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The impact of different players on the volume-volatility relation in the foreign exchange market

Geir Bjønnes Høidal
BI Norwegian Business School[1]

geir.bjonnes@bi.no (correspondent author)

Dagfinn Rime
BI Norwegian Business School[2]

Haakon Olav Solheim
Norges Bank[3]

Abstract

We examine the volume-volatility relation in the foreign exchange (FX) market using a unique data set from the Swedish krona (SEK) market that contains observations of 90–95 percent of all transactions from 1995 until 2002. We show that the strength of the volume-volatility relation depends on the group of market participants trading. Financial trading volume has the highest correlation with volatility. Interbank trading between the largest Market-making banks is also positively correlated with volatility, while trading among Other market-making banks show no correlation with volatility. Trading by Non-Financial customers is not correlated with volatility at all when controlling for trading by other market participants. Interestingly, we show that (unexpected) spot volume and changes in net positions (spot and forward) by Financial customers Granger cause spot volume and changes in net positions by Non-Financial customers. Our results clearly show that market participants in the FX market are heterogeneous, suggesting that differences in trading strategies and information may explain the volume-volatility relation.

Keywords: Volume-volatility relation, microstructure, exchange rates, liquidity

JEL Classification: F31

[1] Department of Finance. E-mail: geir.bjonnes@bi.no
[2] Department of Finance. E-mail: Dagfinn.rime@bi.no
[3] Haakon Olav Solheim. Email: Haakon.solheim@norges-bank.no

1. Introduction

Several researchers (Frankel and Rose, 1995) have claimed that foreign exchange rates are far too volatile to be explained by macro variables. The enormous trading volume—especially the trading among FX dealers—is often mentioned as a source for the "excessive volatility."

This paper investigates whether trading by different FX market participants, who may differ by the information they possess and their motives for trading, has different effects on the volume-volatility relation. We use a unique data set from the Swedish krona (SEK) market that contains observations of 90–95% of all transactions in five different instruments from 1995 until 2002.[i] Each primary dealer reports their trades with (Swedish or Foreign) Financial and Non-Financial customers, other primary dealers (Swedish or Foreign), and with the Swedish Central Bank.

Studies by Bessembinder and Seguin (1993) and Daigler and Wiley (1999), both studying futures markets, suggest that heterogeneity among market players may be important in understanding the volume-volatility relation. Daigler and Wiley (1999) differentiate between customers registered at the exchange and outsiders. They find evidence that trading by outsiders tends to be more correlated with volatility than trading by clearing members and floor traders. Their interpretation is that outsiders are less informed "noise traders," as they are not actually present at the exchange. This is consistent with the hypothesis by Shalen (1993) that uninformed traders increase volatility because they cannot differentiate liquidity demand from fundamental value change.

Our analysis is based on market microstructure theory where price is associated with private information. The quality of information held by FX participants may be different, they may have different types of information, or they may have dispersed expectations based on the same information. In FX markets, Financial customers trade for portfolio reasons in order to make money on capital assets. It is reasonable to assume that they use substantial amounts of both time and money on market research in a fast-moving market. Although there is no clear-cut difference between Financial and Non-Financial customers, dealers typically consider trades with Financial customers (e.g. hedge funds and mutual funds) as more informative than trades with Non-Financial customers (Bjønnes et. al., 2017; Moore and Payne, 2011; Mende and Menkhoff, 2003).

Non-Financial customers may be considered as ”current account” traders. Their FX trading is motivated by trades in goods markets. Primary dealers provide liquidity. Since they aggregate demand from Financial and Non-Financial customers (and central banks), it is reasonable to assume that this group is well informed. This is, of course, particularly the case for the largest primary dealers (Lyons, 2001).

Our empirical results show that Financial customers drive the positive volatility-volume relation found in previous studies. There is also evidence of a positive relation between volatility and trading by primary dealers; most important is trading among the largest primary dealers. Their role as liquidity provider would predict a negative relation with volatility. However, their role as information aggregator may be consistent with a positive relation with volatility. Controlling for trading by other market participants and macroeconomic conditions, trading by Non-Financial customers is not correlated with volatility. In fact, it turns out that Financial customer volume tends to forecast Non-Financial volume. When we look at the volume-volatility relation over five-day periods, it emerges that increased volume by Non-Financial customers is in fact negatively correlated with volatility. These observations are consistent with behavior where Non-Financial customers are the long-run liquidity providers, as suggested by Bjønnes et al. (2005a).

