Identifying Cross-Sided Liquidity Externalities

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Background - Two sided markets and externalities

Two-sided market (Rysman, 2009)

- two sets of agents ("sides"), one platform
- the decision of each side affects the outcomes of the other side, typically through an externality

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▶ transaction **volume** depends on how platform **allocates fees** between sides (Rochet/Tirole,2006)

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Applied to understand pricing decisions in wide range of settings... e.g newspapers, matching markets, payment card industry, video game systems, software OS etc.

Background - a model with cross-side externalities

Foucault, Kadan, Kandel (JF, 2012)

- two "sides" in a limit order market
  - **makers:** supply liquidity $\longrightarrow$ post limit orders
  - **takers:** demand liquidity $\longrightarrow$ market orders
- new cross-side liquidity externality between makers and takers
  - faster liquidity supply induces faster liquidity demand
- rationalizes the adoption of maker/taker pricing by trading platforms
  - fee breakdown between make/take side matters for volume

Alternative Hypothesis: Negative cross-sided externality

Glosten (1994), Rock (1996) and Seppi (1997) argue that informed traders favor and submit market orders

- private information shock will generate net-orderflow in one direction: **taker cycle duration** $\Downarrow$
- strategic makers might delay posting limit orders (e.g. Admati and Pfleiderer (1988)): **maker cycle duration** $\Uparrow$
- Private information shock decreases take cycle duration, but increases make cycle duration (temporary) until new equilibrium is reached

Violation of FKK (2012)'s assumption where traders can choose to be either makers or traders

What we do in this paper..

- **propose a measure of liquidity cycles** separated between liquidity makers and takers
- **identify a new cross-side liquidity externality** between liquidity makers and takers
- **quantify the economic size** of the cross side externality by evaluating the pricing decision of a trading platform

First paper to empirically study the economics of two-sidedness in equity markets

Theoretical underpinning

Foucault, Kadan and Kandel (2012)

Trading is characterized by liquidity cycles with two phases

- "take" phase - taker consumes liquidity through market order
  - $\Rightarrow$ bid/ask spread widens, order-book $\rightarrow$ "empty" state
  - $\Rightarrow$ creates profit opportunity for makers..
- "make" phase - maker posts limit order
  - $\Rightarrow$ bid/ask spread narrows, order-book $\rightarrow$ "full" state
  - $\Rightarrow$ creates profit opportunity for takers..

Empirical implications

Phase durations depends on monitoring intensity of makers/takers

- ..race to be first to identify/react to profit opportunities

Monitoring intensity depends on..

- monitoring costs, make/take fees, number of makers/takers

$\Rightarrow$ increased monitoring intensity of one side exerts a positive externality on the other side (increased likelihood to find a profit opportunity)

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- **Empirical implication**
  - exogenous shocks to these variables for one side will be useful for identifying the cross-side externality to the other side

