Price Limit Performance: Evidence from Tehran Stock Exchange

S. Jalali[1] M. Rahmati[1] A. Ebrahim Nejad[2]

[1]Graduate School of Management and Economics
Sharif University of Technology

[2]Cornerstone Research

Fourth International Conference on Iran's Economy, 2016

Outline

Outline

What is a price limit?

Daily price limits are boundaries imposed by market regulators and constrain price movements to a prespecified range.

What is a price limit?

Daily price limits are boundaries imposed by market regulators and constrain price movements to a prespecified range.

- Symmetric
- Percentage of previous day's closing price

The price limit range in a number of stock exchanges

The price limit range in a number of stock exchanges

Country	Exchange	Price limit(%)
Turkey	Istanbul SE	10
China	Shanghai SE, Shenzhen SE	10
Japan	Tokyo SE	10-50
Italy	Borsa Italiana S.p.A.	10-20
Finland	Helsinki SE	15
Greece	Athens SE	8
Korea	Korea SE	15
Malaysia	Bursa Malaysia	30
France	Euronext Paris	10
Belgium	Euronext Brussels	10
Iran	Tehran SE	4

Why do price limits exist?

The regulator's hope is that the price limit

- Dampen the volatility of stock prices
- Enable stocks to be traded close to their intrinsic value
- Provide enough time for more thorough analysis by investors

Advantages of imposing price limit

- Decrease volatility (Ma, Rao, and Sears [1989], Kim, Liu, and Yang [2013])
- Counter overreaction (Ma, Rao, and Sears [1989], Arak and Cook [1997], Kim, Liu, and Yang [2013]

Disadvantages of imposing price limit

- Volatility spillover (Kim and Rhee [1997], Fama [1989], Berkman and Lee [2002])
- Delay the equilibrium price (Chan, Kim and Rhee [2005], Phylaktis, Kavussanos and Manalis [1999], Kim and Rhee [1997])
- Decrease liquidity (Lehman [1989], Fama [1989], Kim and Rhee [1997])
- Magnet effect (Subrahmanyam [1994], Arak and Cook [1997], Cho, Russell, Tiao, and Tsay [2003])

Why there is not a general agreement on the price limit effects?

Because of the Lack of proper dataset they use event study type methodology. But

Problems with Event study:

- Sample selection bias
  - stocks that hit limits on consecutive days are excluded from the final samples
- Natural behavior of stocks after limit hit day
  - Lower volatility after a high volatility

Iran stock market

Iran stock market has two separate stock exchanges with different regulations:

- Tehran Stock Exchange (TSE)
  - 4% price limit (In our study period)
  - Price limit has changed several times
  - Trading volume threshold rule
- Fara-Stock Exchange (FSE)
  - 5% price limit

Why do we have two exchanges in Iran?

Problem and solution

The best way to capture the impact of the price limit is that actually the allocation of firms between two exchanges would be random.

Propensity score methods:

- use observational data
- Attempt to replicate experimental design with statistics

Outline

Propensity score

Rooted in experimental design

- Treatment group
  - Exposed to some treatment
- Control group
  - Not exposed to treatment
- Treatment

- Causal effect

Propensity score

Rooted in experimental design

- Treatment group
  - Exposed to some treatment
- Control group
  - Not exposed to treatment
- Treatment
- Stocks listed in FSE
- Causal effect

Propensity score

Rooted in experimental design

- Treatment group
  - Exposed to some treatment
- Control group
  - Not exposed to treatment
- Treatment

- Causal effect

- Stocks listed in FSE
- Stocks listed in TSE

Propensity score

Rooted in experimental design

- Treatment group
  - Exposed to some treatment
- Control group
  - Not exposed to treatment
- Treatment
- Causal effect

- Stocks listed in FSE
- Stocks listed in TSE
- Treatment is 5% price limit in FSE

Propensity score

Rooted in experimental design

- Treatment group
  - Exposed to some treatment
- Control group
  - Not exposed to treatment
- Treatment
- Causal effect

- Stocks listed in FSE
- Stocks listed in TSE
- Treatment is 5% price limit in FSE
- Price limit effect

Propensity Score

Propensity score is defined as the probability of being treated, given a set of observables.

