

Zhen-Xing Wu¹, Yin-Feng Gau²

¹School of Finance, Zhongnan University of Economics and Law, Wuhan, Hubei, China.

²Department of Finance, National Central University, Taoyuan, Taiwan.

Abstract

We study the effect of high-frequency trading (HFT) on the intraday trading of currencies at the platform of Electronic Broking Services (EBS). We use the realized variance-based information share to measure the price discovery efficacy and find that the contribution of HFT is time-varying and is highest during the overlapping trading hours of London and New York, after dividing the 24-hour trading of FX markets into Asian, European, London-NY overlapping and U.S. sessions. Our new evidence shows that the liquidity supply from HFT accounts for the improvement of price discovery attributed to HFT, while the arrival of new information around macroeconomic announcements does not weaken the contribution of HFT to price discovery.

Introduction

• Motivations

- 1) The prevalence of electronic trading in the foreign exchange (FX) market leads to significant changes in the market structure and price dynamics.
- 2) In the digital marketplace, the price discovery process may change when some traders conduct algorithmic trading strategies (Brogaard, Hendershott, and Riordan, 2014).

• Research Gaps

Algorithmic traders can react more quickly to public information than non-HFTs and have positive influences on the pricing, and therefore enhance the price discovery. However, fast traders can increase the price informativeness by revising their quotes quickly after news arrivals. Hence, until now, how HFTs contribute to price discovery is still under debate.

• Research Questions

This paper aims to explore whether, when, and how HFTs improve the pricing efficiency in the FX market. By analyzing the mechanism of price discovery, we find that HFTs can significantly improve the price efficiency on US-announcement days, and HFTs can also facilitate the price efficiency through providing liquidity and by posting quotes that are updated quickly to reflect new information in the market.

• Research Ideas

- 1) We study the overall impact of HFTs on price discovery in FX markets.
- 2) Then, exploiting the advantage of the market structure of FX markets, we divide the 24-hour trading in the FX market into four trading periods, and investigate how HFTs contribute to price discovery across the four periods.
- 3) Finally, to explore the reason behind the contribution to price discovery of HFTs, we further consider the interaction effects of trading-period dummy variables and HFT, news announcements, as well as liquidity in the analysis.

• Contributions

- 1) We provide a deeper analysis on the time-varying impacts of HFT on the intraday price discovery process across four sequential trading segments.
- 2) We do not directly measure the information shares of all kind of order flows. Traders could change their order submission strategies across different market conditions and this could lead to those contrary conclusions in the prior literature. This paper shifts to investigate what the mechanisms between HFT and price discovery.

Data & Methods

• Data

- 1) The EBS data consist second-by-second quotes and trading data for EUR/USD and USD/JPY, covering the period from 2008 through 2012.
- 2) The macro news surprises are from Reuters Economic Indicator Poll.

