Transaction Costs on the Swiss Stock Exchange

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Current Version: September 2001

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Abstract

This paper analyzes the transaction costs on the Swiss Stock Exchange. Firstly, it provides a survey on bid-ask spread components models. Secondly, the main cost components affecting the trading in a sample of highly liquid Swiss stocks are measured. The spread components are also examined in relation with market liquidity, trade size and the time of the day. While the order processing costs are identified as the largest cost component, the adverse selection and order persistence components are also significant. Adverse selection and order persistence increase with stock liquidity and characterize the afternoon trading. Also, the adverse selection (order processing) component increases (decreases) with trade size.

JEL Classification: G15

Introduction

In a price-driven market such as the NASDAQ, a dealer making a market for a stock provides immediacy services to traders who want to transact promptly. Instead, in a pure order-driven market such as the Swiss Stock Exchange (hereafter SWX), there is no designed market maker. Some traders spontaneously offer liquidity, filling the order book with limit orders. To compensate the liquidity providers, traders who want an immediate purchase (sell) trade at a relatively higher (lower) price, i.e. the bid and the ask quotes. The difference between the prevailing ask- and bid-quotes is the bid-ask spread that represents the liquidity provider's gross profit. The bid-ask spread is the liquidity providers' compensation for several cost components and services such as bearing the inventory and adverse selection risks, brokerage commissions, communication costs, clearing and others. On the contrary, the bid-ask spread represents the transaction cost for the market order traders, i.e. "the price takers" who demand an immediate execution.

The analysis of the transaction costs in a pure order driven market is the main objective of this work. More specifically, the objectives of this research are the following:

- To provide straightforward measures of the transaction cost and its components on the SWX;
- The investigation the relationships between stock liquidity and transaction cost components;
- The analysis of the components of the transaction costs conditional on the volume size of the trades and the time of the day.

The microstructure literature identifies three main components of the transaction costs, namely the asymmetric information costs, the order processing costs and the order persistence. These three cost components represent the whole transaction cost. Further on, a survey on the cost component modeling and the related theoretical issues is presented. I then apply the Lin, Sanger and Booth model (1995) (hereafter LSB) that allows a straightforward measurement of the three cost components.

This paper is relevant for several reasons. Firstly, there has been little research devoted to the SWX market structure and no one has investigated its bid-ask spread components. Secondly, the current trend towards automation of trading system raises pertinent questions about the efficiency and the convenience of such a market structure. With the introduction of the Virt-x, i.e. the pan-European exchange system based on the SWX technological platform, this study becomes more relevant. Thus, using a unique database, this study addresses central questions such as (1) how does a market structure rooted in the voluntary liquidity provision cope with the existence of adverse selection?, (2) does a market driven by professional intermediation provide more convenient transaction fees and a more stable trading?. Finally, in recent times the traders pay a more deal of attention to the transaction cost and the competitive advantages of the exchange systems. Institutional traders such as fund managers, assess more carefully the price competitiveness and the microstructure characteristics that an asset market can assure.

This work provides several insights. Firstly, it provides empirical evidence to the existence of order processing costs, adverse selection costs and order persistence patterns in the transaction costs on the SWX. The order processing cost appears to be main cost component as adverse selection and autocorrelation components are shown to be significantly smaller. Secondly, the results provide evidence that the less liquid the stock, the more severe the asymmetric information cost. Likewise, order processing costs affect to a wider extent less liquid stocks. Thirdly, this study shows that large trades convey informative trading while order processing costs decrease with the order size. Finally, this study delivers some insights into the cost components patterns over the trading day. Previous literature documents a downward (upward) intraday pattern of the asymmetric information (order processing) costs in the US markets. Here I find opposing evidence. The analysis of this result suggests how the cross-board transmission of public and private information among stock exchanges generally occurs.

The paper proceeds as follows. Section 1 describes the main features of the market structure of SWX, the dataset as well as a preliminary analysis of the bid-ask spread. Section 2 provides a survey of the bid-ask components models and some econometric specifications. Section 3 reports the empirical findings and the related discussion. Concluding remarks follow thereafter.

