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 affect the outcomes of the other side, typically through an externality

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Important for platform's pricing decisions

▶ 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 $\rightarrow$ post limit orders
  - **takers:** demand liquidity $\rightarrow$ 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

What we do in this paper..

Using the empirical implications of Foucault et. al (2012) we,

- **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

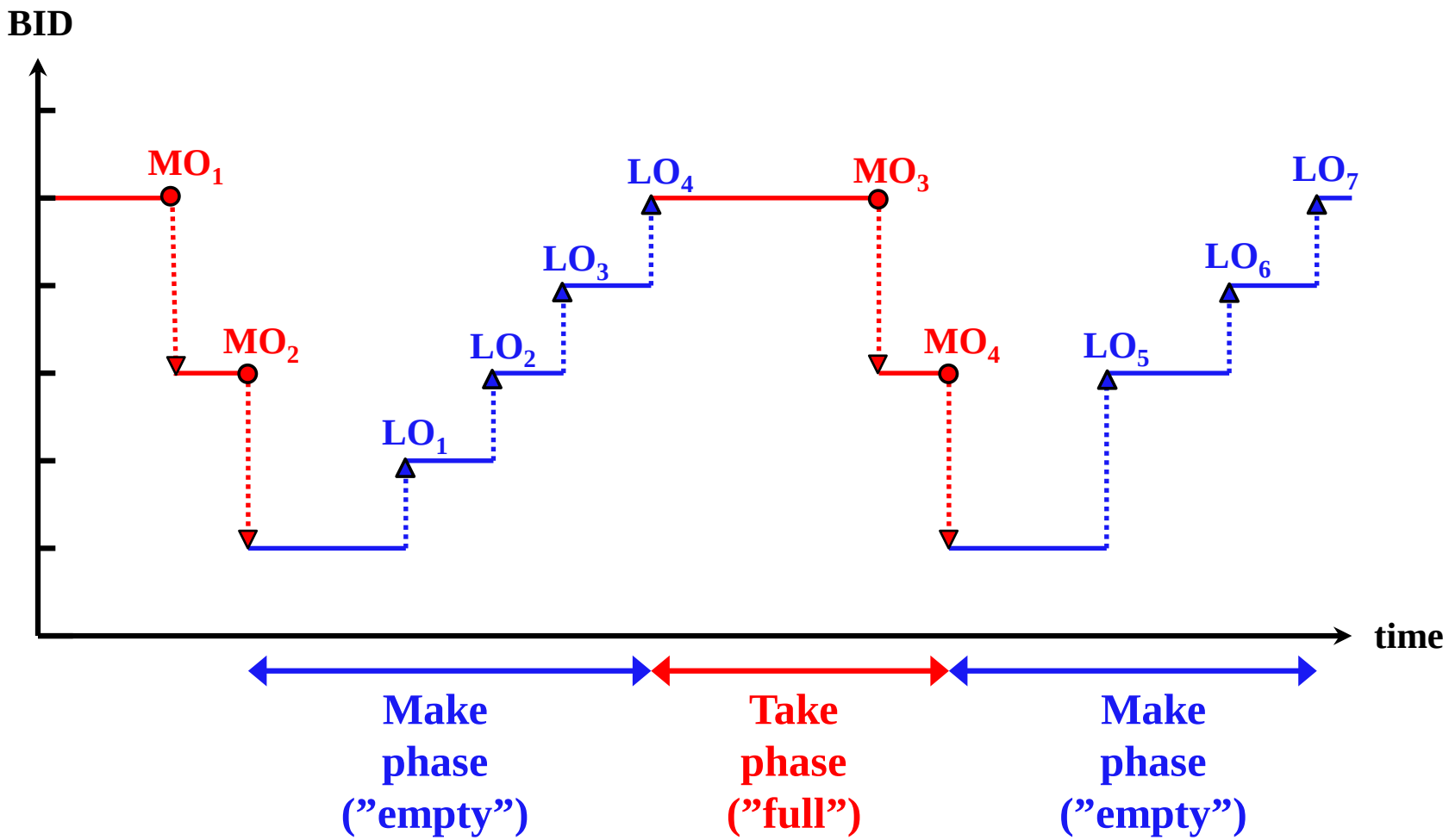
Empirical strategy involves two main ingredients..