$$p(X_i) = Pr(T_i = 1|X_i)$$

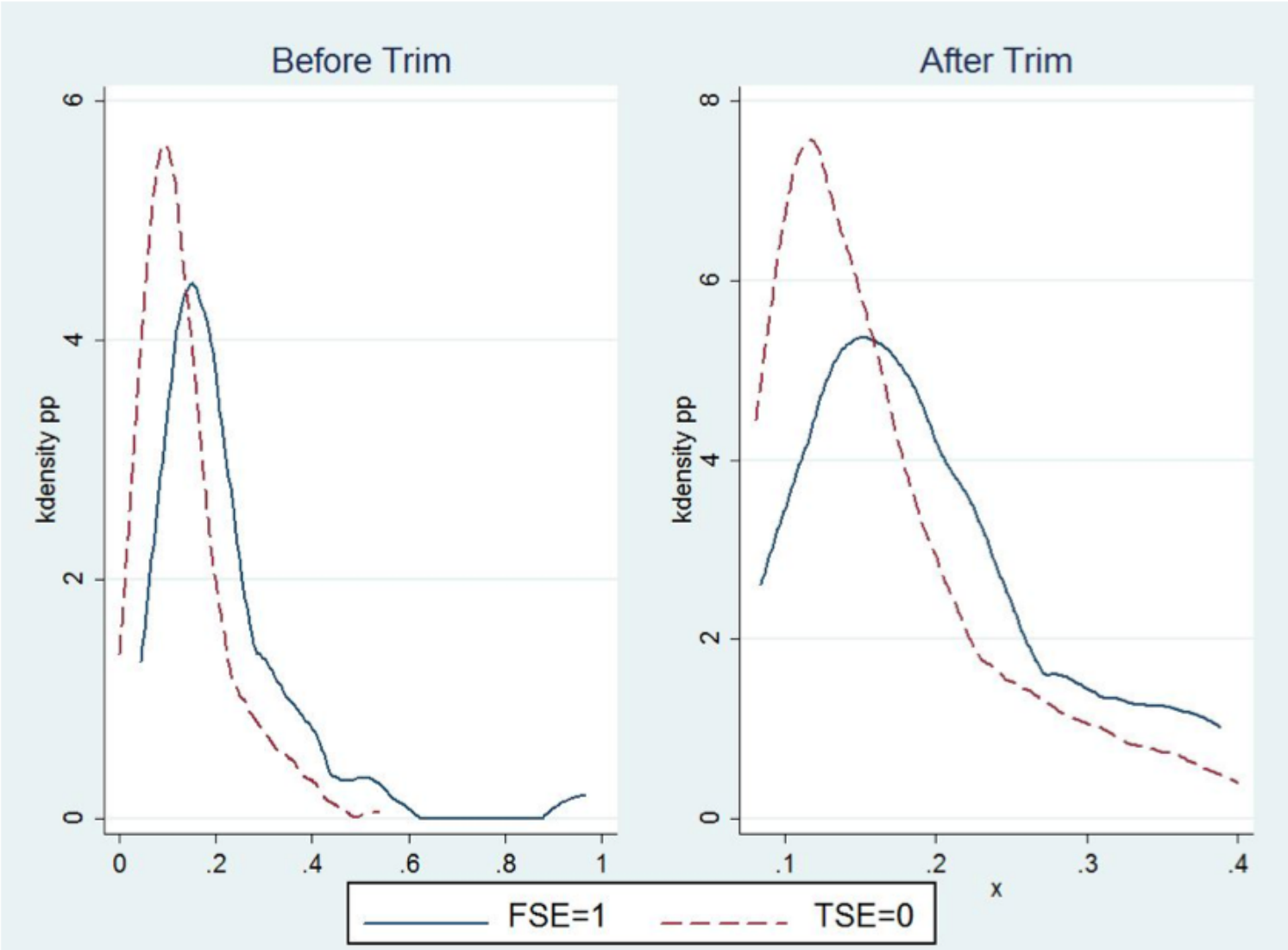
- X_i : observable characteristics
- $p(X_i)$: the propensity score of unit i
- T_i : treatment indicator (1 if exposed to treatment, 0 otherwise)