1. Dataset and Market Microstructure

The SWX is based on an electronic trading platform. All orders are routed electronically via a large number of member terminals to the central limit order book (hereafter LOB). The trading occurs continuously from 9 a.m. to 5 p.m. with two electronic call auctions establishing the opening and closing prices[1]. The LOB contains the trade and quote

[1] This is one of three exchange periods of "regular trading". The other two periods are the "pre-opening" and the "opening". Notice that in the 1997 the regular trading time started at 10 a.m. and finished at 4:30 p.m.

information, namely (1) time stamp trades, price and trade volume in number of shares, (2) time stamp, limit price and order size of all the pending limit orders. The steps for entering an order are as follows. First, the investor submits the order to her/his bank or broker. Then, the bank transmits the order to the exchange system. The exchange system verifies the order validity and inserts the order data into the LOB that is publicly visible (SWX, 1996). Investors do therefore have direct access to all the pending quotes and are not obliged to trade through a market maker paying additional bid-offer spread. This market structure is very similar to the Paris Bourse. Nonetheless the SWX is a pure order-driven market while the Paris Bourse sets up special agreements with intermediaries (member firms) called *animateurs*. *Animateurs* undertake to ensure orderly trading in a given security and, more specifically, a maximum size for the bid-ask spread and a minimum depth in the LOB (Paris Bourse, 1999)[2].

In the SWX, orders can be placed at best price, i.e. *market order*, or at a limit price, i.e. *limit order*. Two other order types are the *hidden order* and the *fill or kill order* (FOK).[3] The tick sizes, i.e. the minimum price changes, are set in 6 ranges according to the stock price level. Hence the tick size system is similar to the tick system in the Paris Bourse[4].

The dataset used in this study contains the tick-by-tick history of trades and orders of 15 actively traded stocks on the SWX, for March and April 1997. Table 1 presents descriptive statistics for the 15 firms in the sample. The average is obtained by calculating the average by firms for all trading days, then averaged across the 15 firms. Table 1 shows that the stocks constituting the sample are extremely liquid. In fact, comparing the data in Venkataraman (2000), one can observe that the daily average number of trades and the average daily turnover in the sample is higher than a similar sample of the NYSE and almost equal to a similar sample of the Paris Bourse. This consideration gives an idea about the liquidity extent of the sample stocks.

Table 2 reports the descriptive statistics of several variants of the bid-ask spread. Let us

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[2] In the Continous A, i.e. for stocks with the highest market capitalizations, the *animateurs* ensure bid- and ask-quotes for a minimum order size of Euros 22'500 and at a maximum spread of 3%.

[3] The hidden order exempts orders above 200'000 CHF to be publicly visible until the execution. The FOK order must be completely matched in order to create a trade, otherwise the FOK order is cancelled. Market orders are matched against the pending limit orders according to the price-time priority rule, which consists in ordering the order book as follows: best price to worst price (where Market Orders are followed by Limit Order); then, within price, first in to last in.

[4] For a stock value less than CHF 9.99 the tick size is CHF 0.01, for a stock value from CHF 10 to 99.95 it is 0.05, for a stock value from CHF 100 to 249.75 it is 0.25, for a stock value from CHF 250 to 499.50 it is 0.5, for a stock value from CHF 500 to 4999 it is 1 and, finally, for a stock value higher than CHF 5000 the tick size is CHF 5.

denote A_t and B_t the ask and the bid quotes at time t, and $M_t = (A_t + B_t)/2$ is the correspondent midquote price in t. The Quoted Spread, abbreviated QS, is the simple difference between A_t and B_t. It is a rough measure of the gross profit for providing liquidity, or, in other words, the cost of a round-trip trade. Table 2 gives an idea about the difference in the QS across stocks, starting from a minimum of 0.323 CHF for CS stock to a maximum of 10.48 CHF for Roche stock. The Percentage Relative Spread (PRS) allows a more straightforward comparison across stocks since it corresponds to the QS in t divided by M_t. According to the PRS, the most liquid stocks are Novartis, Roche and Nestle and the least liquid stocks are SMH, Ciba and Clariant. The lowest PRS in the sample are even lower than the most liquid stocks in the CAC 40 (Declerck, 2000; and Jong, Nijman and Röell, 1995) and imitating the lowest PRS in the NYSE (e.g. Bessembinder and Kaufman, 1997). The relevance of the tick size in assessing trading costs is highlighted by Venkataraman (2000) who shows that the quoted spread in the Paris Bourse is lower than on the NYSE only if the tick size is not taken into consideration. Accordingly, the Spread Over Tick (SOT) ratio is calculated by dividing the QS by the minimum tick of any stock. The SOT measures the proportion between the expected QS size and the minimum possible transaction cost for a given stock, i.e. the tick size. The SOT shows that, on average, the transaction cost for trading in Novartis stocks requires only an additional 50% of the minimum cost whereas the SMH transaction cost requires around 250% of the smallest available cost. This suggests that transaction costs may vary widely and significantly across stocks.

