Price Impact and Profit of Xetra-Traders: Does Profitability increase with Trade Size?

by

Anne-Kerstin Kampovsky & Siegfried Trautmann

Johannes Gutenberg-University Mainz

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1. Introduction

- Little direct *empirical* research has been conducted on the question whether a *non-price-taker* (”large investor”) gains any advantage through taking into account his effect on prices.
- In models where the presence of a non-price-taker is generated *endogenously* by his superior information over the other agents (e.g. Kyle (1985), or Holden/Subrahmanyam (1992) when there are multiple informed trader), non-price-taker are better off.
- In models with *symmetric* information where the presence of a non-price-taker is specified *exogenously* the non-price-taker has either no advantage (e.g. Grinblatt/Ross (1985), Kampovsky/Trautmann (2000)) or is at least as well off as if he were a price-taker (e.g. Basak(1996,1997)).
- We use a unique data set of the German stock market to examine the profitability of non-price-taker empirically.

2. Institutional Framework

- Xetra (eXchange Electronic TRAding), Deutsche Börse AG‘s *electronic* securities trading platform, accounts for more than 87 percent of the turnover in the DAX blue chips and more than 80 percent of the turnover in stocks traded at German Securities Exchanges.

- Xetra is a *hybrid market place*. The basic trading platform is an electronic limit order book (the *continuous order-driven market*). Linked in with the book are at least three call auctions (the *batched market*) a day: at the open, intra-day, and at the close. Additionally, dealers (*Betreuer*) provide quotes to the public upon request.

- In Xetra execution of trade against the book occurs in a "*discriminatory*" fashion. That is, if a trade is large enough to execute against several limit orders at different prices, each limit order transacts at its limit price.

  For *example*, if there were two offers at 50 for 1,000 shares of each, and two offers at 51, each for 1,000 shares, a 4,000-share purchase would in effect lead to four transactions – two at 50 and two at 51. The marginal price for this 4,000-share trade would be 51, while the average price would be 50.5.

Data

- We use high-frequent transactions data with flagged trader identification uniquely available from the Trading Surveillance Unit of the Frankfurt Securities Exchange (*Handelsüberwachungsstelle der Frankfurter Wertpapierbörse*).
- All matched buy/sell transactions in 11 DAX-stocks and 5 MDAX-stocks traded in Xetra during the 253-trading day period from August 31, 1998 through August 31, 1999.
- Each data record consists of a time-stamped, matched buy/sell transaction at a given price and quantity with (encoded) buyer/seller identification and information
  - whether the transactor is acting for his own account (labelled with 'P'), for a customers account ('A'), or as a specialist (Betreuer,'M'),
  - whether the buyer or the seller initiated the transaction, and
  - whether the order is a limit order or a market order.

Trading Activity Statistics

- Average number of daily trades for DAX-stocks ranges between 378 (Metro) and 1.063 (DaimlerChrysler).
- Average number of daily trades for MDAX-stocks ranges between 13 (Fr. Krupp) and 107 (Continental).
- Average number of traders (member firms) for each DAX-stock is about 1.500 (250) and for MDAX-stocks about 800 (170).
- Percentage of traders trading only for their own account: about 50%.
- Percentage of trading volume due to proprietary trading: about 66% for DAX-stocks and about 50% for MDAX-stocks.

3. Test Hypotheses:

H1: Price Impact hypothesis: Price Impact is linear.

H2: Trade size hypothesis: Trading profits per transaction increase with increasing trade size.

H3: Frequent trading hypothesis: Trading profits per transaction increase with the number of transactions.

H4: Dual trading hypothesis: Traders active for their customers *and* their own account outperform non-dual traders.

H5: Trade initiating hypothesis: Trading profits per transaction decrease with fraction of initiated trades.

H6: Institutional economics of scale hypothesis: Trading profits per transaction increase with the size of the member firm.

