

Transaction Taxes in a Price Maker/Taker Market

Dale W.R. Rosenthal[◦] Nordia D.M. Thomas*

[◦] University of Illinois at Chicago

* University of Wisconsin-La Crosse

Frontiers of Finance 2012

Warwick University

14 September 2012

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), Habermeier and Kirilenko (2001), Forbes (2001).
- Umlauf (1993): Sweden 1%; some trading moved, volatility \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 .

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.

¹Predicted by Black (1971).

Results Preview

We find a transaction tax:

- Widens quoted, effective spreads by more than tax;
- Lowers likelihood of trading (volume); increases search times.
- Greatly reduces value of limit orders and gains from trade;
- Increases volatility (up to $1.5\times$);
- Affects markets with market makers more than those without; and,
- Is revenue-optimal for 60–75 bp.

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

²More 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 $d_t \stackrel{iid}{\sim} F$.
 - Market maker: $d_t = 0$;
 - Investors: $d_t \stackrel{iid}{\sim} (0, L^2)$.
- 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:

R_T = benefit of taking Ilsa's bid/ask

$R_Q|d_{t+1}$ = benefit of quoting optimal bid, ask for Sam

Taking and Quoting Benefits

- Ilsa is in the same position.
- Denote prior trader's³ quotes by $v - \delta_{t-1}$, $v + \beta_{t-1}$.

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

$$R_Q|d_t = \rho \overbrace{F(-R_Q^{0*} - \delta - 2\tau)}^{P(\text{next trader sells at bid})} (d_t + \delta - 2\tau) + \rho \overbrace{F(-R_Q^{0*} - \beta - 2\tau)}^{P(\text{next trader buys at ask})} (\beta - d_t - 2\tau) \quad (2)$$

$$R_Q^{0*} = \int_{\Omega} R_Q|d_t dF \quad (3)$$

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

³Ugarte'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 ($\beta > \delta$)⁴
- 3 Bid-ask spread $\delta + \beta > 4\tau =$ twice trader's tax.
- 4 For $F = \Phi$ (Gaussian cdf): unique Bayesian Nash equilibrium.⁵

⁴And likewise for $d_t < 0$.

⁵Markov Perfect?

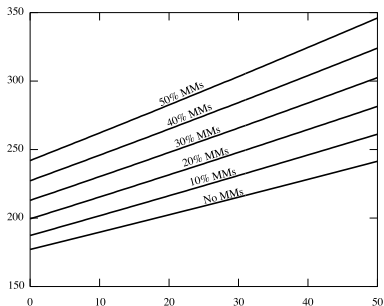
Model Setup: Numerical Analysis

Consider a market calibrated to typical characteristics:

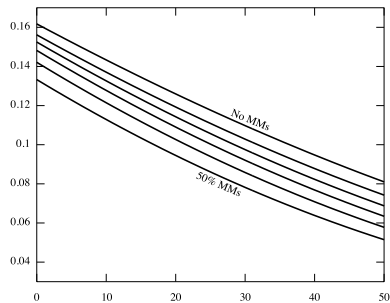
- Value $v = \$20$; private reservation values $v + d_t$.
- Traders: $d_t \stackrel{iid}{\sim} F$
- P(trading continues next period) $\rho = 0.9$
- Transaction tax τ : \$0–\$0.10/share traded (0–50 bp).
- Investor: w.p. $1 - \mu$, $d_t \stackrel{iid}{\sim} N(0, L^2)$
- Reserve price volatility $L = \$0.5 = 2.5\%^6$

⁶If daily net trades \Rightarrow 40% annual volatility.

Quoted Spread and Optimal Quoting Benefit



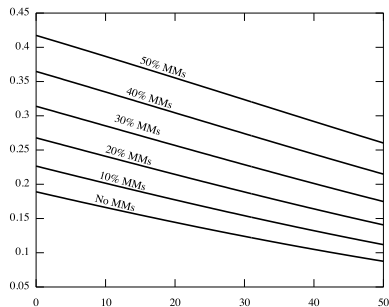
Spread (bp) vs. tax (bp)



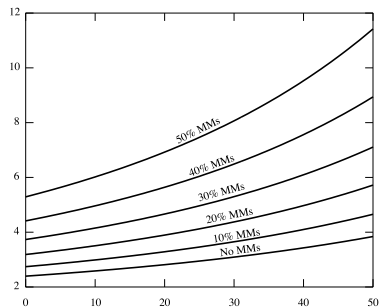
Optimal Quoting Benefit R_Q^* vs. tax (bp)