- **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)

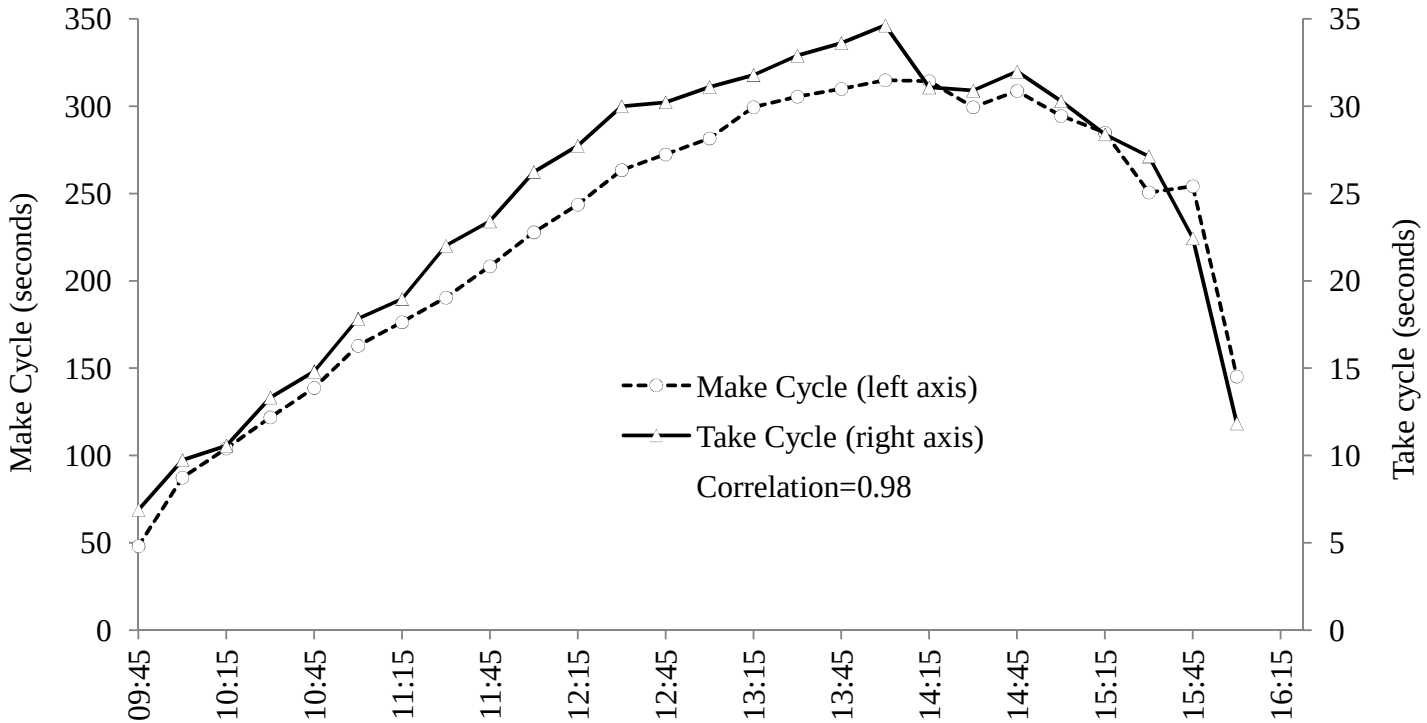
Measuring Liquidity Cycles



