A Mechanism Design Approach to Merger Review

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Introduction

- Mergers raise competitive concerns if they “encourage one or more firms to raise price, reduce output, diminish innovation, or otherwise harm customers as a result of diminished competitive constraints or incentives.” (HMG)
- Review often employs tools based on market shares and diversion ratios
  - HHI
  - UPP
  - Merger simulation

Introduction

- Recent review by the DOJ of the proposed merger of two oilfield services firms, Halliburton and Baker Hughes, highlighted challenges:
  - Multi-product firms offering bundled services: cost synergies, demand complementarities, one-stop shopping preferences
  - Some large, powerful buyers (Shell, ExxonMobil)
  - Low and high WTP buyers (low/high value wells)
  - Buyers seek competing bids
- DOJ Complaint focused on effects within individual product markets, but then raised multi-product issues as amplifying competitive concerns

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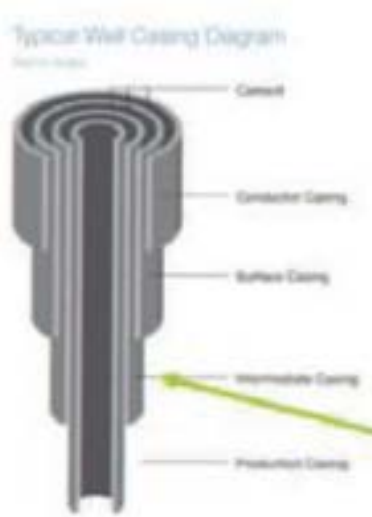

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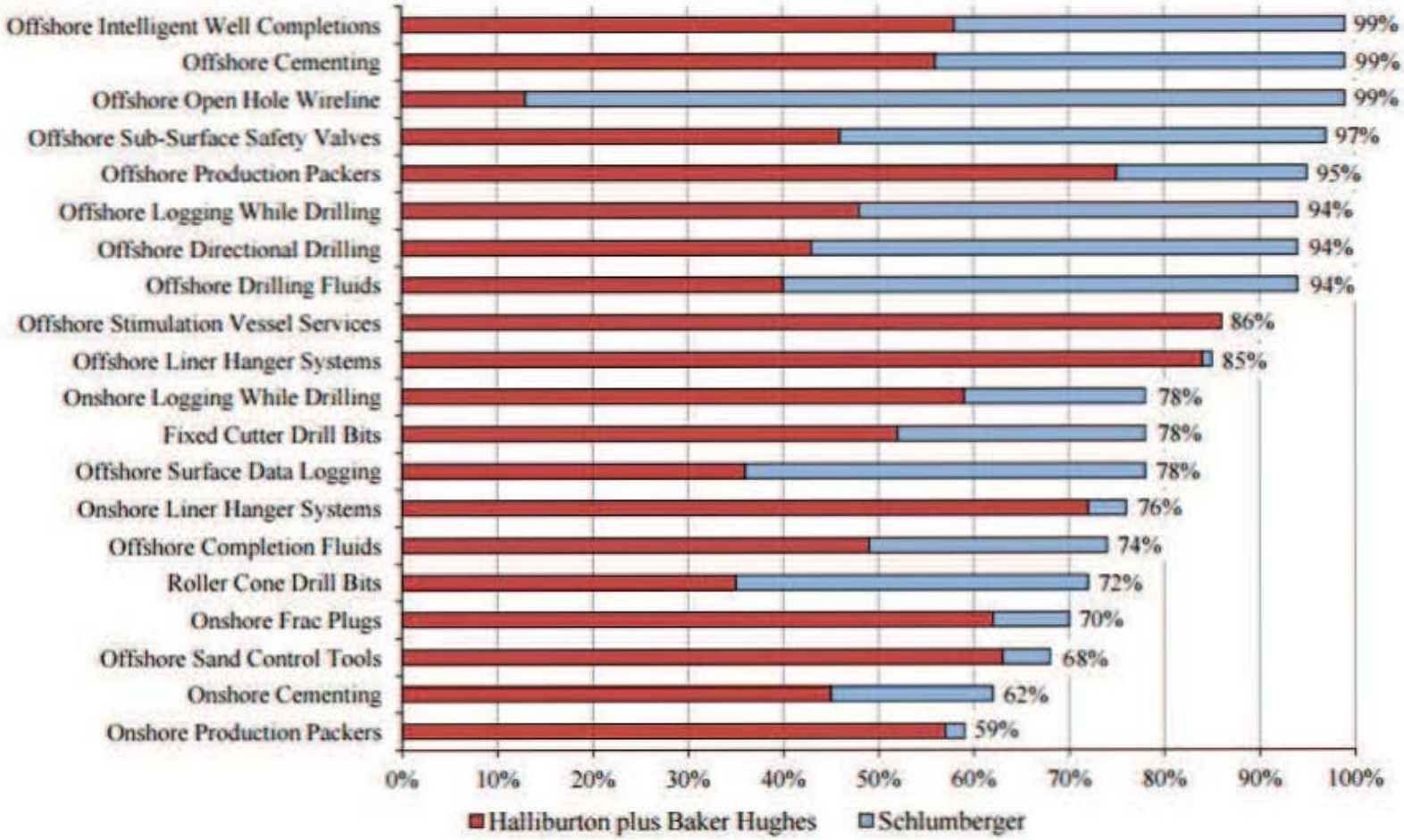
United States v. Halliburton and Baker Hughes

Merger Harms Customers By Leaving Them With Two Dominant Suppliers



Shares are for the U.S. market as alleged in the Complaint. Three problematic markets are not shown above because of data limitations: Cased Hole Wireline Services for Rigs in Deepwater, Multilateral Completions Systems, and Integrated Refracturing Solutions.

This Paper

- Provides a mechanism design based approach that allows analysts to capture:
  - Purchases made through competitive procurement
  - Multi-product suppliers
  - Demand complementarities
  - One-stop preferences
  - Cost synergies
  - Varying buyer power and WTP

Mechanism design based approach

- Model the market as a mechanism that determines the allocation and payments
- View markets as having a mix of weak and powerful buyers
- **Weak buyers**:
  - Must rely on competition among suppliers to police prices
  - Trade whenever buyer value exceeds production cost
- **Powerful buyers**:
  - “Powerful buyers are often able to negotiate favorable terms with their suppliers.” (HMG)
  - Can negotiate a price below what is required for a supplier simply to outcompete rivals
  - Trade only when the production cost is below the buyer’s optimal reserve price

Mechanism design based approach

- Market outcome maximizes:

  $$\alpha(\text{expected buyer surplus}) + (1 - \alpha)(\text{social surplus})$$

  subject to dominant strategy incentive compatibility and individual rationality
- $\alpha \in [0, 1]$ measures buyer power
- Focus on dominant strategy implementation

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Key Findings

- Merger of firms producing complements can be good for buyers (even without one-stop preferences)
- Merger of firms producing substitutes:
  - Increases price and reduces quantity and buyer surplus
  - Buyer power:
    - Mitigates without eliminating effects on price and buyer surplus
    - Exacerbates quantity effects
  - Buyers with low buyer power and low WTP affected most
  - One-stop preferences amplify merger effects, especially when buyer power is low

Literature

- Merger analysis based on auction models of procurement
  Waehrer (1999), Waehrer & Perry (2003), Miller (2014)
- Mergers with multi-product suppliers
  O'Brien & Shaffer (2005)
- Buyer power and its role in merger analysis
  Crawford & Yurukoglu (2012), Gowrisankaran, Nevo, & Town (2015), Collard-Wexler, Gowrisankaran, & Lee (2016)
- Role of entry in merger analysis
  Werden & Froeb (1998)
- Coordinated effects

  Gayle, Marshall, Marx, & Richard (2011), Miller & Weinberg (2016)

Plan

- Setup with multi-product suppliers
- Approach to modeling merger
- Illustration of results using an example

