The Role of Dealers in Providing Interday Liquidity in the Canadian-Dollar Market

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- *Dealing institutions operating in foreign exchange markets not only provide liquidity throughout the trading day, they are key participants in providing interday liquidity.*
- *Part of the compensation dealers receive for holding undesired inventory balances derives from the information they receive through customer trades.*
- *Evidence presented in this article suggests that Canadian dealers are more likely to provide interday liquidity to foreign, rather than Canadian, financial customers, since foreign financial flows can be more informative about future movements in the exchange rate.*
- *A statistical relationship is revealed between the supply of liquidity provided by non-financial firms and that provided by dealing institutions across time, and across markets.*
- *When customer trades are informative, dealers manage risky positions across spot and forward markets. By operating in both markets, dealers can provide liquidity in one market, while partially hedging that risk in the other.*

In financial markets where trading is dispersed and immediacy is desirable, it is important to understand how liquidity is provided, and who provides it.[1] An illiquid or poorly functioning foreign exchange (FX) market, for example, imposes additional transactions costs on companies engaged in international trade or involved in foreign investment and funding activities. As well, it may hinder the speed with which information is reflected in the exchange rate.

Although intraday liquidity in FX markets is provided by dealers who stand ready to buy and sell foreign exchange at their posted bid / ask quotes throughout the trading day, it is commonly assumed that dealing institutions hold only limited interday (overnight) FX positions.[2] Bjønnes, Rime, and Solheim (2005) present preliminary evidence that while the burden of interday liquidity provision falls on non-financial participants, dealing institutions provide some liquidity interday, and continue to do so over several days or weeks.[3] This article examines the circumstances in which dealing institutions in the U.S.-dollar / Canadian-dollar FX market hold interday positions, and the manner in which they off-load these positions over time, across related markets, and across participants.[4,5]

* The research reported in this article is summarized from a working paper written by the author (D'Souza 2008).

1. Typically, a liquid financial market is characterized as one in which traders can rapidly execute large transactions with only a small impact on prices.

2. Transactions are not always executed at these quotes. Other factors, such as the size of a trade, may influence the transacted price.

3. Lyons (1995) and Bjønnes and Rime (2005) illustrate that dealers do not usually hold open positions for a significant period of time.

4. The U.S.-dollar / Canadian-dollar FX market is the sixth-largest currency market in the world (BIS 2007). US$ / Can$ will hereafter be used to represent the exchange rate or FX market.

5. Empirical research analyzing the behaviour of individual traders may not reflect the norm across all trading desks.

The article begins with a brief discussion of the possible sources of information relevant to the value of the exchange rate and of the link between information and liquidity provision. This is followed by a short description of a strategic trading model of the FX market and a list of testable implications associated with the provision of interday liquidity. A description of the data employed in the study is then offered. The methodology used to uncover the relationship between the positions of participants and the level of the exchange rate is discussed in the results section, followed by evidence of interday liquidity provided by individual participants. The article concludes with a summary of the findings.

Information Flows and Participants in FX Markets

Access to information about the future direction of the exchange rate can be extremely valuable in the FX market, where the daily turnover of trades is valued in trillions of dollars.[6] Yet one important characteristic that distinguishes FX trading from trading in equities, for example, is the lack of trade transparency available to the market. Individuals and firms that need to buy and sell foreign exchange typically trade with dealers on a bilateral over-the-counter basis.[7] These trades are only known to the two counterparties involved in the transaction.[8] FX dealers, acting as market-makers, observe a large fraction of these trades over the course of the trading day.

Dealers may choose to hold an open (and risky) position arising from a customer trade because such trades provide valuable information about future movements in the exchange rate.[9] In particular, if order flow is measured as the volume or number of buy orders relative to sell orders, observing an excess quantity of net buy (sell) orders for the Canadian dollar, for example, suggests that market participants as a whole have a positive (negative) sentiment about the future prospects of the Canadian dollar.[10] Dealers may use this information as part of their own trading strategy.

