



An antitrust expert's approach to analyzing cartel damages

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How does an antitrust expert approach an analysis of cartel damages?

- Part I: Understanding the institutional context
- Part II: Measuring overcharges

The Team

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Part I: Understanding the institutional context

Part I: Understanding the institutional context

- Understanding the product
 - What is it?
 - Who provides it?
 - How is it priced?
 - What determines normal non-collusive prices?
- Understanding the FX cartels
 - According to the EC Decisions, who participated?
 - According to the EC Decisions, what types of conduct did the FX cartels practice?
 - How might FX cartel members' collusion have impacted prices?

Understanding the product: What is it, and who provides it?

In our approach, the product is transaction services for FX trading, and the providers are FX dealers

- Various types of companies buy and sell currencies either for operations (e.g., manufacturers trading inputs/outputs internationally) or for investment returns (hedge funds, mutual funds, pension funds).
- Each transaction involves a currency pair, a *base currency* and an *quoted currency*, as well as an *exchange rate*.

Understanding the product: What is it, and who provides it? (continued)

In our approach, the product is transaction services for FX trading, and the providers are FX dealers

- As in many other financial markets, transactions go through intermediaries (here, *dealers*).
- Instead of matching buyers and sellers, dealers enter into separate transactions with buyers and with sellers, and hold inventories of currency to bridge the difference. The dealer thereby provides *liquidity* to the FX market.
- Dealers therefore provide a *transaction service*, which piggybacks on the good being traded (here, currency), and is distinct from that good.

Understanding the product: How is it priced?

- If dealers charged an explicit fee for matching buyers and sellers, the price of their transaction services would obviously be the fee. But that's not what they do.
- At any moment in time, each dealer quotes:
 - A *BID* -- a rate of exchange indicating the amount the dealer is willing to pay, in the base currency, to buy a unit of the quoted currency.
 - An *ASK* -- a rate of exchange indicating the amount the dealer is willing to accept, in the base currency, to sell a unit of the quoted currency.
 - Generally, the *ASK* exceeds the *BID*.
- To avoid holding ever-expanding positions, each dealer adjusts the *BID* and the *ASK*.

Understanding the product: How is it priced? (continued)

The price of the product is (half of) the bid-ask spread

- Definition of the *BID-ASK SPREAD* (or more simply, the *SPREAD*):

$$SPREAD = ASK - BID$$

- Imagine a customer sells one unit of a currency to a dealer at the *BID*, and then immediately buys it back at the *ASK*.
 - The customer's holdings currency holdings are unchanged, but he is poorer by exactly the *SPREAD*.
 - The *SPREAD* is therefore what the customer has paid for two FX transactions, i.e., the total price of those transactions.
 - The *HALF SPREAD* is therefore the economic price (the implicit fee) for a single FX transaction.

Understanding the product: How is it priced? (continued)

- It's important to avoid confusing the price of the transaction service (the *SPREAD*) with the price of the currency that is being transacted (the *EXCHANGE RATE*).
 - Easy to confuse because the *BID* and *ASK* are prices of the quoted currency.
 - However, the price of the quoted currency and the size of half-spreads can and do vary independently.
- Example:
 - Assume the *BID* for EURUSD is 1.2026 and the *ASK* is 1.2030.
 - The *mid-price* is 1.2028 (usually taken as the measure of the *EXCHANGE RATE*).
 - The *SPREAD* is 0.0004, or 4 *pips* (percentage in points), and the *HALF SPREAD* is 0.0002 (2 pips).

Understanding the product: How is it priced? (continued)

- The economic analyses in this matter will likely distinguish between three different notions of half-spreads.
- *Quoted half-spread*: Half the difference between a dealer's ASK and BID quotes at a given point in time.
 - We do not expect to have data on quoted half-spreads in this matter.
- *Effective half-spread*: The difference between the transaction price and the market mid-point at a given point in time.

Understanding the product: How is it priced? (continued)

- *Realized half-spread*: The difference between the transaction price and the market mid-point at a slightly later point in time.
 - Equals the effective half spread plus the change in the exchange rate immediately after the transaction.
 - The exchange rate tends to move against the dealer's interests after a large trade.
 - Because rebalancing is asynchronous, the realized half spread may provide a better measure of what the dealer receives from customers for the round trip, after rebalancing.

Understanding the product: What determines normal non-collusive prices (spreads)?

- Competition between many dealers would tend to force spreads toward dealers' costs, which involve three components:
 - *Operating costs* – staff, equipment, licenses, legal, ...
 - *Inventory risk* – because offsetting buy and sell orders do not necessarily arrive at the same time, the dealer is exposed to the risk of adverse FX movements.
 - *Adverse selection risk* – when dealers trade with parties who have better information than they do, they take the risk that the price will tend to fall after they buy and rise after they sell.

Understanding the product: What determines normal non-collusive prices (spreads)? (continued)

- How does adverse selection work?

- The basic idea:

“I would never belong to a club that would have me as a member.”

- Groucho Marx

- In the context of asset markets:

I am reluctant to sell to anyone who wants to buy, because their desire to buy may mean they know the price is likely to go up.

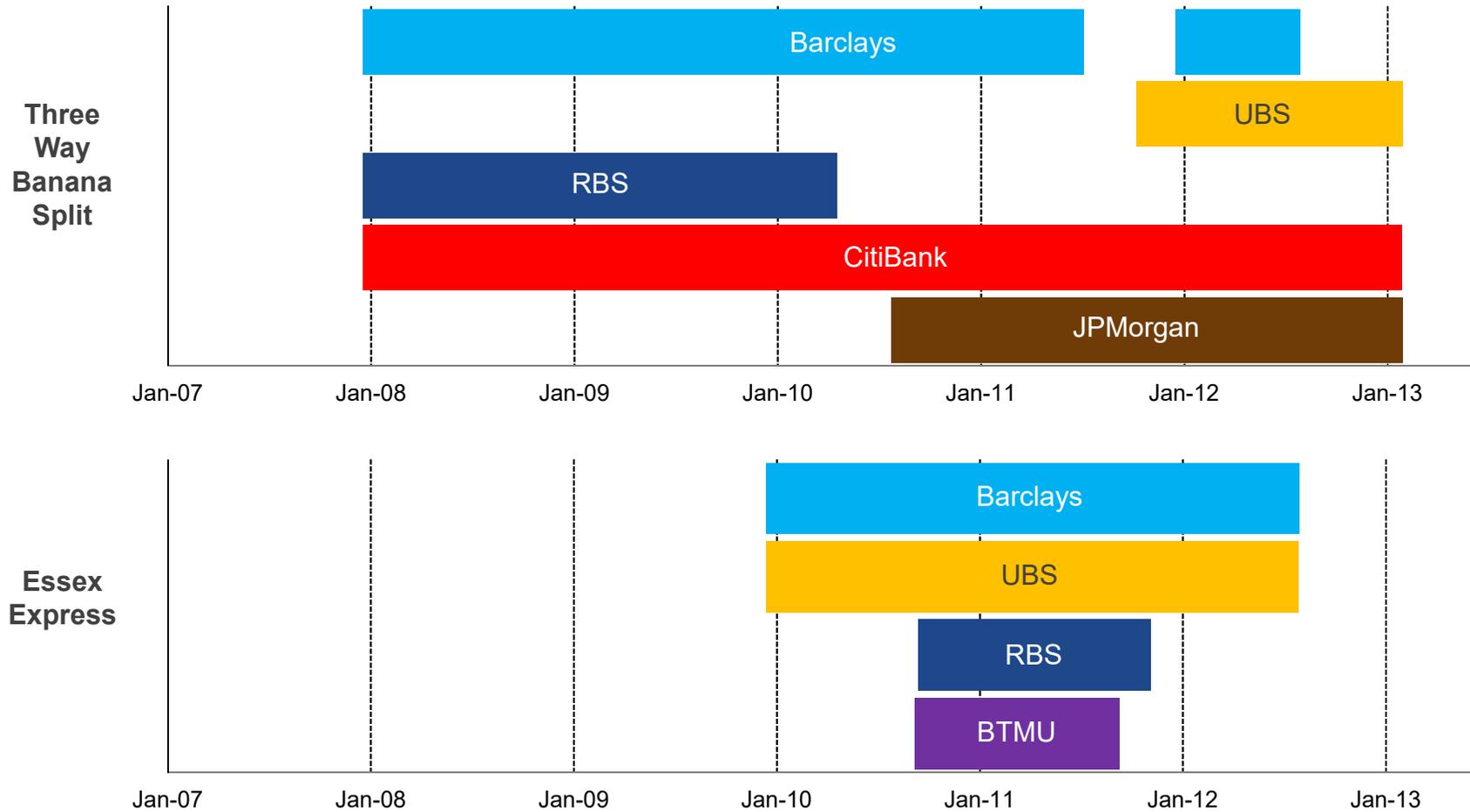
I am reluctant to buy from anyone who wants to sell, because their desire to sell may mean they know the price is likely to go down.

