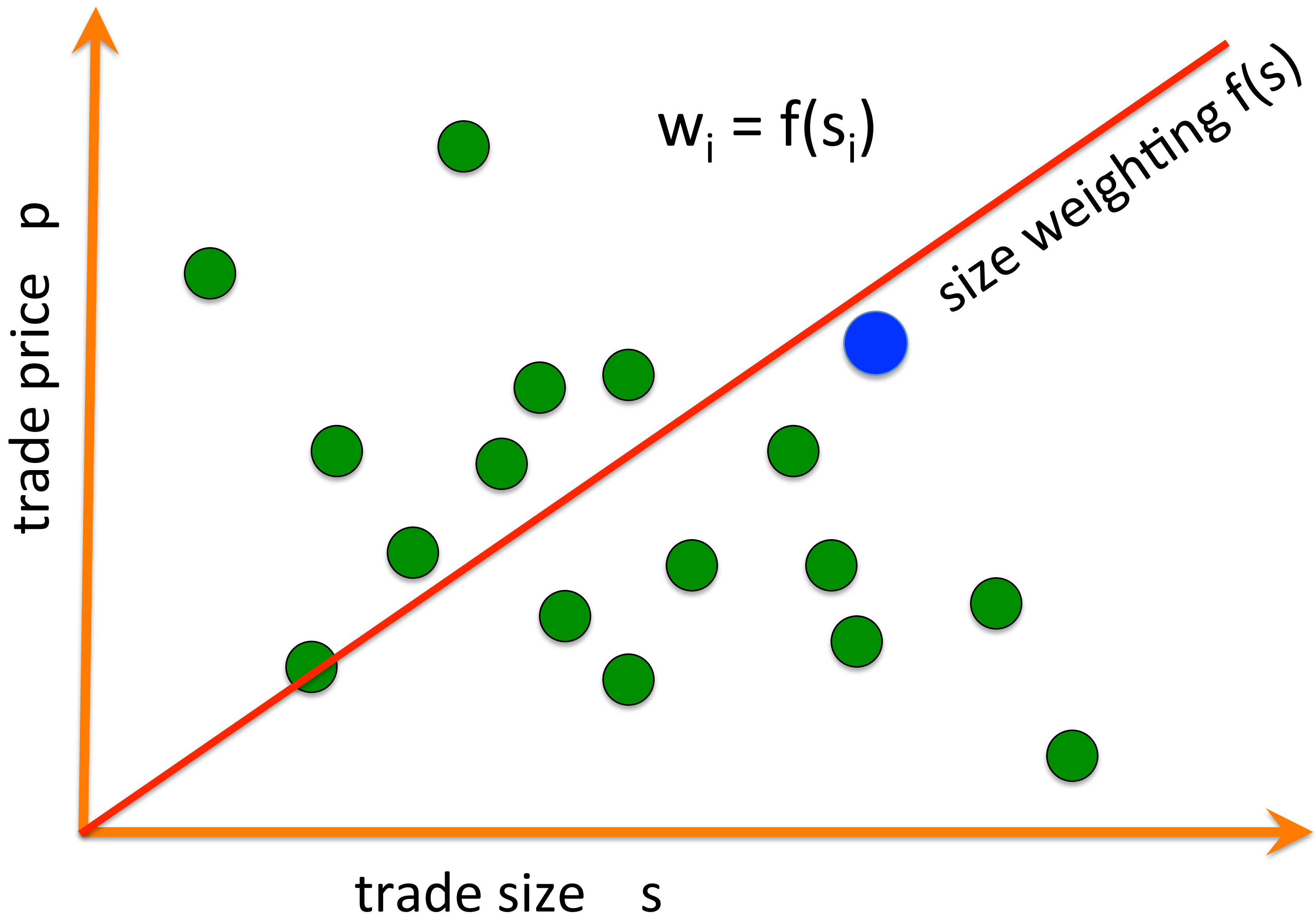
A fixing “anchored in transactions”



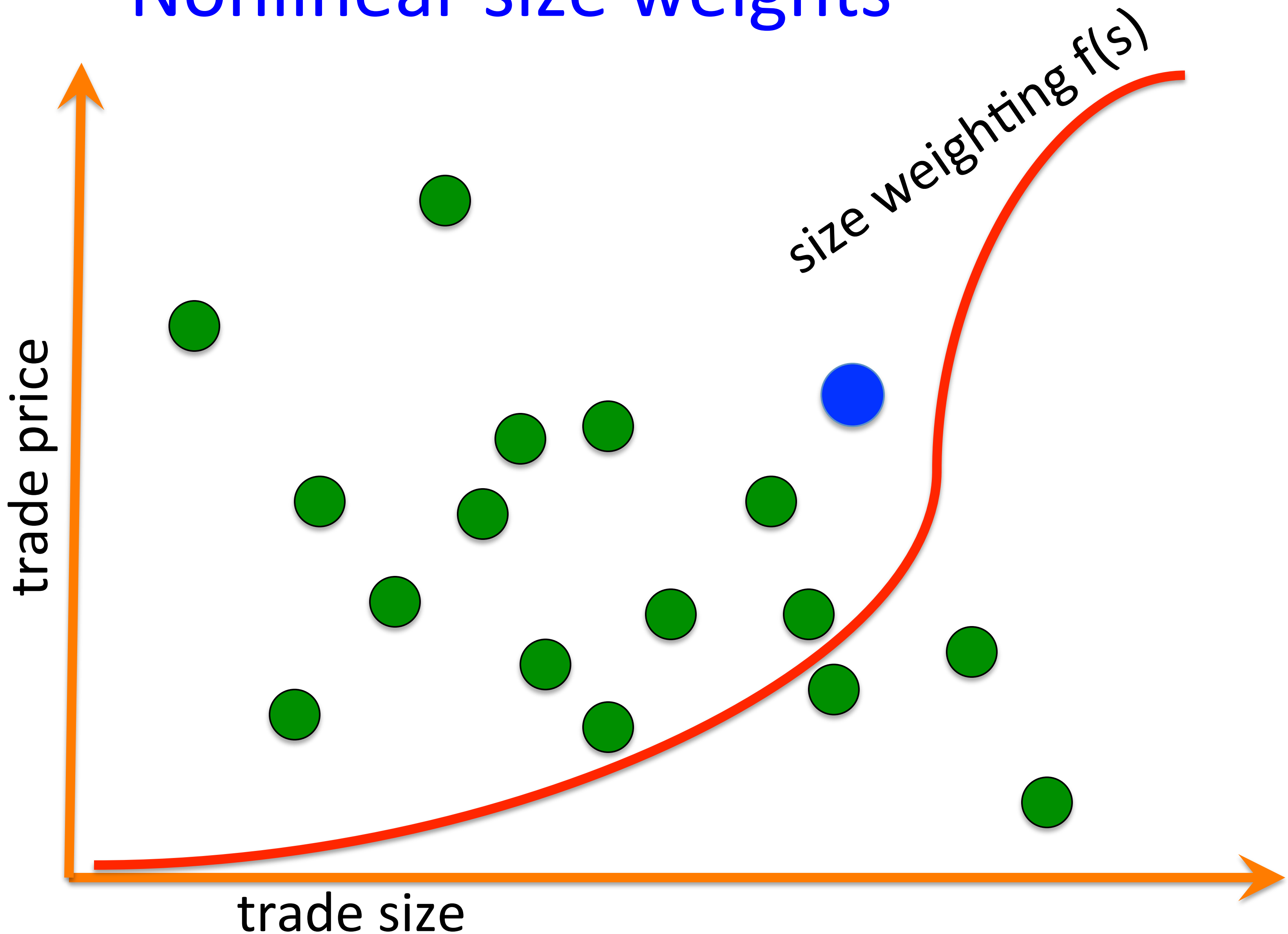
$$\text{Benchmark} = \sum_i w_i \, p_i$$