It is hard to argue that Financial customers are noise traders (as outsiders in Daigler and Wiley (1999)). Instead, differences in trading strategies and information may explain the volatility-volume relation.

We experimented with including changes in (absolute) net position of Financial customers in the regressions. Although changes in (absolute) net position are strongly correlated with volatility, the coefficient is not significant in regressions including volumes.

Daigler and Wiley (1999) find similar empirical evidence for futures markets. Evans and Lyons (2005), Bjønnes et al. (2005a) and Froot and Ramadorai (2005) show that there is positive correlation between changes in the position of Financial customer and changes in FX rates. However, this correlation is not very strong at the daily horizon, but becomes strong at lower frequencies (e.g. at the monthly horizon).

The paper is organized as follows. Section 2 reviews the existing literature and evidence. Our data is presented in Section 3. Section 4 describes how we separate between expected and unexpected volume. In Section 5, we present the results. Section 6 concludes.

2. Literature review

There are two related theories that explain the volume-volatility relation. Information models such as the ”the mixture of distribution model” (Clark, 1973; Epps and Epps, 1976; Tauchen and Pitts, 1983) suggest that daily price changes and trading volume are both mixtures of independent normals with the same mixing variable. A mixing variable will typically be the number of information arrivals. The intuition is that the arrival of new information drives both the exchange rate changes and volume. Jones, Kaul, and Lipson (1994) use volume per transaction and the number of transactions as mixing variables.

Models of heterogeneous trader behavior emphasize the availability of different types of information or the existence of differing beliefs concerning the importance of information. In “differences in opinion models” such as Harris and Raviv (1993), investors are expected to act differently on the same news. Dispersion of beliefs creates both more price variability and excess volume. Asymmetric information is important in many market microstructure models. Shalen (1993) argues that uninformed traders increase volatility because they cannot differentiate liquidity demand from fundamental value change. Informed traders have relatively homogenous beliefs. Hence, informed traders will buy and sell within a small range of prices.

In other market microstructure models, it is the privately informed investors that increase volatility (e.g. Glosten and Milgrom, 1985; Kyle, 1985). Glosten and Milgrom (1985) develop a sequential trade model with informed and uninformed investors and find that market makers and uninformed traders experience adverse selection when trading with informed investors. In this model, each investor transacts one unit of stock per unit of time. Easley and O’Hara (1987) extend the model to allow for different trade sizes and by introducing uncertainty in the information arrival process of the informed trader. With investors that act competitively, Easley and O’Hara (1987) find that large trades tend to be executed by better-informed investors. This means that large trades carry more adverse selection effects, which gives a positive relation between trade size and price volatility. In other models, investors may act strategically, breaking up their orders into a number of smaller trades as in Admati and Pfleiderer (1988) and Kyle (1985). In common for these models (e.g. Glosten and Milgrom, 1985; Kyle, 1985; Easley and O’Hara, 1987; Admati and Pfleiderer, 1988) they all predict that more trading volume from informed investors will increase volatility.

Studies from a number of different market settings suggest that there is a positive relation between volume and volatility (see Karpoff, 1987). Due to the lack of data there are few studies of the FX market, and those that include actual volume data have only had access to a limited part of total volume. The studies conducted by Goodhart and Figliuoli (1991) and Bollerslev and Domowitz (1993) both use the frequency of indicative quotes on the Reuters FXFX screen as a proxy for volume. Grammatikos and Saunders (1986) and Jorion (1996) use the number of futures contracts traded at the CBOE. Wei (1994) and Hartmann (1999) use the Bank of Japan's data set on brokered transactions in the Tokyo JPY/USD market. Galati (2000) uses data provided by the BIS on actual trading volume for seven developing countries. In general, these studies suggest a positive relationship between volatility and volume consistent with evidence from other markets.