- The magnitude of adverse selection risk depends on the degree of *informational asymmetries* between traders in a market.

Understanding the product: What determines normal non-collusive prices (spreads)? (continued)

- Research shows that adverse selection risk is an important contributor to spreads in FX markets.
- Any development that increases the adverse selection risk traders face will increase their costs, typically causing them to increase their spreads.

Understanding the cartels: According to the EC Decisions, who participated?



Source: EC Decisions, recital 148.

Understanding the cartels: According to the EC Decisions, what types of conduct did the FX cartels practice?

- “Extensive exchange of information amongst competitors pursuant to the underlying understanding”
 - “Exchange of information on open risk positions of the participating trades”
 - “Exchange of information on outstanding customers’ orders”
 - “Exchange of information on other details of current or planned trading activities”
 - “Exchange of information on bid-ask spreads”
- “Occasional instances of coordination facilitated by the exchange of information”
 - “Coordinated trading with a view to affecting a fix”
 - “Standing down”

Source: EC Decisions, sections 4.1.2.2 and 4.1.2.3.

Understanding the cartels: According to the EC Decisions, what types of conduct did the FX cartels practice? (continued)

The following three types of orders characterising the customer-driven trading activity (market making) of the participating traders are pertinent in the present infringement:

- (1) Customer immediate orders, to immediately enter trades for a certain amount of currency based on the prevailing market rate;
- (2) Customer conditional orders, which are triggered when a given price level is reached and opens the traders' risk exposure. They only become executable when the market reaches a certain level (for example a stop-loss or take-profit order);
- (3) Customer orders to execute a trade at a specific Forex benchmark rate or "fixing" for particular currency pairs, which in the current case only concerned the WM/Reuters Closing Spot Rates (hereinafter the "WMR fixes") and the European Central Bank foreign exchange reference rates (hereinafter the "ECB fixes").¹¹

Source: EC Decisions, recital 9.

Understanding the cartels: How might FX cartel members' collusion have impacted prices?

As a general matter, collusion may impact prices through the following channels:

1. Explicit agreements among cartel members to raise prices
2. Tacit understandings to compete less aggressively
3. Coordinated behavior that has the effect of raising rivals' costs
 - An increase in rivals' costs causes rivals to raise their prices
 - As rivals prices rise, competitive pressure on cartel members abates, allowing them to raise their own prices

The exchange of information supports all three mechanisms.

Understanding the cartels: How might FX cartel members' collusion have impacted prices? (continued)

- The impact of information exchanges on rivals costs:
 - A dealer's market share gives it insight into order flow, etc., for a portion of the market.
 - When five dealers, each with 10% of the market, agree to share information, they have the benefit of knowing what's going on in 50% of the market, rather than 10%, which places their trading partners at an informational disadvantage.
 - Dealers use the interdealer market to manage inventory. Increased adverse selection risk in the interdealer market (arising from trades with cartel members) increases the costs of doing business.



Part II: Measuring overcharges

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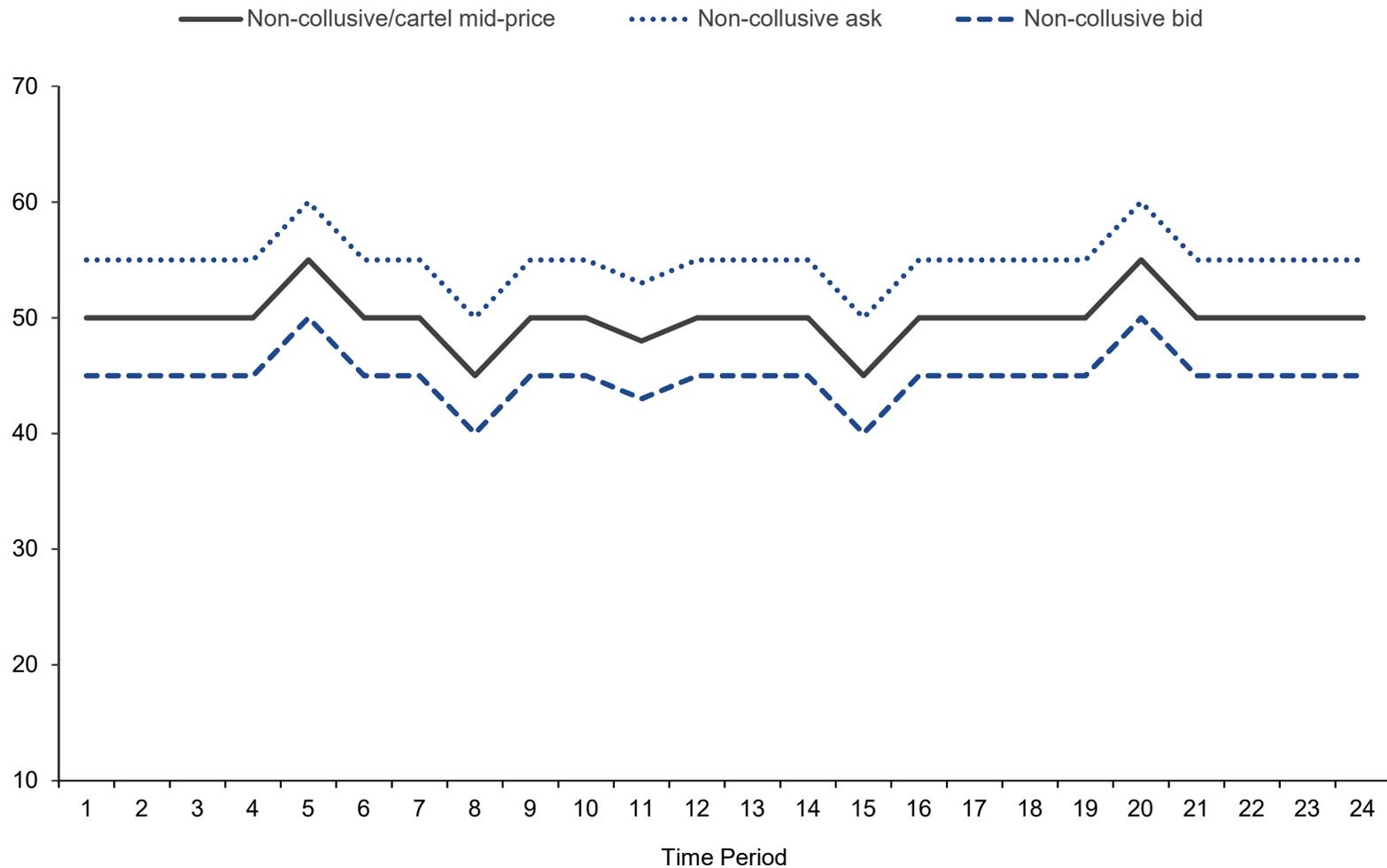
- Selecting the measure of spreads
- A primer on regression methods

