An Intraday Analysis of the Mexican Stock Exchange

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Abstract

This paper provides an intraday analysis of the Mexican Stock Exchange. Although the structure of this developing market differs from that of the U.S., intraday patterns are similar: volume, returns, standard deviations, bid-ask spreads and the spread adverse selection component follow U-shaped patterns throughout the trading day. We examine the effect of competition from U.S. markets by comparing intraday behavior of Mexican stocks with and without American Depositary Receipts (ADRs).

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1. Introduction

The Bolsa Mexicana de Valores (BMV), or "Mexican Stock Exchange", provides an unparalleled opportunity to examine an emerging market with close links to the U.S. market. Increased trading activity in the Mexican market and the large (and increasing) number of Mexican firms with American Depositary Receipts (ADRs) trading in U.S. markets has stimulated investor interest in the Mexican market. The BMV is also of interest because of the structural differences between it and the NYSE. One benefit of using the BMV to study the effects of structural differences is the common trading hours of the NYSE and the BMV. Hence, it is possible to study the forces that affect trading in Mexico during times when trading is also occurring in the U.S.[1]

Despite the differences in structure and integrity, we find that intraday trading patterns on the BMV are similar to those described in previous studies of U.S. and other markets. We find that intraday volume, returns, standard deviation of returns, bid-ask spreads, and the adverse selection component of the spread follow patterns largely consistent with those found in prior work using NYSE data. The similarity in patterns of these two different markets suggests that price discovery, one of the most important functions of a securities market, occurs in a similar manner despite the dramatic differences in market structure.

[1] Studies showing that information flow is reflected in security prices faster during trading rather than non-trading hours include French and Roll (1986), Barclay, Litzerberger and Warner (1990), Jones, Kaul and Lipson (1994), and Forster and George (1995).

This paper is organized as follows: Section 2 reviews the relevant literature on intraday trading characteristics. Section 3 describes the Mexican market, the data and our sample. Section 4 presents the empirical results. Section 5 concludes the paper.

2. Previous Studies of Intraday Trading Characteristics

Admati and Pfleiderer's (1988) model predicts that volume and variance are concentrated at the opening and closing of trading due to an increase in (nondiscretionary) liquidity trading at the open and close. As a result, discretionary liquidity trading (as well as informed trading) will also be concentrated in these periods. This is consistent with French and Roll's (1986) U.S. empirical evidence that the variance over nontrading periods is much lower than the variance of returns over trading periods. For example, if the liquidity-trading volume is higher at the end of the trading day, trading at that time will allow better-informed traders to trade against the uninformed liquidity traders, over whom they have the greatest information advantage. As a result, prices at the end of the trading day will reflect more of the information that will be released publicly during the subsequent nontrading hours.

Wood, McInish, and Ord (1985) document a U-shaped pattern in NYSE return volatility throughout the trading day, while Harris (1986) shows strong intraday patterns in return volatility and presents his results by firm size. Jain and Joh (1988) show that the trading volume is different within and across days. They show evidence of an inverted U-shape in volume across days. Monday and Friday have the lowest volume, and the most active periods are in the middle of the week. Ho, Cheung and Cheung (1993) also find intraday and intraweek return and volume patterns in their study of the Hong Kong

market, finding volume surges as the morning session and trading day closing times approach.

Similar intraday volatility patterns are documented for other markets. Choe and Shin (1993) find the highest levels of index return volatility at the opening, and following trading halts, of the Korea Stock Exchange, a non-Specialist market. Abhyankar, Ghosh, Levin and Limmack (1997) observe U-shaped intraday volatility patterns on the London Stock Exchange, while Andersen, Bollerslev and Cai (2000) find U-shaped index volatility patterns within both the morning and afternoon trading sessions of the Tokyo Stock Exchange. These results are similar to those found on the NYSE, indicating that the presence of the Specialist is not responsible for the observed NYSE volatility patterns.

McInish and Wood (1992) observe a reverse J-shaped pattern of NYSE spreads over the trading day, and find spreads to be inversely related to the number of trades and the number of shares per trade. U-shaped spreads are documented for the London (Abhyankar et al. (1997)) and Hong Kong (Ahn and Cheung (1999)) markets. The level of spreads is directly related to both differential risks across stocks and differential risks across intervals of the trading day. Intervals with unusually large-size trades have higher spreads reflecting the information content of those trades.