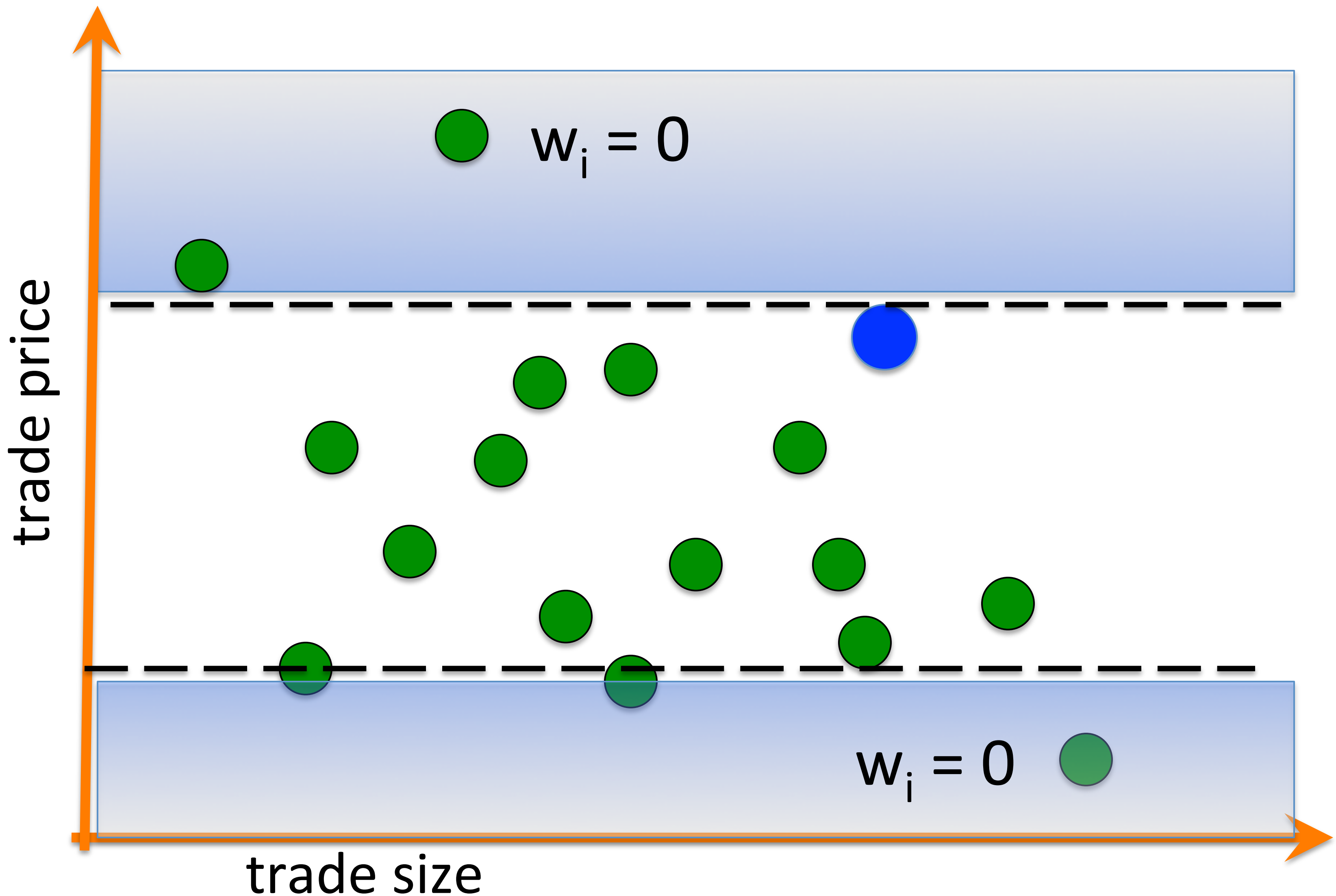
Volume weighted average price (VWAP)