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Cheung and Wong (2000), in survey evidence, find that dealing banks list a larger customer base and better order-flow information as two sources of comparative advantage. Evans and Lyons (2007) and Osler (2008) have suggested that customer trading in the FX market is a valuable source of relevant information about macroeconomic exchange rate fundamentals. At a more disaggregated level, certain trades in the FX market have been found to be more informative than others. Several studies, including Fan and Lyons (2003); Froot and Ramadorai (2005); and, Osler, Mende, and Menkhoff (2007) find the trades of financial firms to be more informative than those of non-financial firms. D'Souza (2007) finds that dealers operating from the largest FX commercial centres in the world—London and New York—are also asymmetrically informed. Dealers domiciled in these locations observe a disproportionate share of international capital flows, attributed to the number and influence of portfolio managers located there.

Not all relevant information in the FX market is associated with macroeconomic variables, however. Cao, Evans, and Lyons (2006) illustrate how dealers can use private information about their own inventories as a profitable avenue for speculation, since any undesired inventories must be absorbed elsewhere in the marketplace. This has direct implications for the supply of liquidity in the FX market. In particular, providing liquidity to customers affords dealers an opportunity to speculate and profit on future movements in the exchange rate. Each dealer will know his or her own

6. Barker (2007) discusses the evolving structure of the FX market.

7. Dealers are the individual traders in financial institutions, i.e., the big banks in Canada. Although the terms market-maker, dealer, and intraday liquidity provider are used interchangeably, in this article the term "dealer" will primarily be used to refer to financial institutions rather than to individual traders.

8. While searching for the best available dealer quotes, individuals and firms may also reveal to other dealers in the market their intention to buy or sell FX.

9. A bid / ask spread is also applied to compensate for inventory risk. O'Hara (1995) describes how dealers can manage their inventories by adjusting their bid / ask quotes.

10. Evans and Lyons (2002) demonstrate that order flow predicts future foreign exchange returns. Hasbrouck (1991a,b) and Brandt and Kavajecz (2004) find similar evidence in equity and fixed-income markets, respectively.

customer orders through the course of the day, and will try to deduce from the order flow the net imbalance in the market.[11]

Since dealers have a comparative advantage in acquiring order-flow information as a result of their private dealings with customers, they balance the inventory risk associated with providing liquidity against the expected higher returns generated from informed speculation.

Market Microstructure Models

Market microstructure models focus on the trading behaviour of individual participants in the FX market and on the institutions in the market. The strategic trading models of Lyons (1997, 2001) and Cao, Evans, and Lyons (2006) provide a number of testable hypotheses associated with the provision of liquidity in FX markets. The most interesting aspect of these models is that they incorporate many realistic features of the market, including the fact that dealers recognize that their individual trades can affect the level of the exchange rate, and will consequently take speculative positions based on their private information.

Given that the catalyst for all trading is customer demand for liquidity, multiple rounds of quoting and trading are built into each model to demonstrate how the private information of dealers is revealed to the wider market over time. Specifically, consider a dealer who has just purchased U.S. dollars from a customer and feels confident that this is a source of private information. Suppose that the trade is judged to reflect fundamental information; say, that the Canadian dollar will depreciate relative to the U.S. dollar in the future. The dealer will begin to sell Canadian dollars in interdealer trading. But each time a trade is negotiated with another dealer, information that was initially private is passed on to another market participant, who will then update its trading strategy accordingly. As the initially private information becomes public, and hence less valuable, dealers must adjust the timing of their trades so as to capitalize on the private information of their customer trades.

A final round of trading occurs between dealers and liquidity suppliers. Suppliers may include any or all types of participants in the FX market, including the trading desks of financial institutions, as long as each participant is sufficiently compensated (in terms of higher returns) for the risky inventory position they take on at the end of the day.

In the Cao, Evans, and Lyons model, speculation in interdealer trades is not related to macroeconomic fundamentals, but to inventory information.[12] Customer-dealer trade flows serve as the main source of private information collected by dealing banks when forecasting the future level of the exchange rate. In particular, these trades help dealers forecast the overall inventory position in the market. With this information, dealers can then determine the return required by liquidity providers for bearing exchange rate risk.

Customer-dealer trade flows serve as the main source of private information collected by dealing banks when forecasting the future level of the exchange rate.

The qualitative predictions of the model are similar with and without fundamental macroeconomic information:

1. Dealers speculate on the future direction of the exchange rate using the private information learned from their trades with customers.
2. Dealers speculate and hedge positions across time.
3. Dealing institutions in FX markets provide interday liquidity if adequately compensated for risk.