4. Price Impact and Trade Size

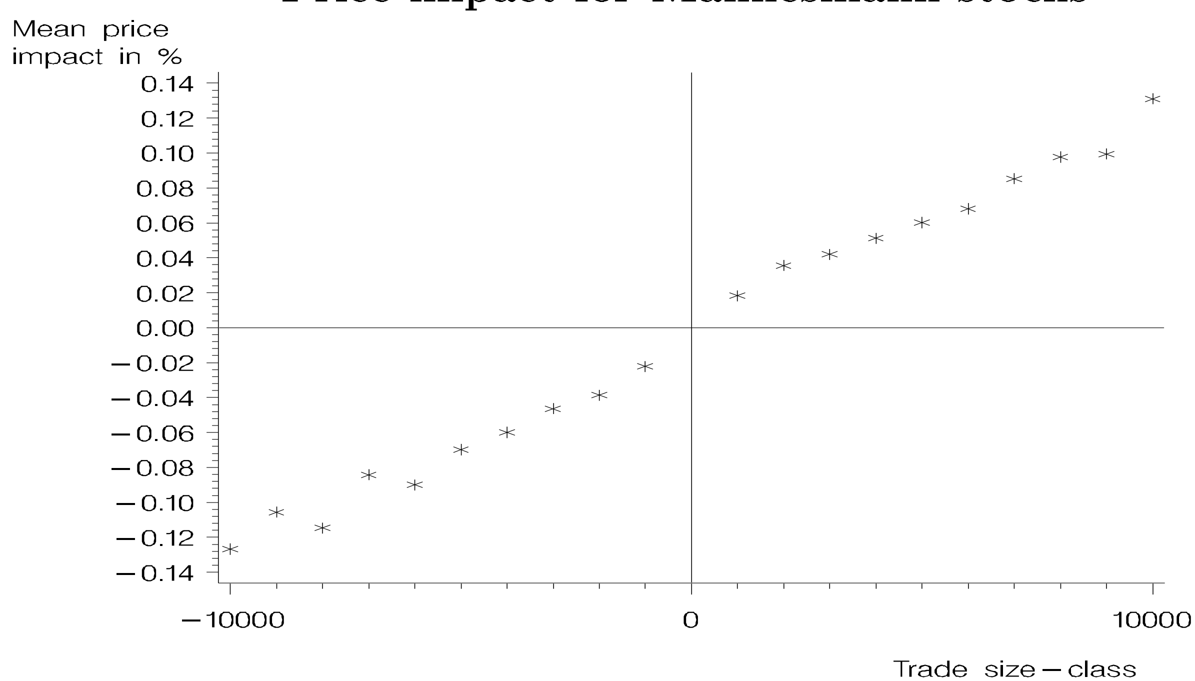
- The relationship between Price Impact and Trade Size is examined only for the *continuous order-driven market* (accounting for as much as 92% (95%) of the trading volume in DAX-stocks (MDAX-stocks)).
- Price Impact of a trade is defined as: $\ln\left(\frac{\text{marginal price of trade}}{\text{last transaction price}}\right)$
- Price Impact of Block trades (the 40 biggest buys and the 40 biggest sales per month and stock initiating a trade) result in an excess return of $\pm 0,12\%$ on average.
- Price Impact function is slightly concave in the unsigned (absolute) trade size. The non-linear regression explains the relationship quite good:

$$\ln\left(\frac{p_t}{p_{t-1}}\right) = \alpha \ \mathrm{TrSize}_t + \beta \ \mathrm{TrSize}_t \cdot \ \mathrm{abs}(\mathrm{TrSize}_t) + \varepsilon_t, \quad t = 1, 2, \ldots$$

Examples:

Stock	$\hat{\alpha}$	$\hat{\beta}$	meanTrSize
ALV	$4,9 \times 10^{-7}$	$-7,16 \times 10^{-11}$	545
DTE	$0,6 \times 10^{-7}$	$-0,07 \times 10^{-11}$	3170
MMN	$1,6 \times 10^{-7}$	$-0,53 \times 10^{-11}$	1205

Price impact for Mannesmann stocks



- Price impact decomposition via spectral analysis:

$$\ln(\frac{p_t}{p_{t-1}}) =: \sum_f \ln(\frac{p_t}{p_{t-1}})^f$$

where f= Day, Week, Month, Year denotes the maximal duration of the price impact.

- A trader's price impact not related to trade size is identified by running the regression

$$\ln(\frac{p_t}{p_{t-1}})^f = \alpha_1^f \text{ TrSize}_t + \alpha_2^f \text{ TrSize}_t|\text{TrSize}_t| + \sum_{i=1}^{N} \beta_i^f \text{sign}(\text{TrSize}_t) \cdot 1_{\{Trader=i\}}$$
$$t = 1, 2, \ldots,$$

where f = Day, Week, Month, Year or Total.