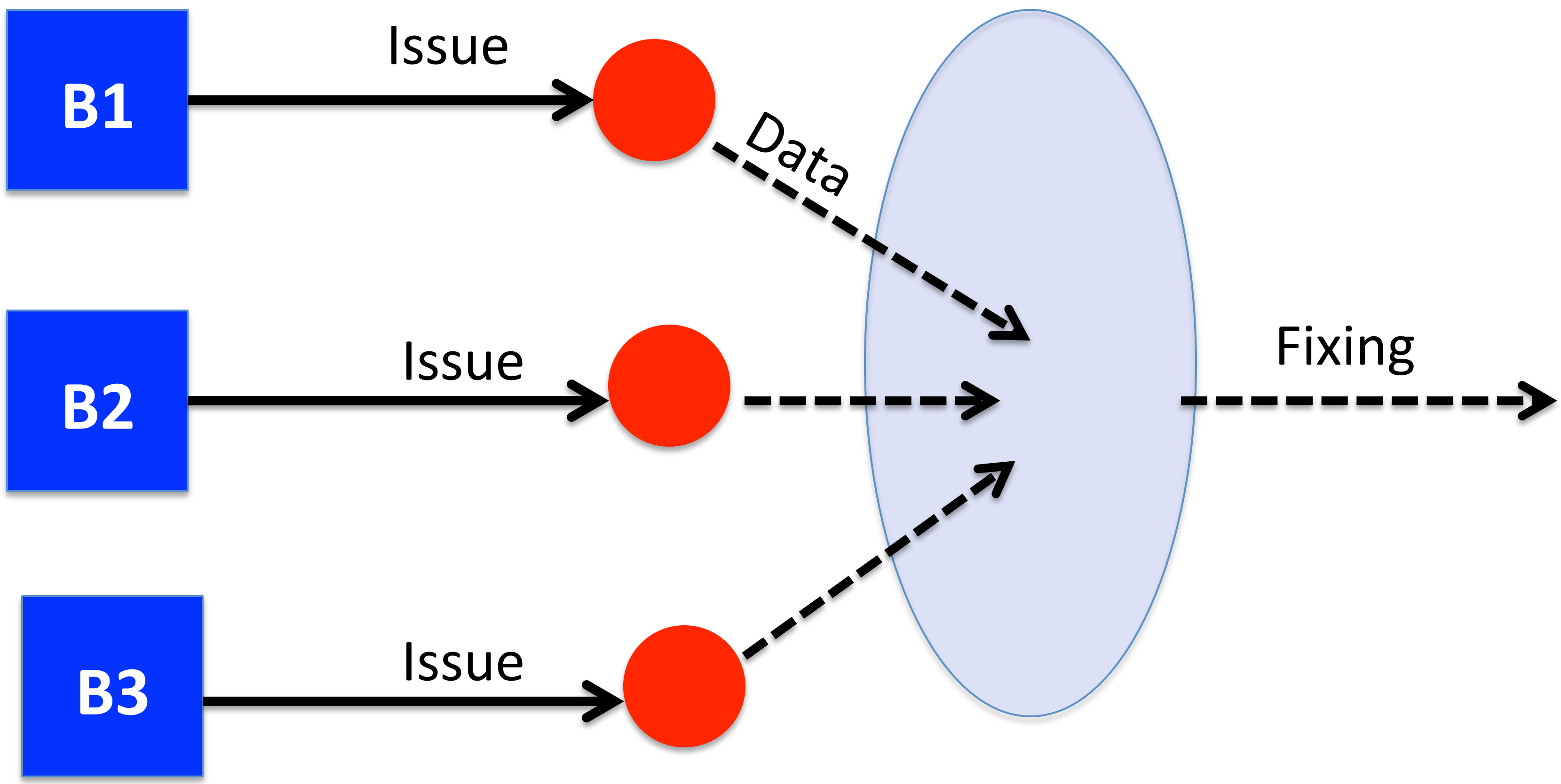
Nonlinear size weights

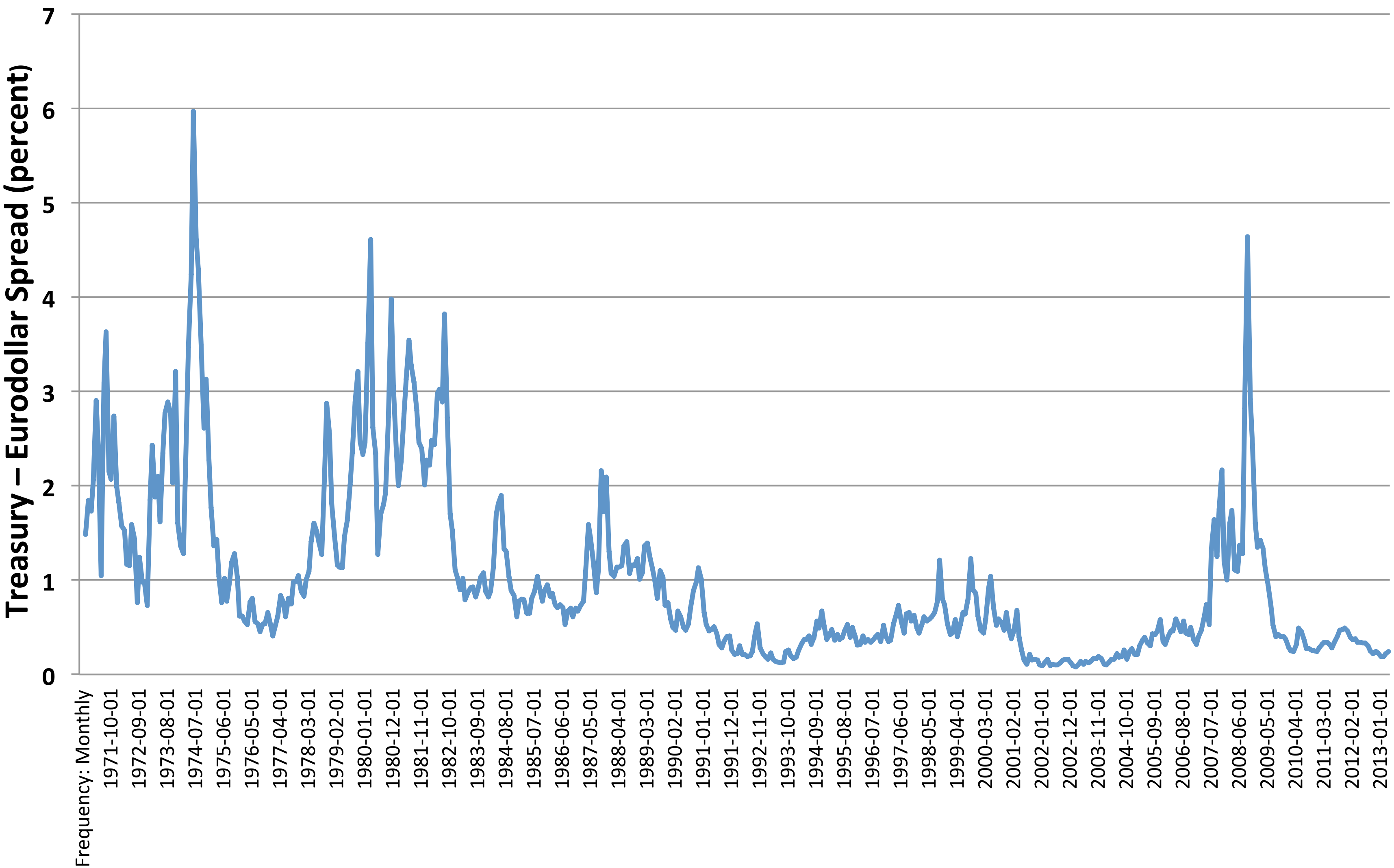


Eliminate or underweight price outliers



Bank CP-CD primary market