3. Data

The Riksbank receives daily reports from a number of Swedish and foreign banks (primary dealers or market makers, 10 as of spring 2002) on their buying and selling of five different instruments (spot, forward, short swap, standard swap and option). In our sample, stretching from 1995 until 2002, a total of 27 reporting banks are represented. Only five banks are represented in the whole sample, and there are never more than 15 at any point of time. The reporting banks are anonymized, but we know whether they are Swedish or foreign. The reported series is an aggregate of Swedish krona (SEK) trading against all other currencies, measured in krona, and covers 90–95% of all worldwide trading in the SEK. Close to 100% of all interdealer trading and 80–90% of customer trading are in SEK/EUR. In our analysis we will therefore focus on the SEK/EUR exchange rate.[ii]

Aggregate volume information is not available to the market. Foreign exchange markets are organized as multiple dealer markets, and have low transparency. The specific reporter only knows its own volume and a noisy signal on aggregate volume that it receives through brokers. Reporting banks obtain some statistical summaries of volume aggregates from the Riksbank, but only with a considerable lag. The data set used in this paper is not available to market participants.

Each Market-making bank reports trading with four counterparties: (i) trades with other Market-making banks, (ii) trades with Financial customers, (iii) trades with Non-Financial customers, and (iv) trades with Sveriges Riksbank (the central bank). The sum of this trading will amount to the change in the currency position (flow) of the Market-making bank. Financial customers are represented by hedge funds, mutual funds, pension funds and investment managers, while Non-Financial customers are mainly represented by corporates.

The spot market is regarded as the driving force of the FX market (see, e.g. Lyons, 2001). Hence, we will focus on this market when examining the volume-volatility relation. The only exception is when we focus on the effect of changes in net positions or changes in absolute net positions. Here we also include forward trading since these trades affect net positions. By comparison, a swap transaction has no "order flow" effect, as it is just two opposing transactions being made at the same time (see Bjønnes et. al. (2005b) for results on the volume-volatility relationship using different instruments).

Table 1 presents some descriptive statistics on gross spot volume for different groups of market participants on the daily horizon. Daily spot volume is 32 billion SEK.[iii] Of this total spot volume, Financial customers are on average responsible for 46 percent, while Non-Financial customers are responsible for 32 percent.

Table 1: Descriptive statistics

The table shows descriptive statistics on volumes of different market participants. Financial or Non-Financial represent their trading with Market-making banks, while Market-making banks represent trading among Market-making banks. All numbers are calculated on a daily basis. Volume is measured in units of 10 billion SEK. Sample: 01.1995–06.2002.

	Financial	Non-Financial	Market-making banks
Mean	1.45	1.02	0.72
Median	1.38	0.96	0.66
Std. Dev.	0.59	0.43	0.40
Skewness	1.04	1.15	1.15
Kurtosis	6.57	7.87	5.21

Table 2: Correlations

All numbers are calculated on a daily basis. Financial, Non-Financial and Market-making banks refer to their trading volume. Net. pos. Financial refers to the absolute value of net changes in the position of Financial customers. The following macro information is included (absolute changes): log(USD/EUR), German stock index, Swedish stock index, oil price, 10-year and 3-month interest rate differential between Sweden and Germany, and a dummy that takes the value 1 on days when Sveriges Riksbank reports an intervention. Sample: 01.1995–06.2002.

	Financial	Non-Financial	Market-making banks
Non-Financial	0.56		
Market-making banks	0.74	0.53	
log(USDEUR)	0.15	0.08	0.12
log(DAX30)	0.10	0.08	0.09
log(LOMX16)	0.13	0.12	0.11
log(OIL)	0.04	0.03	0.02
RDIF3M	0.13	0.08	0.13
RDIF10Y	0.20	0.11	0.20
INT	0.12	0.08	0.14
Net pos. Financial	0.35	0.23	0.28

Table 2 shows correlations between volumes of Financial and Non-Financial customers, interbank volume, and some macro variables. The highest correlation is between trading volume of Financial customers and Market-making banks. The other correlations between the volume numbers are 0.53 and 0.56, respectively. We also note the positive correlation between changes in net position of Financial customers and the volume numbers. In general, there is also positive correlation between the volume numbers and the macro variables.

4. Expected vs. unexpected volume

Tauchen and Pitts (1983) differentiate between an increase in volume due to an increase in the number of traders, and an increase in volume due to e.g. new information. An increase in volume due to an increase in the number of traders can be interpreted as “expected volume.” Expected volume should primarily increase liquidity, and should have little or negative impact on volatility. Bessembinder and Seguin (1992) and Hartmann (1999) document the importance of unexpected volume in explaining the volume-volatility relationship.