Theories of the bid-ask spread are usually based on the premise that intermediaries must cover three trading-related costs. Demsetz (1968) and Tinic (1972) discuss order processing costs made up of exchange and clearing fees, bookkeeping, the time and effort of the intermediary, and other "costs of doing business." Stoll (1978), and Ho and Stoll (1983) identify inventory holding costs brought about by order-flow imbalances as the second cost component of the bid-ask spread. The process of

equilibrating order imbalances causes the market maker's inventory position to deviate from optimal levels. Finally, Copeland and Galai (1983), Glosten and Milgrom (1985), and Easley and O'Hara (1987) assume that market makers incorporate an adverse selection cost into the spread to cover their expected losses to informed traders.

The Admati and Pfleiderer (1988) model predicts that trading costs are lowest in periods where the volume is highest because liquidity traders pool their trades in an effort to reduce their transaction costs. While more informed traders submit orders in response to this concentration of liquidity, competition among these traders ensures that adverse selection costs are lower.

The Foster and Viswanathan (1990) model, on the other hand, predicts that the adverse selection cost component is a function of trading activity, as well as the precision of public information. They hypothesize that, if public information is precise and the informed trader has more private information, then discretionary liquidity traders delay their trades. This delay leaves less liquidity in the market and makes it easier for the market maker to infer the informed trader's reasons for trading. As a consequence, the volume is lower, prices are more informative (volatile), and trading costs are higher.

Foster and Viswanathan (1993) estimate trading costs using NYSE transactions data. They find that the adverse selection cost component of price change varies within the day and across days. In particular, adverse selection costs are high in the first half-hour of trading, fall during the middle of the day, and then increase again towards the close of trading. While their data are very noisy, high adverse selection costs are found at times of the day with higher trading volume, which is inconsistent with the Admati and Pfleiderer model.

In their analysis of 1990 data, Madhavan, Richardson and Roomans (1997) find that bid-ask spreads, share volume, information asymmetry, and trading frequency exhibit the U-shaped pattern documented by previous research. They also find that transactions costs increase steadily over the day, which may reflect the increasing risks associated with carrying inventory over night.

In summary, several studies provide evidence of intraday patterns in trading activity and costs. The empirical work of Foster and Viswanathan (1993) and Madhavan et al. (1997) is broadly consistent with observed patterns in the volume-volatility relation. That is, intraday trading volume is high when returns are most volatile and adverse selection costs are highest. They find little significant interday variation in return volatility. Theoretical models do not explain the intraday phenomenon of high trading costs when trading volume is high, which appears to be inconsistent with the interests of discretionary liquidity traders.

To date, no comprehensive intraday analysis of trading in the BMV has been performed. Such a study is of interest not only to participants in the BMV, but to participants in other markets as well, given the overlapping trading hours with the U.S. market, and the significant number of cross-listed securities (via ADRs) in the U.S. market. Our study sheds light on how information is reflected in security prices throughout the day in an emerging market.

3. Description of the Mexican market, the dataset and our sample

3.1. Description of the Mexican stock market

The BMV is an electronic market owned by Mexican brokerage houses. The BMV maintains a central order book. Orders are submitted via networked terminals located in brokerage firm offices. Networked terminals provide two screens, one for information look-up, and the other for trading. All users have access to buy and sell quotations, volume, prices, advances, declines, and last price of all shares. Market hours correspond to those of the NYSE, as trading takes place from 8:30 a.m. to 3:00 p.m. Central Time.

3.2. The data set

Data for this study is from the BMV, and consists of all transactions on the exchange. Information for each transaction includes the security name, series, date, time-of-day, buying and selling brokers, price, and number of shares for the period January 1 through December 31, 1998. The data has 1,071,060 observations. We eliminate twenty-seven observations for transactions with market value greater than 100 million pesos. These transactions appear to be records of mergers or firm reorganizations.

