

# Transaction Taxes in a Price Maker/Taker Market

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Auckland Finance Meeting 2012  
Auckland University of Technology  
20 December 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.<sup>1</sup>
- 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.

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<sup>1</sup>Predicted 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;<sup>2</sup>
  - Differences between quoted and effective spreads;
  - Realized volatility.
- Offers insight into how market metrics (e.g. volume) change with tax

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<sup>2</sup>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.  $\mu$  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  $\tau$ /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  $v - \delta$  and ask  $v + \beta$  for Sam.
- Rick must also determine his optimal  $\delta$  and  $\beta$ .
- Thus Rick chooses  $\max(R_T, R_Q | d_{t+1})$  where:

$R_T$  = 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's<sup>3</sup> 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.

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

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<sup>4</sup>And likewise for  $d_t < 0$ .

<sup>5</sup>Markov Perfect?

# Model Setup: Numerical Analysis

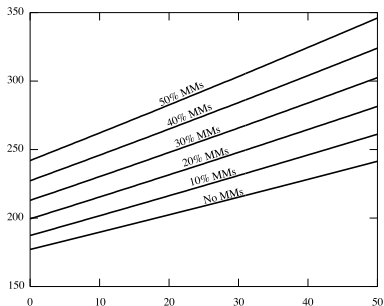
Consider a market calibrated to typical characteristics:

- 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  $\tau$ : \$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  $L = \$0.5 = 2.5\%^6$

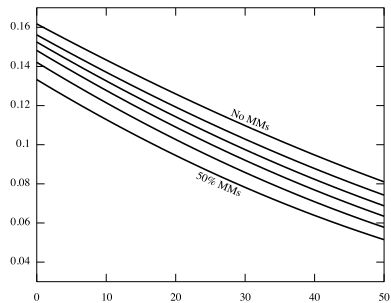
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<sup>6</sup>If daily net trades  $\Rightarrow$  40% annual volatility.

# Quoted Spread and Optimal Quoting Benefit



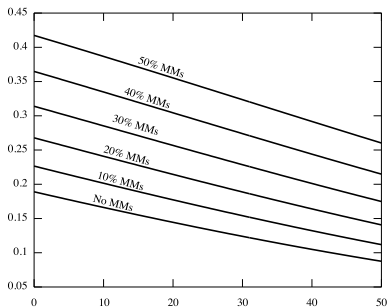
Spread (bp) vs. tax (bp)



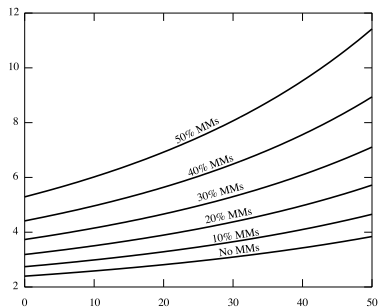
Optimal Quoting Benefit  $R_Q^*$  vs. tax (bp)

- 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)<sup>7</sup>



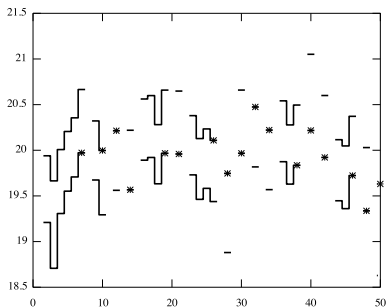
Search Costs (periods) vs. tax (bp)

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

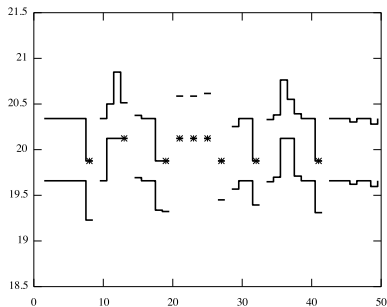
<sup>7</sup>Labels are reversed. Fill rate =  $P(\text{order trades})$

# Simulated Trades

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

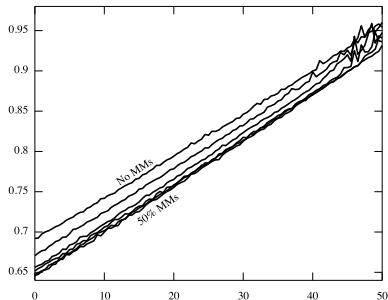


No MMs, No Tax

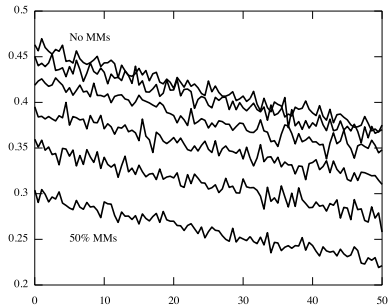


50% MMs, No Tax

# Effective Spread and Gains from Trade



Effective Spread (bp) vs. tax (bp)

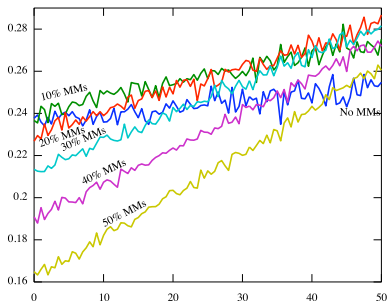


Gains from Trade vs. tax (bp)

- 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.



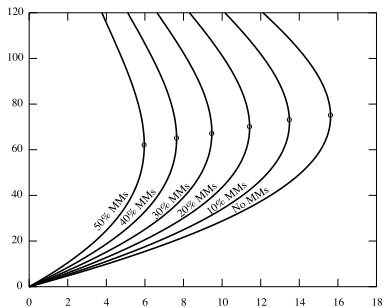
# Volatility



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?