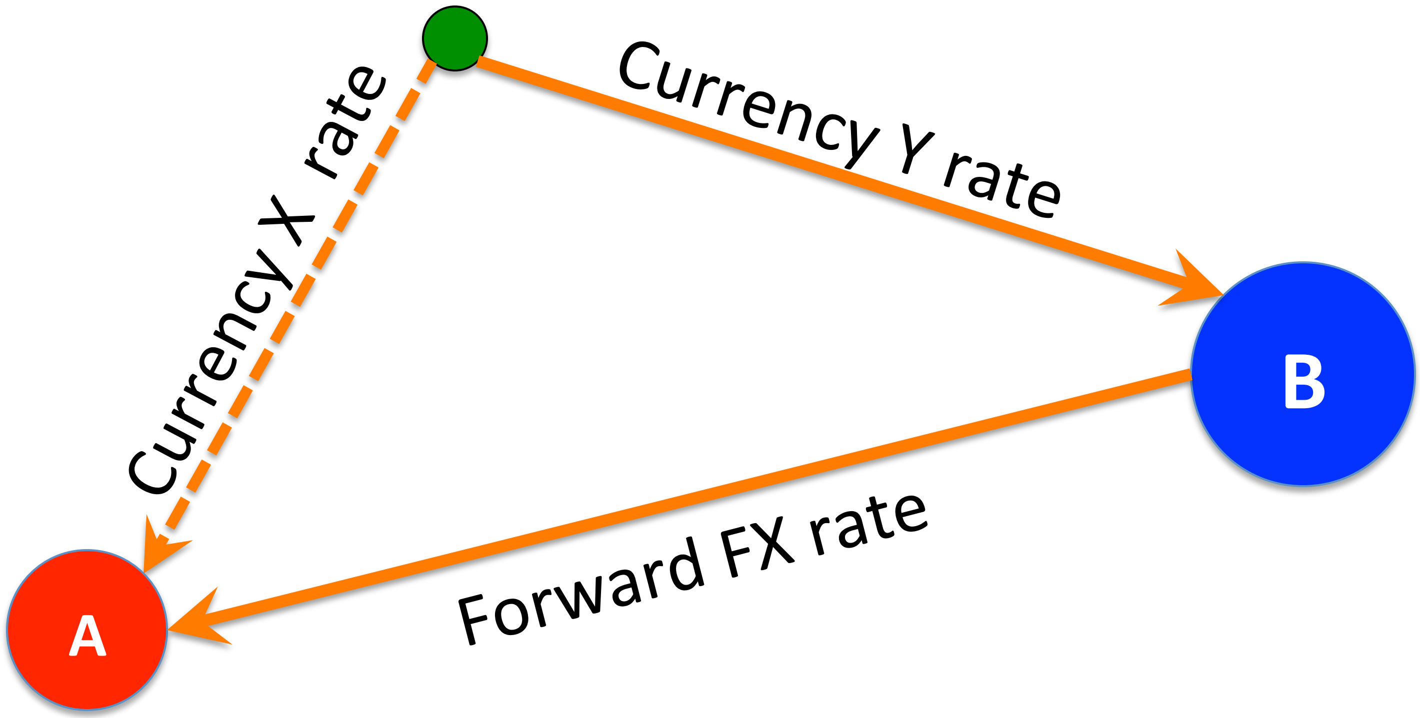


Data: Federal Reserve Bank of St. Louis

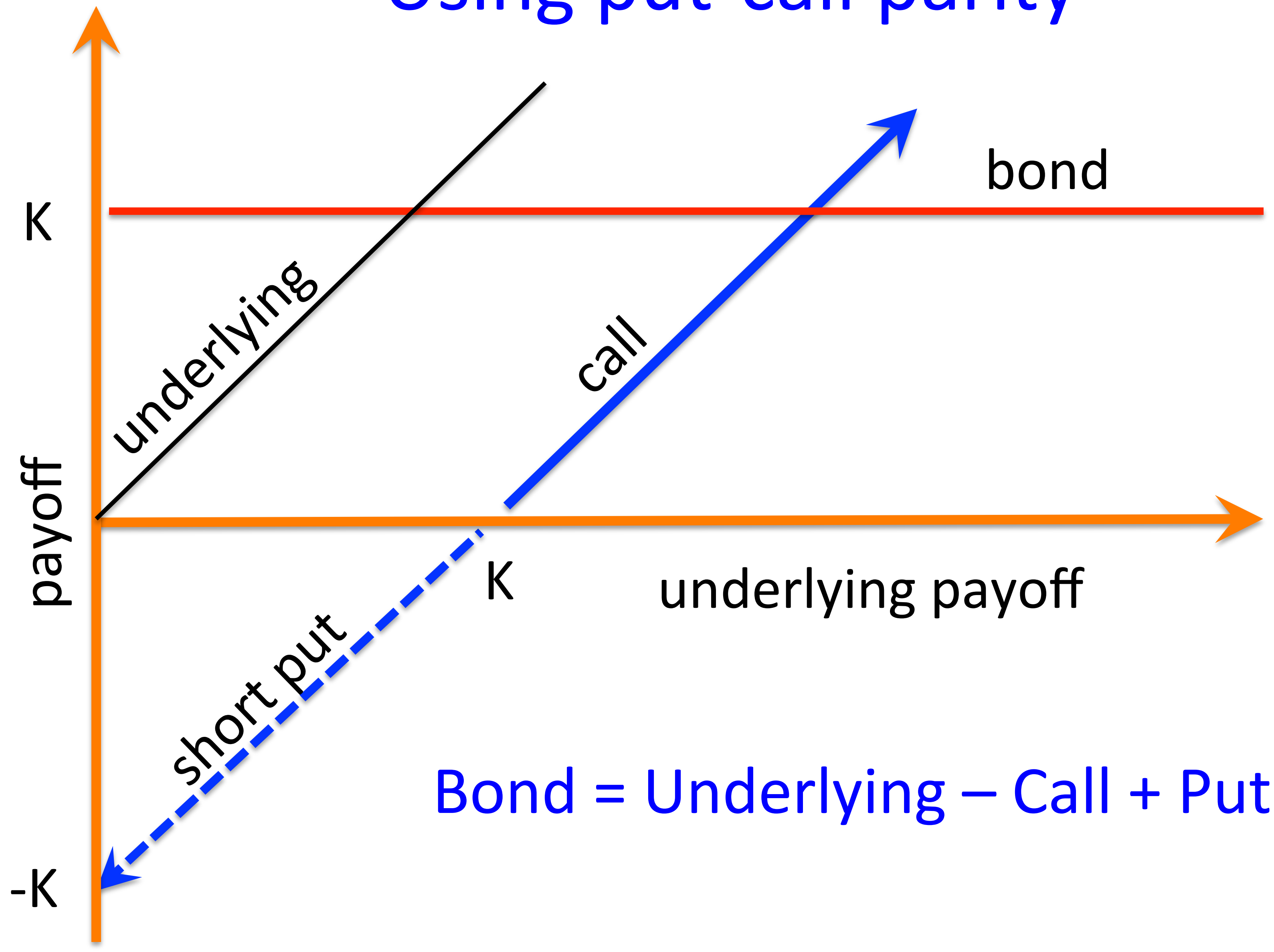
Proposed Reform of Interbank Offered Rates Recommendations of MPG, OSSG, Duffie-Stein