3.3. Our sample

To examine intraday trading characteristics, we limit the sample to stocks that trade 100 or more times during a calendar-month period. The remaining sample consists of 888,753 observations for 107 stock series of 34 firms. Table 1 provides a description of the stocks that fit the minimum trading screen. The average per share series daily volume is 29,612 shares, with a value of 604,619 pesos. Share prices range between 2 and 122 pesos, with an average of 28 pesos. The market values of the share series are

between 193 and 24,651 million pesos. Daily open-to-open returns average -0.48%, with an average standard deviation of .064.

We use The Complete Depositary Receipt Directory (1997, 1998) to identify stocks with ADRs, and the month during which the ADRs became effective. Twenty-three firms in our sample have ADRs.

4. Empirical Results

4.1. Volume, Returns and Standard Deviation

Prior studies find a positive correlation between volume and returns (see Wood, McInish and Ord (1985), Jain and Joh (1986), and Harris (1983, 1986)); hence we expect to find similar patterns in our volume and return results. Figure 1 depicts intraday variation in number of shares traded, share volume and value of trades in Pesos. Similar to the U.S. markets, high volume at opening is followed by a sustained period of lower volume, and an increase prior to the close.

Insert Figure 1 about here

Figure 2 provides the intraday return and standard deviation patterns for the Mexican equities.[2] Both series exhibit a U-shaped pattern with high returns and standard deviations at the open followed by fairly stable patterns of returns and standard

[2] To calculate minute-by-minute returns, we use the first price for a security that trades multiple times within a given minute. As in Wood, McInish and Ord (1985), returns are divided equally over the interval between the two trades, and results are aggregated across all stocks for each minute throughout the day.

deviations throughout the day, until 2:30 p.m., when both series increase and continue to rise during the final 30 minutes of trading. The observed patterns of returns and standard deviations are largely consistent with the U-shaped results of prior studies for other markets. The high levels of returns and standard deviations around the opening and closing of trading are consistent with Admati and Pfleiderer's (1988) model with nondiscretionary liquidity traders trading in these intervals. These results indicate that the flow of information commonly associated with the U-shaped patterns of volume and returns in developed markets is similar to the information flow in the Mexican marketplace.

Insert Figure 2 about here

4.2. Bid-Ask Spreads

We use the Huang and Stoll (1997) model to estimate the trading costs from transaction data on the BMV. The model relates transaction price changes and lagged trade indicators to yield estimates of the spread (S) and the proportion of the spread due to combined adverse selection and the, assumed zero, inventory costs (λ):

$$\Delta P_t = \frac{S}{2}(Q_t - Q_{t-1}) + \frac{\lambda S}{2} Q_{t-1} + \varepsilon_t \qquad (1)$$

where ΔP_t is the change in price from the transaction at time *t-1* to the transaction at time t and Q_t is the trade indicator whose value is 1 for trades at the ask and -1 for trades at the bid. Since quotes are unavailable on a transactions level for the Mexican data, the trade

indicator is assigned using the tick test.[3] Bid-ask spreads and adverse selection components are estimated for each 30-minute interval throughout the day.

The relative bid-ask spread and adverse selection estimates for half-hour intervals are shown in Figures 3 and 4 (Tables 2 and 3) respectively. The estimated spread varies between .094 and .177 pesos. The adverse selection cost varies between 16.1% and 19.8% of the spread estimate. These results indicate a rough J-shaped pattern in the Peso value of the spread. The observed patterns in the spread differ from the reverse J-shaped pattern in the spread found by McInish and Wood (1992), which indicates the highest spreads for NYSE stocks at the beginning of the trading day.

The adverse selection component stays close to 18% throughout the majority of the trading day. Near the end of the day, the adverse selection component increases to 19.8%, with subsequent reversal in the hour preceding the close of trading. This reversal in the percent of the spread associated with adverse selection costs may be explained by the dramatic rise in the overall spread dominating the absolute increase in the adverse selection component, resulting in a decrease in the percentage of the spread attributable to adverse selection.[4] The upturn in adverse selection in the final 30-minute interval is

[3] Finucane (2000) finds that the tick test provides better estimates of effective spreads and signed volume than Lee and Ready's (1991) method, while Theissen (2001) finds that the tick test performs almost equally well on the Frankfurt Stock Exchange. Ellis, Michaely and O'Hara (2000) find that all classification rules have difficulty with trades executed inside the quotes, trades during high volume periods, and Electronic Communications Network trades.

