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

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 $v_L$. 
Microstructure Approach

- Market microstructure: perfect for analyzing tax effects.
- Foucault (1999): buyers, sellers choose to make/take prices.
- Mirrors current realities of trading:
  - 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 $\mu$ of traders who are pure market makers; and,
  - Each trader pays tax of $\tau$/share traded.
- Calibrated model allows studying many market phenomena.

¹Predicted 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 $3 \times 50 \text{ bp}$);
- Affects markets with market makers more than those without; and,
- Is revenue-optimal for 55–70 bp.
Why Extend Foucault (1999)?

- Traders actively choose price taking versus price making.
  - If tax changes decisions, strategic action is key.
  - 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;
  - 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

- $v = \text{asset value (constant)}$
- Sequence of iid traders enter market, one per period
- Traders iid; may be market maker w.p. $\mu$ or investor.
  - Private reservation value: $v + d_t$ where $d_t \sim F$.
  - Market maker: $d_t = 0$;
  - Investors: $d_t \sim (0, L^2)$.
- Market continues w.p. $\rho \in (0, 1)$ after each period.
- Each trader taxed $\tau$/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 $\nu - \delta$ and ask $\nu + \beta$ for Sam.
- Rick must also determine his optimal $\delta$ and $\beta$.
- Thus Rick chooses $\max(R_T, R_Q|d_{t+1})$ where:
  - $R_T = \text{benefit of taking Ilsa’s bid/ask}$
  - $R_Q|d_{t+1} = \text{benefit of quoting optimal bid, ask for Sam}$
Taking and Quoting Benefits

- Ilsa is in the same position.
- Denote prior trader’s\(^3\) quotes by \(v - \delta_{t-1}\), \(v + \beta_{t-1}\).

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

\[
P(\text{next trader sells at bid})
\]

\[
R_Q|d_t = \rho \left[ F(-R^0_{Q*} - \delta - 2\tau) \ (d_t + \delta - 2\tau) + \right.
\]

\[
+ \rho \left. F(-R^0_{Q*} - \beta - 2\tau) \ (\beta - d_t - 2\tau) \right]
\]

\[
P(\text{next trader buys at ask})
\]

\[
R^0_{Q*} = \int_\Omega R_Q|d_t dF
\]

- But we need to know that \(R^0_{Q*}\) exists.

\(^3\)Ugarte’s?
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 ($\beta > \delta$).
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.

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4 And likewise for $d_t < 0$. 
Consider a market calibrated to typical characteristics:

- Value $v = $20; private reservation values $v + d_t$.
- Traders: $d_t \overset{iid}{\sim} F$
- $P(\text{trading continues next period}) = \rho = 0.9$
- Transaction tax $\tau$: $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)**
- Optimal spread: 60→240 bp (no MMs), 85→240 bp (50% MMs).
- $R_Q^0$: $0.064 \rightarrow 0.032$ (no MMs), $0.074 \rightarrow 0.027$ (50% MMs)
  - $32bp$ → $16bp$
  - $37bp$ → $14bp$
- MMs ⇒ spread (bit), quoting value more sensitive to tax.
- MMs compete for fill: quoted spread ↑, quoting value ↓

**E(Quoting Benefit) $R_Q^0$ vs. tax (bp)**
Fill Rate and Search Costs

- 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.
Simulated Trades

- Can then simulate trading \((N = 100000)\) to see more effects.
- Example quote and price paths for no tax:
Effective Spread and Gains from Trade

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

- For taxes up to 50 bp, more MMs $\rightarrow$ 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

- Revenue-optimal tax: 57–69 bp.
- More MMs $\Rightarrow$ 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: $\mathbb{E}$(quote revenue) ↓ 50%, gains from trade ↓ 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.