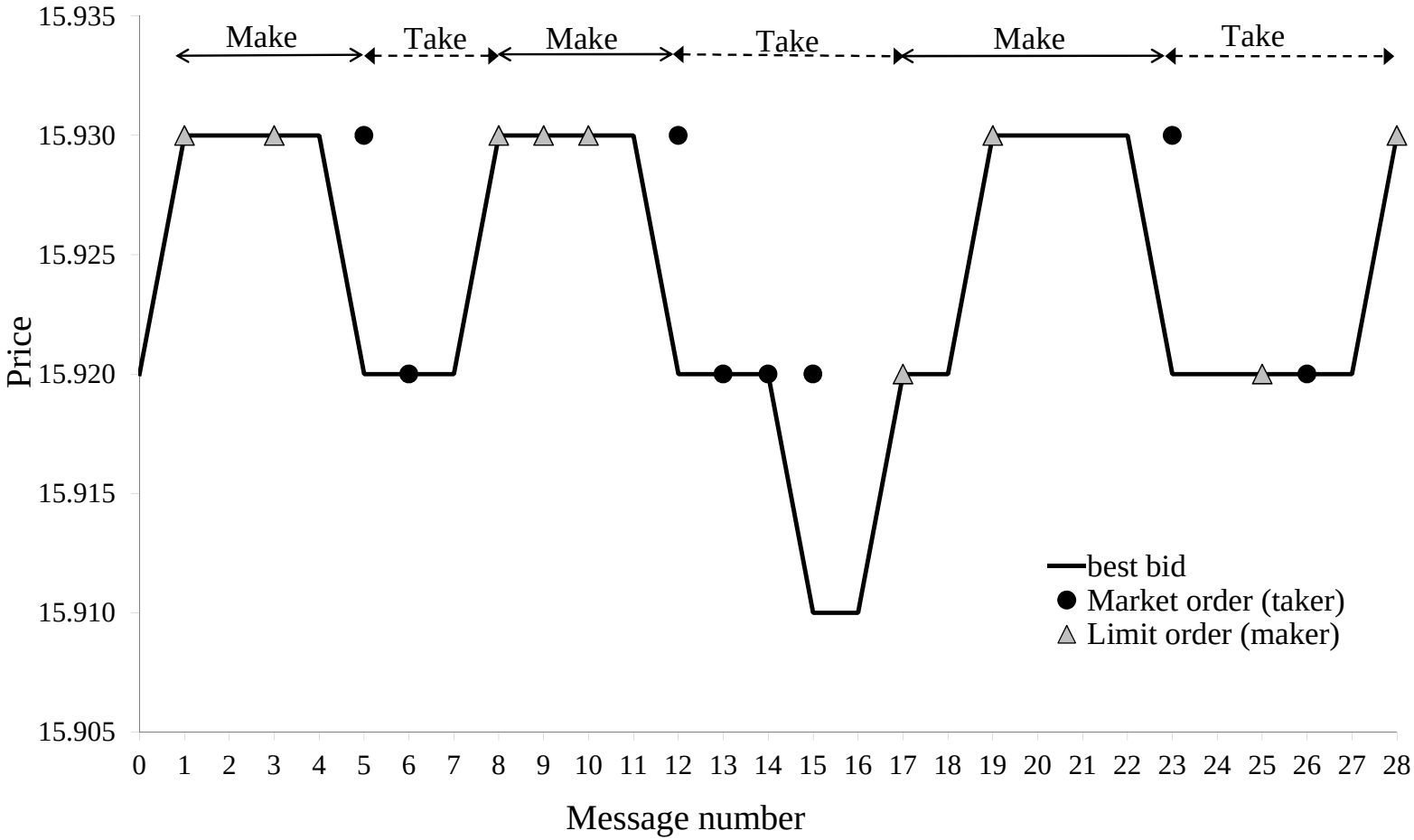
Empirical strategy involves two main ingredients..

- **a measure** of make and take cycle durations
- **exogenous shocks** that shift the monitoring intensity of one side, without directly affecting the monitoring intensity of the other side

Data Description

- complete set of order/trade messages at NASDAQ BX (ITCH TotalView data)
  - unique order ids, nanosecond timestamp, track full history of each individual order
  - period: October 2010 - March 2011
- retain common stock for which information is available in CRSP, TAQ and Compustat $\rightarrow$ 1867 stocks
- rebuild the complete limit order book for each stock (message by message)
- use this to construct measure of liquidity cycles compatible with Foucault et al. (2012)