Number of traders with price impact not related to trade size

			Number of traders with price impact on cycles with a period up to a			
Stock	Trader in total	**Total**	Day	Week	Month	Year
DAX-Stocks:						
ALV	324	**2**	2	-	-	-
BAY	330	**-**	1	-	-	-
DBK	453	**3**	2	-	-	-
DCX	436	**3**	3	-	-	-
DTE	363	**-**	-	-	-	-
LHA	238	**1**	1	-	-	-
MEO	225	**2**	2	-	-	-
MMN	356	**7**	4	-	-	-
RWE	228	**2**	2	-	-	-
SIE	371	**5**	2	-	-	-
VEB	282	**3**	3	-	-	-
MDAX-Stocks:						
BHF	92	**1**	1	-	3	2
CON	233	**3**	2	2	-	-
DOU	87	**-**	-	-	-	-
FKR	30	**1**	1	-	1	4
SGL	100	**3**	1	4	3	3

5. Trading Profits and its Sources

- The mark-to-market profit is defined as

$$G_t = N_{t-1}(S_t - S_{t-1})$$

where

S_t price per share of the security at time t,
N_t number of shares held at time t

- The average excess trading profit per transaction is

$$\overline{G} = \frac{1}{T-1}\sum_{t=2}^{T} N_{t-1}^{deme}(S_t - S_{t-1}) = \frac{1}{T-1}\sum_{t=2}^{T} N_{t-1}(S_t - S_{t-1}) - \underbrace{\frac{1}{T-1}\overline{N}(S_T - S_1)}_{\text{Benchmark profit per transaction}}$$

where

$N_t^{deme} = N_t - \overline{N}$ demeaned value
$\overline{N}$ = average number of shares held in the sample period

- Average excess trading profits per transaction are decomposed via spectral analysis (see e.g. Hasbrouck/Sofianos (1993, JoF)):

$$\overline{G} = \overline{G}^{Day} + \overline{G}^{Week} + \overline{G}^{Month} + \overline{G}^{Year},$$

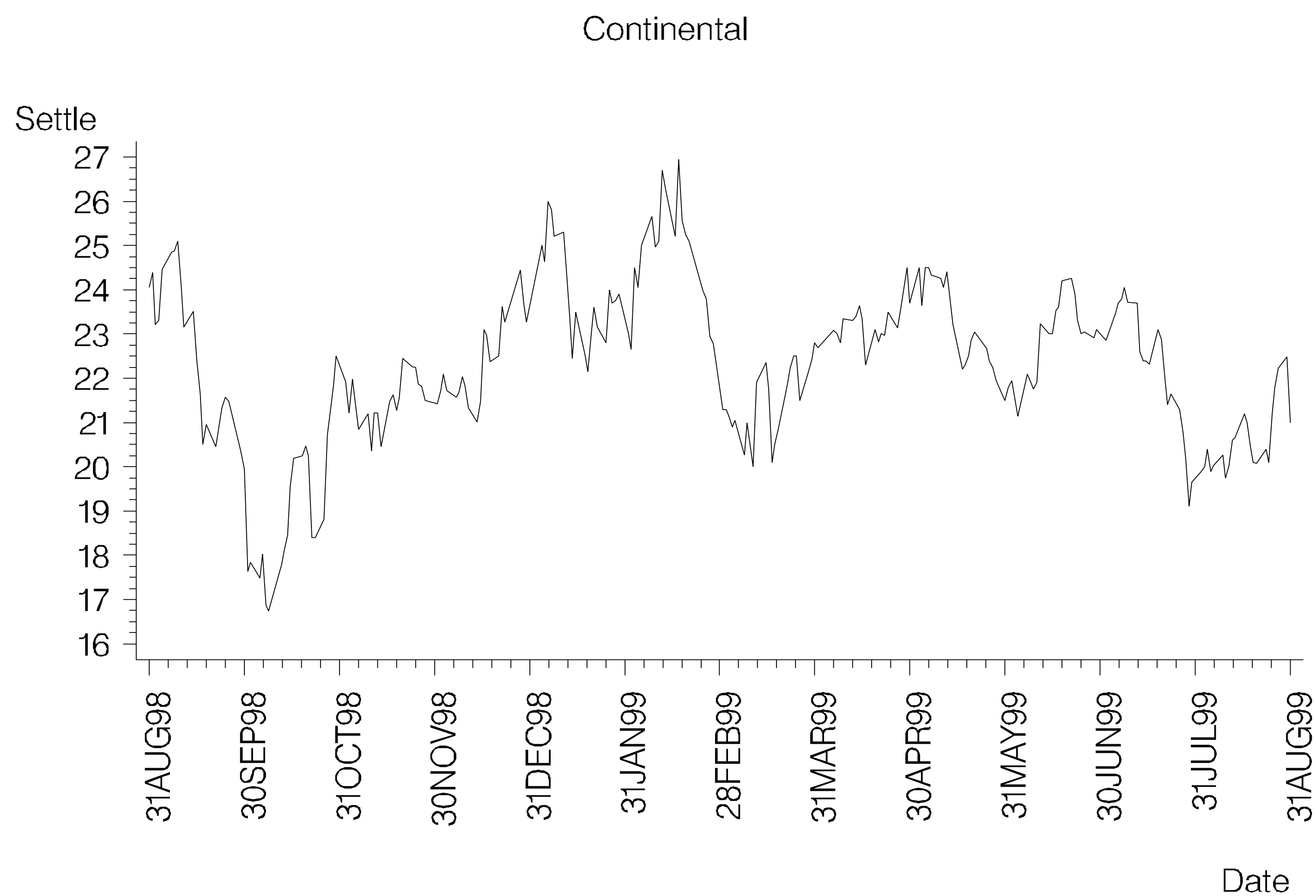
where $\overline{G}^{f}$ denotes profits per transaction corresponding to an implied trading horizon f = Day, Week, Month, Year.