The standard method to distinguish between expected and unexpected volume is to identify systematic time-series behavior in the volume data, i.e. using an ARIMA model. Using stationarity tests like the augmented Dickey-Fuller or the Phillips-Perron, we find no evidence of non-stationarity. However, when we estimate an ARMA model on the volume series, the AR root tends to be close to or outside the unit circle. At the same time, we find that the MA coefficient is close to -1.

Similar observations have been made by Hartmann (1999). Hartmann has volume data reported from Tokyo-based brokers covering trading in JPY/USD over the period from 1986 to 1994. He reports that the series are stationary according to standard tests, but the AR roots have a unit root and the MA is close to -1. According to Hartmann, the fact that the MA is close to -1 might distort the stationarity tests. He therefore argues that one should treat the series as non-stationary.

Hartmann (1999) argues that an ARIMA(9,1,1) gives the best fit for his data. However, repeated tests on our sample do not seem to give any firm evidence of improvement when we move beyond an ARMA(2,2). We have run regressions using a number of different ARIMA specifications, and these do not seem to influence the results. Nor does it have any effect whether we use the level or the first difference in these regressions. We therefore choose to use a model that is as simple as possible.

Further, Hartmann argues that an ARCH(3) process removes ARCH/GARCH effects from his series. This feature can also be replicated in our data. However, again we find no improvement from using a GARCH(3,0) rather than the more standard GARCH(1,1). We therefore choose to use a GARCH(1,1).

To the ARMA(2,2) model we add a constant and dummies for each of the first four days of the week. Chang, Pinegar, and Schachter (1997) document that there tend to be weekday patterns in volume data. Harris and Raviv (1993) have a model that predicts an increase in the volume on Mondays, as the dispersion of beliefs is higher after a period of closed markets. Foster and Viswanathan (1990) predict that volume on Mondays will be lower than Tuesdays due to the fact that private information accrues over weekends, while public information does not. We find strong evidence in support of lower volume on Mondays, and some evidence in support of higher volume on Wednesdays. The predictions are in accordance with Foster and Viswanathan (1990). The results of the regressions are reported in table 9 in the appendix.

Our model of expected volume has a reasonable fit. For most series we find an R^2 between 30 and 60 percent. We use the fitted values as “expected,” and the residual as “unexpected.”

5. Results

In this section we provide our empirical results. First, we start by testing the volume-volatility relation using total spot volume. Second, we examine the volume-volatility relation using volumes for different customers (Financial or Non-Financial) and Market-making banks. We also investigate the dynamics of volume and changes in net positions between different groups of market participants. Finally, we separate Large from Other Market-making banks to see how their customer and interbank trading are related with volatility.

In all our regressions, a measure of volatility will be the dependent variable. Volatility is measured by the absolute return.

In the regressions we need to control for volatility that is expected, and hence cannot be driven by new information or revisions in beliefs. To control for the expected volatility, all reported regressions are estimated using a GARCH(1,1)-M, meaning we include the squared root of the variance term in the regression as an estimate of conditional volatility.

We also take into account that volatility might be driven by the same underlying macro variables. It is therefore reasonable to include macro variables. These include absolute changes in the log of the USD/EUR, the log of a German stock index (DAX30), the log of a Swedish stock index (OMX16) and the 10-year and 3-month interest rate differential between Sweden and Germany. We also include a specific dummy that takes the value 1 in every period where Sveriges Riksbank reports an intervention. It is a notable result that this dummy is significant and positive in most regressions reported. Last, we include the absolute change in net position (spot plus forward) of Financial customers. This is a measure of correction of market imbalance, and is further discussed below.

Theory suggests that it is unexpected volume that should be positively correlated with volatility. We estimate expected volume using ARMA(2,2) models. The residual from these models is defined as unexpected volume. Using generated regressors might bias the parameter estimates. All results should therefore be interpreted with care. We do, however, find that the results for the volume terms are stable with regard to choice of estimation methods.[iv] Further, the important issue in our discussion is the comparison of volume from different groups of market participants—not the coefficient of volume itself. We have no reason to believe that a possible bias in the volume coefficient should be different between different groups.