Setup

- 1 buyer and 2 products A and B
- n sellers partitioned into multi-product sellers, $\mathbb{M}$, sellers of only A, denoted $\mathbb{A}$, and sellers of only B, denoted $\mathbb{B}$
- Products are perfect complements for the buyer (zero value for each individually)
- Value v for the pair if purchased from different suppliers and $v^1 \geq v$ if from the same supplier (common knowledge)

Setup: Seller types

- Each seller i independently draws a cost type c_i from distribution G_i with support $[\underline{c}_i, \overline{c}_i]$, with $\overline{c}_i > v$[1] (worst types seller never trade), and density g_i
- Sellers' types are their private information
- The cost type of a multi-product seller is the cost producing both products, whereas the cost type of a single-product seller is the cost of producing only one product
- Multi-product seller $i \in \mathbb{M}$ can supply only A at cost $\gamma_i^A c_i$ and only B at cost $\gamma_i^B c_i$
  - $\gamma_i^A, \gamma_i^B < 1$ are common knowledge
  - If $\gamma_i^A + \gamma_i^B > 1$, then there are cost synergies
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Setup: Payoffs

- Players are risk neutral
- A buyer's payoff is 0 if he does not trade, otherwise value minus payment
- A seller's payoff is 0 if she does not trade, otherwise payment minus cost

Optimal mechanism

Expected buyer surplus under allocation rule $(\mathbf{q}^A, \mathbf{q}^B)$ and payment rule $\mathbf{m}$ is:

$$E_{\mathbf{c}}\left[\sum_{i\in\mathbb{M}} v^1 q_i^A(\mathbf{c}) q_i^B(\mathbf{c}) + \sum_{\substack{i\in\mathbb{M}\cup\mathbb{A}\\ j\in\mathbb{M}\cup\mathbb{B}\\ i\neq j}} v q_i^A(\mathbf{c}) q_j^B(\mathbf{c}) - \sum_{i=1}^{n} m_i(\mathbf{c})\right]$$

and similarly for social surplus with costs replacing payments

Optimal mechanism

Proposition

Using IC and IR, can write the α-weighted objective as:

$$E_{\mathbf{c}}\left[\sum_{i\in\mathbb{M}}\left(v^1-\Gamma_i^{\alpha}(c_i)\right)q_i^A(\mathbf{c})q_i^B(\mathbf{c})\right.$$
$$\left.+\sum_{\substack{i\in\mathbb{M}\cup\mathbb{A}\\ j\in\mathbb{M}\cup\mathbb{B}\\ i\neq j}}\left(v-\gamma_i^A\Gamma_i^{\alpha}(c_i)-\gamma_j^B\Gamma_j^{\alpha}\left(c_j\right)\right)q_i^A(\mathbf{c})q_j^B(\mathbf{c})\right]$$

where

$$\Gamma_i^{\alpha}(c)\equiv c+\alpha\frac{G_i(c)}{g_i(c)}$$

is the weighted virtual cost.

Optimal mechanism: Allocation

Corollary

In the α-optimal mechanism, quantities traded are determined by the maximum among:

1. $0 \quad \rightarrow$ *no trade*
2. $v^1 - \Gamma_i^\alpha(c_i) \quad$ *for* $i \in \mathbb{M} \quad \rightarrow \quad q_i^A = q_i^B = 1$
3. $v - \gamma_i^A \Gamma_i^\alpha(c_i) - \gamma_j^B \Gamma_j^\alpha(c_j) \quad$ *for* $i \neq j \quad \rightarrow \quad q_i^A = q_j^B = 1$

Optimal mechanism: Payments to sellers

- In the dominant strategy implementation, payments to sellers are defined by threshold cost types

▸ Payment details

Merger of multi-product firms

- Merged firm's cost type is the min of the merging firms' cost types (assumed regular)
- Cost of just A is determined by the lowest A-share of cost for the merging firms (similarly for B)

$$\gamma_{ij}^{A} = \min\{\gamma_i^{A}, \gamma_j^{A}\} \text{ and } \gamma_{ij}^{B} = \min\{\gamma_i^{B}, \gamma_j^{B}\}$$

Illustration: Merger of multi-product firms

- 3 multi-product firms and 2 single-product firms
- Merger of 2 of the multi-product firms

▸ Distribution details

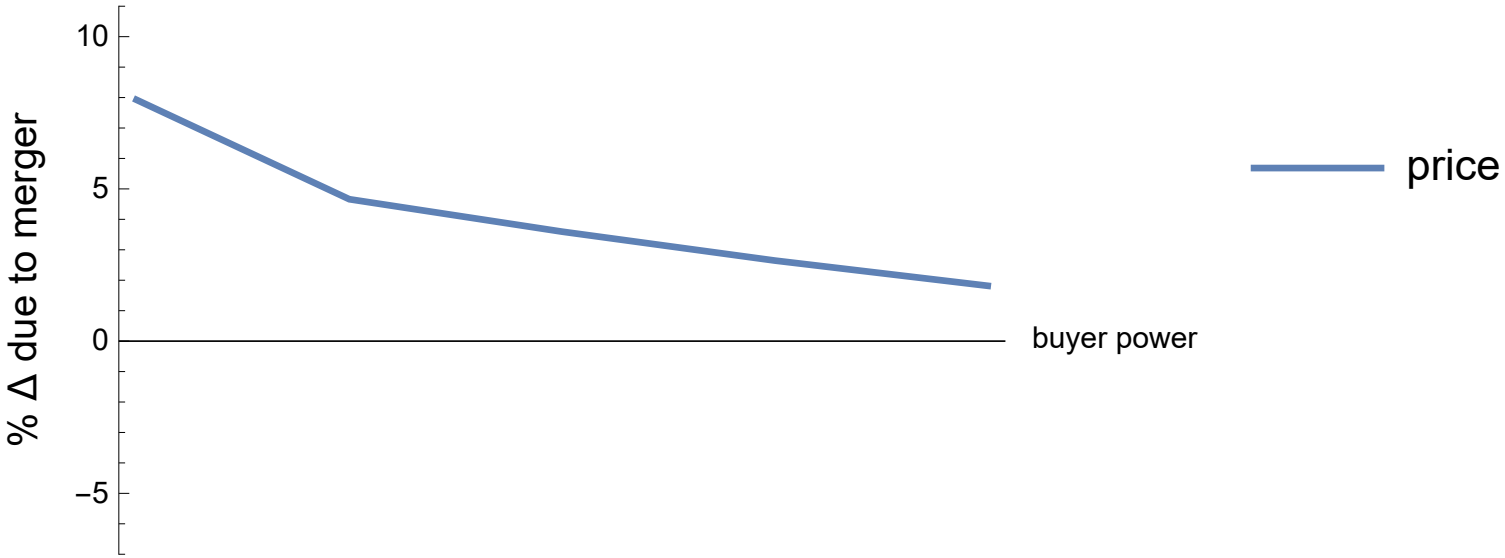
Merger effects
Powerful, High WTP buyers

Pre-merger firm	1	2	3	4	5
Pre-merger revenue share	27	27	27	9	9
Post-merger revenue share	49		31	10	10

$$HHI = 2349,\ HHI' = 3562,\ \Delta HHI = 1213$$

Merger effects
High WTP buyers

- Higher prices, lower output, and lower buyer surplus
- Buyer power mitigates price and surplus effects but exacerbates quantity effects
- One-stop preference exacerbates price and surplus effects