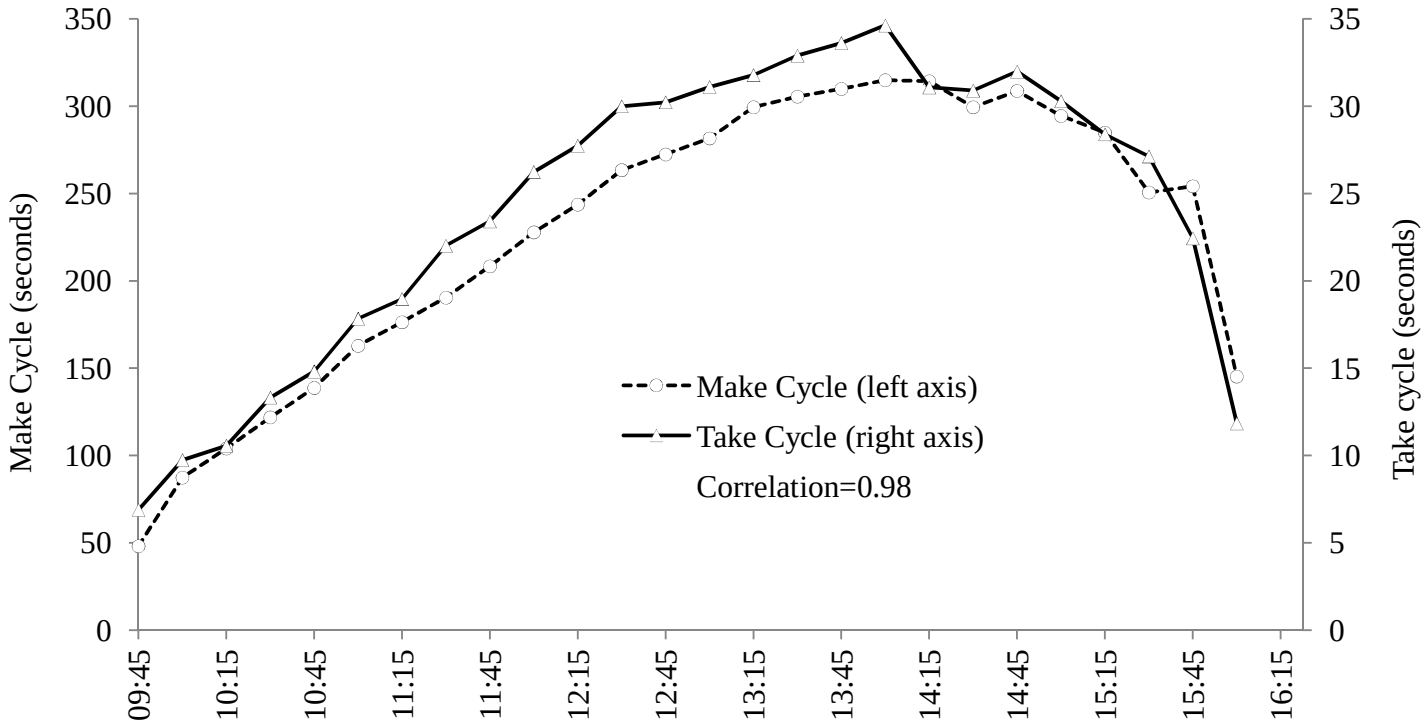
Measuring Liquidity Cycles



- make phase $\Rightarrow$ periods when order book is being replenished
- take phase $\Rightarrow$ periods when the order book is being drained