According to de Jong, Nijman and Röell (1995) and Bessembinder and Kaufman (1997), among others, the Percentage Effective Spread (PES) is calculated by taking twice the absolute value of the difference between the transaction price in t and the midquote immediately preceding this trade. Bessembinder and Kaufman (1997) interpret the PES as the measure of the closeness of trade price to the asset’s underlying value. The PES thereby estimates the percentage execution cost actually paid by the trader, or the gross liquidity provider revenue. As expected, the PRS is always larger than PES and, on average, the difference amounts to 14.28%. Overall, these results show the SWX market structure ensures high liquidity and cost efficiency.

2. Empirical Model

In the past, the martingale and the related random-walk specification have been the essential references in modeling price dynamics. This was due to several reasons. Theoretically, the martingale embodies the properties of the "efficient price" and it allows one to link a wide area of research to the efficient market hypothesis. Statistically, the random-walk is a martingale that processes with tractable features and regularities such as the stationarity and the incremental independence.

As far as price dynamics investigations employ daily or longer time scales data, the martingale and the random-walk models could be seen as a reasonable specification. In fact, on daily or longer time-scales, it is a useful simplification to neglect the details of the trading process. However, over shorter intervals such as intraday or tick-by-tick times, the finer details of the trading process are not negligible. The bid-ask bounce arising from trades that randomly occur at the bid and ask price constitutes an intuitive example of those frictions and anomalies that impose a departure from the random-walk model.

The univariate random-walk decomposition is the natural starting point to make a survey on the bid-ask components models in market microstructure. Hereafter, let us assume that the price changes are covariance stationary and ergodic. Suppose that the (unobservable) efficient price, μ_t, follows a random walk:

$$\mu_t = \mu_{t-1} + u_t \qquad (1)$$

where $E[u_t]=0$, $E[u_t^2]=\sigma_\mu^2$, $E[u_t u_s]=0$ for $t \neq s$. It is straightforward to relate u_t to i.i.d. innovations due to new public information arrivals. The observed transaction price, p_t, corresponds to the efficient price plus a component that impounds various microstructure effects:

$$p_t = \mu_t + s_t + \varepsilon_t \qquad (2)$$

Intuitively, s_t expresses the half bid-ask bounce and ε_t denotes the i.i.d. residual term embodying all the main microstructure effects such as the price discreteness and similar features that appear to be vanishing, i.e. the transient effects on price dynamics. The residual terms in Equation 1 and 2 are uncorrelated.

Let us assume now, that the observed price changes follow a more precise dynamic process in which the transient component s_t is a function of the order direction, x_t, and a constant spread, s. Hence s increases (decreases) the efficient price μ_t if a buy (sell) order occurs. The order direction is expressed with $x_t = 1$ if a purchase and $x_t = -1$ if a sell occurs. Consequently, Equation (2) can be written as:

$$p_t = \mu_t + s(x_t) + \varepsilon_t \tag{3}$$

This turns out to be the Roll model (1984) that is one of the first and most appealing models in microstructure. In this framework s represents the order processing cost that can be interpreted as the liquidity provider's compensation for inventory risk bearing and transaction costs such as labor, communication and clearing. In Roll, the upward and downward price change is equally likely, i.e. $P[x_t = 1] = P[x_t = -1] = 0.5$, the constant spread s, thus, imposes three possible price changes, i.e. $\Delta p_t = \{-2s; 0; 2s\}$. This simple model allows estimating the realized bid-ask spread size through the covariance of two subsequent price changes.

Up to this point, the univariate random-walk model has been extended in order to involve transitory effects affecting the price dynamics. However information symmetry among the economic agents was not considered. The information symmetry refers to information not yet embodied in the fundamental asset value. In Copeland and Galai (1983) and Glosten and Milgrom (1985) some traders have superior information and, thus, trades convey information about the expected equilibrium price. In the Glosten model (1987) the innovations in the efficient price are not only driven by public news but also due to *private* information conveyed by the trading activity. More specifically, equation (1) becomes:

$$\mu_t = \mu_{t-1} + \theta(x_t) + u_t \tag{4}$$

In contrast with Equation 1, the efficient price depends now on the arrival of new public information u_t and on a new component $\theta(x_t)$ that captures the measure of information asymmetry θ conveyed by the trade in t, x_t. Since the order processing fix cost is not any more the sole component of the transaction cost, Equation 3 has to be modified and s has to be divided into more than one factor. Let us denote ϕ the order processing cost. Hence $s(x_t)$ in Equation 3 becomes $\phi(x_t)$ where ϕ and θ capture, respectively, the transient and permanent components of the price changes.