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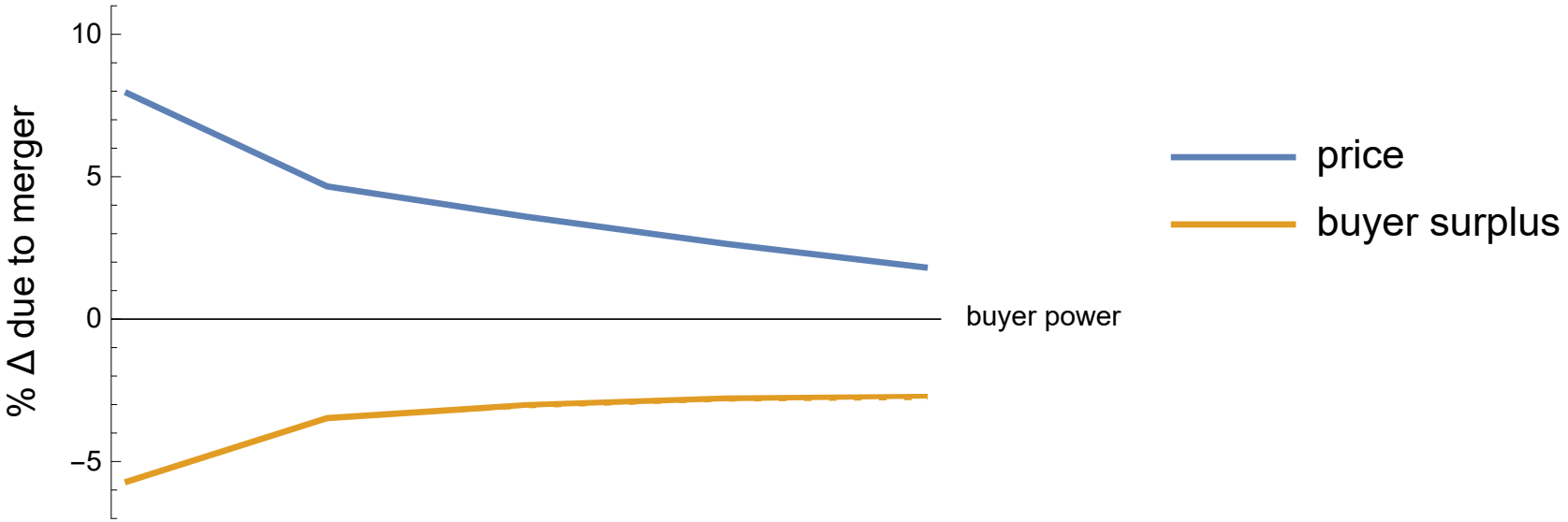

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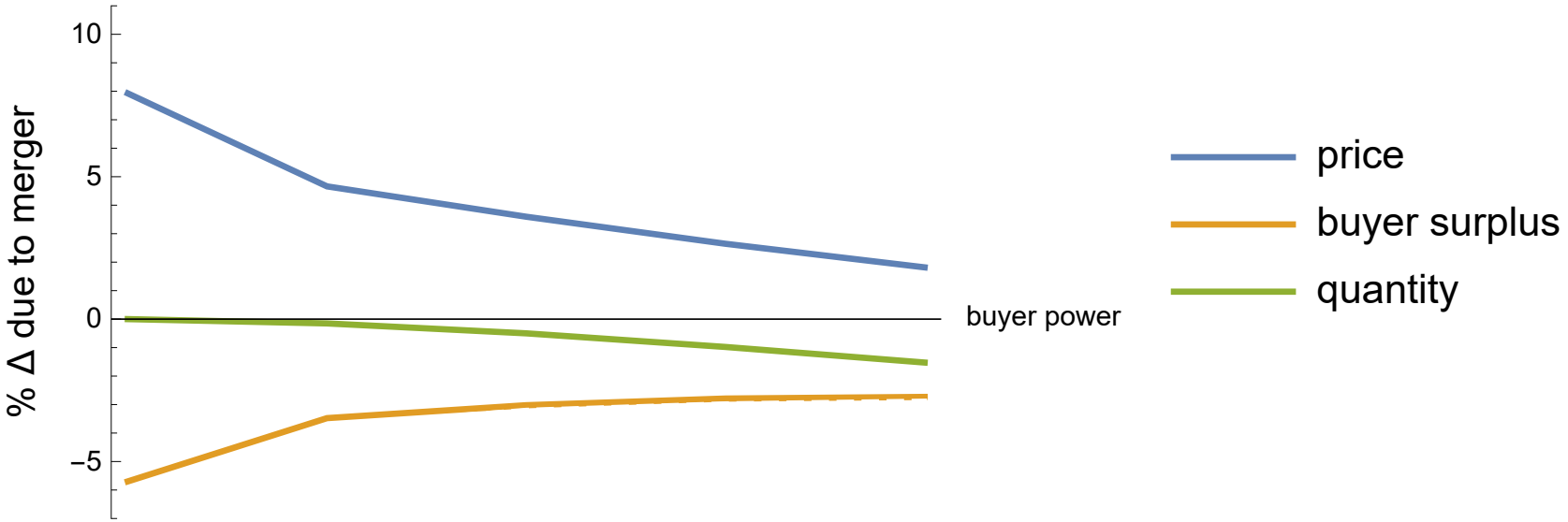

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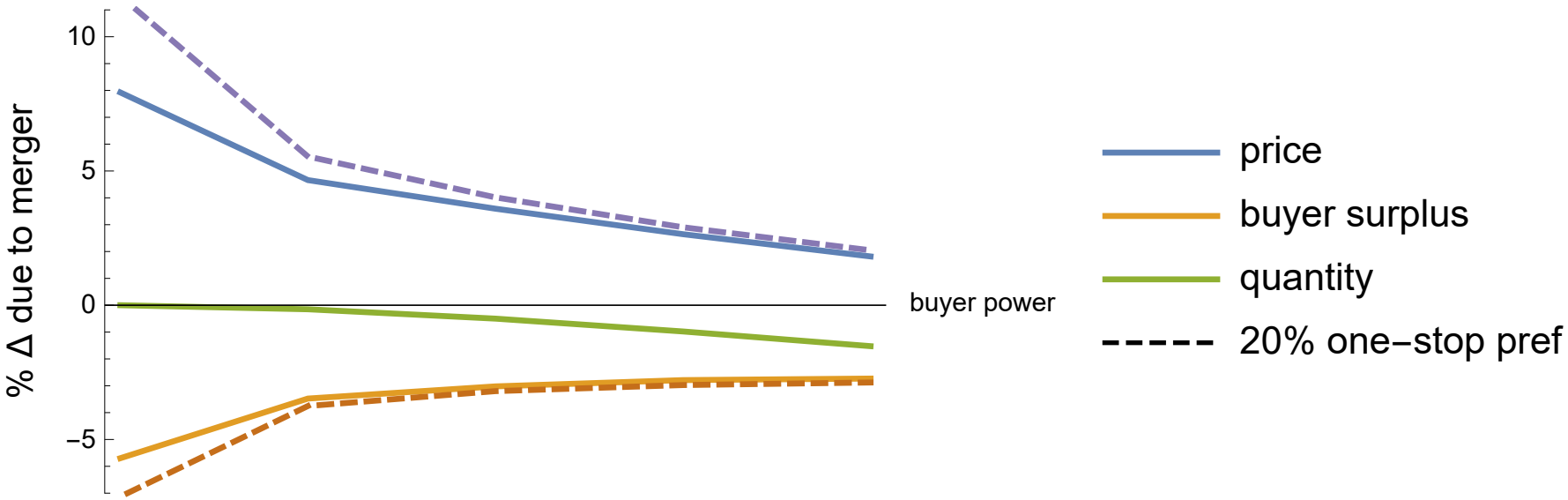