Descriptives - intraday characteristics

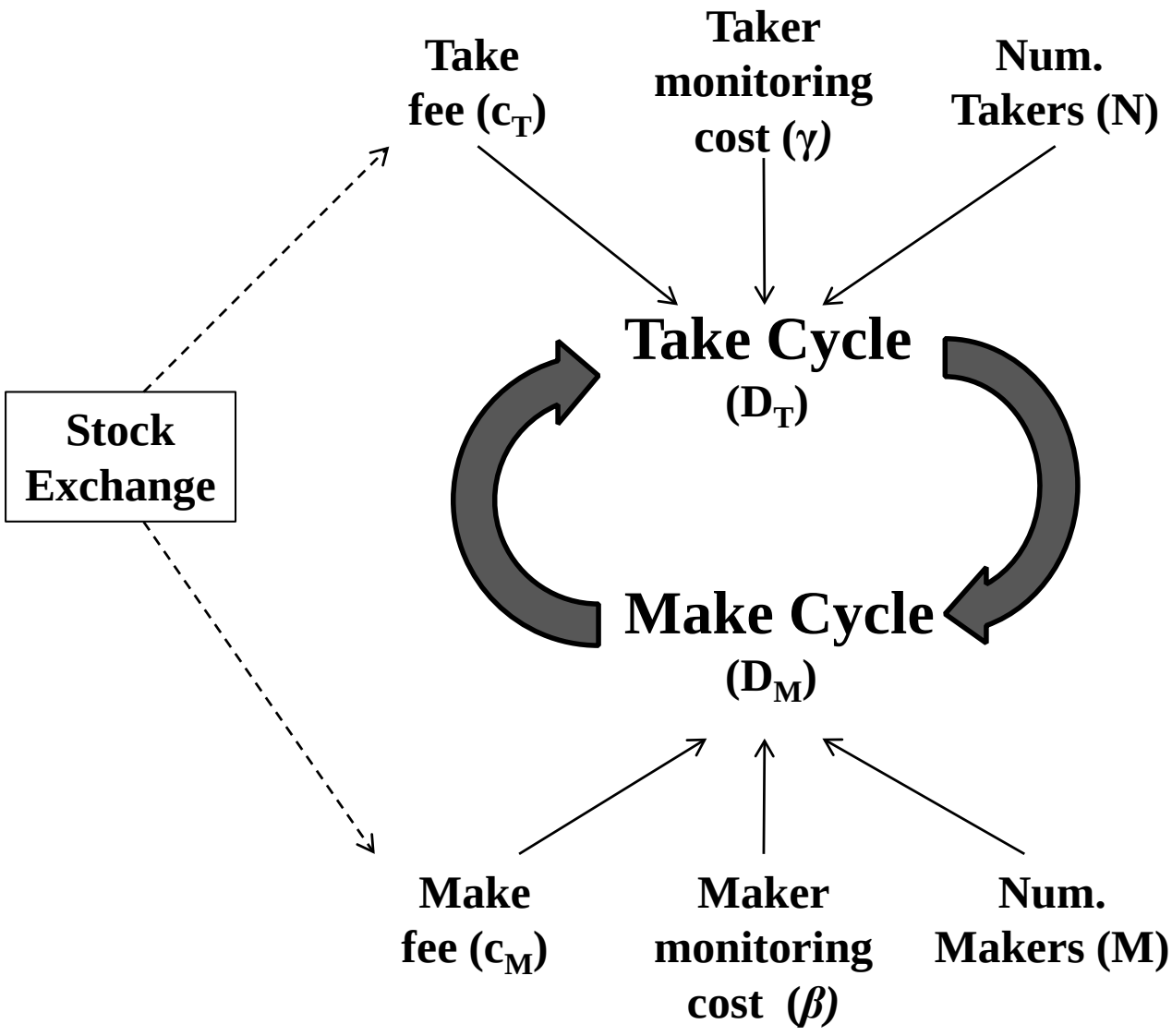
Figure: Intraday make take cycle durations