A. Volume and volatility

Table 3 reports the estimations of volatility (absolute change in the FX rate) on the spot volume (expected and unexpected). We see that the effect of expected volume is not significantly different from zero. Theory predicts that the coefficient should be negative rather than positive since more expected volume from e.g. an increase in the number of dealers would typically mean higher liquidity. For unexpected volume we find a positive and significant effect. An increase in unexpected volume of one standard deviation (0.93), would typically be related to an absolute change in the FX rate of 0.08 percent. Compared with the standard deviation of absolute changes in SEK/EUR (0.3 percent), this number is economically significant.

We also see that many of the coefficients on the macro variables turn out to be significantly positive. However, the economic significance is smaller than for unexpected spot volume. For instance, an absolute change in USD/EUR rate of one standard deviation would typically be related to an absolute change in the SEK/EUR-rate of 0.02 percent. Hence, volatility in the most important currency pair (that is, USD/EUR) is not a very important driver of volatility in SEK/EUR. An absolute change in the 10-year interest rate differential of one standard deviation would typically be related to an absolute change in the FX rate of 0.03 percent. Lastly, the coefficient on the GARCH term turns out to be significantly positive and also economically significant. Here, a one standard deviation increase in predicted volatility will be related to an absolute change in the SEK/EUR rate of 0.08 percent.

In the following subsections, we will focus on only unexpected spot volume.

Table 3: Spot volume and volatility

The table reports GARCH(1,1) regressions on the absolute value of (log) changes in SEK/EUR. Expected volume is the fit of an ARMA(2,2) model, while unexpected volume is the residual of this estimation. Estimation includes the squared root of the conditional variance (ARCH-in-mean). Net. pos. Financial refers to the absolute value of net changes in the position of Financial customers. The following macro information is included (absolute changes): log(USD/EUR), German stock index, Swedish stock index, oil price, 10-year and 3-month interest rate differential between Sweden and Germany and a dummy that takes the value 1 on days when Sveriges Riksbank reports an intervention. t-values are reported together with regression coefficients, and ** and * indicates 1 percent and 5 percent significance levels, respectively. Volume is measured in units of 10 billion SEK. Sample: 01.1995–06.2002.

	Absolute change		
SQR(GARCH)	1.041105	6.54	**
C	-0.000638	-1.84	
Unexpected spot volume	0.000828	17.36	**
Expected volume	3.56E-05	0.55	
log(USDEUR)	0.049015	4.64	**
log(DAX30)	0.028727	5.44	**
Log(OMX16)	0.00969	2.06	*
log(OIL)	0.003298	1.14	
RDIF3M	0.178164	1.12	
RDIF10Y	0.868646	7.70	**
INT	0.001053	5.63	**
Net pos. Financial	0.000541	1.55	
Variance Equation			
C	5.58E-08	2.94	**
ARCH(1)	0.05063	10.16	**
GARCH(1)	0.941319	211.61	**
R2	0.26		
DW	2.01		

B. Volatility and different groups of market participants

In table 4 we separate between (unexpected) volumes from Financial and Non-Financial customers, and the interbank volume. The interbank volume will obviously be influenced by customer trading. This will thus be an “extra” source for multicollinearity. For instance, if the interbank volume is just a constant multiplied by the customer volume, as in the Evans and Lyons (2002) model, we would have perfect multicollinearity.

A priori, it is not obvious that different market participants should be correlated differently with volatility. If the increase in number of transactions is due to the arrival of public information only, we should expect a simultaneous increase in trading from all participants. However, if dispersion of beliefs (different market participants interpret information differently) is important, or if different participants are asymmetrically informed, then the trading volume of some market participants might be more closely correlated with volatility than the volume of other market participants.

From table 4 we see that volume from Financial customers is driving the volume-volatility relation. The coefficient on Non-Financial volume is insignificant. The coefficient on interbank volume is, however, significantly positive. An increase in Financial customer volume of one standard deviation would typically be related to an increase in absolute return of 0.07 percent. Since the standard deviation of the absolute return is 0.3 percent, the effect of Financial volume is economically significant. For the interbank volume, an increase of one standard deviation, would typically result in an increase in absolute returns of only 0.02 percent.