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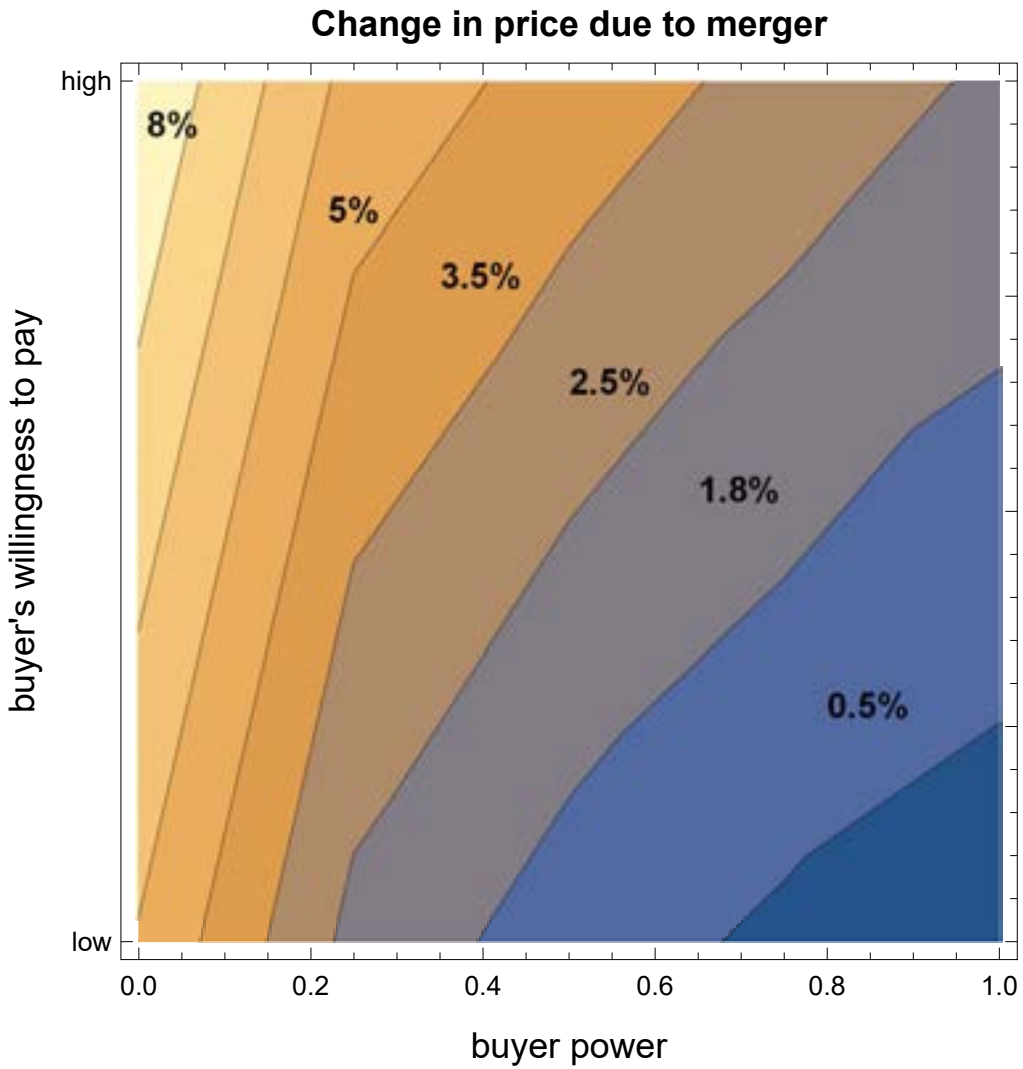

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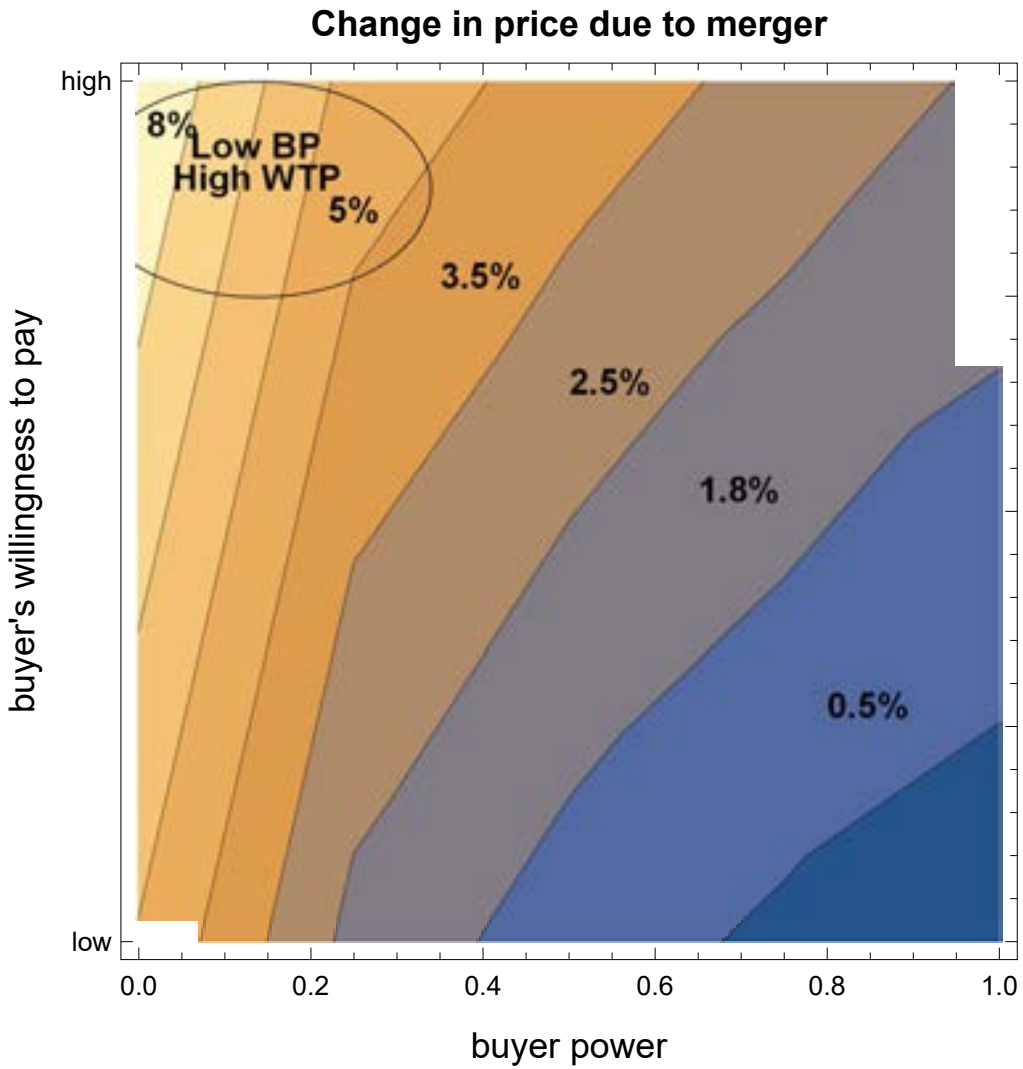