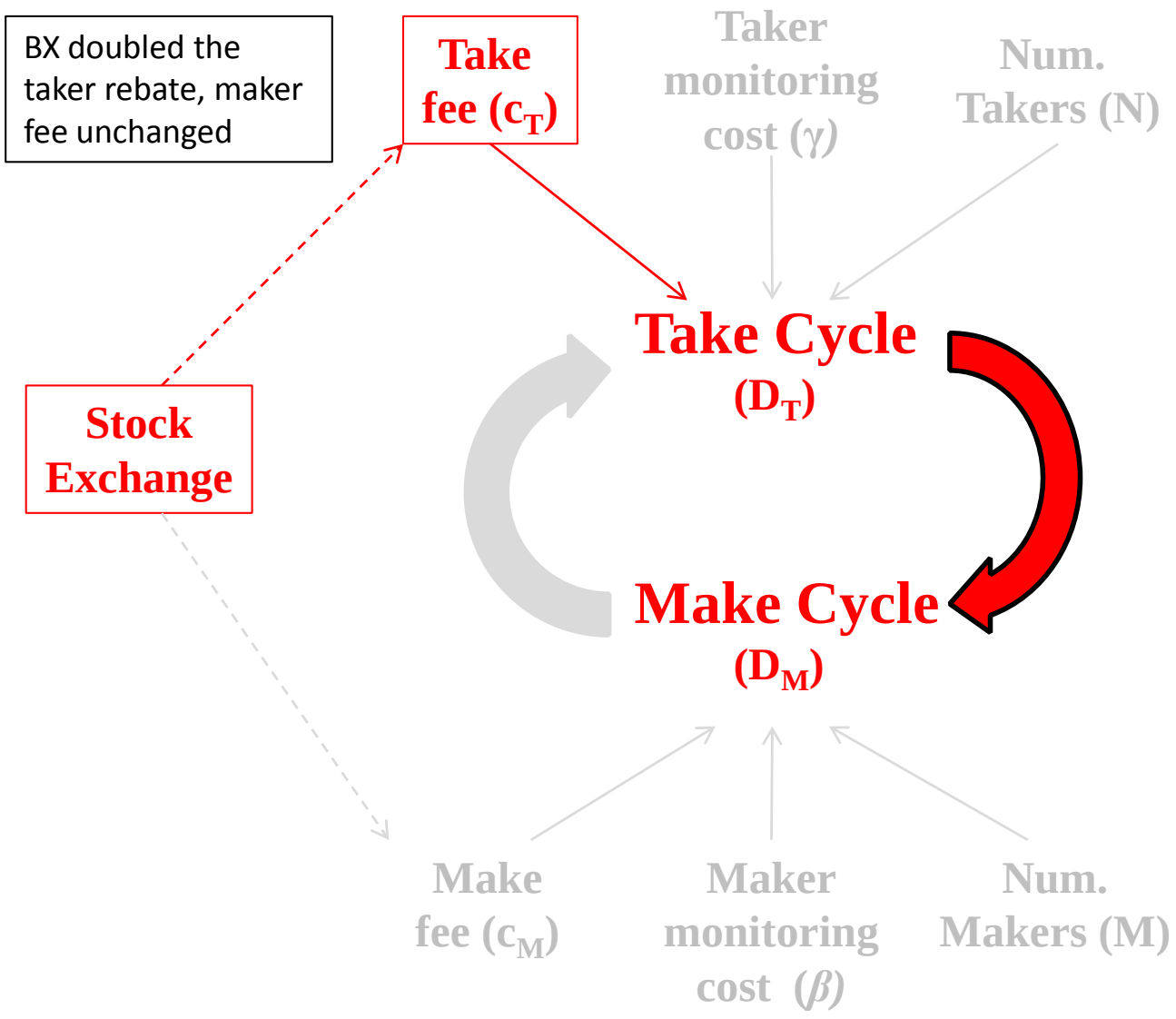
- take cycle $<$ make cycle
- both cycles are quicker at the beginning/end of the day

$\Rightarrow$ intraday clustering of trading activity (e.g. Jain/Joh'88, Admati/Pfleiderer'88)