• Methods

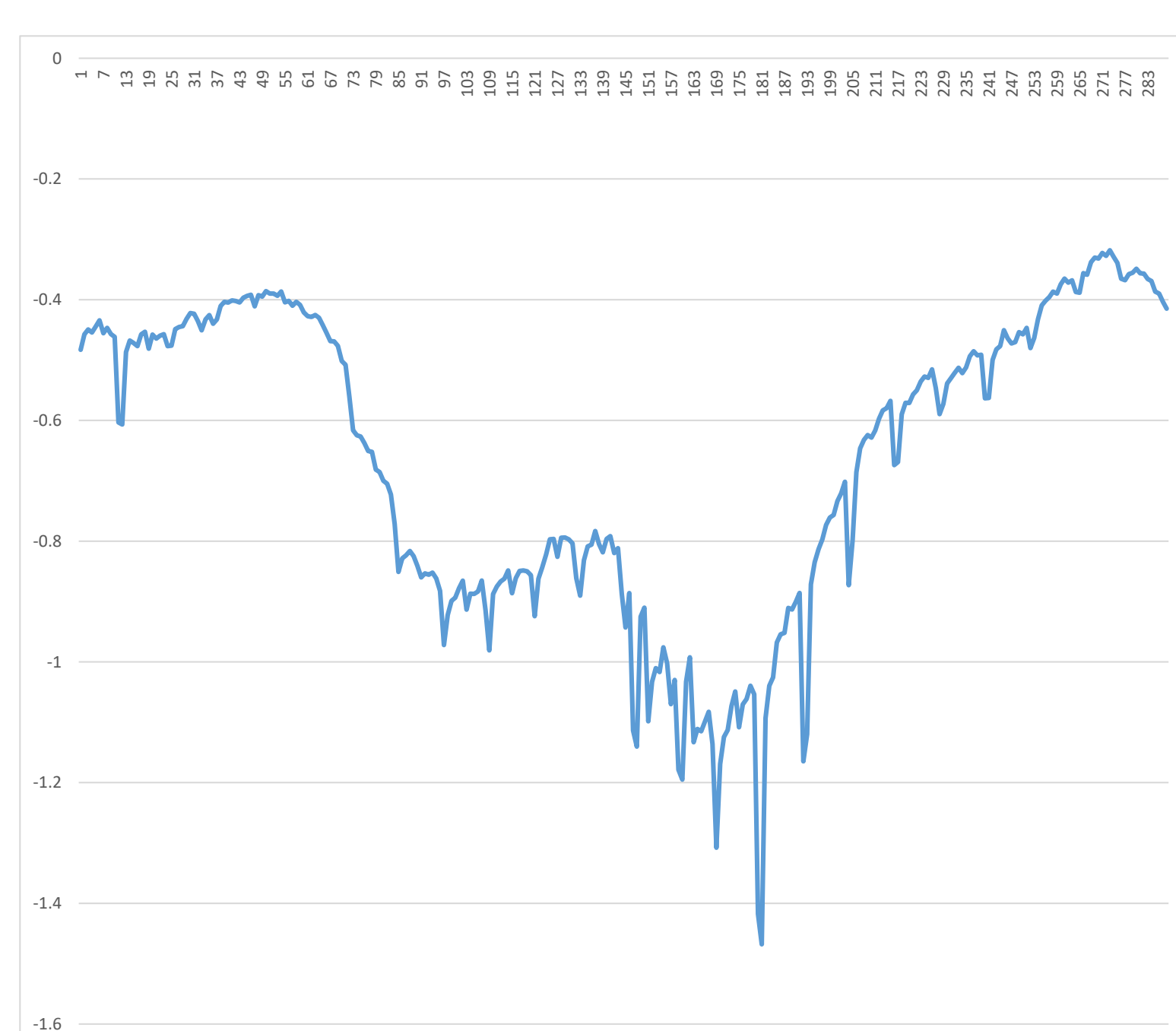
- 1) Since the EBS data do not provide the identification of HFTs, we follow Hendershott et al. (2011) and Boehmer et al. (2015) to define the intensity of high-frequency trading for the i -th trading period during day t , $HFT_{i,t}$.
- 2) To study how the price discovery evolves across different sequential markets, we follow Wang and Yang's (2011) extension of Hasbrouck (1995) to measure the information share.
- 3) To identify the relationship between price discovery and HFT, we use a vector autoregressive (VAR) model.