[4] Although not reported here, we also examine spreads during the first and last half of the month. Spreads are similar for the two halves, with the exception of a greater spread during the opening half-hour of trading during the first half of the month than during the second half. There is no discernable difference in the adverse selection estimates between the first and last half of the month.

consistent with previous studies of the NYSE (Foster and Viswanathan (1993), Wei (1992), and Madhavan, Richardson and Roomans (1997)).

4.3. Univariate analysis of variation in spreads

We investigate the influence of the U.S. equity markets on the Mexican Stock Exchange by comparing the trading characteristics of Mexican stocks with and without ADRs traded on them. Twenty-three of the 107 active share series have an ADR. Cross-listed equities account for 36% of the annual BMV share volume during 1998. The stocks with ADRS contribute 52% of the annual Peso volume on the BMV for 1998. The majority of Peso volume trading on the Mexican exchange is in stocks that have ADRs traded on them. The average transaction price of the cross-listed shares is approximately twice that of Mexican market stocks.

Figure 3 (Table 3) compares the bid-ask spread for stocks that have ADRs traded on them to those that do not. As shown in Panel A, in every 30-minute interval throughout the trading day the spread on the ADR stocks is higher than on the shares of stocks without ADRs, yet the results are only significantly different for the opening intervals. Higher spreads for stocks with ADRs is consistent with Mexican market makers spreading their fixed costs over fewer trades as volume for these stocks is shared with the ADR market.

4.4. Univariate analysis of adverse selection costs

Figure 4 (Table 3, Panel B) provides the adverse selection components for stocks with and without ADRs. For a majority of intervals throughout the day, the adverse

selection component of the spread for the stocks with ADRs traded on them is higher than on the stocks that do not have ADRs traded on them. Notable exceptions are during the opening and closing intervals of the day, but this similarity may be attributed to the difficulty the tick test has in classifying trades during high volume periods, as found by Ellis, Michaely, and O'Hara (2000). A higher adverse selection component of the spread for the ADR stocks indicates greater risk on the part of market participants when trading stocks that are also listed in other markets.

Insert Table 3 and Figure 3 about here

5. Conclusions

We provide evidence that the intraday trading characteristics in an emerging market, the Mexican Stock Exchange, are similar to those of developed markets. The volume, returns, volatility, and bid-ask spreads follow patterns largely consistent with prior work for other exchanges. Given the differences in the structures and trading environments among these various exchanges, the similarity in trading activity patterns indicates that the underlying factors that influence these intraday characteristics are not unique to a specific market structure, or market environment.

Recent listing of ADRs on U.S. exchanges and overall volume declines in the Mexican and other Latin American markets have led to concerns expressed about the viability of Latin American markets. We find that the presence of ADRs does not affect the spreads of the underlying Mexican stocks. The lack of response by BMV participants to competition via the listing of ADRs suggests that there are significant costs or barriers between the Mexican and U.S. markets.

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Table 1
Characteristics of BMV stocks

	Mean	Median	Minimum	Maximum
Daily Volume (Shares)	29,612	9,462	1	85,946,300
Daily Volume (Pesos)	604,619	141,600	9	5,222,100,000
Daily Number of Trades (in thousands)	38.74	16.17	5.83	228.28
Price (Pesos)	28	19	2	122
Market Value (Pesos)	7,291	3,481	193	24,651
Return	-0.0048	-0.0035	-0.0150	0.0004
Standard Deviation	0.0640	0.0540	0.0230	0.1820

The table documents the characteristics and trading activity of BMV firms. The sample consists of 107 share-series that trade at least 100 times per month in 1998. Mean, median, minimum and maximum values are provided for the following or share series characteristics: average daily volume, number of trades, price, market value of shares outstanding, return, and standard deviation of daily returns.

