Transaction Taxes in a Price Maker/Taker Market

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Introduction

- Regulators recently proposed taxing financial transactions:
- Goals of such a tax:
  - Reduce price volatility
  - Raise large revenue from very small tax
  - Solve problem of “too much” trading?
  - Encourage long-term investing
  - Push *harmful* (?) speculators out of the market
- Arguments claimed against such a tax:
  - Reduces: securities’ values, market volume, and liquidity
  - Distorts market (reduces market efficiency)
  - Pushes trade to other venues/countries
- Our goal: study costs and (some) benefits of a tax.

Thinking on Transactions Taxes

- Tobin (1974): tax to help economies manage FX rates.
- Proponents: DeFazio, Merkel, Summers and Summers (1989), Stiglitz (1989), ul Haq *et al* (1996), Spahn (2002), Pollin *et al* (2003).
- Opponents: Friedman (1953), Campbell and Froot (1994), Kupiec (1995,1996), Habermeier and Kirilenko (2001), Forbes (2001).
- Umlauf (1993): Sweden 1%; some trading moved, volatility $\not\searrow$.
- Dupont and Lee (2007): asymmetric info $\Rightarrow$ tax lowers volume more.

Are Transaction Taxes Like Trading Fees?

- Some studies have looked at (analogous?) trading fees:
- Jones and Seguin (1997): lower commissions $\Rightarrow \sigma \downarrow$.
- Liu and Zhu (2009): lower commissions $\Rightarrow \sigma \uparrow$.
- Colliard and Foucault (2012): make/take fees
- Foucault, Kadan, and Kandel (2012): make/take fees; monitoring costs
- However, fees often benefit one side of trading.
- Degryse, Van Achter, and Wuyts (2012): post-trade fees, broker choice; reserve price $= v_H$ or v_L.

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Microstructure Approach

- Market microstructure: perfect for analyzing tax effects.
- Foucault (1999): buyers, sellers choose to make/take prices.
- Mirrors current realities of trading:
  - Anand *et al* (2005), Hasbrouck and Saar (2009): Traders make *and* take prices.
  - Parlour and Seppi (2008): Mostly limit order markets.[1]
- Extended Foucault (1999) to study costs of transaction tax.
  - Continuous distribution of private reserve values;
  - Fraction μ of traders who are pure market makers; and,
  - Each trader pays tax of τ/share traded.
- Calibrated model allows studying many market phenomena.

[1] Predicted by Black (1971).

Results Preview

We find a transaction tax:

- Widens optimal, effective spreads by much more than tax;
- Lowers likelihood of trading (volume); increases search times.
- Greatly reduces value of limit orders and gains from trade;
- May reduce volatility slightly for small tax + markets w/o MMs;
- Increases volatility (up to $3\times$ @ 50 bp);
- Affects markets with market makers more than those without; and,
- Is revenue-optimal for 55–70 bp.

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Why Extend Foucault (1999)?

- Traders actively choose price taking versus price making.
    - If tax changes decisions, strategic action is key.
- Why extend? Taxes do not play nicely with Foucault (1999).
    - Traders only have two reservation values, $v \pm L$
    - $\Rightarrow$ either no effect or eliminates trading.
- Extension allows studying endogenized market phenomena:
    - Traders strategically set bid and ask values;
    - Fail to trade if quotes not appealing to next trader;[2]
    - Differences between quoted and effective spreads;
    - Realized volatility.
- Offers insight into how market metrics (*e.g.* volume) change with tax

[2] More fine-grained than buy vs sell in Foucault (1999).

Setup

- v = asset value (constant)
- Sequence of iid traders enter market, one per period
- Traders iid; may be market maker w.p. μ or investor.
  - Private reservation value: $v + d_t$ where $d_t \overset{iid}{\sim} F$.
  - Market maker: $d_t = 0$;
  - Investors: $d_t \overset{iid}{\sim} (0, L^2)$.
- Market continues w.p. $\rho \in (0, 1)$ after each period.
- Each trader taxed τ/share at position entry+exit.

Strategic Quoting

Traders choose strategically whether or not to quote a bid and ask.