Measuring overcharges: Selecting the measure of spreads

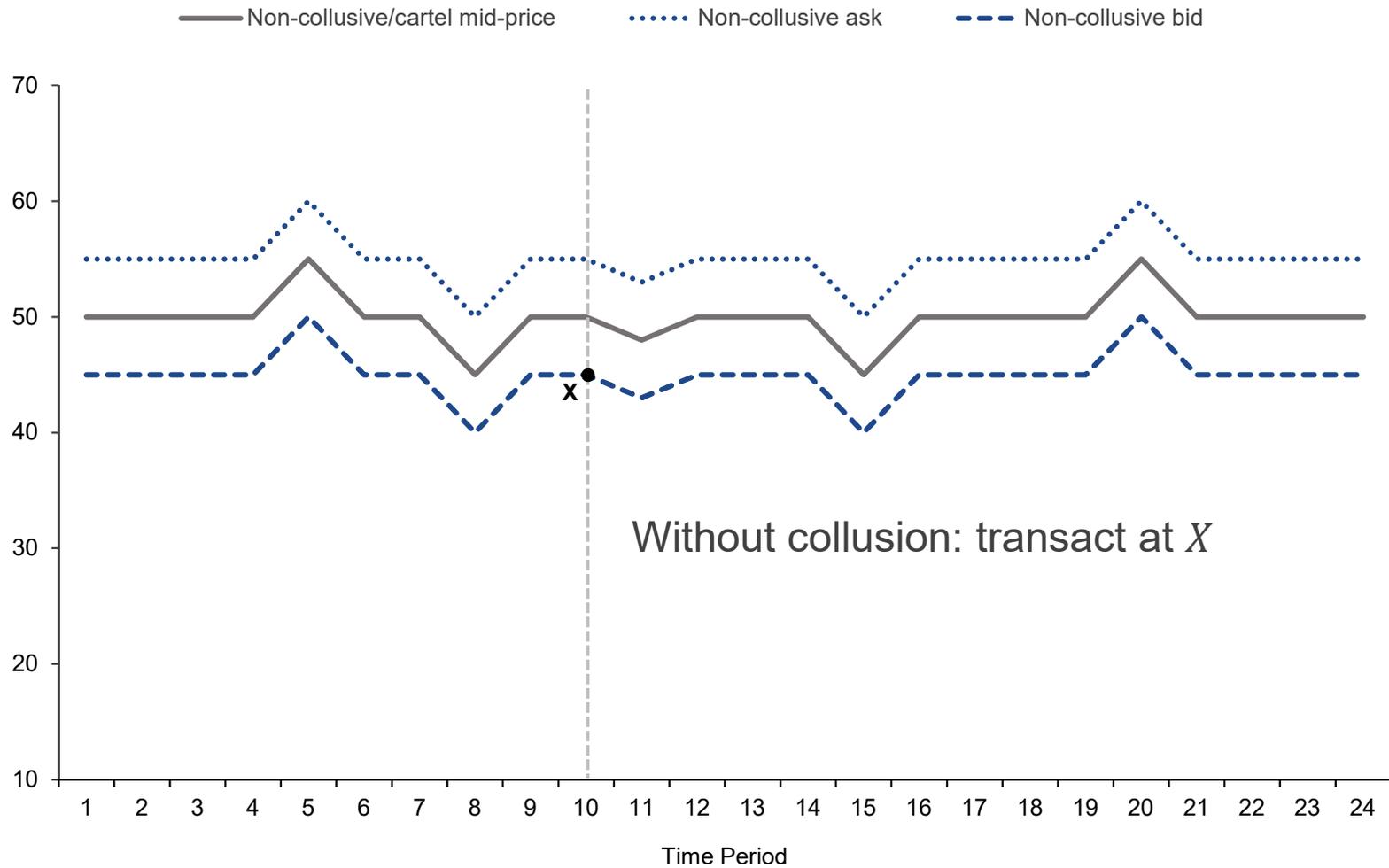
- If effective, the modes of collusion discussed previously would manifest themselves in spreads as follows:

Mode of conduct	Impacts effective spread?	Impacts realized spread?
Tacit or explicit agreements to widen quoted spreads	Yes	Yes
Magnification of adverse selection risk	Yes	Yes
Coordinated price manipulation, such as front running	No	Yes

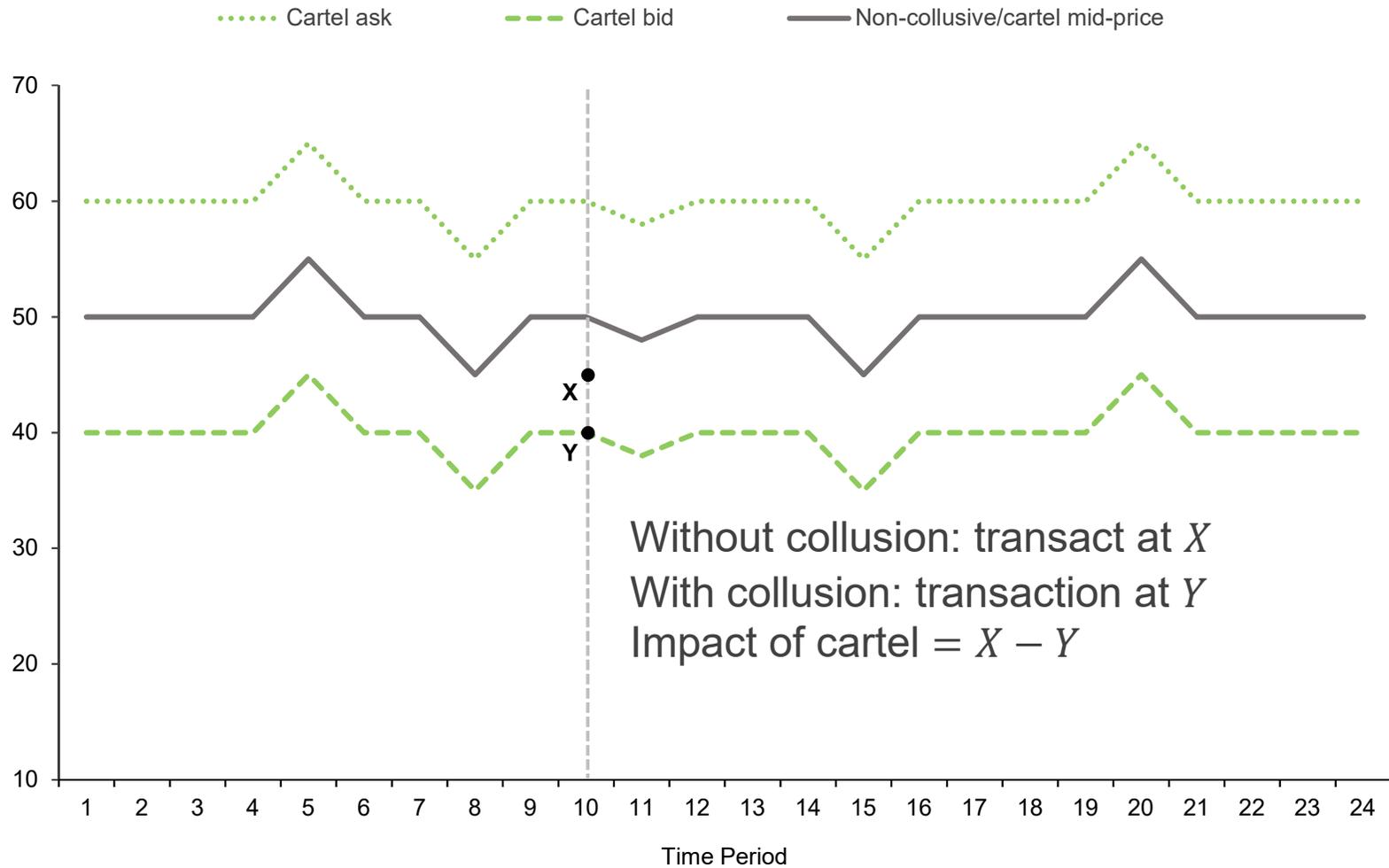
Measuring overcharges: Selecting the measure of spreads (continued) – effective spread



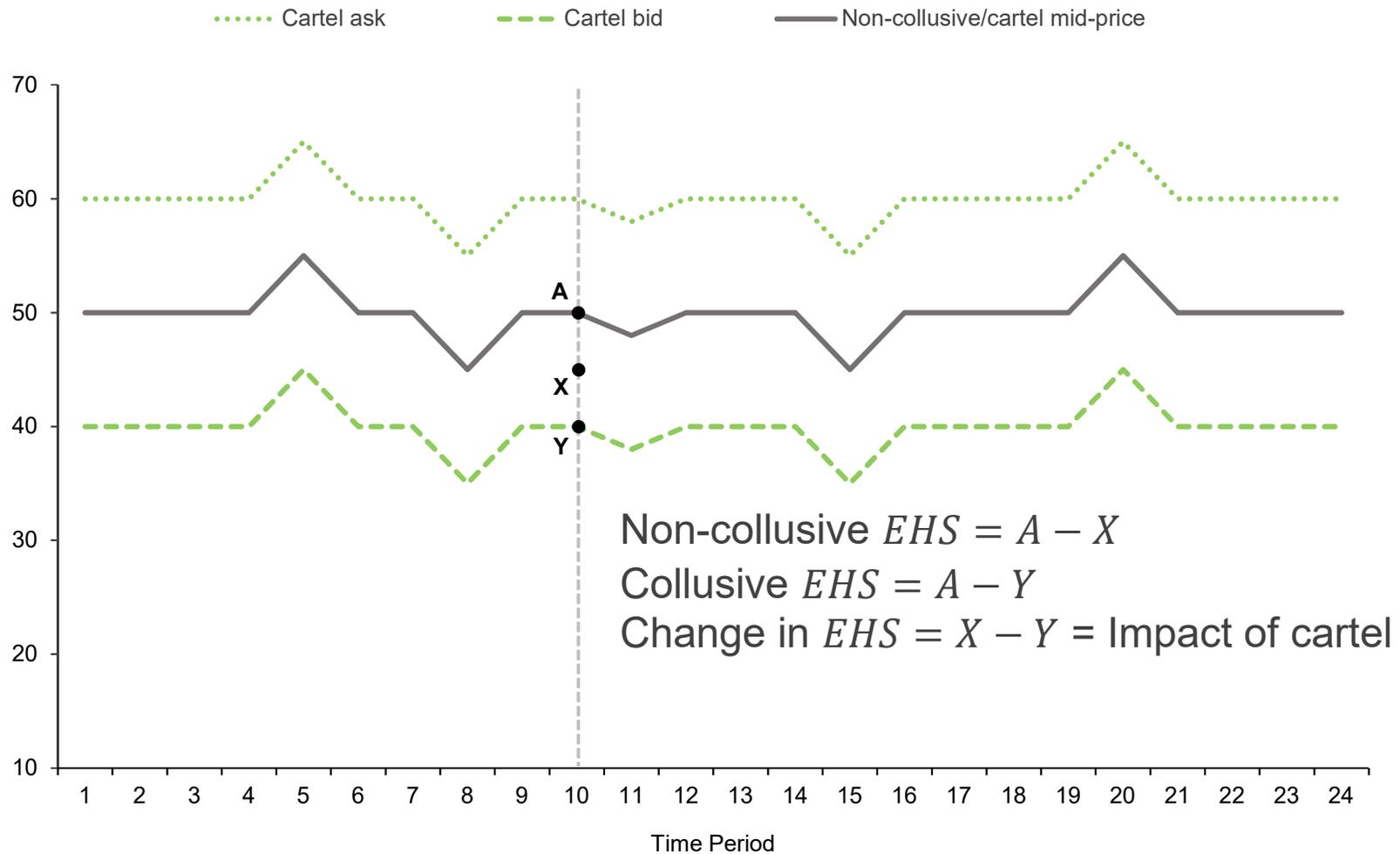
Measuring overcharges: Selecting the measure of spreads (continued) – effective spread