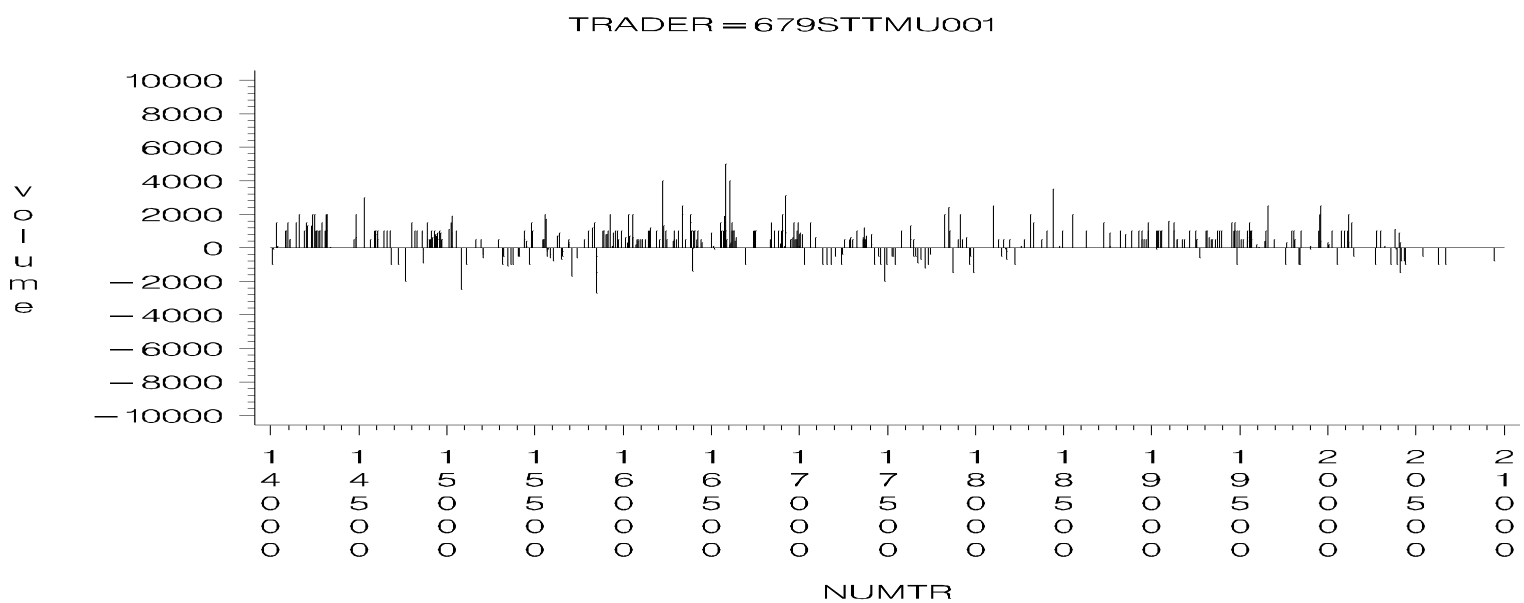
- Minimum, maximum, mean and standard deviation of average excess trading profits per transaction (in Euro):