In FX markets, the customers of dealers are the financial and non-financial firms that are the end-users of foreign exchange for settling imports or exports, investing and borrowing overseas, hedging cross-currency business transactions, or speculating. In aggregate, each type of customer order flow may be

11. Dealing banks also learn about market-wide order flow from brokered interdealer trades.

12. See O'Hara (1995) for a comparison of the inventory and information approaches in microstructure theory.

an important source of information that accrues to individual dealers. If inventory information is the only factor that influences the level of the exchange rate, then all customer trades should be treated similarly by dealers. The analysis below distinguishes between various types of customer flows so that comparisons can be made in terms of the level of liquidity provision.

Data

The primary source of data is the Bank of Canada's daily report on foreign exchange volume, which provides details about FX trading flows, both purchases and sales, across all dealing financial institutions operating in Canada.[13] The analysis covers the five-year period between 2 October 2000 and 30 September 2005, or more than 1,250 daily observations.[14] US$/Can$ spot closing rates, and 10-year and 3-month interest rate spreads between Canadian and U.S. government bond yields are also examined. Since the foreign exchange rate is quoted as the number of Canadian dollars per U.S. dollar, a rise in the exchange rate represents a depreciation of the Canadian dollar.

Trading is disaggregated by FX market (spot and forward) and by dealers' trading partners.[15] Trading flows are reported in Canadian dollars and include trading against all other currencies.[16] Net flows, calculated as purchases less sales, are categorized according to customer type: commercial-client business (CC) includes all transactions of resident and non-resident non-financial customers; Canadian-domiciled investment-flow business (CD) accounts for transactions of non-dealer financial institutions located in Canada, regardless of whether the institution is Canadian-owned; foreign-domiciled investment business (FD) consists of all transactions of financial institutions located outside of Canada, including FX dealers, pension funds, mutual funds, and hedge funds; central bank trades (CB) are those of the Bank of Canada. Participants are grouped in this manner to distinguish between trade-related and capital-related flows. Net interbank transactions are approximately zero when aggregated across reporting dealers.

An examination of the daily net flows and the currency positions of each type of participant shows that, at any point in time, positions are equal to the cumulative sum of all past net flows. The flows and positions of dealers (D_t) are calculated as follows:

$$D_t = -\left(CC_t + CD_t + FD_t + CB_t\right). \qquad (1)$$

Descriptive statistics are presented in Table 1. On average, CC flows and FD investment flows are larger and more volatile than CD investment flows, while dealer flows (D) are just as volatile as CC and FD flows. Not surprisingly, commercial clients, on average, purchase Canadian dollars, while FD financial institutions sell Canadian dollars.[17] The magnitude of the means and medians associated with spot and forward flows suggests that foreign institutions do not utilize the forward market as intensively as domestic participants, such as Canadian dealers and commercial clients.[18]

Panel 2 presents the correlations between participant flows in spot and forward markets, individually and combined. There is a strong negative correlation between CC customers and FD institutions (combined market: -0.673, spot market: -0.421, forward market: -0.257); between FD institutions and dealing institutions in spot markets (-0.698); and between CC customers and dealing institutions in forward contract markets (-0.623). Together, these correlations may indicate that while commercial clients are the ultimate source of liquidity to FD institutions, the process is intermediated through dealers. For example, dealers might initially provide liquidity to FD institutions in

13. The report is coordinated by the Bank and organized through the Canadian Foreign Exchange Committee (CFEC). Over the sample period studied, most FX trades in Canada were handled by the top six banks: Bank of Montreal, Canadian Imperial Bank of Commerce, Banque Nationale, Royal Bank of Canada, Scotiabank, and the Toronto Dominion Bank. Trades may or may not be initiated by traders working directly for an FX desk.

14. The disaggregated data employed in this analysis are not available to market participants. Reporting institutions obtain some statistical summaries of the volume aggregates from the Bank of Canada, but only with a considerable lag.

15. Spot transactions are those involving the receipt or delivery of exchange on a cash basis or in one business day; forward transactions are those involving receipt or delivery of foreign exchange in more than one business day. A forward contract is an agreement between two parties to buy or sell an asset at a specified future point in time. Since FX swaps consist of both spot and offsetting forward contract legs, they are not used in the analysis.

16. In 2005, more than 96 per cent of all spot, forward, and FX swap trades among reporting banks in Canada included the Canadian dollar in at least one leg of the transaction (CFEC 2006). In general, most trades take place in the US$/Can$ market.