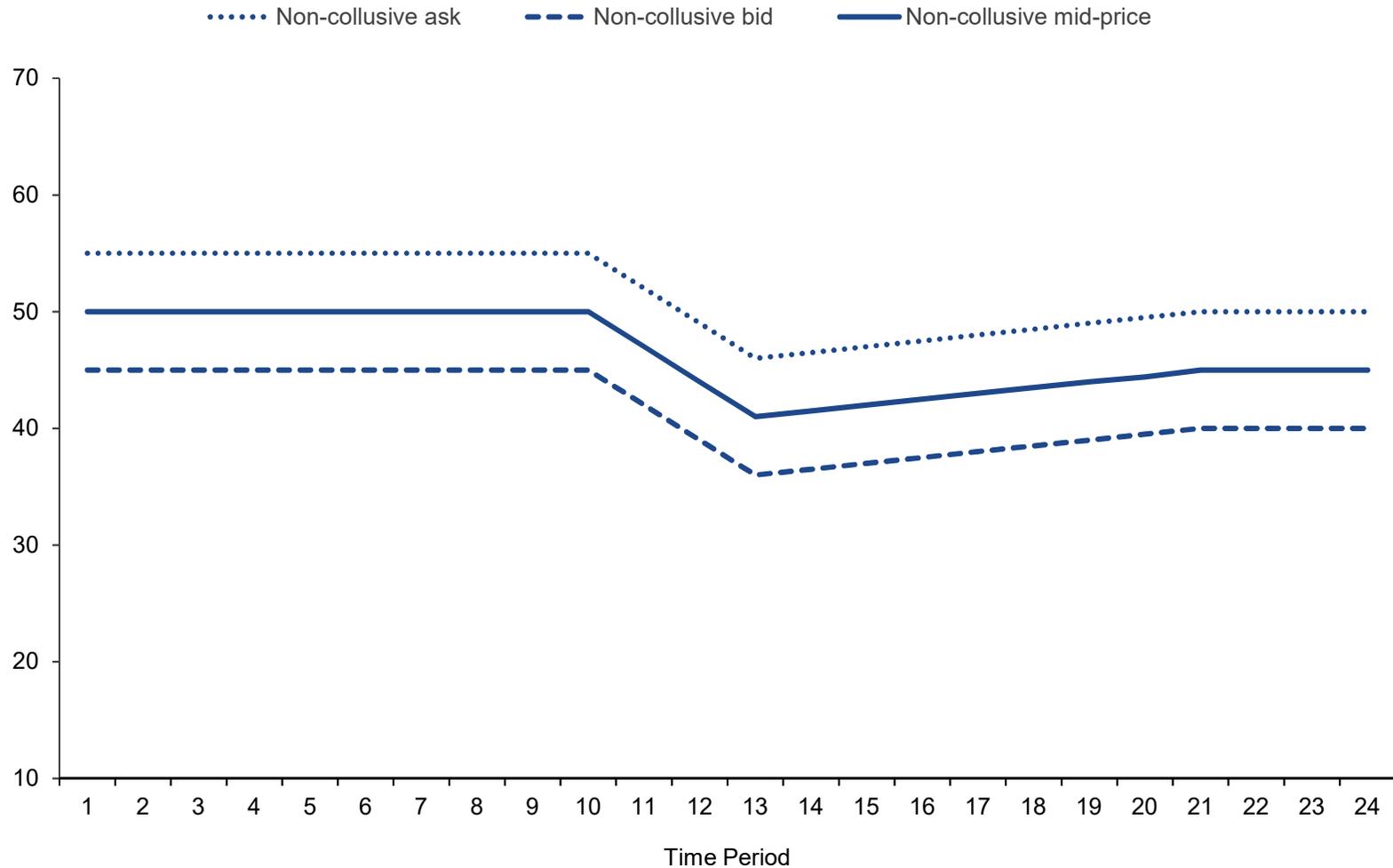
Measuring overcharges: Selecting the measure of spreads (continued) – effective spread



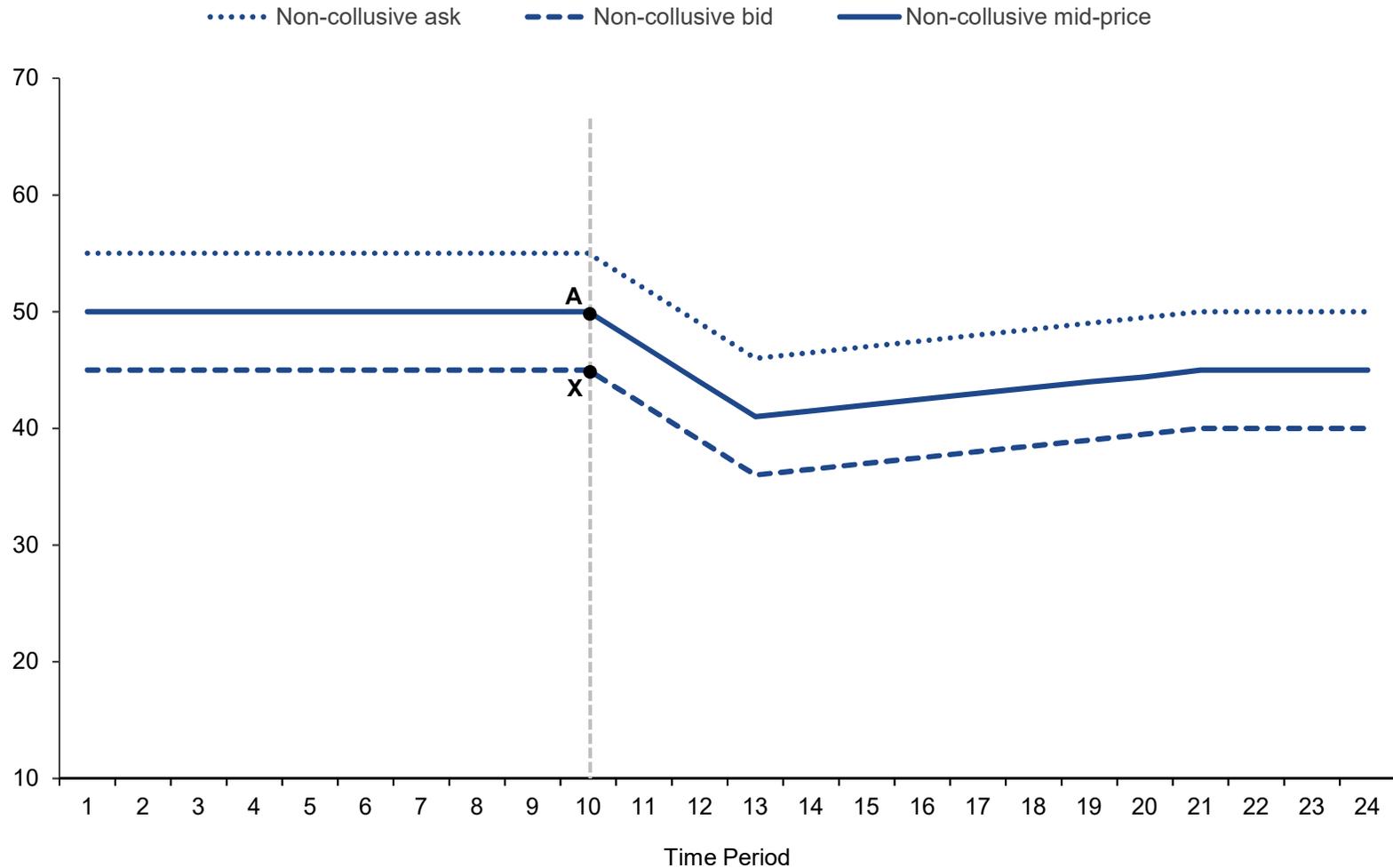
Measuring overcharges: Selecting the measure of spreads (continued) – effective spread