1. New transactions-based fixing method for IBORs, called "IBOR+"
   - Capture transactions on all wholesale unsecured bank borrowings near relevant tenor.
   - Include several days of lagged transactions, with declining weights.
   - Seamless transition for at least 1-month and 3-month USD LIBOR.
2. Introduce new benchmarks for rates trading applications.
   - Treasury bill rate.
   - OIS
   - Compound 1-day treasury repo rates to get 3-month rate.

Using covered interest parity

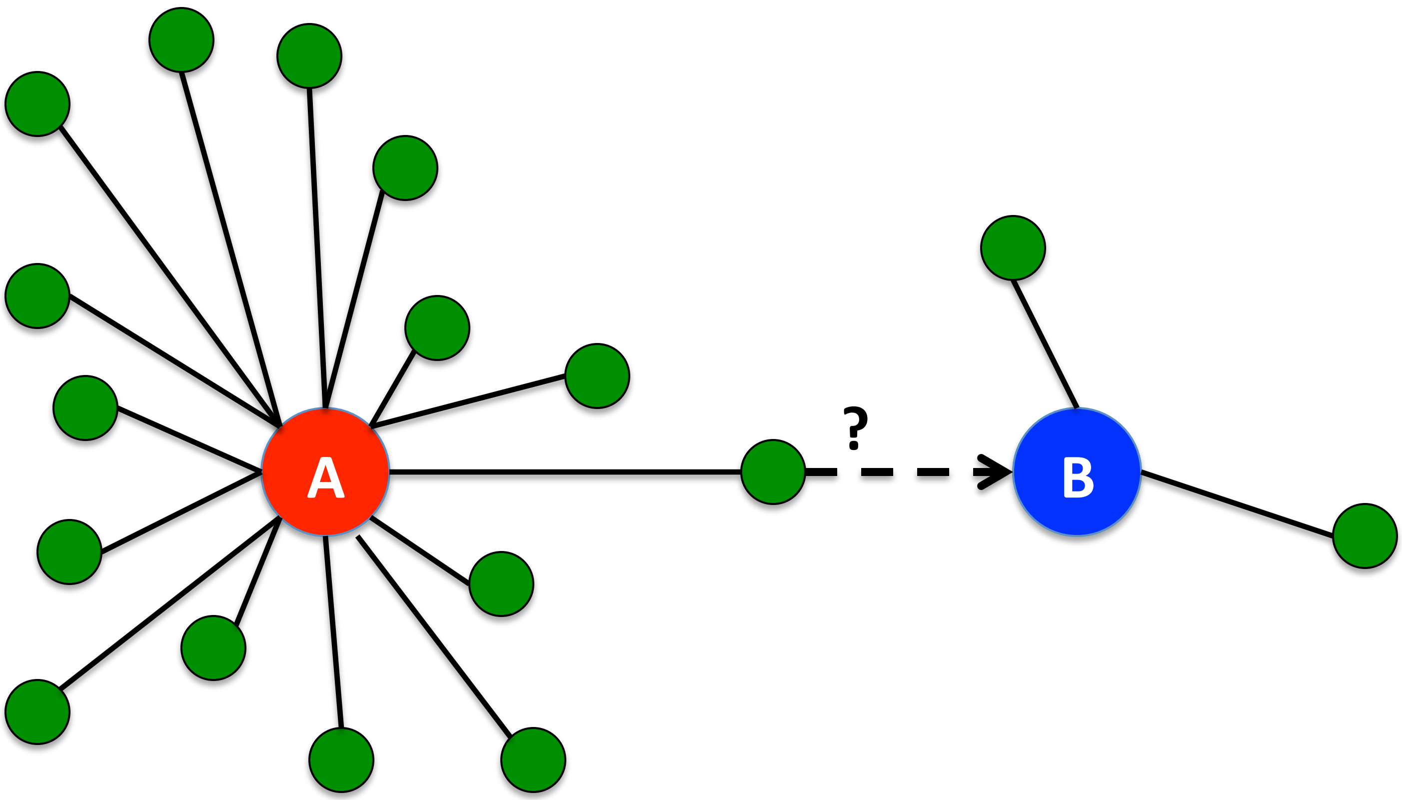


Using put-call parity

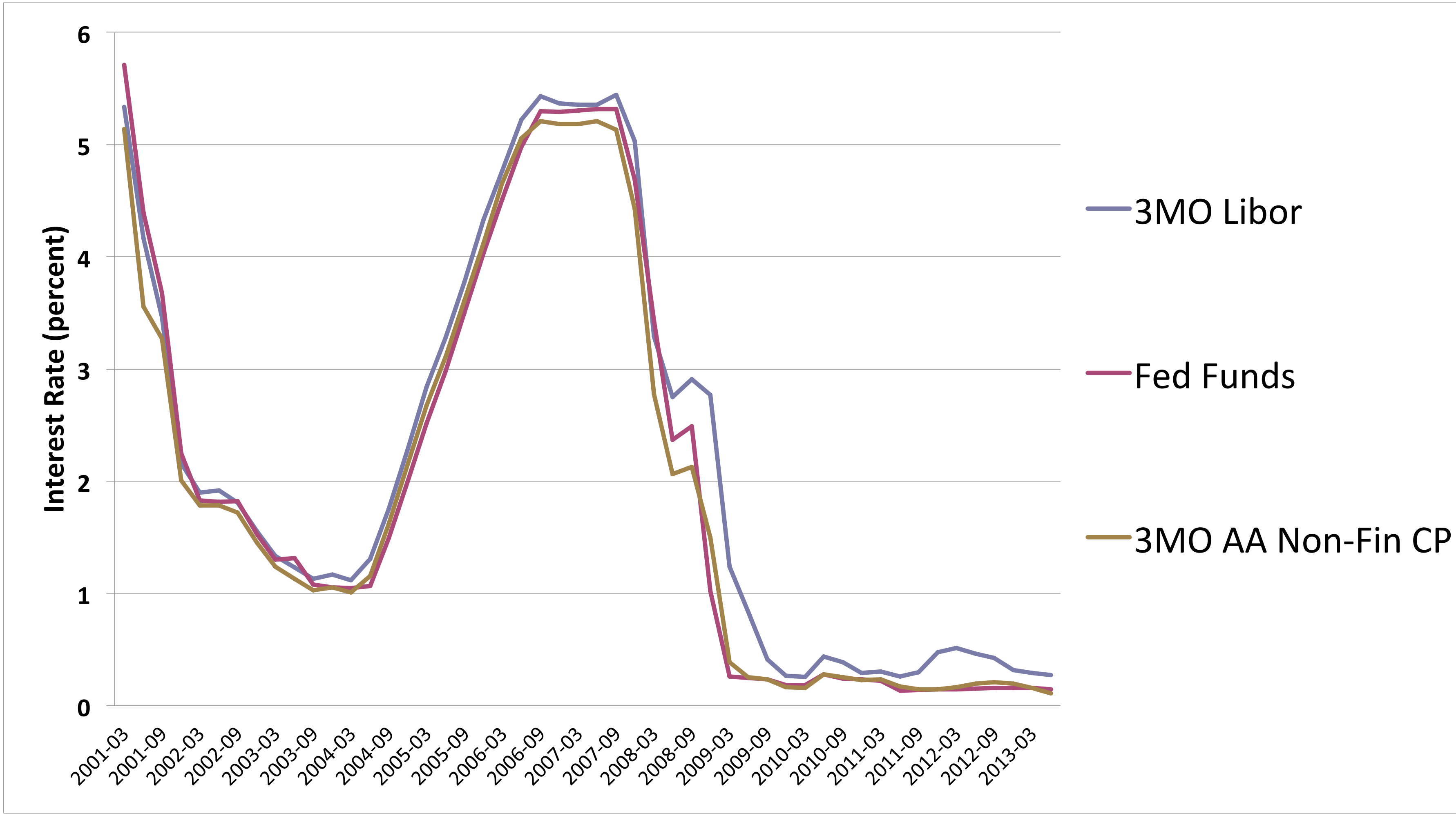


Bond = Underlying – Call + Put

If you build it, will they come?