The representative model accounts now for order processing costs, ϕ, and adverse selection costs, θ. The order autocorrelation of the trade direction, ρ, is a further extension of the spread components models. Order persistence stems from the tendency of trades to continue in the same direction. Let us relax the previous assumption that the inflow of orders implies that buys and sells are equally likely. We then allow for realistic microstructure aspects such as the momentum trading, the order splitting strategy and, in dealer market, inventory effects or, more in general, order continuation induced by the market maker's strategic behaviors. To see this point, let us assume that at time t a sell occurs and thus the transaction price is at the bid. The probability of order persistence, i.e. two subsequent buys or sells, is δ and the probability of reversal order is $1-\delta$. In the example, the probability that the trade in $t+1$ occurs at the bid (ask) is theta $1-\delta$ (δ). Let λ represent the unconditional probability that the transaction price occurs within the spread, i.e. $\Pr(x_t = 0)$. The conditional expectation of the trade direction at time $t+1$, given the trade direction in t, is:

$$E\left[x_{t+1} | x_t\right] = \left(2\delta - (1-\lambda)\right)x_t \tag{5}$$

The Lin, Sanger and Booth model (1995) bears the advantage in providing the measurement of the three spread components we have seen above. The LSB model assumes that the gross profit for a liquidity provider corresponds to the effective spread. A proportion θ of the effective spread s_t compensates the liquidity trader against possible adverse selection. Hence, the expected transaction price in $t+1$ equals the transaction price in t plus $\theta(s_t)$. This specification recalls Equation 4 where the true value is replaced by the expected transaction price represented, in turns, by the midquote price, m_t. The assumption that the expected true value is observable through the midquote price allows estimating the adverse selection component as follows:

$$\Delta m_{t+1} = \theta(s_t) + u_{t+1} \tag{6}$$

The order persistence is derived by the estimate of the first-lag autocorrelation of the effective spread. Hence, we measure the relevance of the order continuation as follows:

$$s_{t+1} = \rho(s_t) + \eta_{t+1} \tag{7}$$

where $\rho = 2\delta - 1$ evokes Equation 5 and represents the order persistence factor. The order processing cost is conceived as the residual of the θ and ϕ components. Following the LSB specification we find that:

$$\Delta p_{t+1} = -\phi(s_t) + \zeta_{t+1} \tag{8}$$

where $\phi = 1 - \theta - \rho$ reflects the order processing. The disturbance terms u_t, η_t and ζ_t are assumed to be uncorrelated. By construction, the order processing cost is conceived as the residual part of the transaction cost. Therefore, the three cost components in the LSB model embrace the entire transaction cost. Each estimated value of the three cost components represents the proportional part of the entire transaction cost and the sum of the three components should be equal 1.

3. Empirical Analysis

The following main research issues are addressed: (1) the measurement of the transaction costs and its three components, (2) the relationships between transaction size and spread components, and (3) the intraday patterns of the spread components.

3.A. Measurement of the Transaction Costs and its Components

Table 2 shows that, on average, the cost to transact one of the 15 stocks in my sample is 1.997 CHF, i.e. the average Quote Spread. The Relative Spread provides a proxy for the trading costs in relative value. The average Relative Spread is 0.176%. This means that the cost for trading one share of a stock quoted at 1000 CHF is around 1.76 CHF. Venkataraman (2001) shows that estimates of the Relative Spread in the NYSE and the Paris Bourse are in line with my results.

Table 3 presents the main sample statistics of the cost components measurement. The estimates of the asymmetric information costs, θ, the order processing costs, ϕ, and order persistence component, ρ, are 0.32, 0.49 and 0.19, respectively. These results are perfectly in line with Brockman and Chung (1999) who use the LSB model to measure the spread components in the Honk Kong Stock Exchange (HKSE). In fact, they find median estimates at the level of the results, namely θ around 0.32, ϕ around 0.44 and a more pronounced ρ around 0.21. The results in Table 3 are also close to the empirical findings in Declerck (2000) and Såndas (2001) who investigate the cost components on the Paris Bourse and on the Stockholm Stock Exchange, respectively. The Paris Bourse, the HKSE as well as the Stockholm Stock Exchange are all order-driven markets with market structures very similar to the SWX. Therefore, one can raise the question whether these results depend on this specific market structure.

The international evidence in Huang and Stoll (1997), de Jong, Nijman and Röell (1996) and MRR (1997) confirms that order processing cost, ϕ, is the main component of the transaction cost. It is generally twice the adverse selection cost, θ, while the order persistence, ρ, is the smallest but significant component.