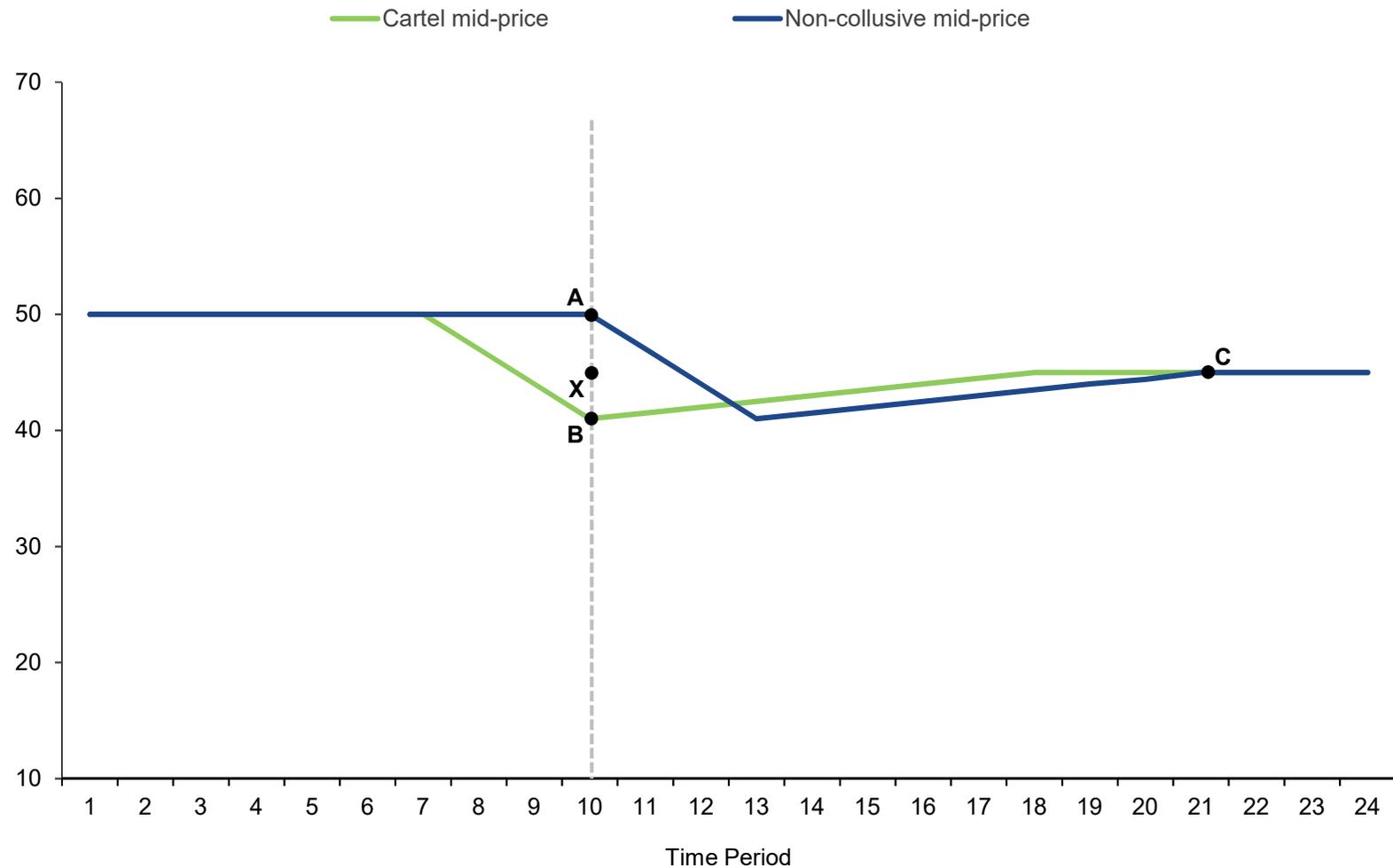
Measuring overcharges: Selecting the measure of spreads (continued) – realized spread



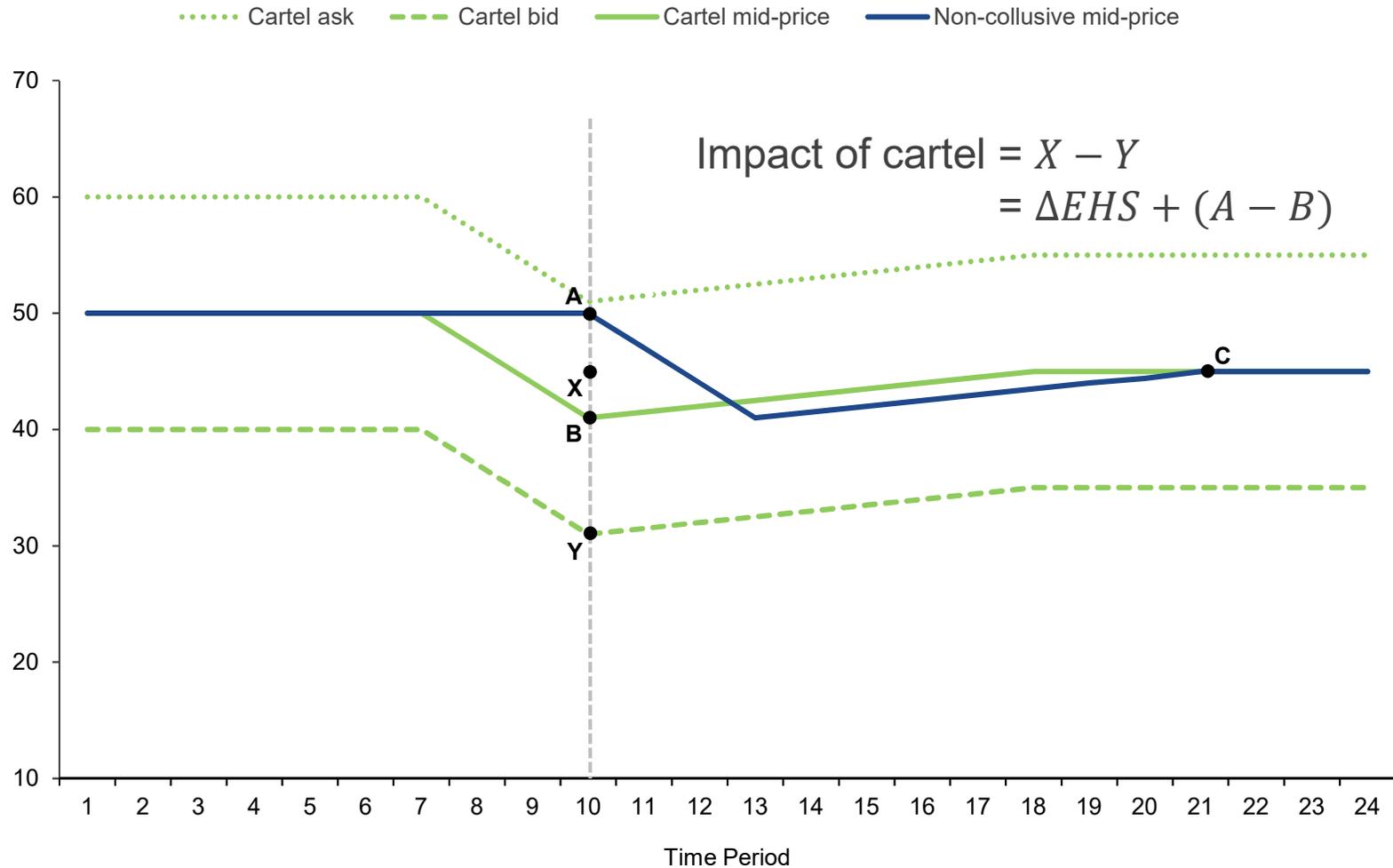
Measuring overcharges: Selecting the measure of spreads (continued) – realized spread