In table 5 we estimate a similar regression as in table 4. The most important difference is that we now consider the weekly horizon. From table 5 we see that Financial volume is positively correlated with volatility just like at the daily horizon. An interesting observation from table 5, however, is the negative relationship between volatility and Non-Financial volume. Thus, higher volume from Non-Financial customers typically goes together with a reduction in volatility. A possible explanation for this is that Non-Financial customers are liquidity providers in the long run. This idea is supported by Bjønnes et al. (2005a). Some further evidence is provided in table 6, where we use Granger causality tests to address causality between volume of different market participants. Similarly, we use Granger causality tests to address causality between changes in net positions of different market participants.

Table 4: The volume-volatility relation and different market participants

The table reports GARCH(1,1) regressions on the absolute value of (log) changes in SEK/EUR. The Financial, Non-Financial and MM volumes, respectively, are the residuals from ARMA(2,2) models. Estimation includes the squared root of the conditional variance (ARCH-in-mean). Net. pos. Financial refers to the absolute value of net changes in the position of Financial customers. The following macro information is included (absolute changes): log(USD/EUR), German stock index, Swedish stock index, oil price, 10-year and 3-month interest rate differential between Sweden and Germany and a dummy that takes the value 1 on days when Sveriges Riksbank reports an intervention. t-values are reported together with regression coefficients, and ** and * indicates 1 percent and 5 percent significance levels, respectively. Volume is measured in units of 10 billion SEK. Sample: 01.1995–06.2002.

	Absolute change		
SQR(GARCH)	0.922671	6.90	**
C	-0.00014	-0.46	
Financial	0.00155	10.34	**
Non-Financial	-6.66E-05	-0.40	
MM banks	0.000749	2.88	**
log(USDEUR)	0.04666	4.46	**
log(DAX30)	0.028817	5.49	**
log(OMX16)	0.009974	2.19	*
log(OIL)	0.002596	0.89	
RDIF3M	0.173181	1.13	
RDIF10Y	0.778017	6.69	**
INT	0.001013	5.51	**
Net pos. Financial	0.000121	0.36	
Variance Equation			
C	4.30E-08	2.47	*
ARCH(1)	0.053207	10.26	**
GARCH(1)	0.941405	211.49	**
R2	0.26		
DW-stat	2.01		

Table 5: The volume-volatility relation and different market participants at the weekly horizon

The table reports GARCH(1,1) regressions on the absolute value of (log) changes in SEK/EUR. The Financial, Non-Financial and MM volumes, respectively, are the residuals from ARMA(2,2) models. Estimation includes the squared root of the conditional variance (ARCH-in-mean). Net. pos. Financial refers to the absolute value of net changes in the position of Financial customers. The following macro information is included (absolute changes): log(USD/EUR), German stock index, Swedish stock index, oil price, 10-year and 3-month interest rate differential between Sweden and Germany and a dummy that takes the value 1 on days when Sveriges Riksbank reports an intervention. t-values are reported together with regression coefficients, and ** and * indicates 1 percent and 5 percent significance levels, respectively. Volume is measured in units of 10 billion SEK. Sample: 01.1995–06.2002.

	Absolute change		
SQR(GARCH)	0.748149	1.77	
C	-0.002213	-0.97	
Financial	0.000866	3.03	**
Non-Financial	-0.000765	-2.46	*
MM banks	0.000185	0.46	
log(USDEUR)	0.139568	7.20	**
log(DAX30)	0.057097	5.32	**
log(OMX16)	0.015824	1.22	
log(OIL)	-0.004793	-0.57	
RDIF3M	0.933237	2.73	**
RDIF10Y	2.363045	6.89	**
INT	7.79E-05	0.05	
Net pos. Financial	0.000422	0.45	
Variance Equation			
C	3.13E-06	2.09	*
ARCH(1)	0.174204	2.89	**
GARCH(1)	0.736439	10.00	*
R2	0.33		
DW	2.04		

The Granger causality test indicates the forecast ability of one series on another. Here, Granger causality is estimated using a standard bivariate framework. This means that we estimate whether the volume (panel a) or flow (panel b) of one group can forecast volume or flow of the other group. We report regressions estimated with 2 lags. However, the results do not change if we change to e.g. 1 or 3 lags. No tests indicate lag lengths other than these.