As in the previous literature (e.g. Hasbrouck, 1991; Bessembinder and Kaufman, 1997), Table 5 reports the correlations between several liquidity proxies and spread components. The following liquidity proxies are used: (1) the market capitalization, (2) the average daily turnover (the average daily total amount of CHF exchanged to trade in a given stock), (3) the average daily number of trades and, finally, (4) the daily standard deviation of all the transaction price changes over the sample period. Table 5 shows that the correlation between θ and stock liquidity is generally negative. Likewise, the correlation between ϕ and stock liquidity is negative but to a lesser extent. The results are in line with the previous literature (e.g. Declerck, 2000; Hasbrouck, 1991 and 1993), which points out that the extent of the information asymmetry appears to be more significant for firms with smaller market values and, in general, more illiquid stocks. The main reason comes from the wider information availability and transparency of the large firms. Clarke and Shastri (2000), for instance, show that there is a significant negative relationship between several proxies of adverse selection for trading in a given stock company and the number of analysts assessing that company.

3.B. Trade Size and Spread Components

The interest of the trade size relies on the theoretical models assuming that large volume-sized trades bring information-motivated orders. On the one hand, the informed trader maximizes his profit by trading the largest amount of shares as possible. Easley and O'Hara (1987) provide a bayesian sequential model in which the trade size depends on the trader's information set. They show that, in equilibrium, informed traders trade only large quantities. Also, several empirical models such as Glosten and Harris (1986) and de Jong, Nijman and Röell (1996) link the magnitude of the adverse selection cost and the trading volume size. On the other hand, rational informed traders, aiming at maximizing their profits, have an incentive to act *strategically*. The Kyle model (1985) shows that, in equilibrium, the informed trader's optimal order quantity depends on the variance of the uninformed trader order flow. According to the *sequential* models we expect to find a positive relationship between adverse selection component and trade size. Instead, if the *strategic* behavior of informed traders prevail, we expect to observe an indefinite linkage between θ and trade size. The results in Table 6 support the argument of the *sequential* model. In fact, the degree of asymmetric information increases with the trading volume size.

The order processing cost is supposed to decrease with the trade size but less than proportionally. On the one hand, the fix part of the processing cost related to the transaction fees benefits from economies of scale of the large orders. On the other hand, a large-sized trade produces larger inventory imbalances. Furthermore, the price mechanism is discriminatory and the market depth is not infinite. In fact, when a trader submits a large-sized buy (sell) market order, it will be more likely that the buy (sell) order will walk up (down) the limit order book. If this is the case, a large order results in two or more contracts, with two or more counterparts and reference prices. The evidence in Table 6 shows that the incidence of the order processing cost actually decreases with the order size. Hence order processing cost is significantly affected by economies of scale.

The relationship between order persistence and order size is however more puzzling. The decreasing proportion of larger-sized orders suggests that the higher the order size the lower the order persistence. Nevertheless, it is possible that splitting strategies of block trades hinge on medium-sized trading volumes. Also, according to the recent literature on institutional trading (e.g. Chan and Lakonishok, 1993 and 1995), institutional traders heavily affect the intraday price behaviors for days or weeks. The institutional traders typically hold liquid assets. Table 6 shows that the order persistence partially decreases with trade size.

3.C. Intraday Patterns of the Spread Components

The third main question is how the three components of the transaction cost change over the trading day. In Admati and Pfleiderer (1988), liquidity traders are better off in clustering their trades over the trading time. The concentration of liquidity trades over time has two main effects. Firstly, it attracts the information-motivated trading because it offers the opportunity to better disguise insider information. Secondly, it engages competitiveness in providing liquidity which, in turns, reduces the liquidity trader’s gain. We would therefore expect that during periods with the highest market liquidity the asymmetric component is relatively large and the order processing cost relatively small.

The empirical evidence however does not clearly support the existence of a pooling equilibrium as predicted in Admati and Pfleiderer (1988). Hasbrouck (1991) and MRR (1997) show that the intraday patterns of the adverse selection (order processing) cost tends to decrease (increase) over time in the NYSE, while the order persistence is rather stable (MRR, 1997).

Little evidence exists for LOB markets. Table 7 reports the statistics of the intraday behaviors of the θ, ϕ and ρ. Figure 1 plots their standardized patterns. These results deserve two main considerations. First, the SWX trading day is characterized by higher (lower) order processing (adverse selection) costs during the morning and lower (higher) order processing (adverse selection) costs before closing. This supports the idea that spread components in European markets have opposite patterns with respect to the US patterns. I interpret these patterns as the worldwide leading effects of the US markets[5]. The literature documents that the main time of information asymmetry in the US markets is after the US opening that corresponds to the afternoon trading in Europe (e.g. Hasbrouck, 1991; MRR, 1997). Thus the price discovery subsequent to the US opening (e.g. Madhavan and Smidt, 1991) remarkably affects the European afternoon patterns. Consistently, this study shows that the adverse selection component not only rises before the closing but possibly also before the US pre-opening (1-1:30 GMT) and before the US opening (2-2:30 GMT). This seems reasonable if we assume that global investors and institutional traders can exploit their privileged positions in the main international centers.