- Quoted spread: 175 → 240 bp (no MMs), 240 → 345 bp (50% MMs).
- R_Q^* : $\underbrace{\$0.16}_{80bp} \rightarrow \underbrace{\$0.08}_{40bp}$ (no MMs), $\underbrace{\$0.13}_{65bp} \rightarrow \underbrace{\$0.05}_{25bp}$ (50% MMs)
- MMs \Rightarrow spread (bit), quoting value more sensitive to tax.
- MMs compete for fill: quoted spread \uparrow , quoting value \downarrow

Fill Rate and Search Costs



Fill Rate vs. tax (bp)⁷



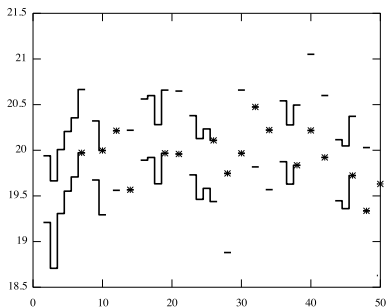
Search Costs (periods) vs. tax (bp)

- Fill rate: 42% → 26% (no MMs), 19% → 8% (50% MMs)
- Search costs (1/fill rate): 5 → 11.5 (no MMs), 2.3 → 4 (50% MMs)
- Roughly: Fill rates halved, search costs doubled.
- Again, markets with MMs are more sensitive to tax.

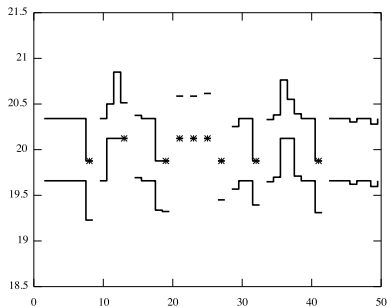
⁷Labels are reversed. Fill rate = $P(\text{order trades})$

Simulated Trades

- Can then simulate trading ($N = 5000$) to see more effects.
- Example quote and price paths for no tax:

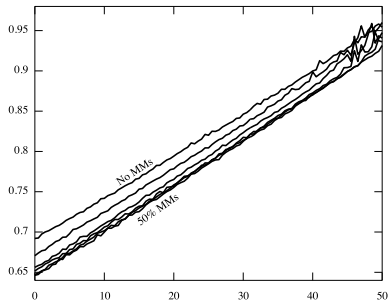


No MMs, No Tax

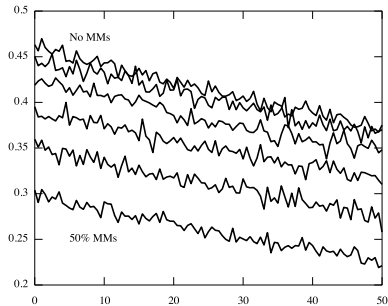


50% MMs, No Tax

Effective Spread and Gains from Trade



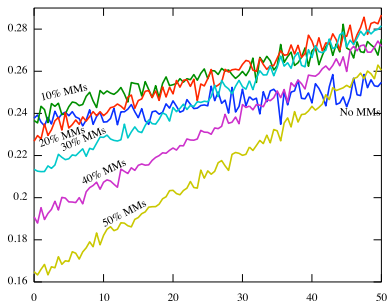
Effective Spread (bp) vs. tax (bp)



Gains from Trade vs. tax (bp)

- Effective spreads are lower with MMs (opposite of quoted).
- MMs: $d_t = 0$, compete for fill \Rightarrow lower gains from trade.
- 50 bp tax roughly halves gains from trade.

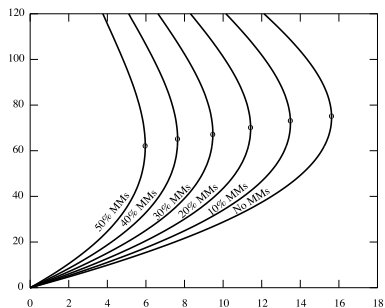
Volatility



Volatility (\$) vs. tax (bp)

- No MMs: Highest volatility at 0 tax, least sensitive.
- 50% MMs: lowest volatility below 40 bp, most sensitive.
- At high taxes, lower volatility w/o MMs than with MMs.
- Taxes increase volatility, up to $1.5\times$.

Tax Revenues



Tax (bp) vs. Revenue

- Revenue-optimal tax: 60–75 bp.
- More MMs \Rightarrow lower optimal tax.

Conclusion

We find that a transaction tax:

- Widens quoted and effective spreads by $> 2\times$ the tax;
- Reduces the likelihood of trading (volume);
 - \Rightarrow increases search times.
- 50 bp: Halves value of limit orders and gains from trade;
- Yields higher price volatility (less stable prices); and,
- Is revenue-optimal for 60–75 bp. (!)

Possible addition:

- Add malicious (albeit irrational) destabilizing traders?