	DAX-Stocks				MDAX-Stocks			
Variable	Min.	Max.	Mean	STD	Min.	Max.	Mean	STD
Exc. Profit (Day)	−16	20	**0,11**	1,3	−23	130	**0,6**	8,7
Exc. Profit (Week)	−21	26	**0,05**	1,8	−137	40	**−0,6**	10,8
Exc. Profit (Month)	−67	51	**0,07**	4,7	−424	89	**−1,9**	30,8
Exc. Profit (Year)	−233	403	**0,48**	17,4	−494	1049	**10,5**	107
Exc. Profit (Total)	**−234**	**398**	**0,71**	**18,2**	**−438**	**729**	**8,6**	**90**

5.1 Trading pattern of profitable and non-profitable traders

Example: Trading pattern in Continental-stocks

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volume
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8000
6000
4000
2000
0
−2000
−4000
−6000
−8000
−10000
14000
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16000
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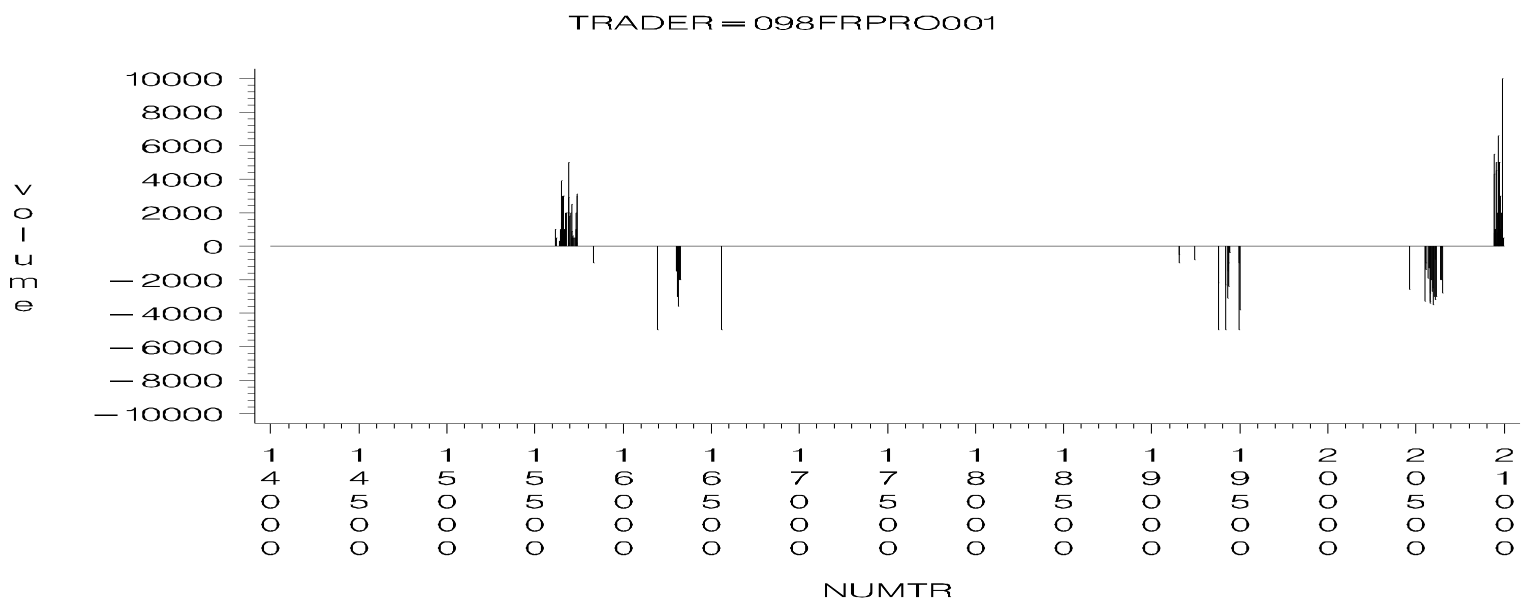
17000
17500
18000
18500
19000
19500
20000
20500
21000
NUMTR