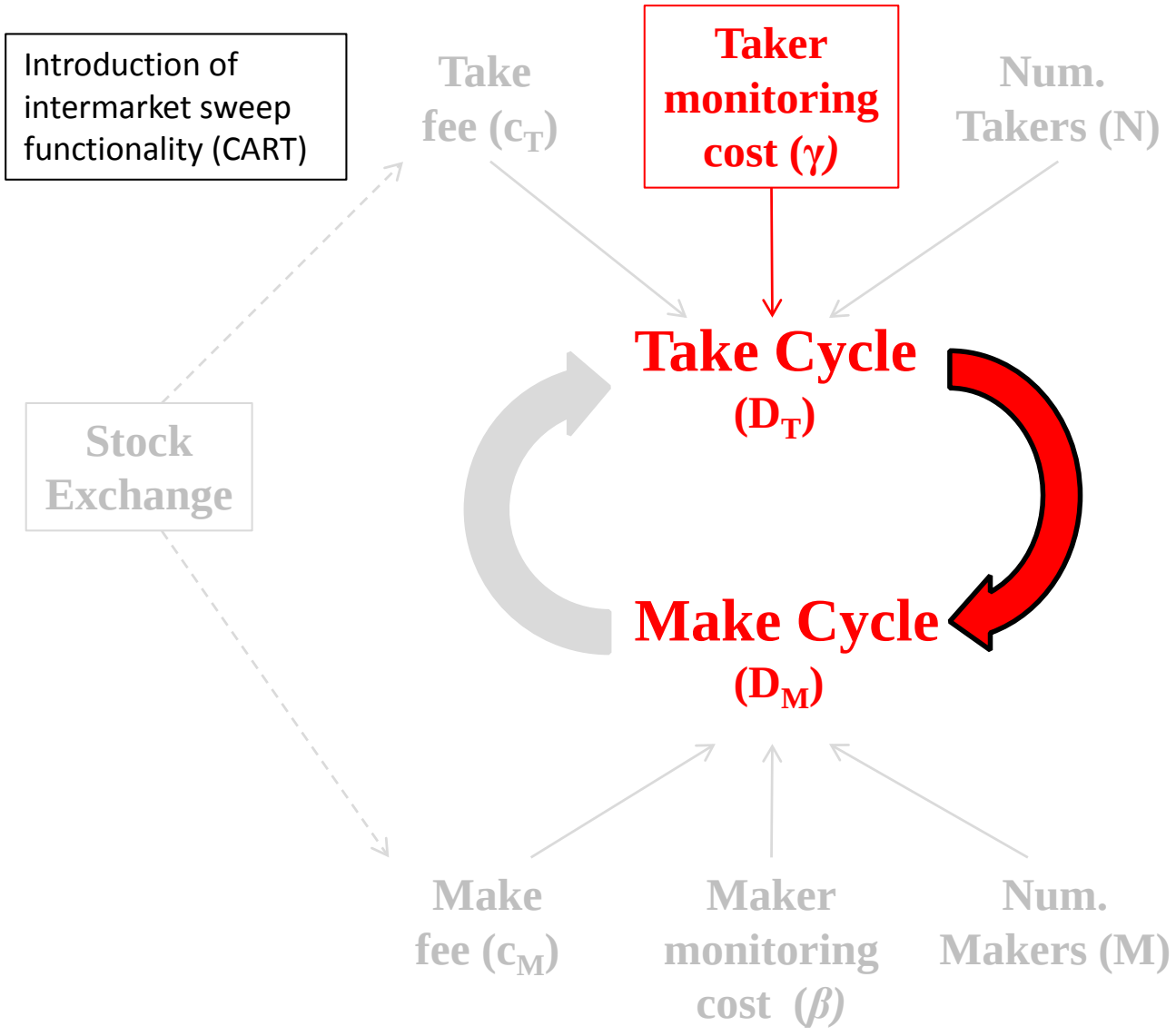
Identification Strategy - cross sided externality



Identification Strategy - take fee shock ($c_T \downarrow$)



Identification Strategy - taker technology shock ($\gamma \downarrow$)



Instrumental variable regression

- **Do shifts in take cycles affect the make cycle?**

Table: Instrumental Variable Regression (2SLS)

	Fee Shock				**Technology Shock**	
	1st Stage		2nd Stage		1st Stage	2nd Stage
Dep.variable	**Take** cycle		**Make** cycle		Take cycle	Make cycle
$\widehat{\text{Take}}$ cycle			**1.63**	**(0.08)**		
Fee Shock	**-7.72**	**(0.00)**				
Trade Size	0.11	(0.59)	0.06	(0.82)		
Trades	-0.01	(0.01)	-0.19	(0.00)		
Traded Shares	0.00	(0.89)	0.51	(0.00)		
Volatility	-40.68	(0.00)	-74.92	(0.50)		
Spread	37.59	(0.00)	256.97	(0.00)		
AP Test	9.38	(0.00)				
Under-Identification	9.30	(0.00)				
Weak-Identification	27.65					
Kleibergen-Paap Wald	9.38					

(firm and time fixed effects, standard errors clustered at firm level.)