4. Conclusions

This paper analyzes the components of the bid-ask spread in the Swiss Stock Exchange that is an electronic limit order book market. I measure the spread components applying the Lin, Sanger and Booth model (1995).

The main results are the following. First, order processing costs are the main component of transaction costs. The adverse selection and the order persistence components are less relevant but significant. The empirical evidence also shows that the correlation between asymmetric information costs and stock liquidity is negative. Likewise, order processing costs decrease with stock liquidity but to a lesser extent.

Second, the relationships between trade size and spread components are investigated. The empirical findings support the idea that large-sized trades convey a higher degree of private information but a lower extent of order processing costs per share. The order persistence, instead, characterizes the medium-sized trades. This supports the idea that institutional traders regularly apply the order splitting strategy in order to mitigate the market impact due to large trades.

Third, the intraday patterns of the spread components are analyzed. Contrary to the evidence for the US markets, we find that the asymmetric information affects the SWX

[5] We cite only few exemples. For the Paris Bourse see Biais, Hillion and Spatt (1995). For the SWX see Ranaldo (1999). For the Honk Kong Stock Exchange see Ahn, Bae and Chan (2000).

afternoon trading whereas the order processing cost characterizes the earlier part of the trading day. These results suggest that the US opening remarkably determines the information inflow in the European markets.

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Table 1: Description of the Sample

This Table reports some descriptions about the company names, the abbreviations, the Reuters Tickers and the sectors of the stock sample. It also exhibits the market capitalization (in millions of CHF) calculated on May 30, 1997 (Guide Des Actions Suisses, 1997), the average daily turnover (in millions of CHF) calculated as the total amount of money exchanged in trading a stock, the average daily number of trades and, finally, the daily Standard Deviation of all log Transaction Price Changes in the sample period times 100 (we denote this proxy of stock liquidity using its acronym SDTPC).

Abbrev.	Name	Reuters Ticker	Sector	Market Capitaliz. (millions CHF)	Daily Turnover (millions CHF)	Daily Number of trades	SDTPC
ABB	ABB AG	ABBZ.S	Engineering, R&D Services	20385	67.4	394.5	0.070
Alusuisse	Alusuisse AG	ALUSn.S	Containers, Paper, Plastic	9221	37.5	238.9	0.093
Ciba	Cida-Geigy AG	CIBNn.S	Medical, Drugs	9738	47.7	673.8	0.157
Clariant	Clariant AG	CLRZn.S	Chemicals	6872	22.2	250.2	0.170
CS	Credit Suisse Group AG	CSGZn.S	Bank	36588	140.6	542.1	0.112
Nestlé	Nestlé SA	NESZn.S	Food	75928	194.9	820.1	0.057
Novartis	Novartis AG	NOVZn.S	Medical, Drugs	162091	281.1	1014.7	0.052
Roche	Roche Holding	ROCZg.S	Medical, Drugs	124853	229.1	939.2	0.056
SBV	Swiss Bank Corp.	SBVZn.S	Bank	30302	66.5	385.9	0.132
SMH	Swatch Group AG	RUKZn.S	Retail, Jewelry	5994	8.6	104.2	0.166
Swiss Re	Swiss Reinsurance	UHRZn.S	Reinsurance	30191	77.8	423.5	0.066
UBSb*	Union Bank of Switzerland	UBSZ.S	Bank	42827	19.9	171.5	0.153
UBSn**	United Bank of Switzerland	UBSZn.S	Bank	42827	171.3	671.2	0.075
Wintethur	Winterthur	WINZn.S	Insurance	12358	67.4	394.5	0.070
Zurich	Zurich Allied AG	ZURZn.S	Insurance	27251	51.1	326.4	0.110
			Mean	42495	98.9	490.0	0.103
			Median	30191	67.4	394.5	0.093
			SD	45474	84.0	278.6	0.043

* UBSb refers to the bearer stock for the UBS stock
** UBSn refers to the nominal stock for the UBS stock

Table 2: Sample Descriptive Statistics for the Bid-Ask Spread

This Table shows the average midquote prices in CHF and the percentage price changes over the sample period. It also reports the Quoted Spread (in CHF), the Percentage Relative Spread, the Percentage Effective Spread, the Tick Size (in CHF) and the Spread Over the Tick. The calculation of these spread indicators is explained in the text.