Implementing propensity score method

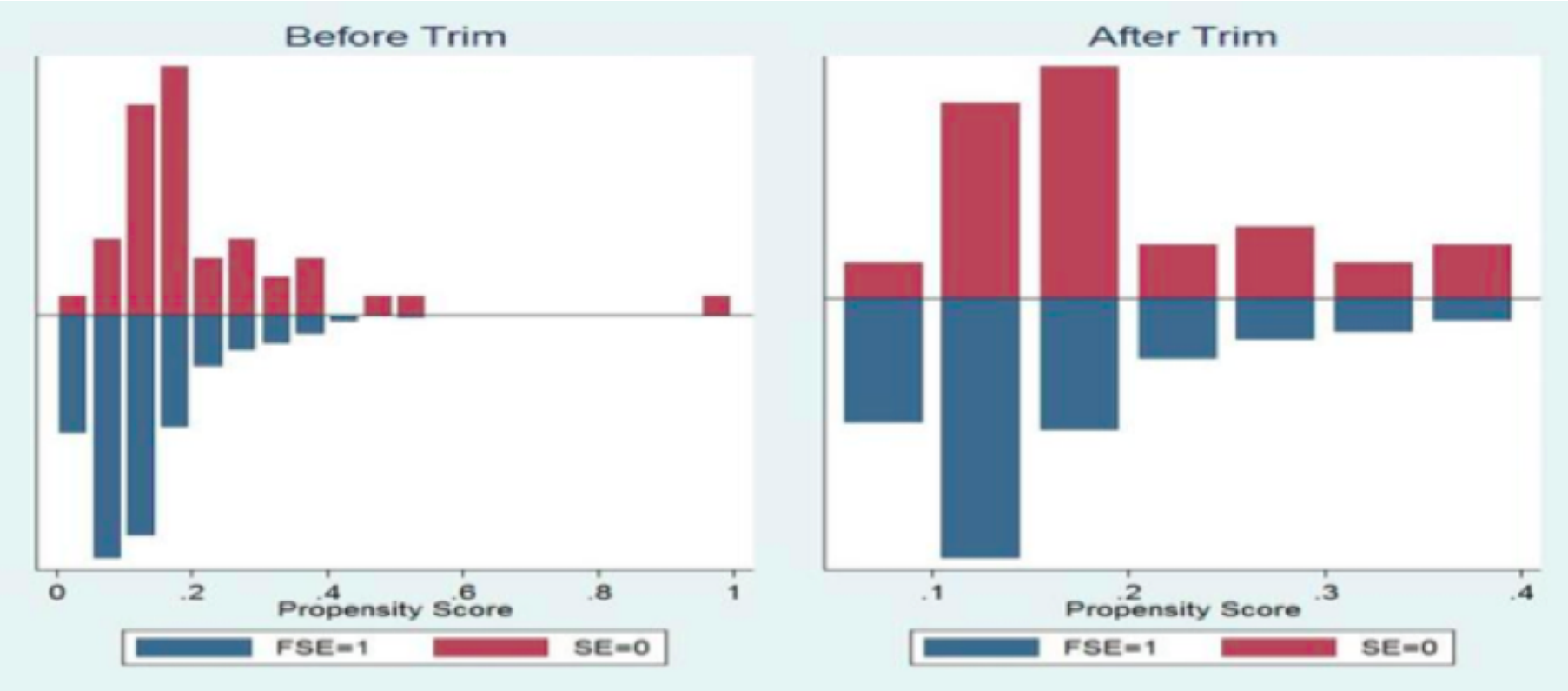
In observational studies propensity scores are not known, so they have to be estimated:

- Run logit/probit regression
  - Dependent variable equals 1 if the firm is listed on the FSE and 0 otherwise
  - Independent variables include any characteristics we can control for across firms
  - Estimate propensity score
- Trim
  - Exclude companies that have extreme propensity scores
  - Eliminate selection bias
  - Create quasi-randomized sample

Kernel density of propensity score for TSE and FSE



Common support



Estimation of treatment effect using propensity score

To obtain unbiased estimates for the treatment effect and balance two nonequivalent samples:

- Matching on the propensity score
- Stratification on the propensity score
- Covariate adjustment using the propensity score
- Inverse probability weighting (IPW) on the propensity score