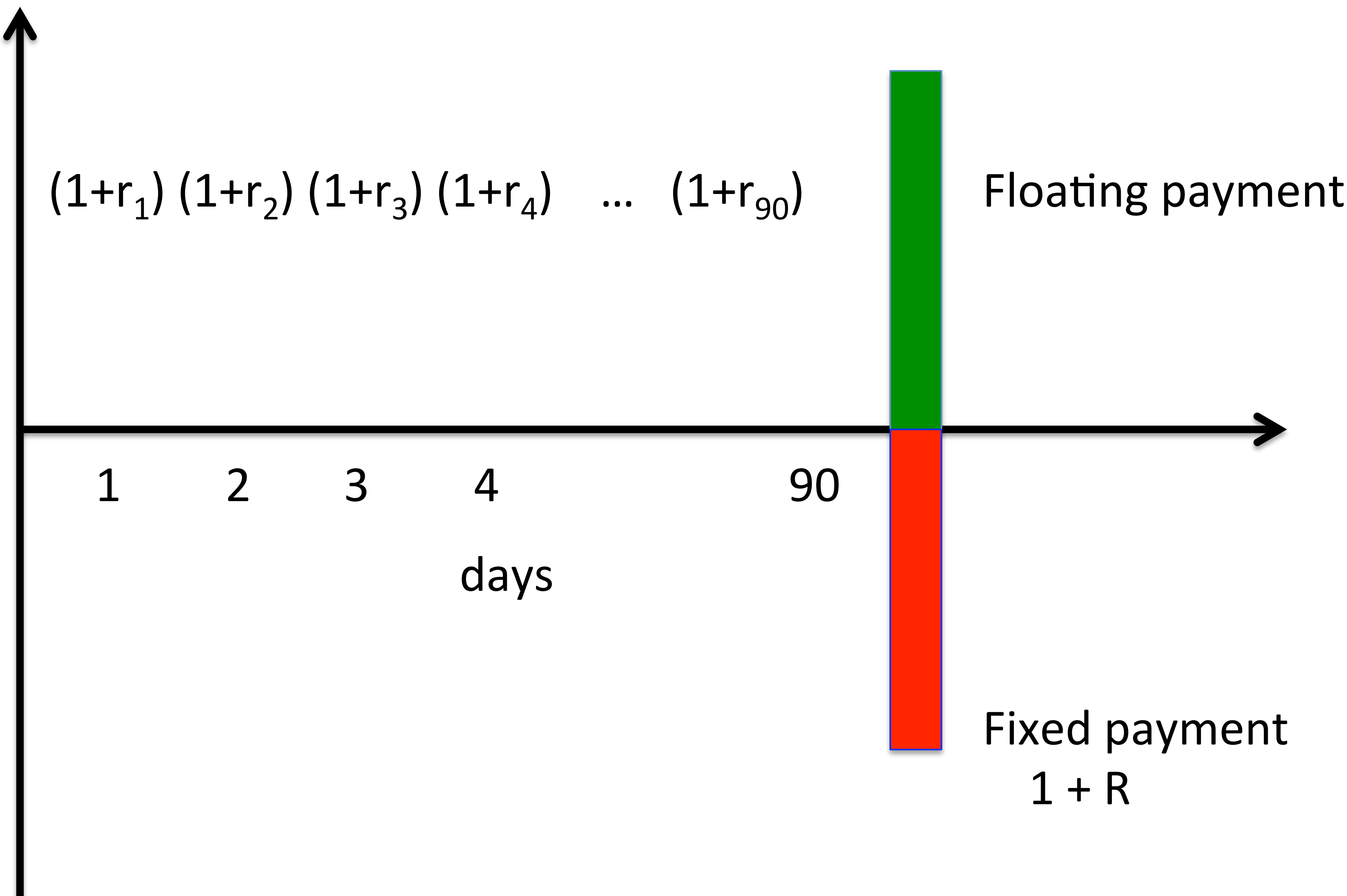


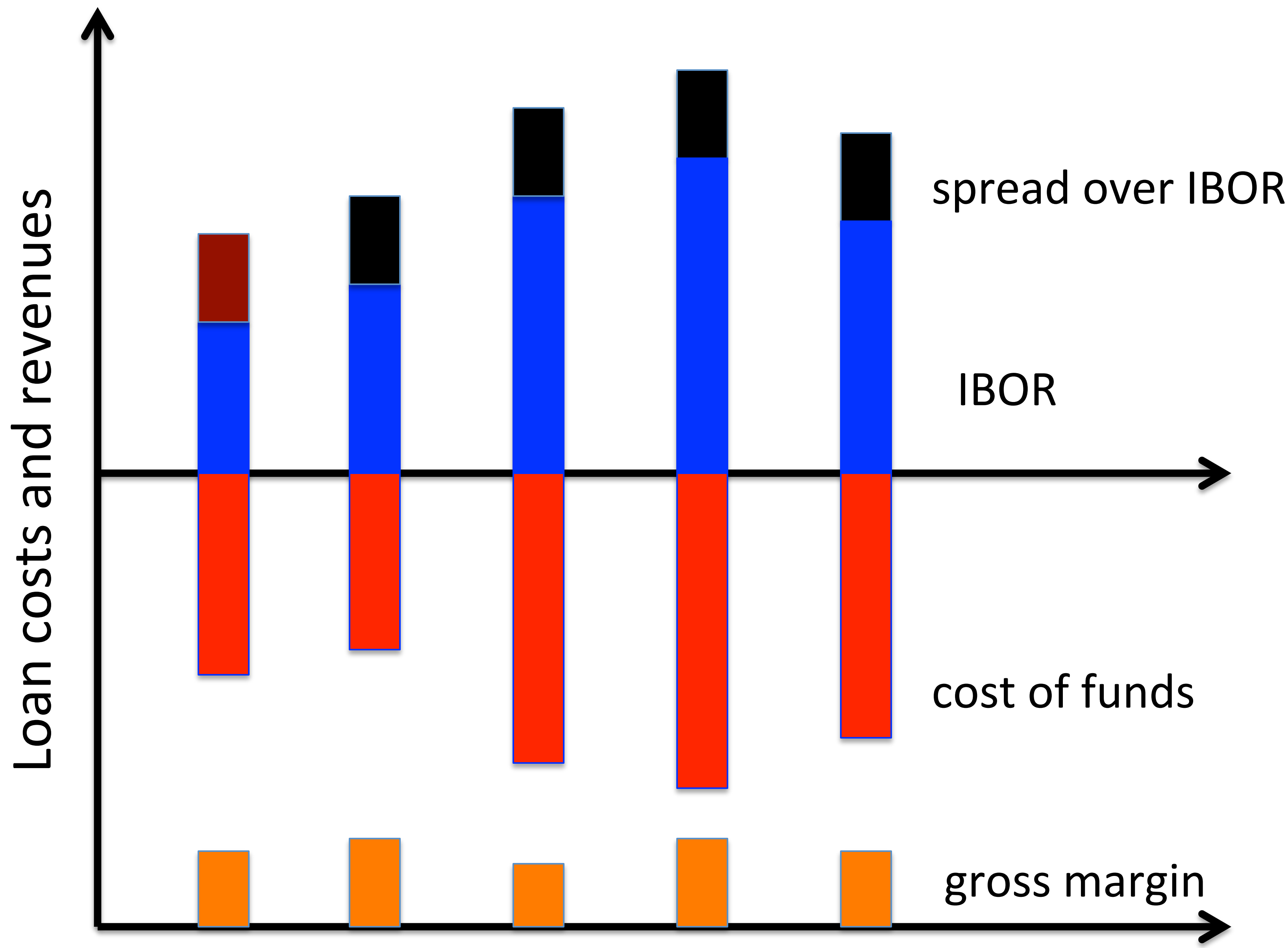
Many short rates are highly correlated



Data: Federal Reserve Bank of St. Louis

90-day Overnight Index Swap (OIS) rate R





Loan costs and revenues
spread over IBOR
IBOR
cost of funds
gross margin

Related Work on Search Market Transparency

- Benabou and Gertner (1993) analyze the influence of inflationary uncertainty on welfare and the split of surplus between consumers and two firms.
- Precursor search theory: Janssen, Pichler, and Weidenholzer (2011).
- TRACE and post-trade price transparency: Bessembinder, Maxwell, and Venkataraman (2006), Edwards, Harris, and Piwowar (2007), Goldstein, Hotchkiss, and Sirri (2007), Bessembinder and Maxwell (2008), Green, Hollifield, and Schürhoff (2007), Asquith, Covert, and Pathak (2013).
- Related theory on transparency in dealer markets: Madhavan (1995), Pagano and Roell (1996).