STOCK	Midquote	% Price Change	Quoted Spread	Relative Spread (%)	Effective Spread (%)	Tick Size (CHF)	Spread over Tick
ABB	1737.6	3.9	2.023	0.117	0.102	1	2.023
Alusuisse	1208.1	5.0	1.894	0.157	0.138	1	1.894
Ciba	119.9	0.9	0.328	0.274	0.258	0.25	1.313
Clariant	761.3	16.4	1.991	0.265	0.241	1	1.991
CS	165.7	0.6	0.323	0.195	0.175	0.25	1.290
Nestlé	1696.1	12.4	1.536	0.091	0.083	1	1.536
Novartis	1813.9	10.9	1.533	0.085	0.074	1	1.533
Roche	12110.4	0.3	10.480	0.087	0.078	5	2.096
SBV	303.5	7.8	0.646	0.213	0.199	0.5	1.292
SMH	193.9	-1.0	0.615	0.318	0.260	0.25	2.459
Swiss Re	1542.7	10.2	1.650	0.107	0.102	1	1.650
UBSb	974.8	9.4	2.449	0.253	0.217	1	2.449
UBSn	1305.0	9.8	1.549	0.119	0.117	1	1.549
Winterthur	1013.0	6.5	1.864	0.184	0.102	1	1.864
Zurich	454.7	8.5	0.774	0.170	0.158	0.5	1.549
Mean	1693.4	6.8	1.977	0.176	0.154	1.050	1.766
Median	1013.0	7.8	1.549	0.170	0.138	1.000	1.650
Min	119.9	-1.0	0.323	0.085	0.074	0.250	1.290
Max	12110.4	16.4	10.480	0.318	0.260	5.000	2.459
SD	2943.7	5.1	2.446	0.076	0.067	1.139	0.384

Table 3: Description of the Main Cost Components.

This Table shows the abbreviations, the meanings as well as the descriptions of the three components of the transaction cost used in the LSB model and in this paper.

Abbreviation	Meaning	Coefficient Symbol	Description
ASC	Adverse Selection Cost	θ	The ASC corresponds to the Asymmetric Information Cost. It refers to information not yet embodied in the fundamental asset value
OPC	Order Processing Cost	ϕ	The OPC includes labor, communication, clearing and inventory costs.
PERS	Order Persistence Cost	ρ	The PERS stems from the tendency of trades to continue in the same direction.

Table 4: Comparison Among the Estimates of the Cost Components in the SWX.

This Table reports the descriptive statistics of the estimates of the adverse selection cost, θ, the order processing cost, ϕ, and the order persistence factor, ρ, estimated according to the LSB model. The fourth column indicates the percentage proportion of ϕ with respect to ϕ.

	In Percent (%)				In Value (CHF)			
	ASC	OPC	PERS	Total	ASC	OPC	PERS	Spread
ABB	0.3138	0.4797	0.1968	0.99	0.6348	0.9703	0.3981	2.00
Alusuisse	0.3909	0.4186	0.2003	1.00	0.7403	0.7928	0.3793	1.91
Ciba	0.1760	0.5250	0.2940	0.99	0.0577	0.1722	0.0964	0.33
Clariant	0.3015	0.4893	0.1981	0.99	0.6003	0.9742	0.3943	1.97
CS	0.3136	0.5187	0.1641	1.00	0.1013	0.1675	0.0530	0.32
Nestlé	0.3435	0.5415	0.1096	0.99	0.5276	0.8318	0.1684	1.53
Novartis	0.3661	0.3636	0.0917	0.82	0.5613	0.5575	0.1405	1.26
Roche	0.3366	0.4994	0.1590	1.00	3.5276	5.2341	1.6667	10.43
SBV	0.2729	0.6155	0.1030	0.99	0.1763	0.3976	0.0665	0.64
SMH	0.3836	0.3238	0.2785	0.99	0.2359	0.1991	0.1713	0.61
Swiss Re	0.3486	0.5640	0.0869	1.00	0.5753	0.9306	0.1435	1.65
UBSb	0.3433	0.4065	0.2365	0.99	0.8408	0.9954	0.5791	2.42
UBSn	0.3187	0.5187	0.1429	0.98	0.4937	0.8035	0.2214	1.52
Winterthur	0.3138	0.4910	0.1967	1.00	0.5850	0.9153	0.3667	1.87
Zurich	0.3000	0.5932	0.1015	0.99	0.2322	0.4592	0.0786	0.77
		0.0000						
Mean	0.3215	0.4899	0.1706		0.3215	0.9601	0.3283	
Median	0.3187	0.4994	0.1641		0.5613	0.8035	0.1713	
Min	0.1760	0.6155	0.0869		0.0577	0.1675	0.0530	
Max	0.3909	0.3238	0.2940		3.5276	5.2341	1.6667	
SD	0.0515	0.0816	0.0662		0.8283	1.2218	0.4017	

Table 5: Correlations between Firm Liquidity Proxies and the Estimated Spread Components.