Table 2
Bid-ask spread and adverse selection component

Beginning Of Interval	Bid-Ask Spread	Adverse Selection (%)	Adv. Sel.*Spread (Peso Value)
8:30 AM	0.139	18.7%	0.026
9:00 AM	0.120	17.9%	0.021
9:30 AM	0.109	17.9%	0.020
10:00 AM	0.106	17.3%	0.018
10:30 AM	0.098	18.0%	0.018
11:00 AM	0.094	18.1%	0.017
11:30 AM	0.097	17.2%	0.017
12:00 PM	0.097	17.3%	0.017
12:30 PM	0.096	17.7%	0.017
1:00 PM	0.099	17.2%	0.017
1:30 PM	0.098	17.6%	0.017
2:00 PM	0.102	17.7%	0.018
2:30 PM	0.122	19.8%	0.024
3:00 PM	0.177	18.5%	0.033
3:30 PM	0.160	16.1%	0.026

Average bid-ask spreads and the adverse selection component for each 30-minute interval of the trading day. Spread and adverse selection components are annual estimates using the Huang and Stoll (1997) model in equation (1). The sample consists of 40 share series with at least 100 trades per month.

Table 3
Spreads and adverse selection costs for BMV stocks with ADRs

Panel A: Estimated Spread

Beginning of Interval	Spread (ADRs) N=23	Spread (Non-ADRs) N=17	Spread Difference (ADRs-Non)	Wilcoxon Signed Rank p-value
8:30 AM	0.175	0.125	0.051	.0001
9:00 AM	0.155	0.104	0.052	.0001
9:30 AM	0.134	0.097	0.037	.0006
10:00 AM	0.127	0.093	0.034	.0025
10:30 AM	0.115	0.088	0.027	.0920
11:00 AM	0.112	0.084	0.028	.2169
11:30 AM	0.114	0.086	0.028	.3400
12:00 PM	0.113	0.088	0.025	.9985
12:30 PM	0.109	0.089	0.021	.2212
1:00 PM	0.115	0.089	0.026	.6491
1:30 PM	0.112	0.089	0.023	.6091
2:00 PM	0.117	0.093	0.025	.8010
2:30 PM	0.138	0.113	0.025	.6129
3:00 PM	0.201	0.164	0.036	.9967

Average bid-ask spreads and the adverse selection component for each 30-minute interval of the trading day. Spread and adverse selection components are estimated using the Huang and Stoll (1997) model in equation (1). The overall sample consists of 40 share series with at least 100 trades per month. Twenty-three of these share series have ADRs, and are in the ADR subsample, with 17 in the non-ADR subsample.

Table 3, continued

Panel B: Adverse selection costs

Beginning of Interval	Adverse Selection (ADRs) N=23	Adverse Selection (Non-ADRs) N=17	Adverse Selection Difference (ADRs-Non)	Wilcoxon Signed Rank p-value
8:30 AM	0.388	0.354	0.034	.0001
9:00 AM	0.348	0.363	-0.015	.0001
9:30 AM	0.375	0.346	0.030	.0001
10:00 AM	0.342	0.348	-0.006	.0001
10:30 AM	0.369	0.356	0.013	.0001
11:00 AM	0.365	0.359	0.005	.0001
11:30 AM	0.353	0.338	0.015	.0001
12:00 PM	0.359	0.339	0.020	.0001
12:30 PM	0.388	0.331	0.056	.0001
1:00 PM	0.346	0.343	0.003	.0001
1:30 PM	0.369	0.341	0.027	.0001
2:00 PM	0.373	0.343	0.029	.0001
2:30 PM	0.408	0.390	0.018	.0001
3:00 PM	0.393	0.355	0.038	.0001