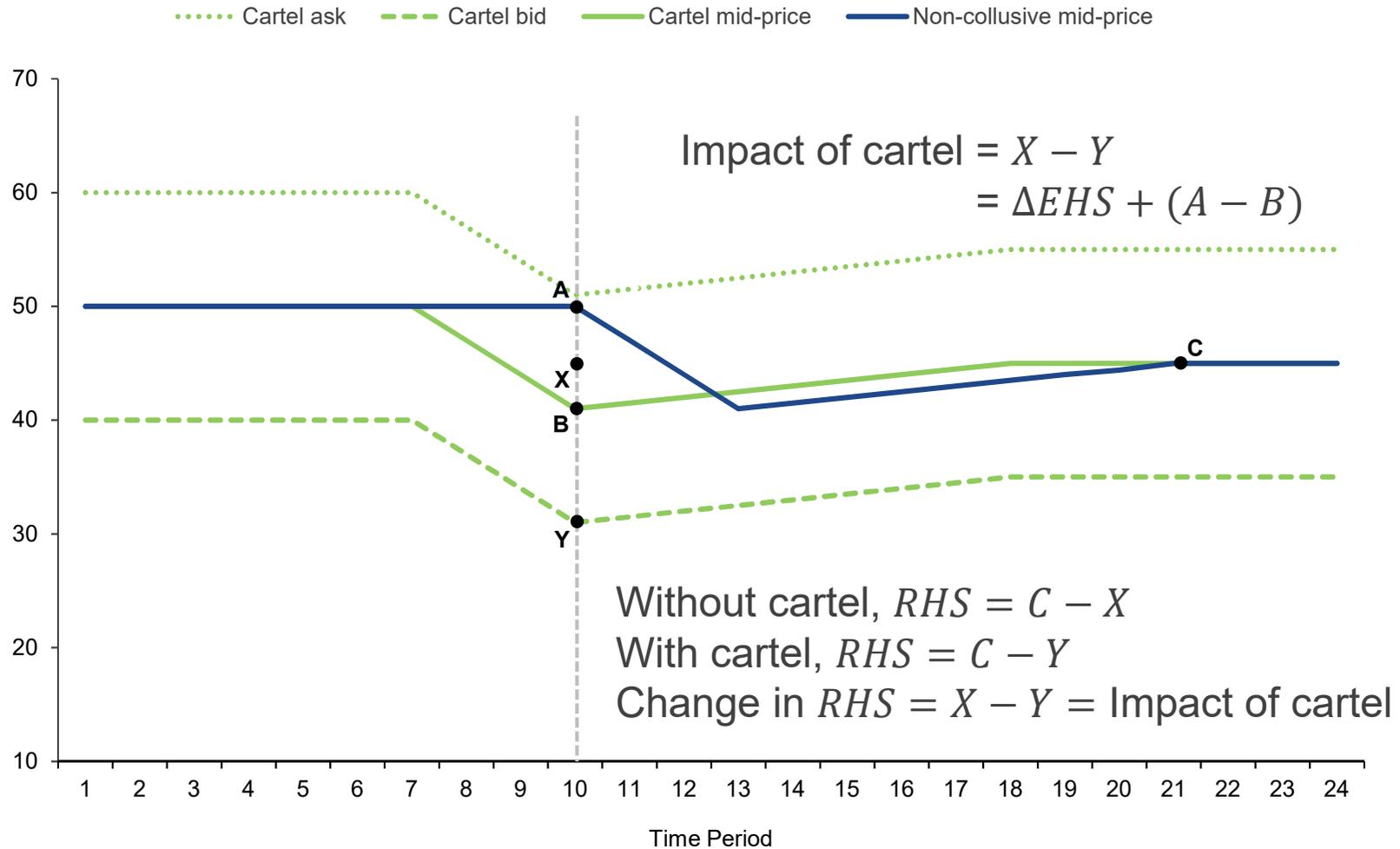
Measuring overcharges: Selecting the measure of spreads (continued) – realized spread



Measuring overcharges: Selecting the measure of spreads (continued) – realized spread

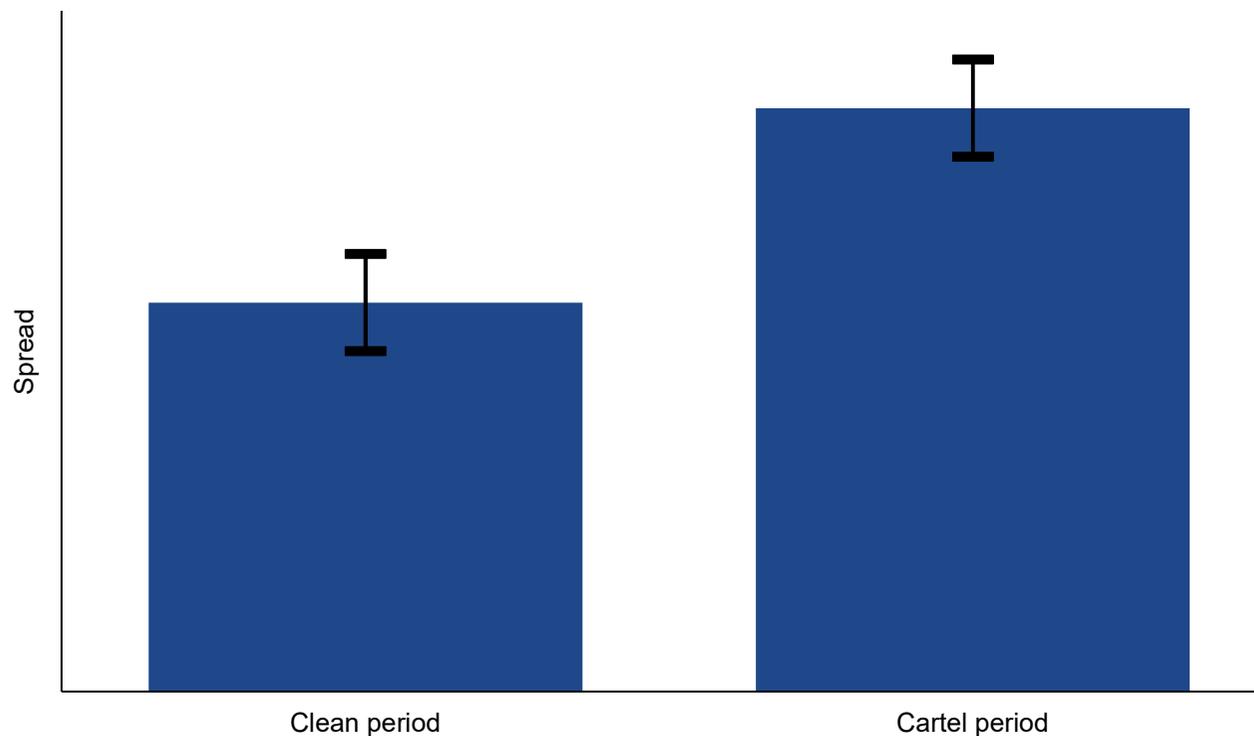


Measuring overcharges: Selecting the measure of spreads (continued) – realized spread



Measuring overcharges: A primer on regression methods

- A simple approach: calculate the average spread for transactions during the operation of the cartels, and for transactions during a “clean” period, and compare them.



Measuring overcharges: A primer on regression methods (continued)

- An Ordinary Least Squares regression is simply a way of calculating *the average of a variable, conditional on the values of other variables*.
- The simplest regression equation (where i indexes a transaction occurring at time t):

$$SPREAD_{it} = a + \varepsilon_{it}$$

- If we estimated this regression equation, the estimate of a would just be equal to the average spread.