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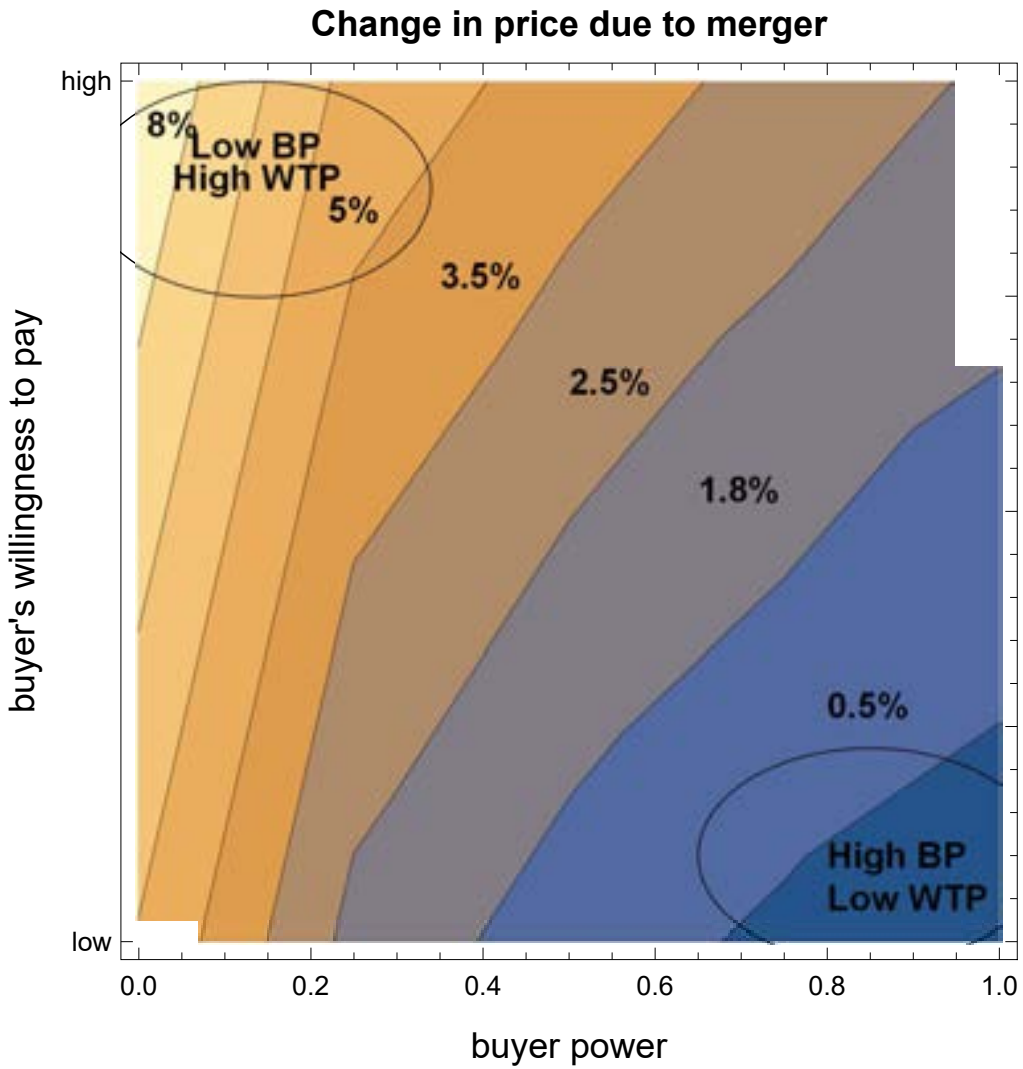

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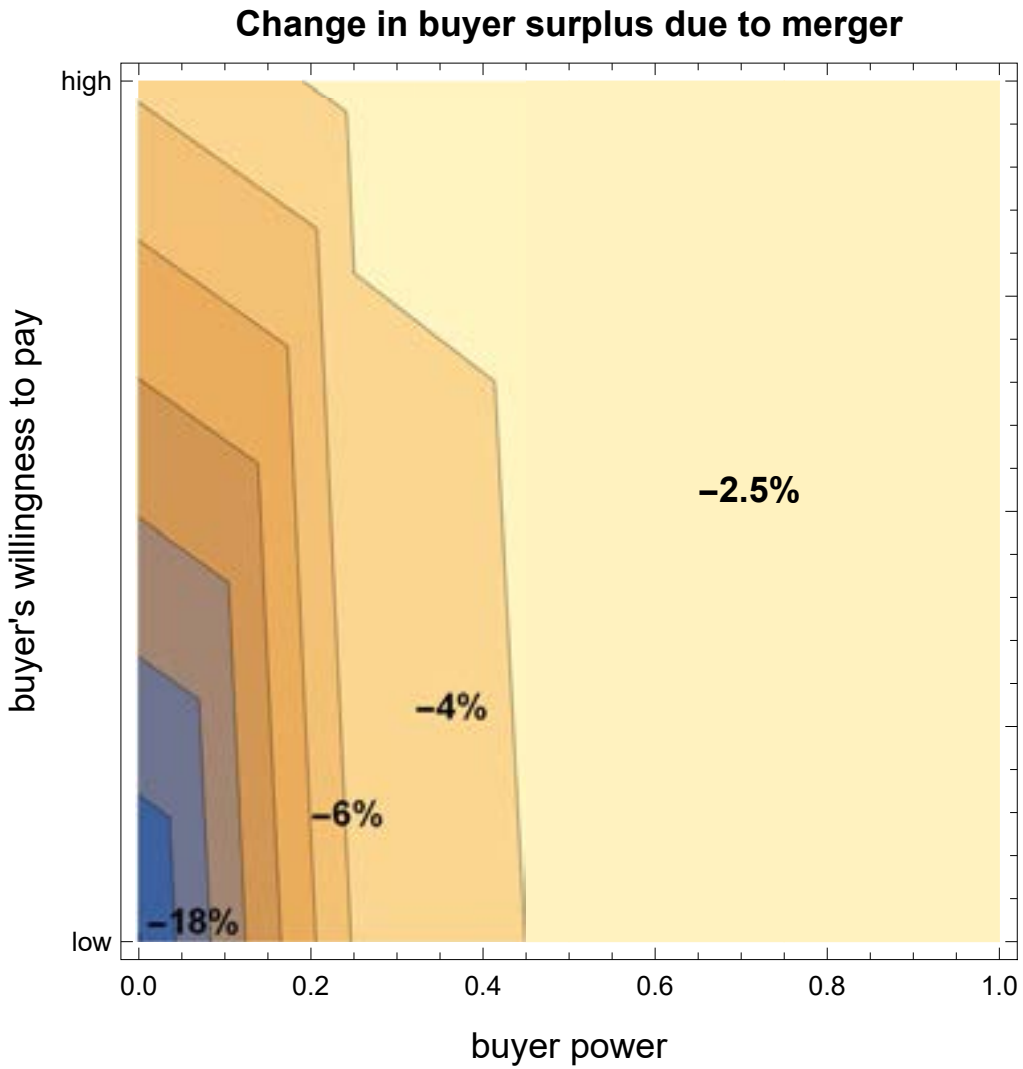

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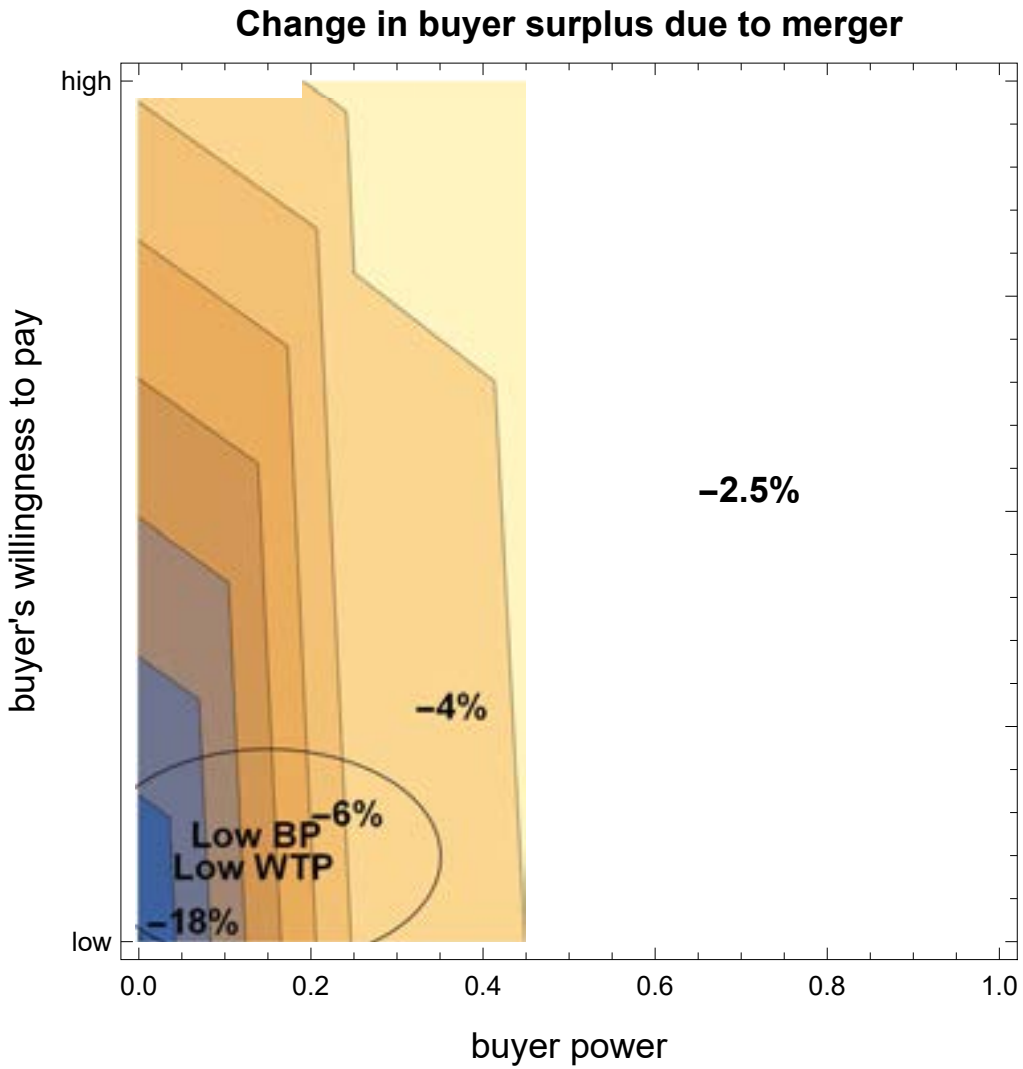