Empirical Results

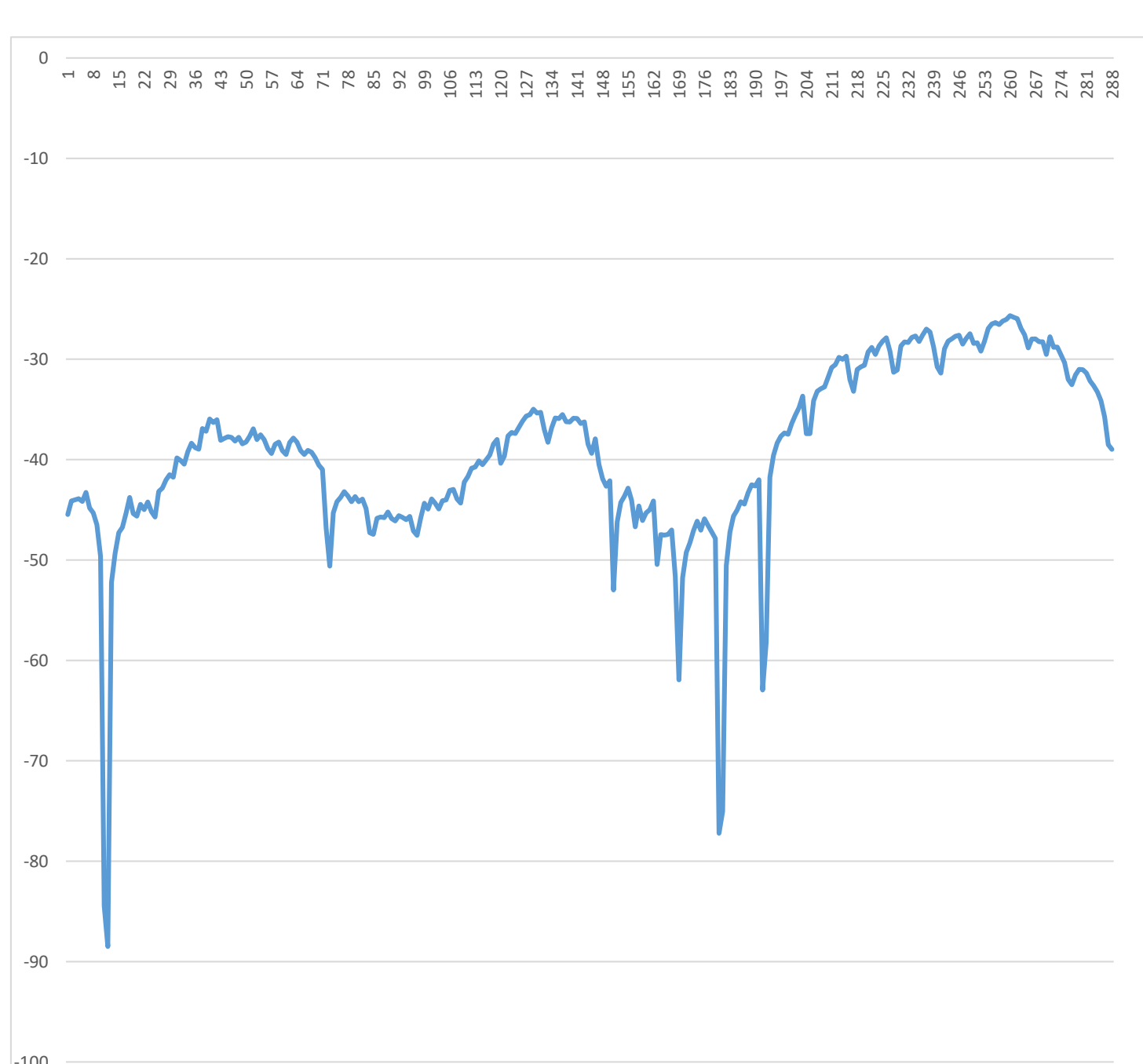
- 1) We find that high-frequency trading contributes to price discovery in the FX market, which is in line with Chaboud et al. (2014).
- 2) Different from prior studies, we further show that HFTs are more likely to improve the price discovery in the most active trading periods.
- 3) By analyzing the mechanism of price discovery, we find that HFTs can significantly improve the price efficiency on US-announcement days, and HFTs can also facilitate the price efficiency through providing liquidity and by posting quotes that are updated quickly to reflect new information.