Figure 1
Intraday Volume

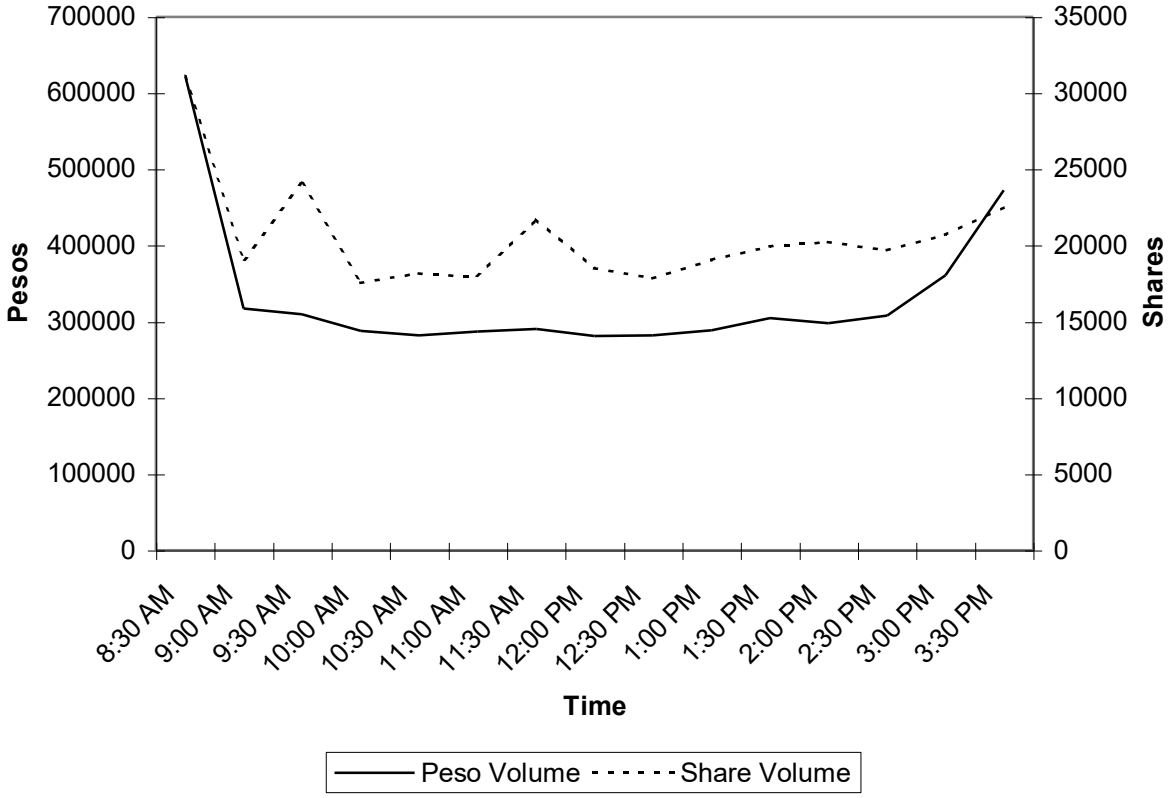


Figure 1 provides 1998 mean intraday share volume (right axis) and peso volume (left axis) for stocks on BMV. The sample consists of the 40 BMV share series with at least 100 trades per month.