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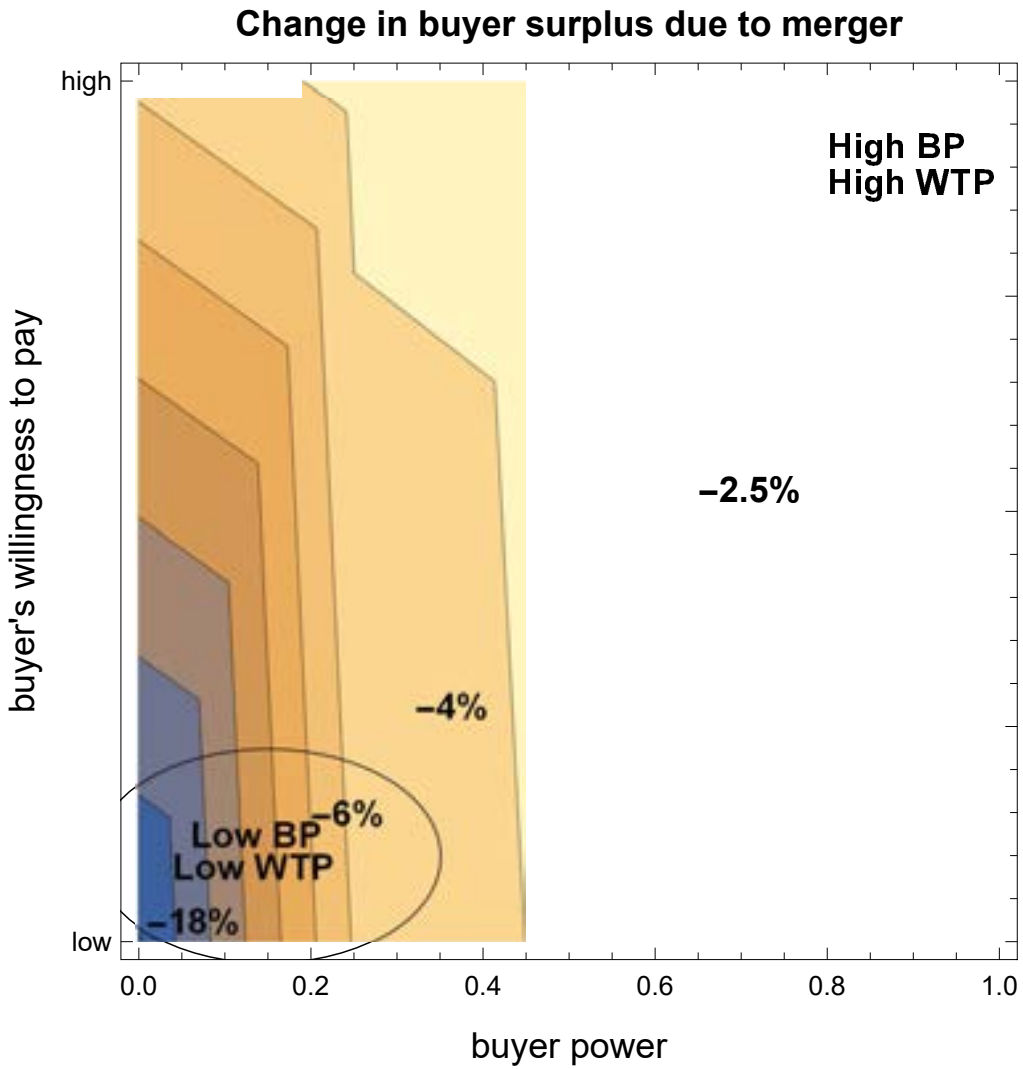
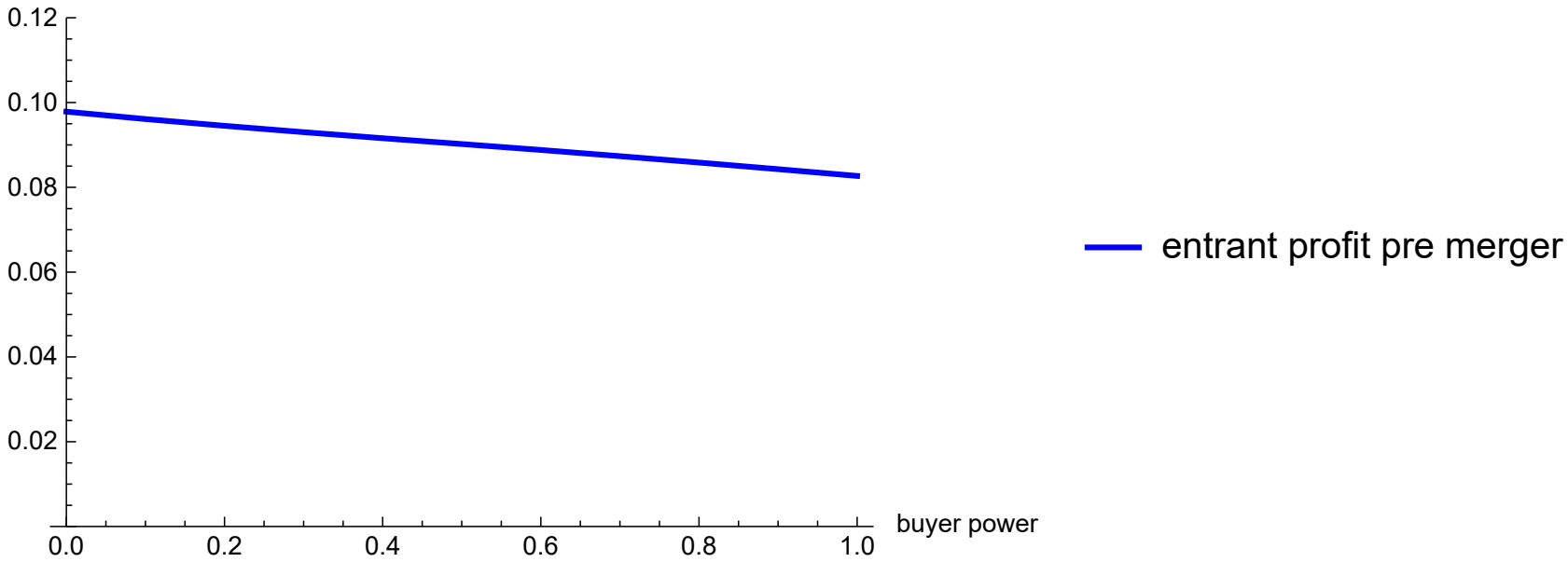


Effects of entry
High WTP buyers

- Entry can offset the price effects of the merger, but should we expect entry?