Intraday Pattern of High Frequency Trading

A. EUR/USD



B. USD/JPY



2. The relationship between high frequency trading and price discovery

	EUR/USD				USD/JPY			
	Model 1		Model 2		Model 1		Model 2	
	IS _{it}	HFT _{it}	IS _{it}	HFT _{it}	IS _{it}	HFT _{it}	IS _{it}	HFT _{it}
Constant	0.0344*** (10.48)	-0.0649*** (-10.99)	0.0241** (2.13)	-0.2142*** (-12.96)	0.0393*** (10.42)	-0.2185*** (-37.77)	0.0338*** (5.29)	-0.2662*** (-27.73)
MKT _{2,t}	0.0317*** (16.76)	-0.2148*** (-63.22)	0.074*** (4.38)	0.1058*** (4.3)	0.0141*** (7.66)	0.1007*** (35.75)	0.0302*** (3.33)	0.1569*** (11.5)
MKT _{3,t}	0.0535*** (27.48)	-0.1841*** (-52.61)	0.0859*** (6.05)	0.2682*** (12.99)	0.0357*** (20.47)	0.0307*** (11.47)	0.0527*** (6.01)	0.1956*** (14.88)
MKT _{4,t}	0.0149*** (6.92)	0.0281*** (7.27)	0.0105 (0.8)	0.0663*** (3.46)	0.0001 (0.06)	0.1354*** (47.9)	-0.0023 (-0.3)	0.1376*** (11.64)
IS _{F,t}	-0.2234*** (-15.32)	0.3017*** (11.52)	-0.2429*** (-11.99)	0.2191*** (7.43)	-0.1391*** (-12.54)	0.1522*** (8.93)	-0.142*** (-12.73)	0.1396*** (8.33)
HFT _{F,t}	-0.0067 (-1.13)	0.6948*** (64.98)	-0.0342 (-1.37)	0.2566*** (7.04)	-0.0081 (-0.98)	0.5695*** (44.87)	-0.0280 (-1.47)	0.4148*** (14.51)
MKT _{2,t} × HFT _{F,t}			0.108** (2.4)	0.8358*** (12.79)			0.0449* (1.77)	0.1758*** (4.62)
MKT _{3,t} × HFT _{F,t}			0.0592* (1.94)	0.9619*** (21.68)			0.0506* (1.95)	0.4846*** (12.43)
MKT _{4,t} × HFT _{F,t}			-0.0063 (-0.22)	0.1852*** (4.56)			-0.0019 (-0.08)	0.0378 (1.1)
Spread _{it}	-31.8413 (-1)	13.8903 (0.24)	-57.3246 (-0.61)	-573.4443*** (-4.19)	27.1716 (0.79)	-196.1938*** (-3.7)	18.7873 (0.54)	-188.6175*** (-3.58)
Volatility _{it}	30.5038 (1.07)	-36.2381 (-0.71)	74.0443 (0.78)	458.7606*** (3.33)	-0.0351* (-1.91)	0.1848*** (6.55)	-0.0296 (-1.57)	0.178*** (6.3)