This Table reports the correlation between the liquidity proxies and spread components. The liquidity proxies are presented in Table 1. These proxies are the averaged daily turnover (Turnover), the averaged daily number of trades (N.Trades), the market capitalization (M.Cap) and the standard deviation of all log transaction price changes over the sample period (SDTPC). The spread components are estimated according to the LSB model. The adverse selection cost is denoted as θ, the order processing cost as ϕ, and the order persistence factor as ρ.

	θ	ϕ	ρ
Turnover	0.191	0.004	-0.460
N. Trades	-0.127	-0.135	-0.315
M Cap	-0.254	-0.124	-0.432
SDTPC	-0.347	-0.143	0.430

Table 6: The Relationships between Trade Sizes and Cost Components.

This Table reports some descriptive statistics of the estimates of the adverse selection cost, θ, the order processing cost, ϕ, and the order persistence factor, ρ, estimated according to the LSB model. Each explanatory variable has been divided in 4 piecewise dummy variables according to quartile of transaction volume size. Consequently, θ_1 (θ_4) denotes the adverse selection for the smallest (largest) volume size. Analogous considerations hold for ϕ and ρ.

	Mean in %	Median in %	SD in %	Mean in CHF	Median in CHF	SD in CHF
θ_1	0.0964	0.0727	0.0527	0.200	0.112	0.257
θ_2	0.1905	0.2011	0.0654	0.399	0.342	0.500
θ_3	0.3476	0.3729	0.1465	0.746	0.660	0.935
θ_4	0.5888	0.6076	0.1160	1.206	0.978	1.519
ϕ_1	0.7221	0.7467	0.1352	1.409	1.232	1.743
ϕ_2	0.6230	0.6106	0.1341	1.204	1.004	1.444
ϕ_3	0.3925	0.4031	0.1682	0.827	0.664	1.187
ϕ_4	0.2355	0.2065	0.1263	0.449	0.334	0.664
ρ_1	0.1667	0.1667	0.1009	0.342	0.209	0.471
ρ_2	0.1680	0.1801	0.1065	0.366	0.208	0.524
ρ_3	0.1808	0.2109	0.0822	0.340	0.185	0.370
ρ_4	0.1509	0.1783	0.0578	0.281	0.175	0.292

Table 7: The Intraday Patterns of the Cost Components.

This Table reports the averaged estimates of the adverse selection cost, θ, the order processing cost, ϕ, and the order persistence factor, ρ, estimated according to the LSB model. The SWX trading day has been divided in 13 half-hour intraday periods. Accordingly, each explanatory variable has been divided in 13 piecewise dummy variables.

	In Percent (%)			In Value (CHF)		
	AIC	OPC	PERS	AIC	OPC	PERS
10-10:30	0.325	0.506	0.156	0.674	0.930	0.352
10:30-11	0.307	0.521	0.156	0.626	0.891	0.435
11-11:30	0.268	0.566	0.153	0.561	1.133	0.263
11:30-noon	0.29	0.547	0.151	0.612	1.086	0.262
noon-12:30	0.302	0.511	0.175	0.646	0.964	0.349
12:30-1	0.303	0.52	0.16	0.637	1.102	0.217
1-1:30	0.306	0.506	0.182	0.609	1.008	0.397
1:30-2	0.292	0.507	0.187	0.630	0.960	0.387
2-2:30	0.287	0.539	0.163	0.614	1.062	0.284
2:30-3	0.31	0.455	0.225	0.680	0.847	0.435
3-3:30	0.313	0.479	0.198	0.633	0.991	0.339
3:30-4	0.338	0.463	0.181	0.718	0.844	0.389
4-4:30	0.324	0.481	0.15	0.678	1.024	0.253

Figure 1: Simplified View of the Intraday Patterns of the Cost Components.

This Figure plots the intraday patterns of the adverse selection cost, θ, the order processing cost, ϕ, and the order persistence factor, ρ, estimated according to the LSB model. The horizontal axis refers to the time of the say of the SWX. The vertical axis refers to the standardized level of the cost components.