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

Descriptives - intraday characteristics

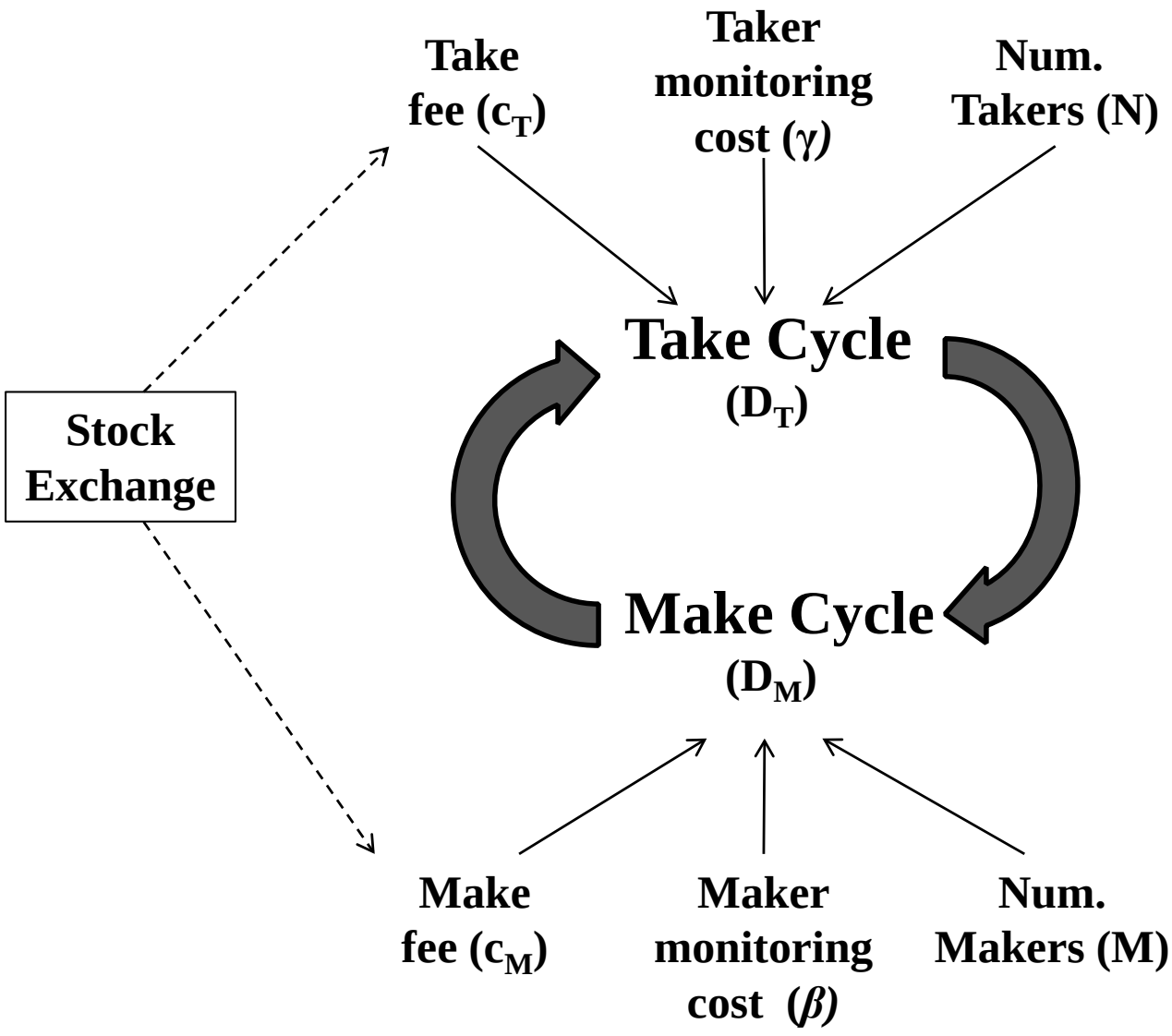
Figure: Intraday make take cycle durations