TRADER = 098FRPRO001
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6000
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0
−2000
−4000
−6000
−8000
−10000
14000
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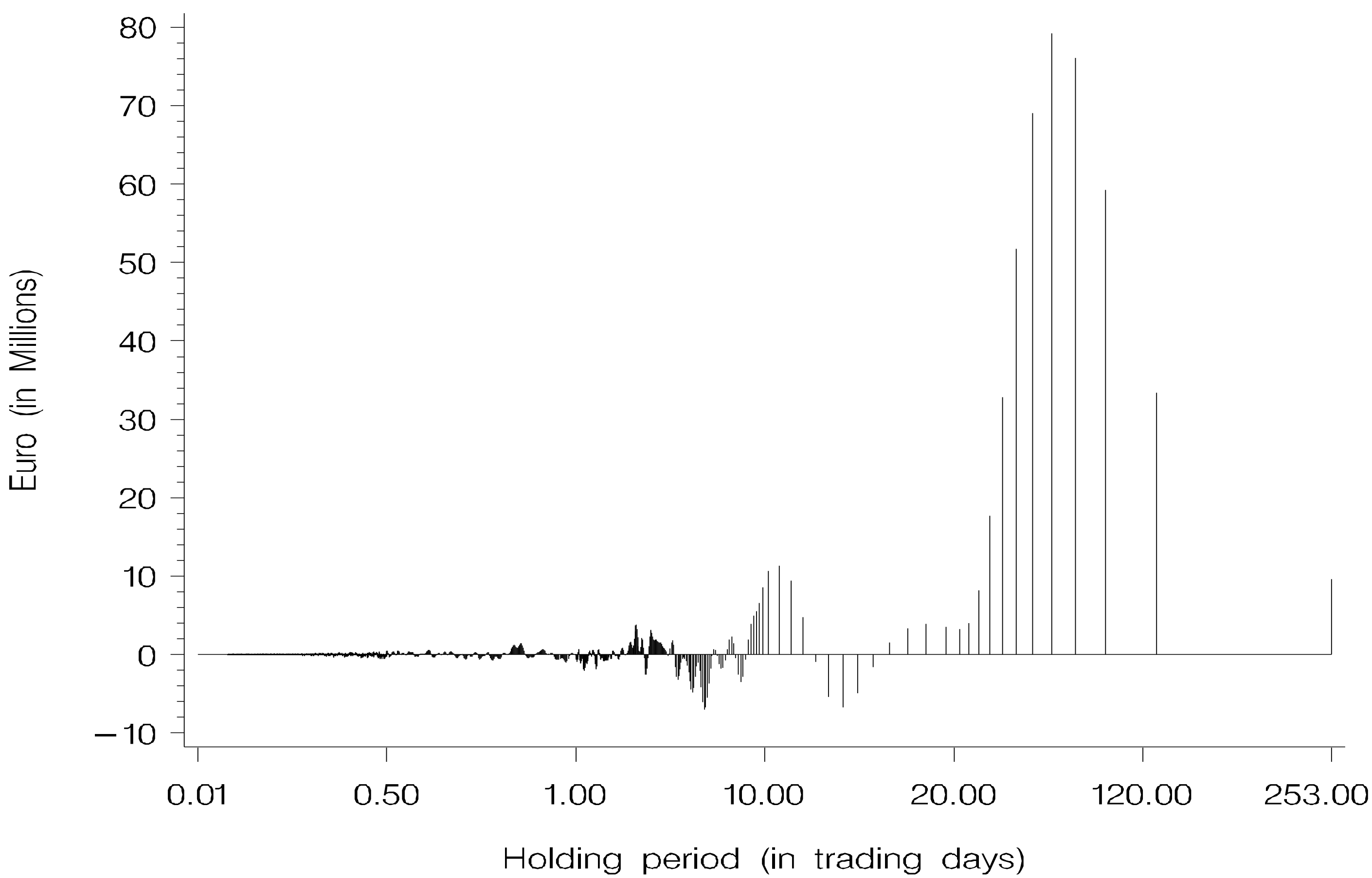
15500
16000
16500
17000
17500
18000
18500
19000
19500
20000
20500
21000
NUMTR