Weighting (IPW)

- Average Treatment Effect on Non Treated (ATNT)
  - What would have happened if the price limit on the TSE would be 5% instead of 4%?

$$W_{i,ATNT} = \frac{T_i(1-p_i)}{p_i} + (1-T_i)$$

- Average Treatment Effect on Treated (ATT)
  - What is the effect of the 5% price limit on the performance of FSE companies?

$$W_{i,ATT} = T_i + \frac{(1-T_i)p_i}{1-p_i}$$

Outline

Data description

Transaction data of the companies both the TSE and the FSE:

- Daily company level information such as
  - closing prices,
  - last prices,
  - trading volumes,
  - shares outstanding
  - financial statements
- From March 2013 until March 2014
- Exclusion based on the number of trading days
  - Include active companies with at least 150 trading days

Our goal

Answering these questions:

- Is wider price limit associated with an increase in stock return volatility?
- Does price limit influence on queue?
- Does price limit impact volume and impact returns?
- Is firm's idiosyncratic risk influenced by the price limit?

Estimation of price limit effect

Multivariable linear regressions using ATT and ATNT weights:

$$Y_i = \beta_i \, Treated_i + \gamma_i X_i + \epsilon_i$$

- Y_i : market variables (Volatility, trading volume, return, etc.)
- $Treated_i$: dummy variable ($Treated_i = 1$ if company listed on FSE)
- X_i : set of covariates related to matching companies (such as profit, market cap, total revenue, etc.)
- β_i : represents the price limit effect on each market variable

Price limit effect on market variables

A comparison of price limit effect on market variables

Market Variable	OLS	Before Trimming		After Trimming	
		ATT	ATNT	ATT	ATNT
Return	0.013 (0.4)	0.016 (0.7)	0.019 (0.7)	0.018 (0.6)	0.36 (1.1)
Volatility	**0.038***** (11.2)	**0.038***** (16.5)	**0.038***** (14.6)	**0.039***** (14.8)	**0.041***** (14.7)
Volume	0.027 (0.6)	0.030 (0.9)	0.054 (1.6)	0.020 (0.5)	0.037 (0.9)
Idio. Risk	**0.033***** (4.7)	**0.032***** (7.7)	**0.034***** (8)	**0.033***** (6.2)	**0.036***** (6.6)
Queue	**-23%***** (-10.3)	**-23%***** (-15.8)	**-23%***** (-14.5)	**-22%***** (-13.1)	**-21%***** (-12.2)

Outline

Controlling Trading Volume Threshold

Market variable	Benchmark	Regression(1)	Regression(2)	Regression(3)	Regression(4)
Return	0.036 (1.19)	0.012 (0.38)	0.010 (1.8)	0.004 (0.11)	0.015 (0.53)
Volatility	**0.041***** (14.7)	**0.034***** (12.2)	**0.075***** (15.1)	**0.035***** (12.8)	**0.037***** (12.9)
Volume	0.037 (0.9)	-0.034 (-0.76)	**0.28***** (4)	-0.01 (-0.25)	0.026 (0.6)
Idio. Risk	**0.036***** (6.6)	**0.027***** (4.7)	**0.078***** (11.4)	**0.030***** (5.6)	**0.031***** (5.1)
Queue	**-21%***** (-12.2)	**-19%***** (-12.3)	**-28%***** (-8.7)	**3.2%*** (2.1)	**-22%***** (-12)

Regression(1): Each observation is weighed based on the percent of days it reaches the TVT.

Controlling Trading Volume Threshold

Market variable	Benchmark	Regression(1)	Regression(2)	Regression(3)	Regression(4)
Return	0.036 (1.19)	0.012 (0.38)	0.010 (1.8)	0.004 (0.11)	0.015 (0.53)
Volatility	**0.041***** (14.7)	**0.034***** (12.2)	**0.075***** (15.1)	**0.035***** (12.8)	**0.037***** (12.9)
Volume	0.037 (0.9)	-0.034 (-0.76)	**0.28***** (4)	-0.01 (-0.25)	0.026 (0.6)
Idio. Risk	**0.036***** (6.6)	**0.027***** (4.7)	**0.078***** (11.4)	**0.030***** (5.6)	**0.031***** (5.1)
Queue	**-21%***** (-12.2)	**-19%***** (-12.3)	**-28%***** (-8.7)	**3.2*%** (2.1)	**-22%***** (-12)