17. This is consistent with Canada being a net exporter, with merchandise trade typically invoiced in U.S. dollars.

18. The Bank of Canada does not use the forward contract market in its operations.

Table 1

Trade Flows in Spot and Forward Markets

Panel 1

Net Daily Trade Flows

	Participant category				
	Commercial client flows (CC)	Canadian-domiciled investment flows (CD)	Foreign-domiciled investment flows (FD)	Central bank flows (CB)	Dealer flows (D)
Total trades across markets					
Mean	153.86	-12.39	-104.62	-5.72	-6.17
Median	150.70	-11.40	-103.90	0.00	-18.60
St. dev.	463.14	229.01	532.39	17.29	402.69
Minimum	-2,447.80	-1,202.80	-2,439.90	-173.07	-1,976.30
Maximum	2,247.10	920.90	2,313.90	0.00	5,766.70
Spot market trades					
Mean	97.49	-46.74	-90.79	-5.72	34.27
Median	94.70	-27.50	-106.10	0.00	24.90
St. dev.	289.81	167.69	489.70	17.29	503.26
Minimum	-2,185.90	-2,738.10	-2,546.00	-173.07	-1,961.20
Maximum	1,469.70	714.10	1,903.80	0.00	2,616.80
Forward contract market trades					
Mean	56.36	34.35	-13.82	–	-90.34
Median	42.40	27.00	-8.50	–	-72.20
St. dev.	338.17	200.99	181.21	–	464.57
Minimum	-2,539.10	-987.40	-1,272.00	–	-5,335.40
Maximum	2,068.50	2,707.70	1,408.40	–	1,779.00

Panel 2

Correlations

	Participant category				
	Commercial client flows (CC)	Canadian-domiciled investment flows (CD)	Foreign-domiciled investment flows (FD)	Central bank flows (CB)	Dealer flows (D)
Correlation across markets					
CC	1.0	–	–	–	–
CD	-0.038	1.0	–	–	–
FD	-0.673	-0.327	1.0	–	–
CB	0.153	0.015	-0.158	1.0	–
D	-0.252	-0.069	-0.262	-0.005	1.0
Spot market trades					
CC	1.0	–	–	–	–
CD	-0.050	1.0	–	–	–
FD	-0.421	-0.103	1.0	–	–
CB	0.112	0.010	-0.135	1.0	–
D	-0.174	-0.215	-0.698	0.027	1.0
Forward contract market trades					
CC	1.0	–	–	–	–
CD	0.060	1.0	–	–	–
FD	-0.257	-0.029	1.0	–	–
CB	–	–	–	–	–
D	-0.623	-0.468	-0.258	–	1.0

Note: Net daily trades flows (per participant) = purchases – sales (Can$) Spot transactions = receipt or delivery on a cash basis or in one business day; forward transactions = receipt or delivery in more than one business day
St. dev. = standard deviation
Sample: 2 October 2000–30 September 2005
Number of daily observations: 1,255

the spot market. Later, they may turn around and demand liquidity from commercial clients in the forward contract market.

Estimated long-run relationships between the positions of market participants and the exchange rate are identified in the next section. The analysis uncovers the length of time that dealers are willing to accept an undesired risky position from each type of customer, and the expected returns demanded for holding these inventories. The positions of market participants across spot and forward FX markets are also examined to better understand the overall determination of interday liquidity.

Results

This section empirically examines the role of each participant in providing interday liquidity to the FX market. The following question is addressed: When a trade is initiated by a particular type of investor, who holds the offsetting position at the end of the day, at the end of the week, or at any time further into the future? Empirical time-series methods are employed

to uncover the dynamic relationship between participant positions and the exchange rate.[19] In particular, the analysis seeks to determine the length of time that dealers are willing to accept an inventory position from each type of customer and the expected returns dealing institutions demand for holding these inventories.

Impulse-response functions provide a convenient way to analyze the time-varying dimensions of liquidity provision, given the interdependent nature of participants' inventories and the exchange rate. An impulse-response function traces out the response of a variable of interest to an exogenous "shock." For example, an unexpected customer trade not only affects dealer inventories (D) but may also, over time, affect the inventories of other participants operating in the market.[20] The reactions of the exchange rate and each participant's inventory to an unexpected purchase of Canadian dollars by commercial (CC) clients, CD financial customers, and FD financial customers are documented in Table 2. Negative values are associated with decreases in the Canadian-dollar position of each participant, or alternatively, with the provision of liquidity. In the case of the exchange rate, negative values correspond to an appreciation of the Canadian dollar.