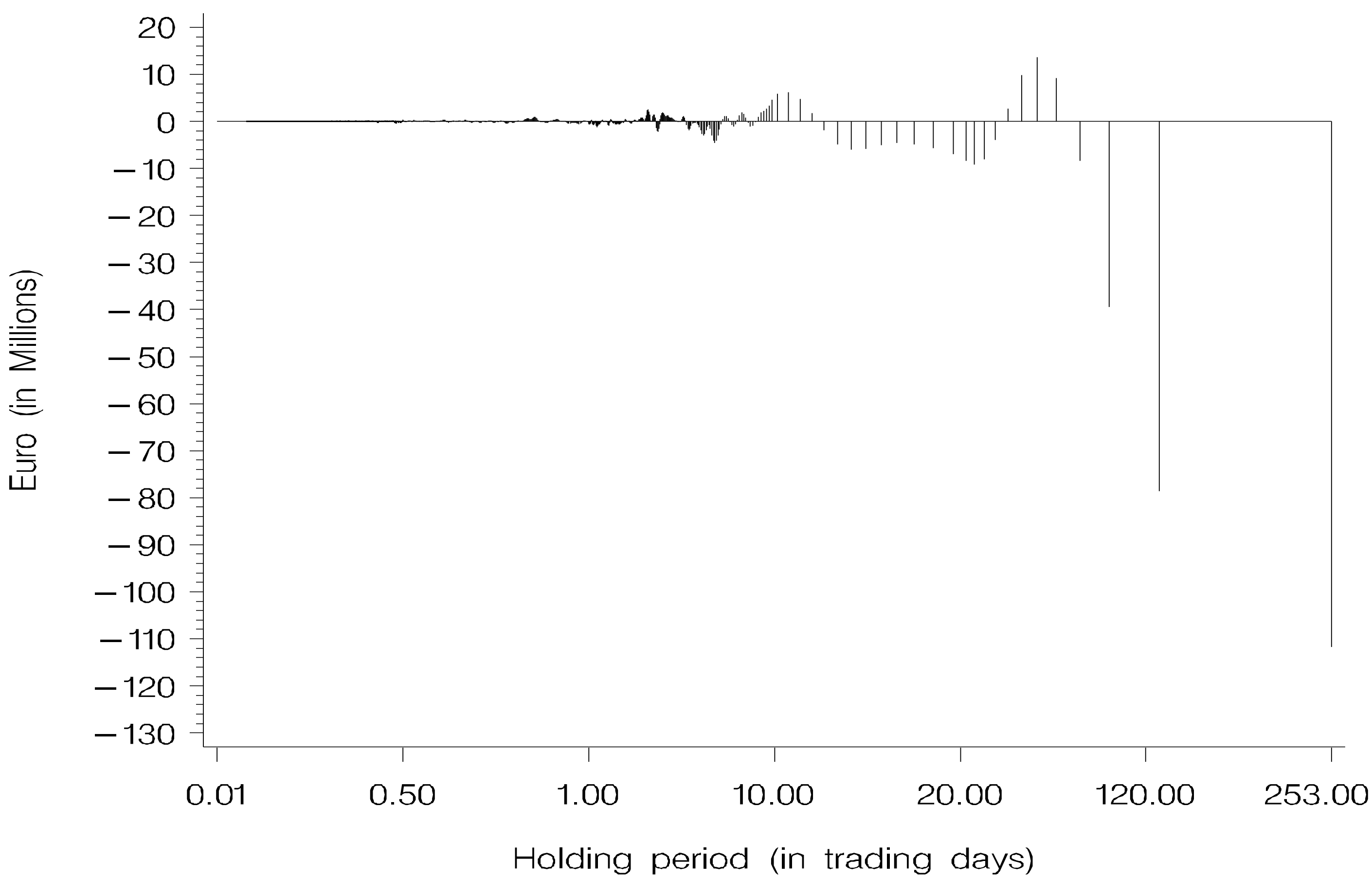
- **Cospectrum of price changes and demeaned trading position**
  (The needles' length equals the trader's trading profit for the corresponding (implied) holding period)