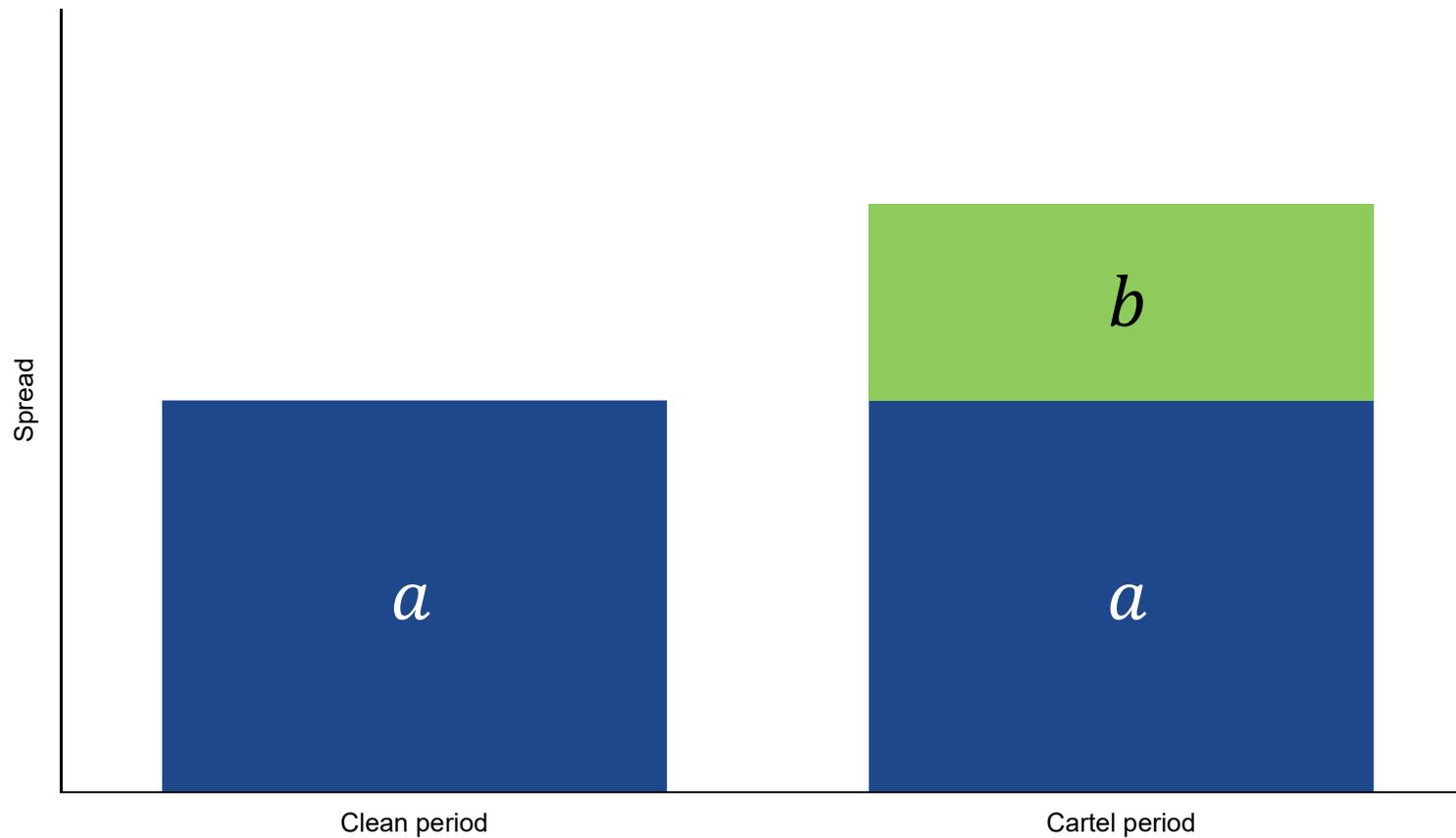
Measuring overcharges: A primer on regression methods (continued)

- To measure the average effect of the cartels on spreads, we might define a “dummy variable,” call it C_{it} , which is equal to 1 if t is in the cartel period and 0 in the clean period. Then we could write a slightly more complicated regression:

$$SPREAD_{it} = a + \mathbf{b}C_{it} + \varepsilon_{it}$$

- If we estimated this regression equation, the estimate of a would just be equal to the average spread in the clean period, and the estimate of $a + b$ would just be equal to the average spread in the cartel period, and b would be equal to the difference between the averages.
- In other words, the regression would just reproduce the original picture.

Measuring overcharges: A primer on regression methods (continued)



Measuring overcharges: A primer on regression methods (continued)

- Why do we need a regression to calculate two averages? We don't, but...
 - Spreads may depend on other market conditions.
 - Other market conditions may have changed between the clean period and the cartel period.
 - Example: If costs were lower (higher) during the cartel period than in the clean period, we'll conclude the cartel increased spreads by less (more) than they actually did.

Measuring overcharges: A primer on regression methods (continued)

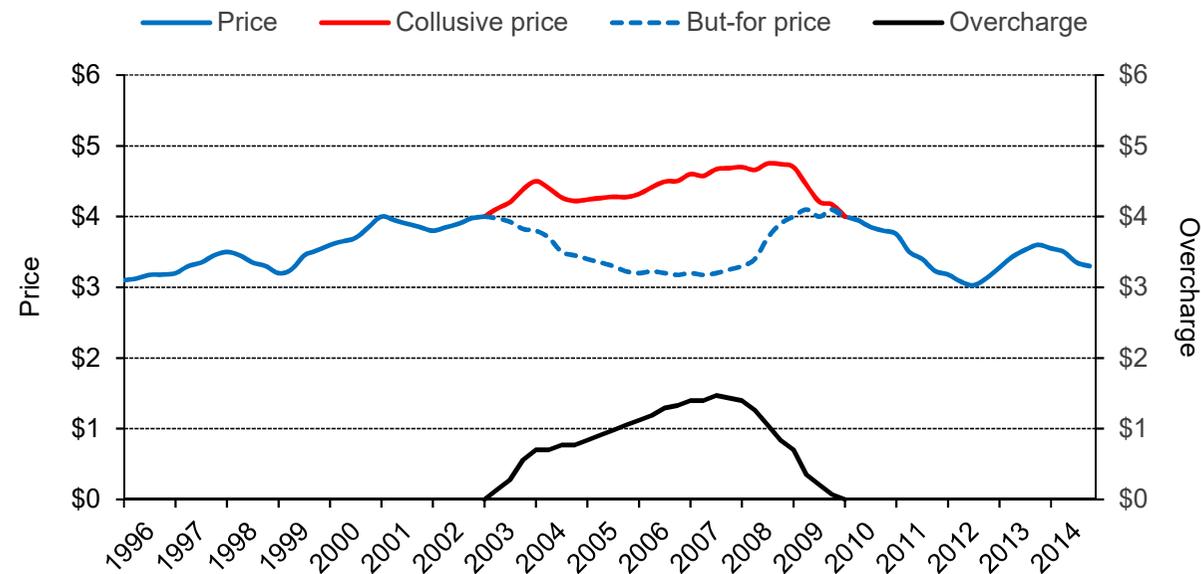
- The solution: include other factors, like costs, in the regression equation

$$SPREAD_{it} = a + b \cdot C_{it} + c \cdot \mathbf{MarketCondition}_{it} + \varepsilon_{it}$$

- Now the estimate of c tells us how the average spread varies with the market condition. Critically, b now measures the difference between average spreads in the clean period and in the cartel period, adjusting for the difference in market conditions.
- This is the *single cartel dummy variable model*.

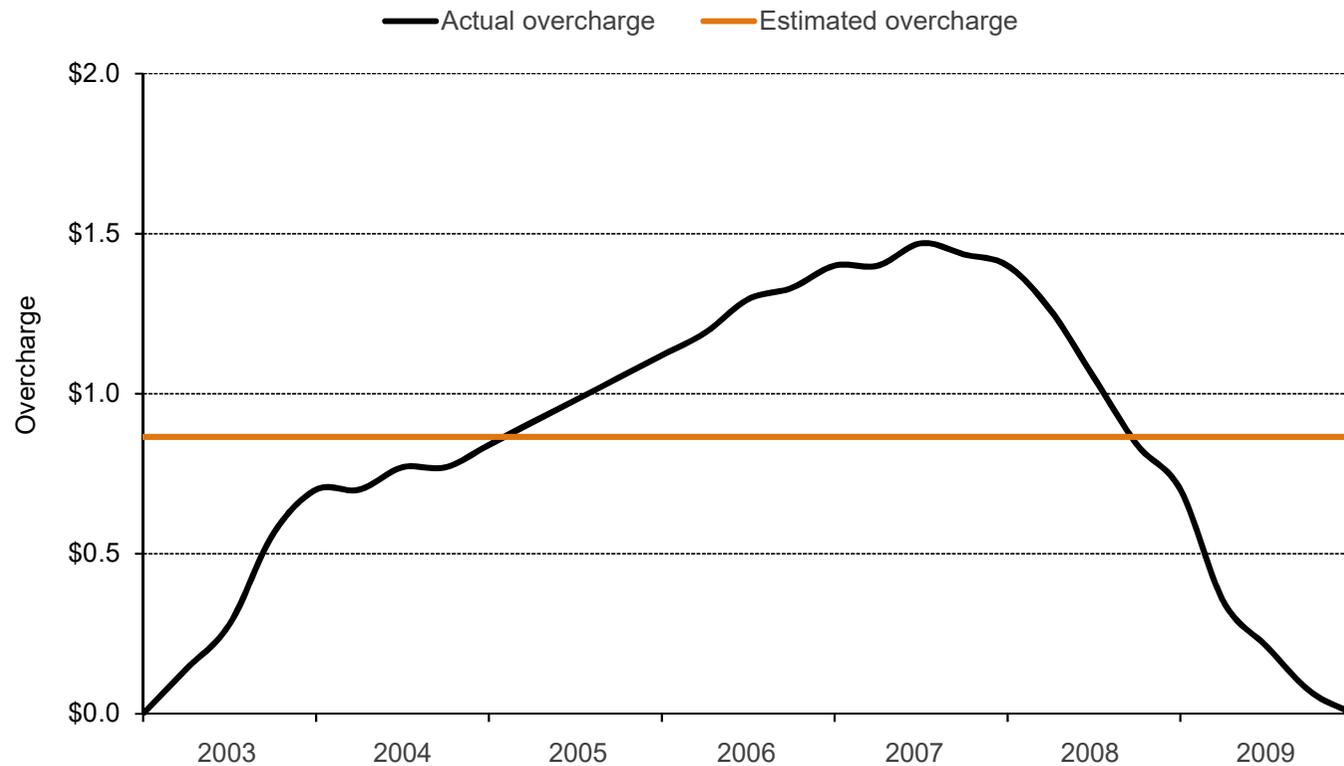
Measuring overcharges: A primer on regression methods (continued)