Table 6: Granger causality tests using two lags

The table presents the probabilities from Granger causality tests. The question asked is whether the variable in the left column does not cause the variable in the upper row. The estimations are based on bivariate estimations. Volume and changes in absolute net positions are measured in units of 10 billion SEK. We only report probability of rejection. Sample: 01.1995–06.2002.

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Panel a: Volume

Does not cause:	Financial	Non-Financial	MM banks
Financial	NA	0.01	0.06
Non-Financial	0.49	NA	0.59
MM banks	0.54	0.00	NA

Panel b: Changes in net positions

Does not cause:	Financial	Non-Financial	MM banks
Financial	NA	0.00	0.45
Non-Financial	0.72	NA	0.72
MM banks	0.34	0.00	NA

In table 6 we see that Financial volume or volume of Market-making banks can predict volume by Non-Financial customers. There is also some evidence that volume from Financial customers can predict the volume of Market-making banks.

We see that changes in net positions of Financial customers can forecast changes in net positions of Non-Financial customers. These observations suggest the following dynamic. First, Financial customers trade with Market-making banks. The net position from these trades is again sold to Non-Financial customers.

The above-mentioned results suggest that absolute changes in the net position of Financial customers may be an alternative measure to volume. However, in all regressions so far this variable has turned out to be insignificant because the volume variables capture the same information. In table 7 we have excluded the volume variables. Now, we see that the coefficient on absolute change in net position of Financial customers is highly significant and positive.

Table 7: The volume-volatility relation and absolute change in net position of Financial customers

The table reports GARCH(1,1) regressions on the absolute value of (log) changes in SEK/EUR. Estimation includes the squared root of the conditional variance (ARCH-in-mean). We only show the coefficient on the absolute change in net position of Financial customers. The following macro information is included (absolute changes): log(USD/EUR), German stock index, Swedish stock index, oil price, 10-year and 3-month interest rate differential between Sweden and Germany and a dummy that takes the value 1 on days when Sveriges Riksbank reports an intervention. t-values are reported together with regression coefficients, and ** and * indicates 1 percent and 5 percent significance levels, respectively. Volume is measured in units of 10 billion SEK. Sample: 01.1995–06.2002.

	Absolute change		
Net. pos. Financial	0.002836	8.28	**
R2	0.21		
DW stat	2.02		

C. Bank size and customers

The FX market microstructure literature suggests that dealers follow different strategies and have different information (see e.g. Lyons, 1995; Bjønnes and Rime, 2005c; Cheung and Chinn, 2001). However, banks are mostly unwilling to reveal their explicit strategies, so this is an area where few results have been published.

In Table 8 we distinguish between trading with the two largest market-making banks and with other market-making banks. The two largest market-making banks have a market share in spot trading just above 40%. A question that arises is whether the customer orders that go to large banks are different from customer orders that go to other banks. For instance, will large Financial customers contact large banks when their trades are most informative, and will the effect on volatility differ? Another question is whether the interbank volumes by Large and Other reporting banks have different effects on volatility. As can be seen in table 8, the impact of Financial is almost identical for both types of banks. However, only interdealer trades including Large banks enter significantly.

Table 8: Volatility and volume from Financial and Non-Financial customers and from the interbank market: Large vs. Other Market-making banks

The table reports GARCH(1,1) regressions on the absolute value of (log) changes in SEK/EUR. The Financial, Non-Financial and MM volumes, respectively, are the residuals from ARMA(2,2) models. Large refers to trade with the two largest Market-making banks, while Other refers to trades with other Market-making banks. Estimation includes the squared root of the conditional variance (ARCH-in-mean). Net. pos. Financial refers to the absolute value of net changes in the position of Financial customers. The following macro information is included (absolute changes): log(USD/EUR), German stock index, Swedish stock index, oil price, 10-year and 3-month interest rate differential between Sweden and Germany and a dummy that takes the value 1 on days when Sveriges Riksbank reports an intervention. t-values are reported together with regression coefficients, and ** and * indicates 1 percent and 5 percent significance levels, respectively. Volume is measured in units of 10 billion SEK. Sample: 01.1995–06.2002.