- Consider traders at time t (Ilsa), $t+1$ (Rick), $t+2$ (Sam).
- Price maker/taker model; Rick strategically chooses:
  - Take: Trade against Ilsa's quote, or
  - Make: Quote bid $v-\delta$ and ask $v+\beta$ for Sam.
- Rick must also determine his optimal δ and β.
- Thus Rick chooses $\max(R_T, R_Q|d_{t+1})$ where:

$$\begin{aligned} R_T &= \text{benefit of taking Ilsa's bid/ask} \\ R_Q|d_{t+1} &= \text{benefit of quoting optimal bid, ask for Sam} \end{aligned}$$

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Taking and Quoting Benefits

- Ilsa is in the same position.
- Denote prior trader's[3] quotes by $v - \delta_{t-1}$, $v + \beta_{t-1}$.

$$R_T = \max(-d_t - \delta_{t-1}, d_t - \beta_{t-1}) - 2\tau \tag{1}$$

$$\begin{aligned} R_Q|d_t &= \rho \overbrace{F(-R_Q^{0*} - \delta - 2\tau)}^{P(\text{next trader sells at bid})} (d_t + \delta - 2\tau) + \\ &+ \rho \underbrace{F(-R_Q^{0*} - \beta - 2\tau)}_{P(\text{next trader buys at ask})} (\beta - d_t - 2\tau) \end{aligned} \tag{2}$$

$$R_Q^{0*} = \int_\Omega R_Q|d_t dF \tag{3}$$

- But we need to know that R_Q^{0*} exists.

[3] Ugarte's?

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Characterizing Propositions

We characterize equilibrium by proving a few propositions.

1. Rick will only want to buy from Ilsa, sell to her, or quote.
2. If $d_t > 0$, the bid-ask quote is shifted higher $(\beta > \delta)$[4]
3. Bid-ask spread $\delta + \beta > 4\tau =$ twice trader's tax.
4. For $F = \Phi$ (Gaussian cdf): unique Markov Perfect equilibrium.

Coming soon: closed form results for simple distributions.

1. *e.g.* If $d_t \sim$ uniform, market makers do not trade.

[4] And likewise for $d_t < 0$.

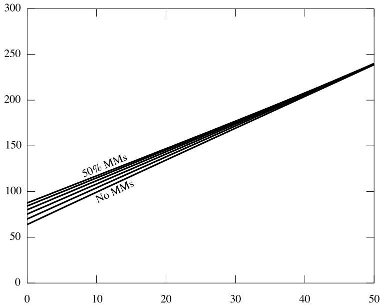
Model Setup: Numerical Analysis

Consider a market calibrated to typical characteristics:

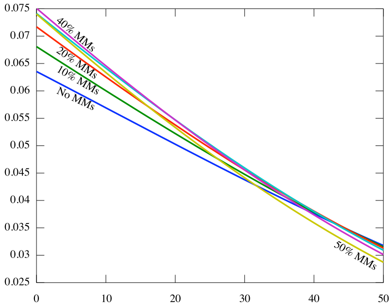
- Value $v = \$20$; private reservation values $v + d_t$.
- Traders: $d_t \overset{iid}{\sim} F$
- P(trading continues next period) $\rho = 0.9$
- Transaction tax τ: \$0–\$0.10/share traded (0–50 bp).
- Investor: w.p. $1 - \mu$, $d_t \overset{iid}{\sim} N(0, L^2)$
- Reserve price volatility $L = \$0.5 = 2.5\%$[5]

[5] If daily net trades $\Rightarrow$ 40% annual volatility.

Optimal Spread and Optimal Quoting Benefit



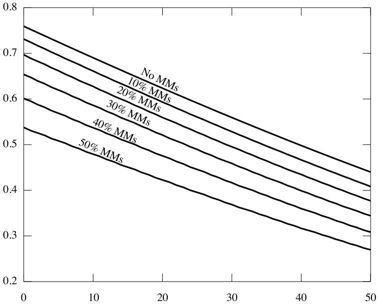
Optimal Spread (bp) vs. tax (bp)



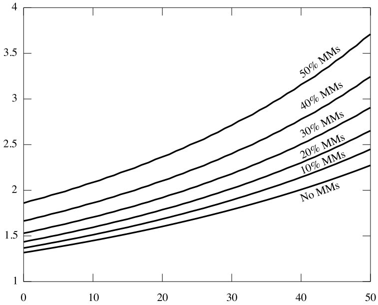
E(Quoting Benefit) R_Q^{0*} vs. tax (bp)

- Optimal spread: 60→240 bp (no MMs), 85→240 bp (50% MMs).
- R_Q^{0*}: $\underbrace{\$0.064}_{32bp} \rightarrow \underbrace{\$0.032}_{16bp}$ (no MMs), $\underbrace{\$0.074}_{37bp} \rightarrow \underbrace{\$0.027}_{14bp}$ (50% MMs)
- MMs ⇒ spread (bit), quoting value more sensitive to tax.
- MMs compete for fill: quoted spread ↑, quoting value ↓

Fill Rate and Search Costs



Fill Rate vs. tax (bp)



Search Costs (periods) vs. tax (bp)

- Fill rate: 75%→45% (no MMs), 54%→27% (50% MMs)
- Search costs (1/fill rate): 1.3→2.3 (no MMs), 1.9→3.7 (50% MMs)
- Roughly: Fill rates halved, search costs doubled.