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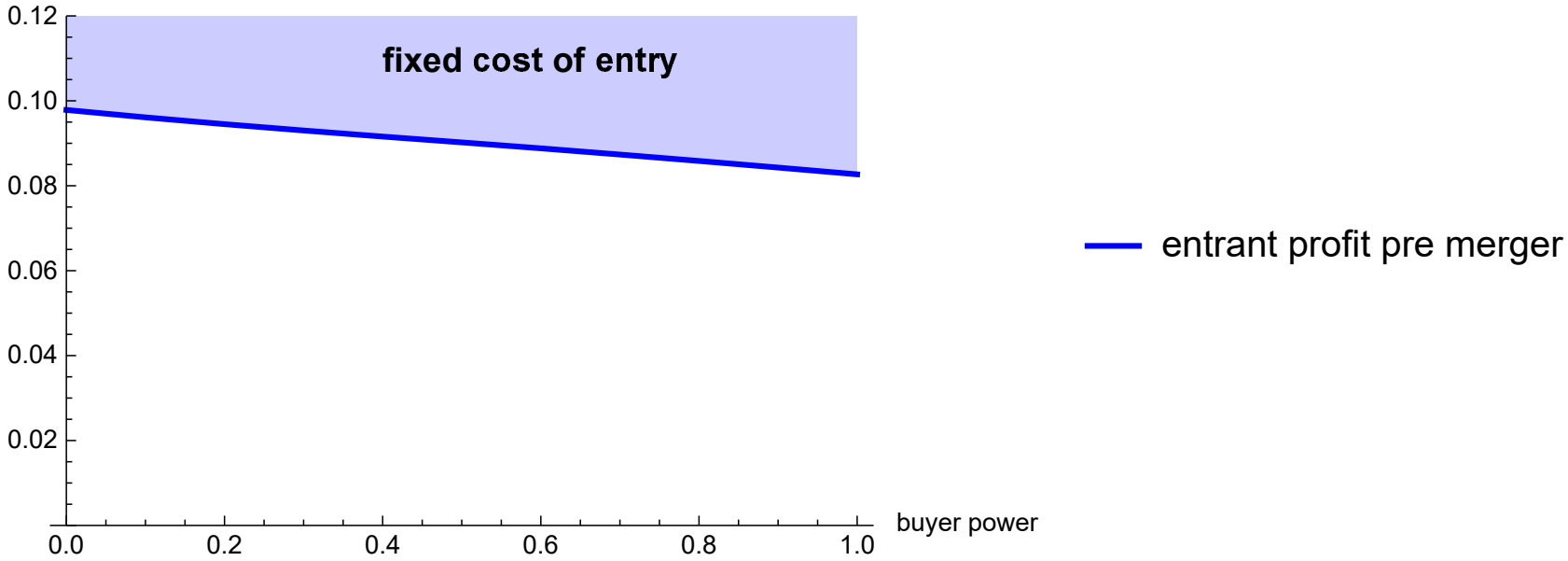

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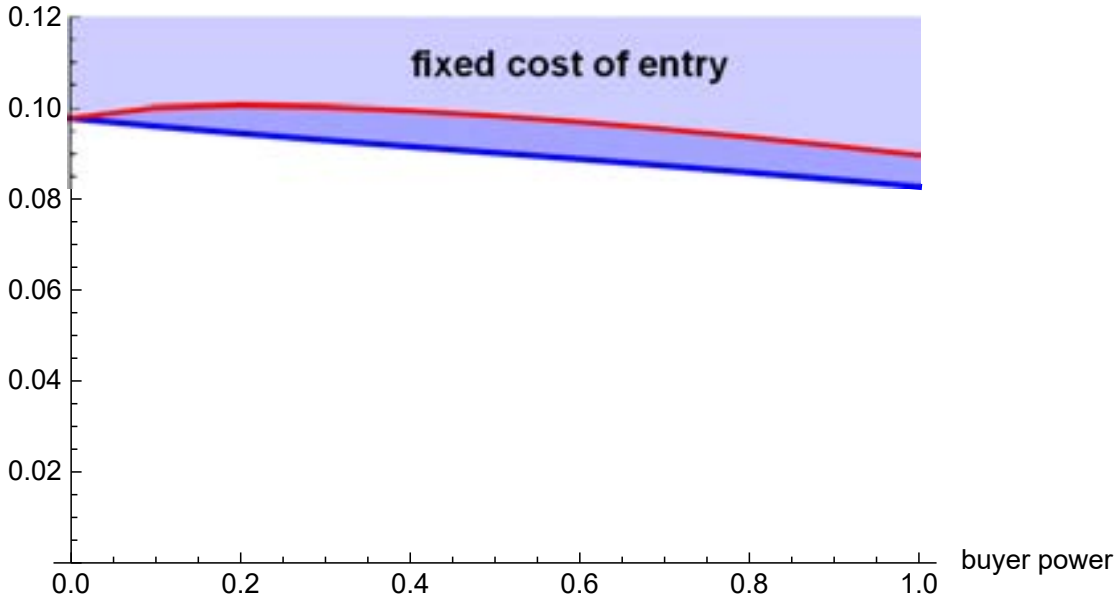