	Absolute change		
SQR(GARCH)	0.969385	6.98	**
C	-2.57E-04	-0.79	
Financial with Other MM banks	1.51E-03	6.64	**
Financial with Large MM banks	1.59E-03	4.58	**
Non-Financial with Other MM banks	-5.50E-04	-1.79	
Non-Financial with Large MM banks	2.86E-04	1.16	
Other MM banks with Other MM banks	2.23E-04	0.55	
Large MM banks with Large MM banks	1.60E-03	2.94	**
log(USD/EUR)	0.046698	4.44	**
log(DAX30)	0.02769	5.15	**
log(OMX16)	0.011172	2.41	*
log(Oil)	0.002739	0.94	
rdiff 10 year	0.15385	0.98	
rdiff 3 months	0.797666	6.87	**
INT	9.85E-04	5.28	**
Net pos. Financial	1.57E-04	0.46	
Variance Equation			
C	4.86E-08	2.72	**
ARCH(1)	0.051425	9.95	**
GARCH(1)	0.941716	204.23	**
R2	0.27		
Adjusted R-squared	0.26		
DW stat	2.01		

6. Conclusion

The literature on the volume-volatility relation asks one primary question: why does the relation arise? If everyone has the same expectations, and all groups behave similarly, the effect should be caused by more trading due to the arrival of new information. However, all rational agents should have the same opportunity to take advantage of the new information, and heterogeneity should be of lesser importance. On the other hand, if the volume-volatility relation is the result of dispersion of beliefs or asymmetric information, then heterogeneity is certainly a central feature in the analysis.

This paper reviews evidence from a unique set of volume data from the Swedish FX market. The Swedish market is a small market compared with e.g. the USD/EUR or USD/JPY market. However, SEK/EUR is among the 10 most-traded currency crosses in the world, and the market is well developed with high liquidity.

We find that spot volume in general shows a positive correlation with volatility. However, the strength of the volume-volatility relation depends on the group of market participants trading. We document that Financial trading volume has the highest correlation with volatility. Interbank trading between the two largest Market-making banks is also positively correlated with volatility, while trading among Other banks shows no correlation with volatility. Trading by Non-Financial customers is not correlated with volatility at all when controlling for trading by other market participants. Furthermore, we show that (unexpected) spot volume and changes in net positions (spot and forward) of Financial customers Granger cause spot volume and changes in net positions of Non-Financial customers. Our results clearly suggest that FX market participants are heterogeneous.

Ex ante we would not expect that Financial customers are less informed than Non-Financial customers. If we compare our finding that trade by Financial traders is most closely associated with volatility with the result in Daigler and Wiley (1999), we gain new insight. If "speculator" and "Financial" trader is indeed the same thing, as our results indicate, it is hard to interpret "speculator" as a noise trader. Instead, one might argue that differences in trading strategies, i.e., like current account vs. portfolio trading, and not information, will determine the correlation between trading volume and volatility. This is an important distinction to consider in future research.

A Tables

Table 9: Estimating an ARMA(2,2) process on volume. Period: 01.95-06.02

Model is estimated to differentiate expected and unexpected volume. We treat the fit of the model as expected, and the residual as unexpected. The model is estimated using an GARCH(1,1).

	Absolute change		
C	1.33	12.57	**
D1	-0.17	-6.91	**
D2	0.06	2.23	*
D3	0.13	5.12	**
D4	0.10	4.03	**
ZERO	-1.38	-15.15	**
AR(1)	1.66	28.24	**
AR(2)	-0.66	-11.40	**
MA(1)	-1.32	-19.37	**
MA(2)	0.35	5.76	**
Variance Equation			
C	0.01	6.13	**
ARCH(1)	0.04	5.74	**
GARCH(1)	0.93	95.56	**
R2	0.49		
DW	1.92		

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[i] Based on results in Bjønnes, Rime and Solheim (2005a) we focus on spot-market trading. The spot market is regarded as the driving force of the FX market (Lyons, 2001).

[ii] For the period prior to January 1, 1999, we use SEK/DEM. The exchange rate is indexed to EUR equivalent terms (SEK/DEM x 1.95583).

[iii] Trading by the Swedish Central Bank is not included in the table. However, this trading is on average small.

[iv] We have also used GMM and simple OLS regressions. There is no indication that this affects any of the results. Recursive regressions reveal that parameter stability in the volume parameters reported is good.