Figure 2
Intraday Returns and Standard Deviation

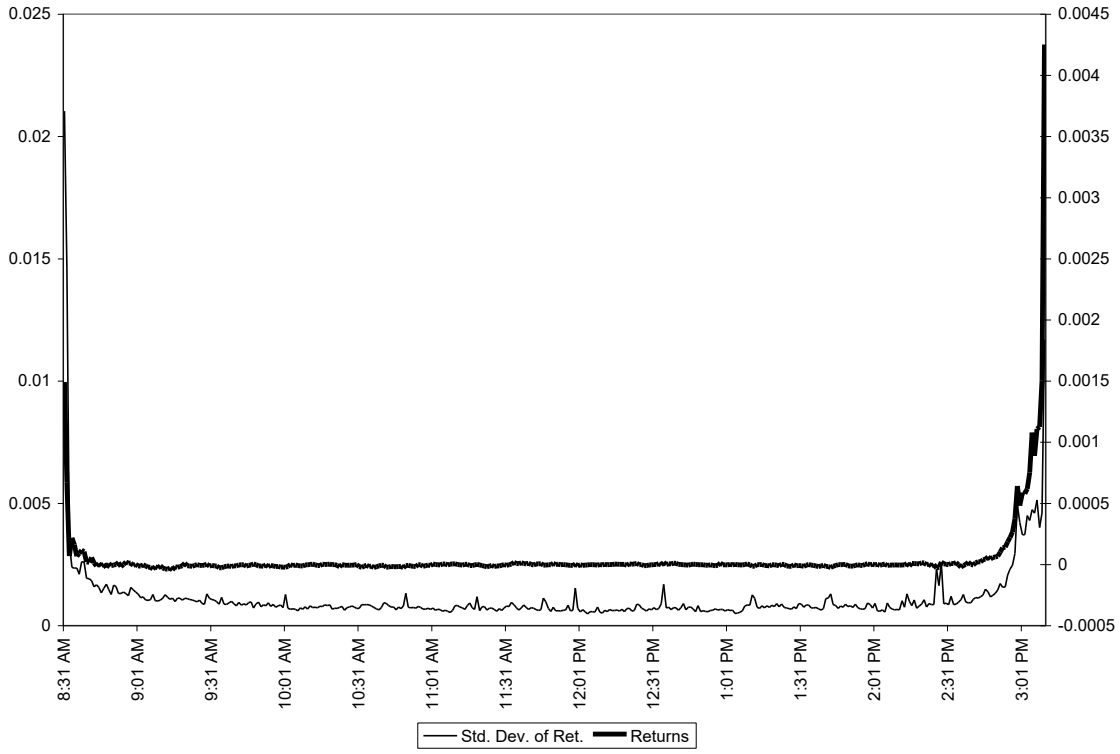
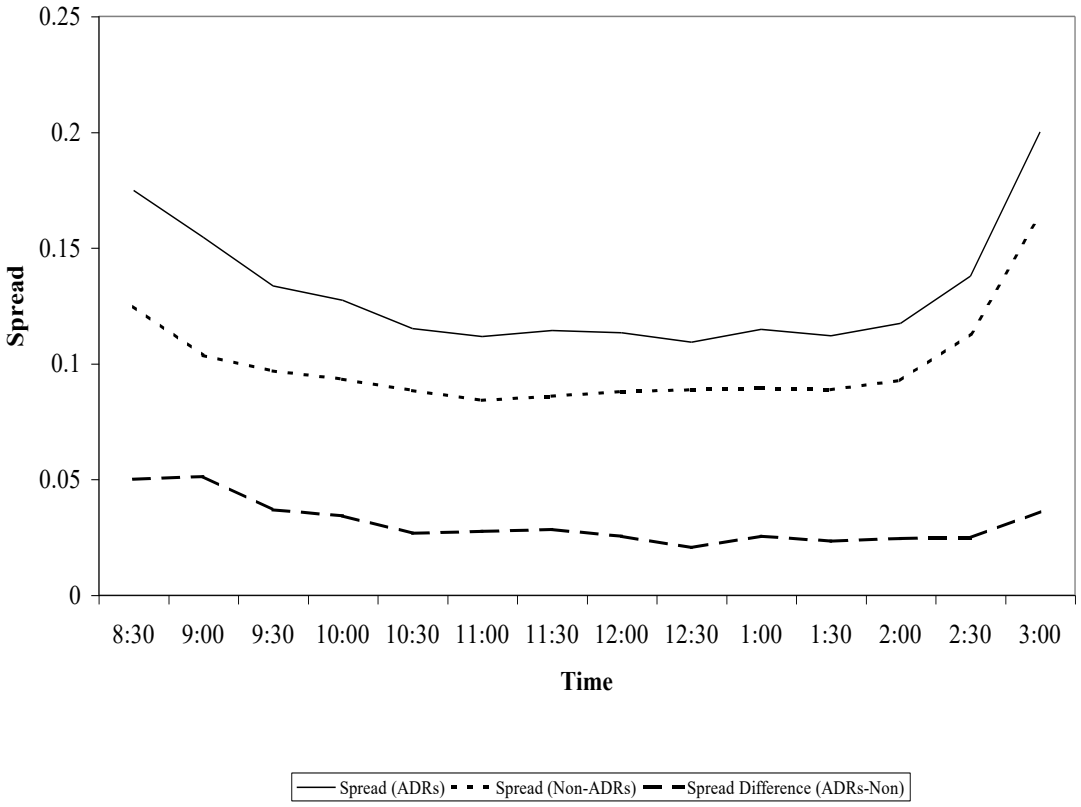