The most profitable trader (679STTMU001)



- **Cospectrum of price changes and demeaned trading position**
  (The needles' length equals the trader's trading profit for the corresponding (implied) holding period)

The least profitable trader (098FRPRO001)



5.2 (Pooled) Regression of trading profits on trader characteristics

$$\overline{G}_{i,j}^{f,adj} = \alpha_j + \beta_1 \text{DumBank}_{i,j} + \beta_2 \text{ DumDual}_{i,j} + \beta_3 \text{ NMemStocks}_{i,j} + \beta_4 \text{ FracInit}_{i,j} + \beta_5 \text{ NTrades}_{i,j} + \beta_6 \text{ PrImpBeta}_{i,j} + \beta_7 \text{ TrSizeMean}_{i,j} + \mu_i + \varepsilon_{i,j},$$

where

$$\overline{G}_{i,j}^{f,\,adj} \equiv \frac{\overline{G}_{i,j}^{f}}{Risk_{i,j}^{f}/\overline{Risk^{f}}_{j}} \quad \text{with} \quad Risk^f := \sqrt{Var(N^{deme}S)^f}$$

risk-adjusted profit per transaction of trader i in stock j
with f = Day, Week, Month, Year, total

DumBank ≡ dummy variable for banks
DumDual ≡ dummy variable for dual traders
NMemStocks ≡ number of traders of the same member as trader i active in stock j.
FracInit ≡ percentage of inititated trades
NTrades ≡ number of trades
PrImpBeta ≡ price impact
TrSizeMean ≡ mean trade size

Regression on trader characteristics: Results

		Maximal length of implied holding period			
	Total	Day	Week	Month	Year
DAX-Stocks (3,602 Observations):					
DumBank	**0,69**	0,08	0,29**	0,08	0,26
DumDual	**−1,74***	−0,03	−0,18*	−0,56**	−0,52
NMemStocks	**−1,49****	−0,08**	−0,08**	−0,23**	−0,50**
FInit	**−4,65****	−1,64**	−0,50**	−1,44**	0,05
NTrades	**1,50****	0,25**	−0,01	0,09	0,38**
PrImpBeta	**2,07**	−0,11	2,90*	8,90	−12,14
TrSizeMean	**−1,54****	−0,13**	−0,07	0,11	−0,72
Adj. R^2 in %	**40**	60	32	23	14
MDAX-Stocks (271 Observations):					
DumBank	**−28,92****	0,69	0,76	−0,63	−27,03**
DumDual	**5,65**	−0,43	0,20	−1,12	0,31
NMemStocks	**3,32**	0,32	−0,54	−0,96	3,56
FrInit	**−20,41**	−4,38**	−2,35	0,45	−17,77
NTrades	**15,72****	0,79**	0,56	−1,37	16,20**
PrImpBeta	**18,92****	0,13	3,06*	−2,31	22,90
TrSizeMean	**5,39**	0,67	−0,83	−2,10	4,14
Adj. R^2 in %	**16**	14	24	1	9

* (**) significant at level 5%(1%)

Minimum, maximum, mean and standard deviation of explaining variables

	DAX-Stocks				MDAX-Stocks			
Variable	Min.	Max.	Mean	STD	Min.	Max.	Mean	STD
DBank	0	1	**0,49**	0,50	0	1	**0,46**	0,5
DDual	0	1	**0,13**	0,34	0	1	**0,15**	0,36
NMemStocks	1	41	**11,14**	9,59	1	23	**7,43**	5,58
FrInit	0,01	0,98	**0,46**	0,17	0,05	0,98	**0,51**	0,18
NTrades	100	35.066	**633**	1.128	50	1.715	**162**	202
TrSizeMean	101	15.489	**2.122**	1.298	89	5.822	**1.495**	926

6. Conclusions

(1) Price impact is slightly non-linear in trade size.

(2) Liquidity risk increases during turbulent trading days even for liquid DAX-stocks: The price impact of a large trade size increases substantially.

(3) Trading profits increase with the number of transactions in a stock.

(4) Trading profits decrease with trade size, especially in liquid DAX-stocks.

(5) Trading profits decrease with the fraction of initiated trades, especially in DAX-stocks.

(6) Dual traders do not profit from trades on customers' account.