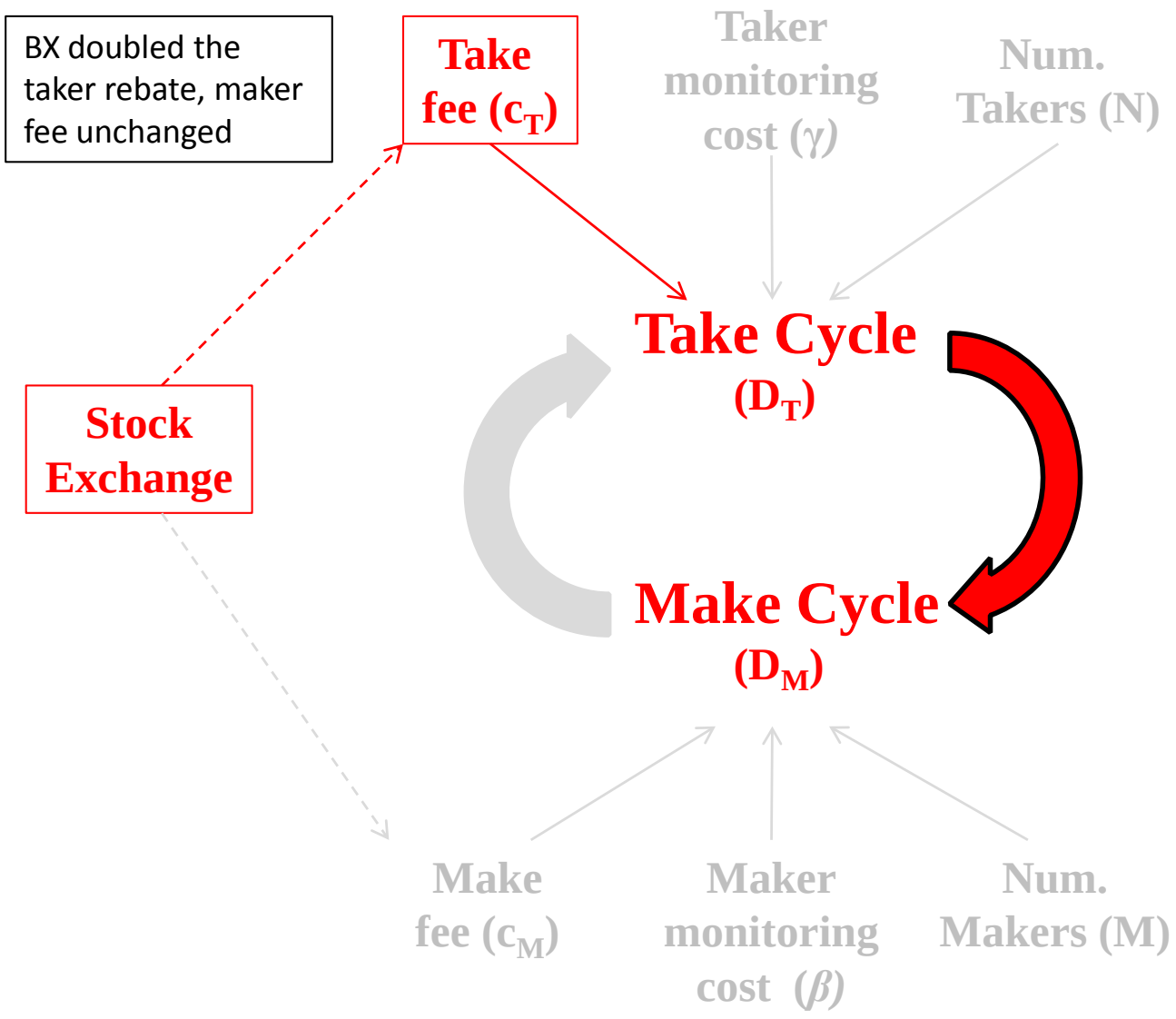
- take cycle $<$ make cycle
- both cycles are quicker at the beginning/end of the day