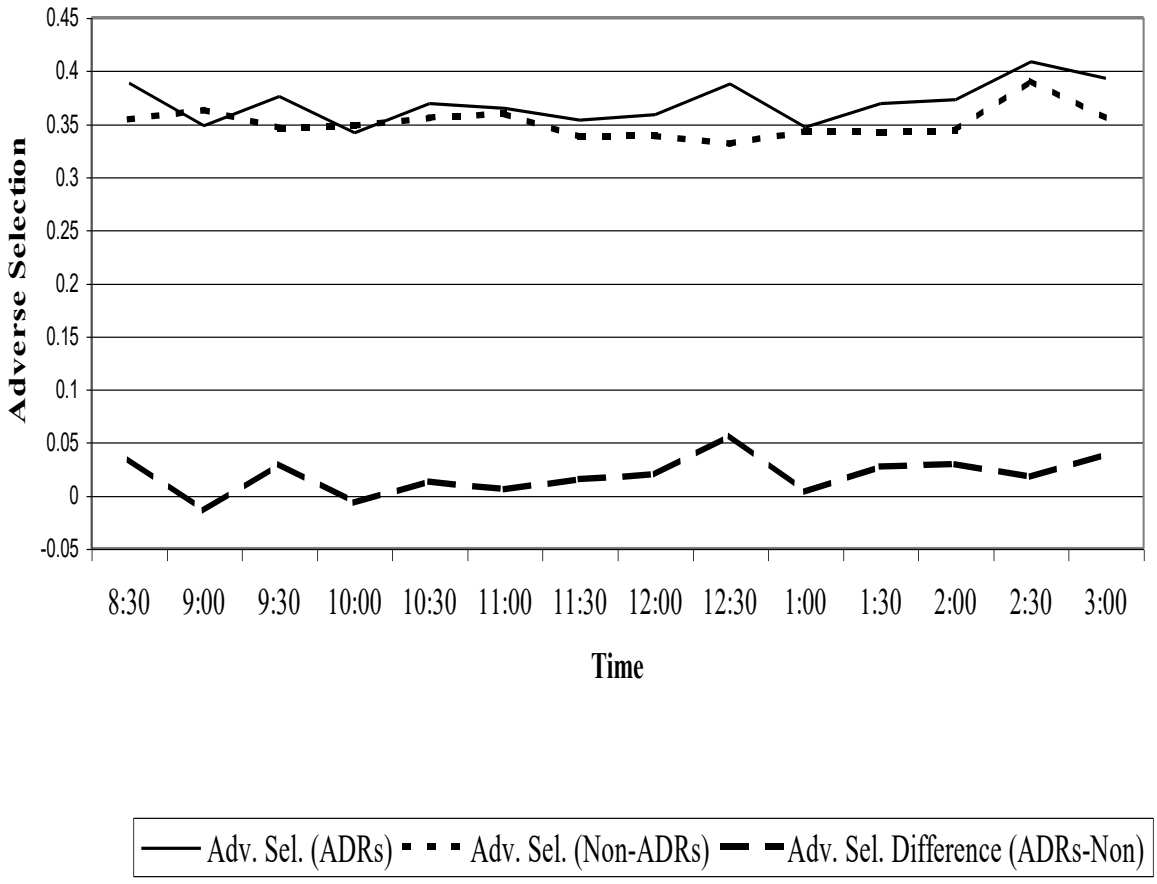
Figure 2 provides 1998 mean intraday returns (right axis) and standard deviation (left axis) for stocks on BMV. The sample consists of the 40 BMV share series with at least 100 trades per month.

Figure 3
Estimated Relative Bid-Ask Spreads



Estimates of the spread are calculated using the Huang and Stoll (1997) model, described in equation (1), for each 30-minute interval of the trading day. The sample consists of 40 share series with at least 100 trades per month on the BMV.

Figure 4
Estimated Adverse Selection Costs



Estimates of the adverse selection costs are calculated using the Huang and Stoll (1997) model, described in equation (1), for each 30-minute interval of the trading day. The sample consists of 40 share series with at least 100 trades per month on the BMV.