3. Explanations for the relationship between HFT and pricing efficiency

A. The mechanism of news announcements

B. The mechanism of liquidity

	EUR/USD		USD/JPY			EUR/USD		USD/JPY	
	IS _{it}	HFT _{it}	IS _{it}	HFT _{it}		IS _{it}	HFT _{it}	IS _{it}	HFT _{it}
Constant	0.0245*** (3.56)	-0.2319*** (-22.05)	0.0322*** (4.61)	-0.2719*** (-25.91)	Constant	0.0304*** (2.64)	-0.2819*** (-16.08)	0.0577*** (5.01)	-0.2508*** (-14.52)
MKT _{2,t}	0.0577*** (5.51)	0.0914*** (5.71)	0.0307*** (3.36)	0.1577*** (11.53)	MKT _{2,t}	0.0568*** (5.44)	0.0943*** (5.93)	0.0281*** (3.06)	0.1463*** (10.62)
MKT _{3,t}	0.0777*** (8.68)	0.271*** (19.81)	0.0525*** (5.98)	0.1944*** (14.76)	MKT _{3,t}	0.0699*** (7.7)	0.292*** (21.12)	0.0495*** (5.54)	0.1926*** (14.38)
MKT _{4,t}	0.0147* (1.77)	0.0628*** (4.97)	-0.0024 (-0.3)	0.1369*** (11.56)	MKT _{4,t}	0.0173** (2.08)	0.0619*** (4.88)	-0.0014 (-0.17)	0.1307*** (10.88)
PD _{F,t}	-0.2258*** (-15.44)	0.2471*** (11.05)	-0.1417*** (-12.69)	0.1408*** (8.4)	PD _{F,t}	-0.2262*** (-15.53)	0.2517*** (11.36)	-0.1427*** (-12.79)	0.1406*** (8.4)
HFT _{F,t}	-0.0283* (-1.8)	0.2923*** (12.17)	-0.0326 (-1.54)	0.4043*** (12.73)	HFT _{F,t}	-0.0043 (-0.14)	0.1517*** (3.34)	0.0569 (1.56)	0.5267*** (9.59)
MKT _{2,t} × HFT _{F,t}	0.0732*** (2.59)	0.8056*** (18.66)	0.0449* (1.72)	0.171*** (4.37)	MKT _{2,t} × HFT _{F,t}	0.0282 (0.89)	0.7798*** (16.14)	-0.0148 (-0.45)	0.0039 (0.08)
MKT _{3,t} × HFT _{F,t}	0.0426** (2.17)	0.9734*** (32.51)	0.0523* (1.96)	0.4809*** (12.02)	MKT _{3,t} × HFT _{F,t}	-0.0436 (-1.59)	1.2016*** (28.73)	0.0229 (0.64)	0.4466*** (8.35)
MKT _{4,t} × HFT _{F,t}	0.0036 (0.2)	0.1754*** (6.46)	-0.0008 (-0.03)	0.0350 (0.99)	MKT _{4,t} × HFT _{F,t}	0.0301 (1.23)	0.181*** (4.86)	0.0199 (0.63)	-0.0560 (-1.19)
USNEWS _{F,t}	0.0023* (1.66)	-0.0014 (-0.67)	0.0034 (0.56)	0.0133 (1.45)	USNEWS _{F,t}	0.0011 (0.18)	0.0098 (1.03)	0.0109 (0.53)	0.0312 (1.01)
HFT _{F,t} × USNEWS _{F,t}	0.0011 (0.18)	0.0098 (1.03)	0.0109 (0.53)	0.0312 (1.01)	HFT _{F,t} × USNEWS _{F,t}	-379.7069 (-0.92)	2338.772*** (3.73)	-1017.113*** (-2.69)	-1150.551** (-2.03)
MKT _{2,t} × HFT _{F,t} × USNEWS _{F,t}	-0.0051 (-0.53)	-0.0066 (-0.45)	0.0025 (0.24)	0.0131 (0.84)	MKT _{2,t} × HFT _{F,t} × USNEWS _{F,t}	685.8013*** (2.63)	497.8668 (1.25)	669.0193*** (3.23)	1760.056*** (5.67)
MKT _{3,t} × HFT _{F,t} × USNEWS _{F,t}	0.018** (2.28)	-0.0299*** (-2.48)	-0.0044 (-0.43)	0.0001 (0.01)	MKT _{3,t} × HFT _{F,t} × USNEWS _{F,t}	1391.659*** (4.87)	-3505.189*** (-8.06)	223.5062 (0.9)	281.8838 (0.76)
MKT _{4,t} × HFT _{F,t} × USNEWS _{F,t}	0.0041 (0.54)	-0.0166 (-1.44)	-0.0026 (-0.25)	0.0004 (0.03)	MKT _{4,t} × HFT _{F,t} × USNEWS _{F,t}	-376.0642 (-1.44)	-181.6473 (-0.46)	-300.5646 (-1.38)	883.5873*** (2.71)
Spread _{it}	-29.2372 (-0.92)	56.5416 (1.16)	21.2316 (0.6)	-179.1199*** (-6.8)	Spread _{it}	-103.3414 (-3.38)	837.9894*** (3.63)	-267.5174** (-3.63)	-311.0408* (-2.14)
Volatility _{it}	31.9336 (1.13)	-19.5128 (-0.45)	-0.0308 (-1.63)	0.1744*** (6.16)	Volatility _{it}	7.9537 (0.26)	48.1304 (1.03)	-0.0469** (-2.39)	0.1587*** (5.38)

Conclusions

- 1) This paper examines the contribution of HFT to price discovery in the FX market. Chaboud et al. (2014) and Brogaard et al. (2014) first to show that the HFT is benefit to price discovery, but they treat the contribution of HFT is constant over time. Although Viljoen et al. (2014) and Gau et al. (2018) find that the density of HFT varies across time, they do not look into how the contribution of HFT to price discovery changes over time. This study firstly investigates whether HFTs uniformly contribute to price discovery ability across Asian, European, London+NY and U.S. periods.
- 2) We find that, in average, high-frequency traders contribute to boost the price efficiency in both EUR/USD and USD/JPY markets. Moreover, high-frequency traders can contribute more to price discovery in the London+NY period. This novel evidence suggests that the impacts of high-frequency trading on price discovery are not uniform across different trading periods.
- 3) We further investigate the possible driving forces behind the improvement of price discovery from high-frequency trading activities. The results show that macroeconomic announcements cannot explain the contribution of HFT to price discovery which does not support the conclusion in Brogaard et al. (2014). However, our results support for Brogaard et al. (2019) that high-frequency traders can contribute to price discovery through providing the liquidity.

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Yin-Feng Gau

Department of Finance, National Central University

Email: yfgau@ncu.edu.tw

Website: http://fm.mgt.ncu.edu.tw/03/main_v.php?id=163

Phone: +886-3-4227151 ext. 66263

Zhen-Xing Wu

Zhongnan University of Economics and Laws

Email: loveaf1225@gmail.com