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

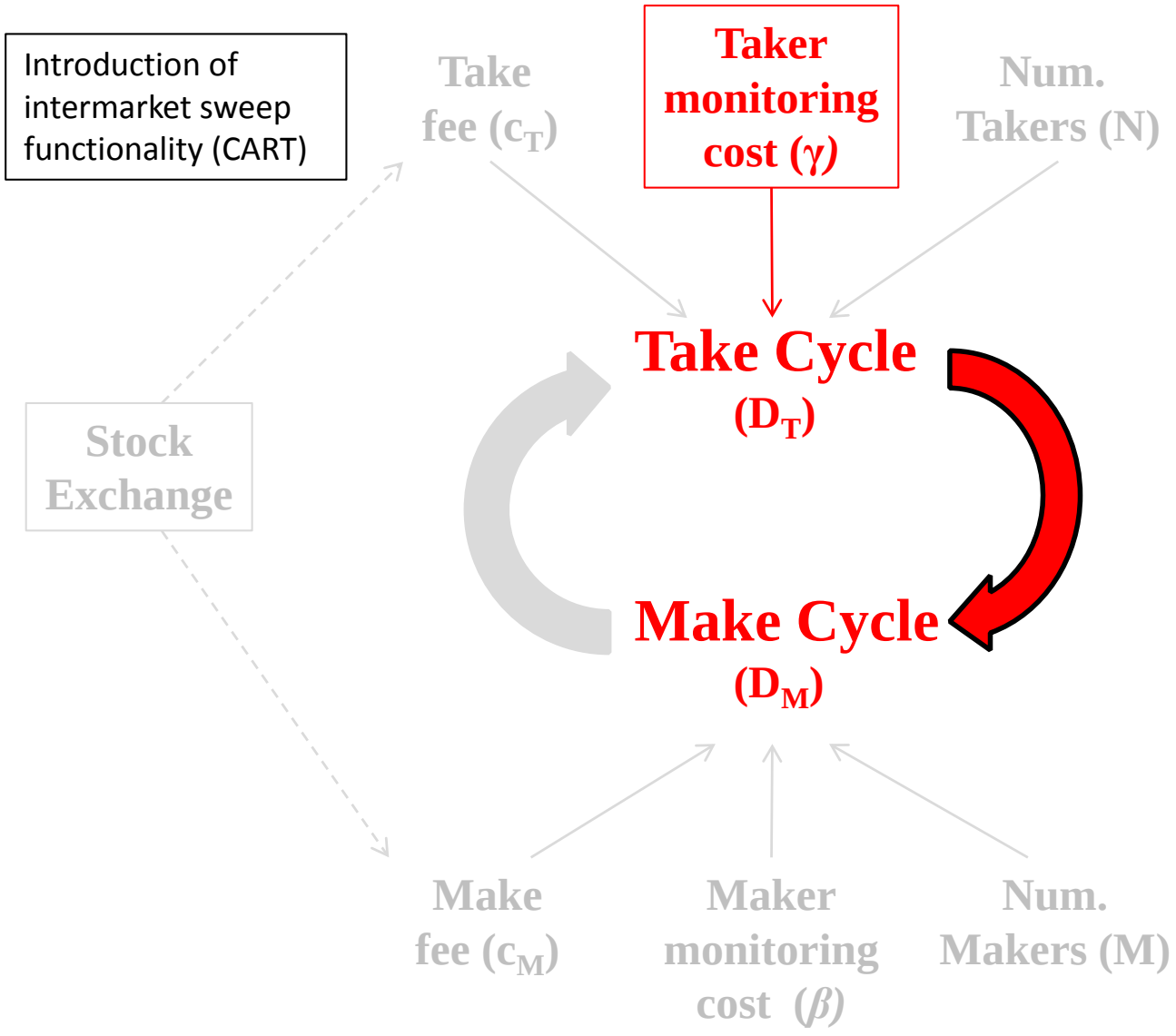
Identification Strategy - cross sided externality



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



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



Instrumental variable regression

- **Does shifts in take cycle 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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$\widehat{\text{Take}}$ 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			

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

Instrumental regression - median cycles

Table: Instrumental Variable Regression (2nd stage) - Median cycles

	Fee Shock		**Technology Shock**	
	Coef.	p-value	Coef.	p-value
$\widehat{\text{Take}}$ cycle	**7.48**	**0.00**	**3.77**	**0.02**
Trade Size	-0.02	0.99	-0.02	0.96
Trades	-0.06	0.00	-0.07	0.00
Traded Shares	0.20	0.06	0.20	0.00
Volatility	89.28	0.14	32.90	0.59
Spread	38.22	0.32	79.47	0.00
AP Test	13.20	0.00	9.33	0.00
Under-identification	13.09	0.00	9.35	0.00

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)

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)