Regression (2): Includ variable to control the TVT

Controlling Trading Volume Threshold

Market variable	Benchmark	Regression(1)	Regression(2)	Regression(3)	Regression(4)
Return	0.036 (1.19)	0.012 (0.38)	0.010 (1.8)	0.004 (0.11)	0.015 (0.53)
Volatility	**0.041***** (14.7)	**0.034***** (12.2)	**0.075***** (15.1)	**0.035***** (12.8)	**0.037***** (12.9)
Volume	0.037 (0.9)	-0.034 (-0.76)	**0.28***** (4)	-0.01 (-0.25)	0.026 (0.6)
Idio. Risk	**0.036***** (6.6)	**0.027***** (4.7)	**0.078***** (11.4)	**0.030***** (5.6)	**0.031***** (5.1)
Queue	**-21%***** (-12.2)	**-19%***** (-12.3)	**-28%***** (-8.7)	**3.2*%** (2.1)	**-22%***** (-12)

Regression (3): Exclude days which hit the limit while do not reach the TVT in TSE

Controlling Trading Volume Threshold

Market variable	Benchmark	Regression(1)	Regression(2)	Regression(3)	Regression(4)
Return	0.036 (1.19)	0.012 (0.38)	0.010 (1.8)	0.004 (0.11)	0.015 (0.53)
Volatility	**0.041***** (14.7)	**0.034***** (12.2)	**0.075***** (15.1)	**0.035***** (12.8)	**0.037***** (12.9)
Volume	0.037 (0.9)	-0.034 (-0.76)	**0.28***** (4)	-0.01 (-0.25)	0.026 (0.6)
Idio. Risk	**0.036***** (6.6)	**0.027***** (4.7)	**0.078***** (11.4)	**0.030***** (5.6)	**0.031***** (5.1)
Queue	**-21%***** (-12.2)	**-19%***** (-12.3)	**-28%***** (-8.7)	**3.2%*** (2.1)	**-22%***** (-12)

Regression (3): Exclude days which hit the limit while do not reach the TVT in TSE

All companies

Market variable	Active Companies	All Companies		
	Benchmark	All	Weighted by days	Weighted by value
Return	0.036 (1.19)	**0.32***** (3.4)	0.043 (1.2)	0.027 (0.56)
Volatility	**0.041***** (14.7)	**0.042***** (12.3)	**0.042***** (15.2)	**0.028***** (13.4)
Volume	0.037 (0.9)	0.314 (1.7)	0.081 (1.9)	-0.027 (-0.21)
Idio. Risk	**0.036***** (6.6)	**0.035***** (6.2)	**0.039***** (8.2)	**0.022***** (4.7)
Queue	**-21%***** (-12.2)	**-21%***** (-9.8)	**-22%***** (-13)	**-16%***** (-10.3)

Price limit effect uning last prices

Price limit effect using last prices

Market Variable	OLS	Before Trimming		After Trimming	
		ATT	ATNT	ATT	ATNT
Return	0.016 (0.5)	0.016 (0.7)	0.02 (0.9)	0.018 (0.6)	0.04 (1.2)
Volatility	**0.029***** (10.1)	**0.028***** (12.6)	**0.03***** (11.9)	**0.028***** (10.7)	**0.03***** (11)
Volume	0.029 (0.6)	0.032 (1.2)	0.06 (1.7)	0.022 (0.5)	0.04 (0.9)
Idio. Risk	**0.024***** (3.7)	**0.023***** (5.9)	**0.03***** (6.5)	**0.023***** (4.6)	**0.03***** (5.1)
Queue	**-23%***** (-10.3)	**-23%***** (-15.8)	**-23%***** (-14.5)	**-22%***** (-13.1)	**-21***%** (-12.2)

Outline

Conclusion

We find that:

- Price limit does not have any effect on return and trading volume.
- Relatively strict price limits could be an effective way of reducing volatility and idiosyncratic risk.
- Increasing the price limit of TSE from 4% to 5% can potentially reduce the number days stocks experience buy or sell queues.