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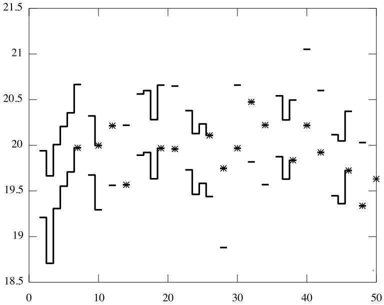
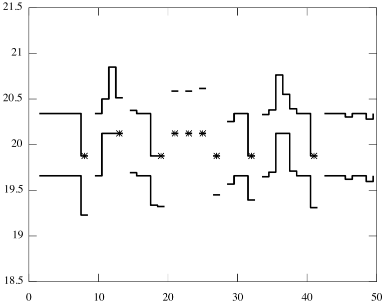
Simulated Trades

- Can then simulate trading ($N = 100000$) to see more effects.
- Example quote and price paths for no tax:

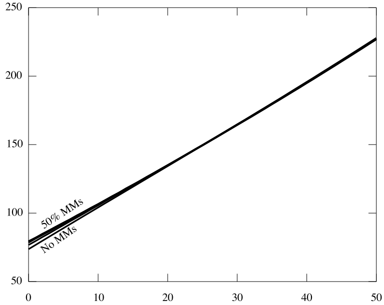


No MMs, No Tax

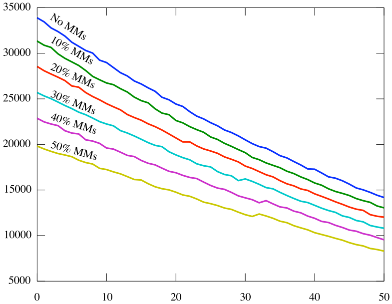


50% MMs, No Tax

Effective Spread and Gains from Trade



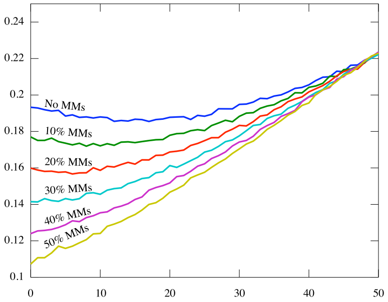
Effective Spread (bp) vs. tax (bp)



Gains from Trade vs. tax (bp)

- Effective spreads are about the same regardless of MMs.
- Effective spreads increase by more than 3× tax.
- MMs: $d_t = 0$, compete for fill ⇒ lower gains from trade.
- 50 bp tax decreases gains from trade by about 60%.

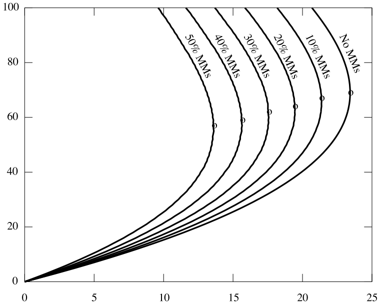
Volatility



Volatility ($) vs. tax (bp)

- For taxes up to 50 bp, more MMs → lower volatility.
- No MMs: volatility ↓ by up to 4% at 15 bp, then increases.
  - This is the only (weakly) positive benefit we see for a tax.
  - At all tax levels, MMs lower volatility more than tax.
- 50% MMs: volatility tripled (!) at 50 bp; most sensitive.

Tax Revenues



Tax (bp) vs. Revenue

- Revenue-optimal tax: 57–69 bp.
- More MMs ⇒ lower optimal tax.
- Revenue per order: 14–23 bp.

Conclusion

We find that a transaction tax:

- Widens optimal and effective spreads by $> 3\times$ the tax;
- Reduces likelihood of trading (*i.e.* volume);
  - $\Rightarrow$ half volume @ 50 bp; double search time.
- 50 bp: E(quote revenue) $\downarrow$ 50%, gains from trade $\downarrow$ 60%;
- Yields higher price volatility for all but small taxes w/o MMs;
- Is revenue-optimal for 55–70 bp; (!)
- Deadweight loss suggests no tax is socially optimal; and,
- Positive feedback (destabilizing) traders are not dissuaded.