Dealers Post Quotes on Platforms

The cost of dealer i is $c_i = c + \epsilon_i$, where c is common, ϵ_i is idiosyncratic.

There is a benchmark if the common cost component c is published.

The quote p_i of dealer i has an equilibrium probability distribution F that depends on c and ϵ_i, and whether there is a benchmark.

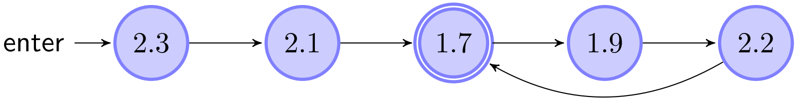
$2.1 \quad 1.9 \quad 2.2 \quad 1.7 \quad 2.3$

The payoff of dealer i is $(p_i - c_i)Q_i$, where Q_i is the total volume of trades.

Fast Traders Pick the Minimum Offer

All traders value the asset at trader at some constant value v.

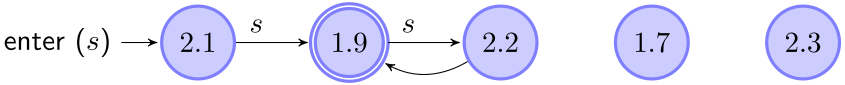
A fraction μ of traders are "fast," that is, have no search cost.



In this example, the payoff of the fast trader is $v - 1.7$.

Feasible Search Path of an Entering Slow Trader

Slow traders visit dealer trade platforms in random order, facing a Pandora Problem.