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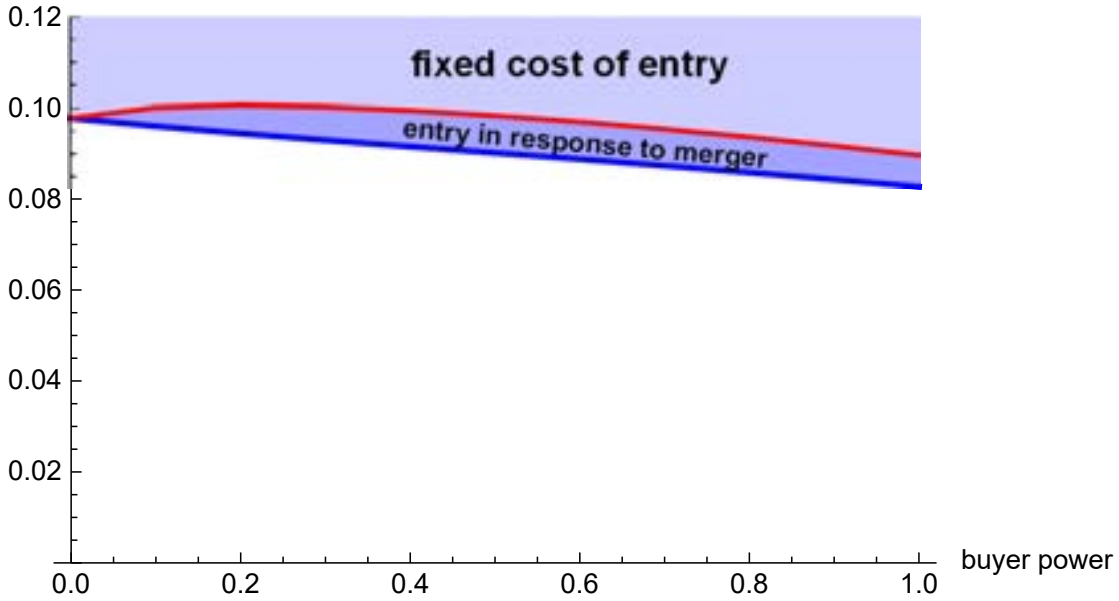
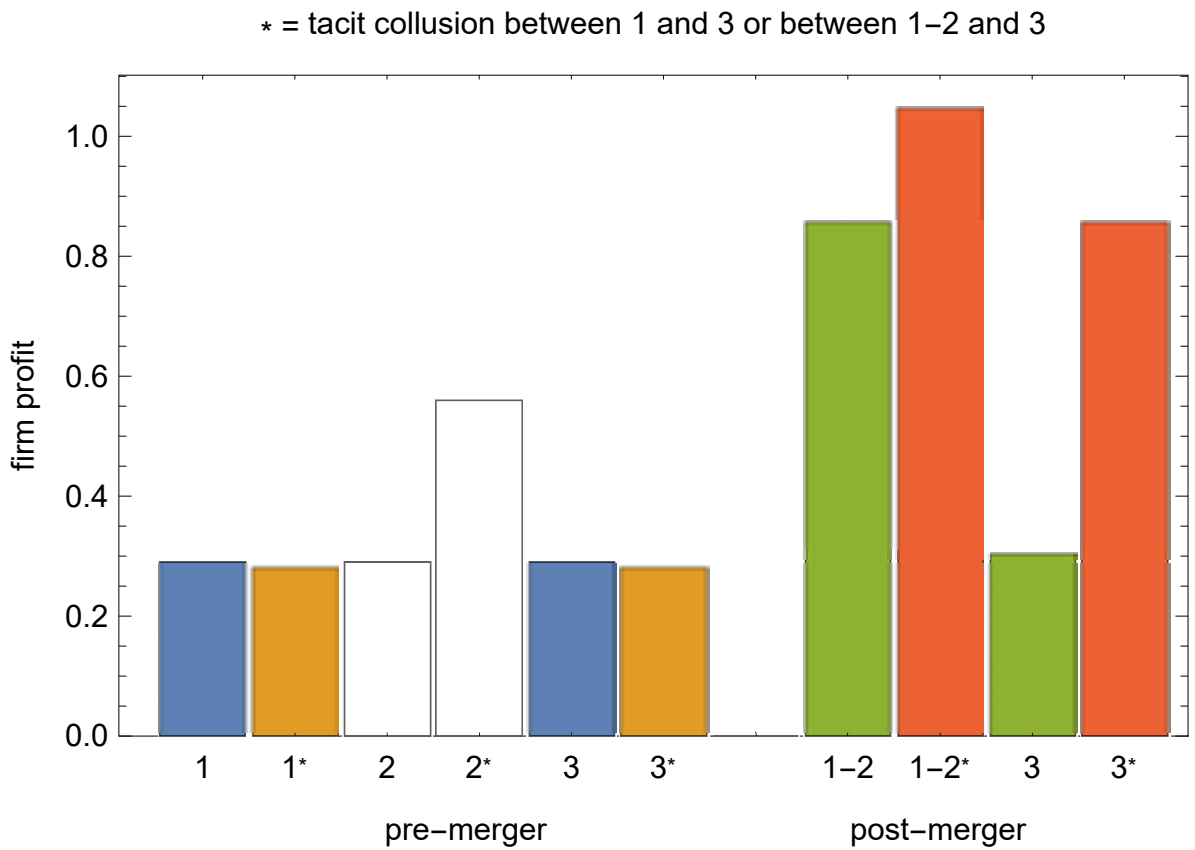


Coordinated effects

- Not explicit collusion – so no communication
- Bilateral rotation scheme
  - Pre-merger: Not profitable for 1 and 3 (or 2 and 3)
  - Post-merger: Profitable for 1-2 and 3



Conclusion

- Take a mechanism design approach to merger review
- Provide a merger simulation tool that:
  - Allows a formalization of buyer power
  - Captures auction-based price formation
  - Addresses multi-product issues
- Potentially fruitful avenue for future research
- More work to be done ...

Thank you

Payments to sellers

- In the dominant strategy implementation, payments to sellers are defined by threshold cost types
- For example, suppose that for a given $\mathbf{c}$, seller i supplies both A and B
- As seller i's cost increases, holding fixed the other costs, i will either cease supplying completely or switch to supplying either only A or only B
- Let $c_i^{AB,-}$ and $c_i^{AB,A}$ denote the costs for i such that for lower costs seller i supplies both A and B and for higher costs she supplies either nothing or only A, respectively
- Other threshold types defined analogously

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Payments to sellers

- Threshold payments are defined by the threshold types: a trading seller is paid the worst cost the seller could report and still trade the same quantity plus the payment associated with any lower quantity that would have been supplied under worse types
- If $c_i^{AB,A} < c_i^{A,B} < c_i^{B,-}$ and $c_i < c_i^{AB,A}$, then i supplies A and B and is paid

$$c_i^{AB,A} + \gamma_i^A(c_i^{A,B} - c_i^{AB,A}) + \gamma_i^B(c_i^{B,-} - c_i^{A,B})$$

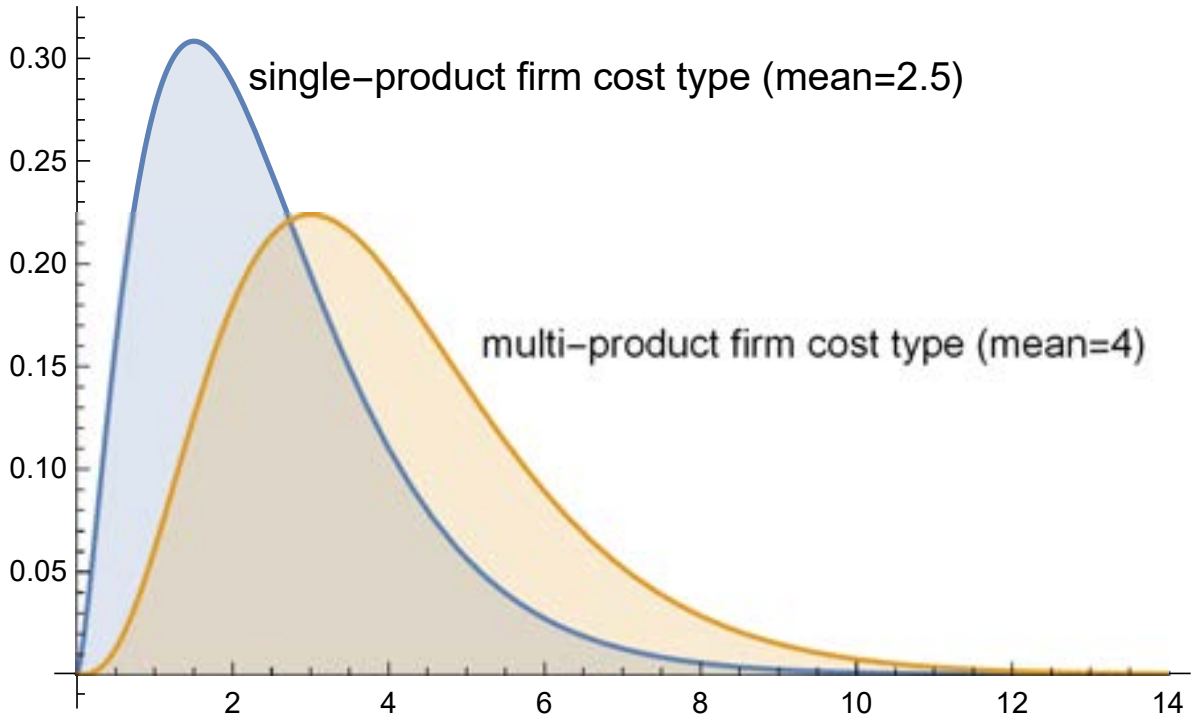
Proposition

Dominant strategy incentive compatibility holds under threshold payments.

Return

Distribution details

- Model costs as drawn from the truncated Gamma distribution
  - Two parameters: s_1 (shape) and s_2 (scale) with mean $s_1 s_2$ and variance $s_1 s_2^2$
  - $s_1 = 4$ for two-product and $s_1 = 2.5$ for one-product sellers
  - $s_2 = 1$ for all



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