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Dep.variable	**Take** cycle		**Make** cycle		Take cycle		Make cycle	
$\widehat{\text{Take}}$ cycle			**1.63**	**(0.08)**			**11.10**	**(0.00)**
Fee Shock	**-7.72**	**(0.00)**						
Technology Shock					**-5.55**	**(0.00)**		
Trade Size	0.11	(0.59)	0.06	(0.82)	0.11	(0.60)	-1.02	(0.67)
Trades	-0.01	(0.01)	-0.19	(0.00)	-0.01	(0.04)	-0.13	(0.00)
Traded Shares	0.00	(0.89)	0.51	(0.00)	0.00	(1.00)	0.50	(0.04)
Volatility	-40.68	(0.00)	-74.92	(0.50)	-40.26	(0.00)	304.31	(0.15)
Spread	37.59	(0.00)	256.97	(0.00)	36.62	(0.00)	-101.48	(0.50)
AP Test	9.38	(0.00)			8.42	(0.00)		
Under-Identification	9.30	(0.00)			8.43	(0.00)		
Weak-Identification	27.65				7.66			
Kleibergen-Paap Wald	9.38				8.42			

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Instrumental regression - Negative Externalities

	Market Capitalization				*Rel. Spread*				*Volatility*			
	1st Stage		2nd Stage		1st Stage		2nd Stage		1st Stage		2nd Stage	
	Group 1 - Largest				Smallest spread				Smallest volatility			
Take			12.40	0.00			17.63	0.00			8.31	0.00
Fee Shock	-4.76	0.00			-3.72	0.00			-8.26	0.00		
Technology Shock	-2.26	0.00			-2.19	0.01			-2.77	0.06		
	Group 2											
Take			9.55	0.00			10.07	0.00			9.52	0.00
Fee Shock	-8.73	0.00			-8.53	0.00			-8.77	0.00		
Technology Shock	-4.80	0.00			-6.62	0.00			-4.87	0.00		
	Group 3 - Smallest				Largest spread				Largest volatility			
Take			4.14	0.00			4.16	0.00			8.21	0.00
Fee Shock	-14.07	0.00			-17.48	0.00			-11.67	0.00		
Technology Shock	-1.52	0.79			-7.42	0.09			-9.12	0.01		

Quantifying the size of the cross-sided externality

- **BX pricing decision, Nov.1, 2010**
  - BX doubled rebate to take liquidity from 1 $\longrightarrow$ 2 cents (per 100 shares)
  - make fee unchanged at 2.5 cents $\Rightarrow$ BX profit reduced from 1.5 to 0.5 cents
- **did BX recover the loss from increased subsidization of takers?**

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- **did BX recover the loss from increased subsidization of takers?**
  - Foucault et al (2012) model, IV and cycle estimates
  - fee-change $\Rightarrow$ reduced profits of **$770k**/year
  - without cross side externality $\Rightarrow$ reduced profits of **$970k**/year
  - value of cross side externality **$200k**/year
    - approx **0.9%** of BX' annual net fee income (2011)

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- Alternative measure of cycles

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  1. End make cycle at last make and end take cycle at last take
  2. Calculate response/monitoring time - Time between last make and first take and vice versa
  3. TAQ-based
     - Make cycle - number of quote updates
     - Take cycle - number of trades

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  1. End make cycle at last make and end take cycle at last take
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  3. TAQ-based
     - Make cycle - number of quote updates
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- TAQ measure allows for additional events in a non-fragmented national market setting
  - Tick size change in 2001
  - Market maker technology shock in 2003 in Hendershott, Jones, and Menkveld (2010)

Summary

- identify the existence of a new cross-sided liquidity externality proposed by Foucault, Kadan, Kandel (2012)
- quantify size of the cross sided externality associated with a fee change at BX
- provide a new (model free) measure of resiliency (cycle duration)