- Other important methods include *models with cartel interactions terms, multiple cartel dummy variable models, and the prediction approach.*
- The motivation for these approaches is that the effect of a cartel might vary over time, possibly because the intensity of collusion varies, or the number of cartel members varies.



Measuring overcharges: A primer on regression methods (continued)

- Taken literally, the single cartel dummy variable model implies that the effect of the cartel doesn't change over time (apart from statistical “noise”).



Measuring overcharges: A primer on regression methods (continued)

- Is this a problem? Could it be that the single cartel dummy variable regression accurately measures the average overcharge, even though it doesn't capture the time pattern of overcharges?
- Answer: maybe yes, maybe no. It depends on whether the effectiveness of the cartel is correlated with market conditions. If there is no relationship between effectiveness and the market conditions that determine spreads, the approach will measure the cartel's average effect correctly.

Measuring overcharges: A primer on regression methods (continued)

- Unfortunately, there are often reasons to think the effectiveness of a cartel is correlated with market conditions. For example:
 - Firms may become more opportunistic, and less likely to collude, as costs rise.
 - Firms may drop out of the market as costs rise, making collusion easier.
 - Demand may become either more or less sensitive to price, making it either harder or easier to collusively raise prices.
 - Firms may join or drop out of the cartel depending on market conditions.

Measuring overcharges: A primer on regression methods (continued)

- One solution: add cartel interaction terms to the regression equation:

$$SPREAD_{it} = a + b \cdot C_{it} + c \cdot MarketCondition_{it} + d \cdot C_{it} \cdot MarketConditions_{it} + \varepsilon_{it}$$

- Here, we allow for the possibility that the effect of the cartel on average spreads varies with market conditions.
- We can also use these sorts of interactions to measure the cartels' effects on different types of transactions.

Measuring overcharges: A primer on regression methods (continued)

- Another approach: use more than one cartel dummy variable
- To illustrate: we might define two “dummy variables,” one called F_{it} , which is equal to 1 if t is in the first half of the cartel period and 0 otherwise, the other called S_{it} , which is equal to 1 if t is in the second half of the cartel period and 0 otherwise. Then we could estimate:

$$SPREAD_{it} = a + \mathbf{b}_f \cdot \mathbf{F}_{it} + \mathbf{b}_s \cdot \mathbf{S}_{it} + c \cdot MarketCondition_{it} + \varepsilon_{it}$$

- This equation allows for the possibility that the cartel has a different impact on average spreads during its first half and during its second half.

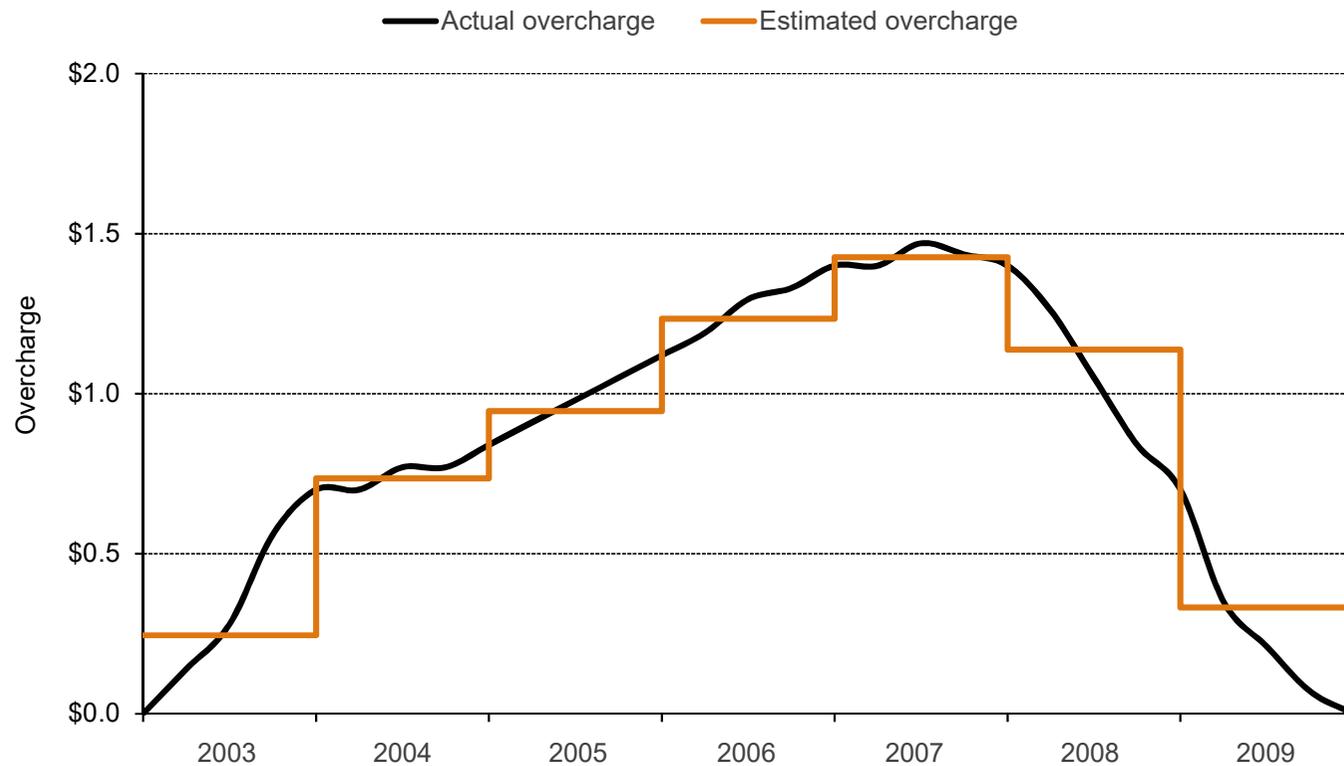
Measuring overcharges: A primer on regression methods (continued)

$$SPREAD_{it} = a + \mathbf{b}_f \cdot \mathbf{F}_{it} + \mathbf{b}_s \cdot \mathbf{S}_{it} \\ + c \cdot MarketCondition_{it} + \varepsilon_{it}$$

- Notice that the single cartel dummy variable model is the special case of this model where $b_f = b_s$.
 - Once we estimate this model, we can test the validity of that restriction, and determine whether the data are consistent or inconsistent with the single dummy variable model.
 - If these two models imply very different average effects of the cartel, we'll probably find that the data reject the single cartel dummy variable model.

Measuring overcharges: A primer on regression methods (continued)

- If we include enough of these dummy variables, we can approximate the variation in the cartel's effectiveness over time.



Measuring overcharges: A primer on regression methods (continued)

- A natural thought: if we obtain a better approximation for the variation in the cartel's effectiveness over time by using more cartel dummy variables representing shorter periods, why don't we just take the shortest possible period?
- Mathematically, this approach would “dummy out” all the data from within the cartel period. It is equivalent to:
 - Estimating a regression equation depicting the relationship between spreads and market conditions using data only from the clean period.
 - Using the estimated model to predict spreads for the cartel period.
 - Evaluating the impact of the cartel by calculating the difference between the actual and predicted spreads for each transaction, and averaging them within any desired period.

Measuring overcharges: A primer on regression methods (continued)

- This procedure is known as the *prediction approach*. It is essentially the *most flexible version of the dummy variable approach*.
- The prediction approach is no more computationally complex than the single dummy variable approach.
- The statistical assumptions required for the validity of the prediction approach are less restrictive than those required for the validity of the other approaches I've mentioned.
- Like the single and multiple cartel dummy variable approaches and models with interactions, the prediction approach is widely used to measure cartel damages in the U.S.



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