The net payoff of this path is $v - 1.9 - 3s$

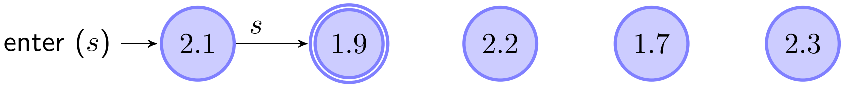
Outline of Results

- A welfare comparison of market equilibria with and without a benchmark.
- With heterogeneous-cost dealers, how benchmarks improve matching efficiency (and welfare).
- The incentives of homogeneous-cost dealers to introduce a benchmark.
- The strategic introduction of benchmarks by low-cost dealers to increase market share.
- Benchmark manipulation incentives for dealers.

Equilibrium Search of a Slow Trader with a Benchmark

Enter with a probability λ_c that depends on the observed benchmark c.

Immediately accept the first offer below an optimal reservation price r_c.



The net payoff of this path is $v - 1.9 - 2s$.

Simplifying the Benchmark Case

The support of the distribution of c is $[\underline{c}, \overline{c}]$.

We begin with the case of only low-cost dealers.

We examine behavior on the event $\{c < v - s\}$. (Otherwise, slow traders don't enter and dealers compete à la Bertrand, offering to sell for c.)

The unique equilibrium probability distribution F of offer quotes has no atoms and has upper support limit r_c.

Dealer Quote Strategy

For a dealer, the probability that a quote-observing trader is fast is

$$q(\lambda_c) = \frac{\mu}{\mu + \frac{1}{N}\lambda_c(1-\mu)}.$$

Dealers are indifferent between all price offers in the support of F, so

$$\left[1 - q(\lambda_c) + q(\lambda_c)\left(1 - F(p)^{N-1}\right)\right](p - c) = \left[1 - q(\lambda_c)\right](r_c - c).$$

Solving,

$$F(p) = 1 - \left[\frac{\lambda_c(1-\mu)}{N\mu}\frac{r_c - p}{p - c}\right]^{\frac{1}{N-1}}.$$

Slow Trader Strategy

Pandora solution of Weitzman (1979): Indifference to search when observing the quote r_c implies that

$$v - r_c = v - s - \mathbb{E}_F(p).$$

Solving,

$$r_c = c + \frac{1}{1-\alpha(\lambda_c)} s,$$

where

$$\alpha(\lambda_c) = \int_0^1 \left(1 + \frac{N\mu}{\lambda_c(1-\mu)}\, z^{N-1}\right)^{-1} dz < 1.$$

An interior entry probability λ_c solves

$$s = (1-\alpha(\lambda_c))(v-c).$$

Equilibrium Search Path of an Entering Slow Trader Without a Benchmark

Enter with probability λ.

Accept the offer on the first platform visited if it is below v.

Then exit.

Because $v < 2.1$, this path has net payoff $-s$.

When Does a Benchmark Improve Welfare?

- Change variables to gain from trade $x = \max(v - c, 0)$.
- Letting $\Lambda(x) = \lambda_c$, the social surplus with a benchmark is

$$W(x) = \mu x + \Lambda(x)(1 - \mu)(x - s).$$

- The total social surplus with no benchmark is $W\left[\mathbb{E}(x)\right]$.
- If μ is small enough or s is at least a given fraction of X, then $W(\,\cdot\,)$ is sub-differentiable at $\mathbb{E}(x)$.
- In these cases, $\mathbb{E}[W(x)] \geq W[\mathbb{E}(x)]$, so benchmarks increase expected social surplus.

surplus
$x-(1-\mu)s$
$W_b(x)$
supporting hyperplane at X
0
s
X
$\frac{s}{1-\bar{\alpha}}$
$v-\underline{c}$
Gain from trade x

Benchmarks Do Not Always Improve Welfare!

- If the expected gain from trade of slow traders is sufficiently large relative to search costs, then even without the benchmark all of the slow traders may enter.
- In the presence of the benchmark, however, slow-trader entry may be low in the event of a high realization of c (still allowing gains from trade).
- Thus, adding a benchmark could *reduce* welfare if the entry of slow traders is already nearly efficient without the benchmark.

Matching Efficiency

Proposition. Suppose the search cost is sufficiently low and there is always a gain from trade ($v > \overline{c} + \Delta$). Then, with a benchmark:

- All trade is with low-cost dealers.
- If, in addition, the search cost is not too low, then slow traders always trade with the first encountered low-cost dealer.

Theorem. If the search cost is within a specified interval and if $\overline{c} > \underline{c} + \Delta$, then the expected social surplus is strictly greater in the equilibrium with a benchmark than in any equilibrium without a benchmark.

Incentive for Dealers to Introduce a Benchmark

Theorem. Suppose all dealers have the same cost, and the search cost is high enough. Then dealer profits are higher with a benchmark than without.

Whenever dealers would opt for the benchmark in this sense, it must be the case that the introduction of the benchmark raises social surplus. The converse is not true.

Low-Cost Dealers Can Use Benchmarks Strategically

- A slight change in the cost distribution, so that the number L of low-cost dealers is zero or at least two.
- Any non-trivial coalition of dealers can commit to a benchmark (by voting).
- Dealers enter if and only if their expected profit is strictly positive.
- The number of entering dealers is publicly observed.

Proposition. Suppose that the dealer cost difference Δ is sufficiently large and the search cost s is not too high. Then:

- There exists an equilibrium of the extended game in which low-cost dealers always vote in favor of the benchmark, and high-cost dealers always vote against it. Moreover, there are no profitable group deviations in the voting stage.
- If the environment is competitive (that is, $L \geq 2$), the benchmark is introduced, all high-cost dealers stay out of the market, all low-cost dealers enter the market, and all traders enter the market.
- If the environment is uncompetitive ($L = 0$), the benchmark is not introduced, and all dealers enter the market.

Manipulation Incentives

- Suppose homogeneous dealer costs.
- If traders ignore the potential of manipulation and dealers can arrange for any benchmark distortion at no cost, then dealers would falsely announce that the benchmark is $v - s/(1-\alpha(1))$.
- A mechanism is a pair (M, g), where $M = (M_1 \times \cdots \times M_N)$ is the product of the message spaces of the N respective dealers, and where $g : M \to [\underline{c}, \bar{c}] \times \mathbb{R}^N$.
- The function g maps the dealers' messages $(m_1, \ldots, m_N)$ to an announced benchmark $\tilde{c}$ and to transfers $t_1, \ldots, t_N$

Proposition. Truthful revelation of c is Nash implementable, but is not fully Nash-implementable.