The reaction of the long-run exchange rate to each shock reflects the fundamental information content of

19. Estimation of vector error-correction models (VECM) is discussed in the Appendix and in Hamilton (1994) and Johansen (1995). Unit-root tests are performed on all variables included in the model. In all cases, the null hypothesis of a unit root cannot be rejected at the 5 per cent significance level. Trace-test statistics are employed to determine the number of cointegrating relationships. Results indicate the presence of two cointegrating vectors. A number of coefficient restrictions are imposed on the estimated model, reflecting the institutional considerations of the Canadian FX market, the implications of the theoretical model, or the statistical significance of the estimated coefficients. In the absence of FX intervention, the Bank of Canada has chosen FX trading levels to have little or no impact on the exchange rate. In both cointegrating vectors identified, coefficient estimates on CB are also set to zero.

20. Impulse-response functions associated with the reaction of each variable to shocks in the positions of each customer type are computed from the estimates of the VECM. Generalized impulse-response functions are calculated rather than orthogonalized responses, since the ordering of variables can be an important factor. See Pesaran and Shin (1998).

Table 2

Impulse-Response Functions

		Number of days after impulse					
Impulse	Accumulated response	2	5	10	20	40	100
CC	CC	346.86*	380.67*	373.81*	355.31*	322.85*	247.67*
	CD	-9.57	-27.80	-28.37	-27.75	-23.98	-9.43
	FD	-21.60	-38.97	-40.34	-37.34	-32.34	-21.57
	CB	-0.29	-0.34	-0.40	-0.37	-0.31	-0.18
	D	-315.38*	-313.55*	-304.69*	-289.84*	-266.21*	-216.47*
	$\log(e)*10^{-3}$	0.231*	0.251*	0.202	0.120	0.006	0.000
CD	CC	-101.30*	-131.27*	-144.31*	-157.89*	-159.78*	-116.54*
	CD	215.16*	196.88*	168.48*	128.51*	87.56*	55.83
	FD	-11.00	7.18	13.91	21.79	27.80	24.86
	CB	-0.10	0.17	0.28	0.35	0.40	0.34
	D	-98.27*	-72.96*	-38.37	7.22	44.00	35.50
	$\log(e)*10^{-3}$	-0.093	-0.064	-0.033	-0.069	-0.100	-0.103
FD	CC	-234.50*	-308.89*	-334.89*	-374.31*	-445.84	-617.57*
	CD	-98.58*	-106.65*	-103.55*	-97.10	-83.59	-47.42
	FD	516.04*	590.75*	599.46*	605.38*	615.67*	639.85*
	CB	0.30	0.83	1.05	1.14	1.27	1.56
	D	-183.25*	-176.03*	-162.07*	-135.11*	-87.50*	-23.58
	$\log(e)*10^{-3}$	-0.054*	-0.089*	-0.167*	-0.305*	-0.541*	-1.080*

Note: Impulse-response functions are presented subsequent to a "shock" in each trade-flow variable. Generalized impulse-response functions are described in Pesaran and Shin (1998). An asterisk (*) is used to indicate responses that are statistically significant at the 5 per cent level. Bootstrap methods with 200 replications are employed to calculate standard errors (Efron and Tibshirani 1993). Sample: 2 October 2000–30 September 2005.
CC = commercial-client flows; CD = Canadian-domiciled investment flows; FD = foreign-domiciled investment flows; CB = central bank flows; D = dealer flows; log(e) is the logarithm of the US$/Can$ exchange rate.

each type of trade (Hasbrouck 1991a). FD purchases of Canadian dollars are associated with an appreciation of the Canadian dollar. Consistent with other findings in the literature, the market interprets net purchases by foreign financial customers as an indication that the dollar is undervalued. Purchases of Canadian dollars by Canadian-domiciled financial institutions (CD) also tend to lead to an appreciation of the Canadian dollar, but this is not statistically significant at any horizon. While CC trades have a statistically significant (and positive) impact on the exchange rate for at least five days after the initial shock, results indicate that these customers must pay liquidity suppliers—especially dealing institutions—for supplying this service. Overall, unlike FD trades, CC and CD trades are not found to be informative about the long-run future value of the exchange rate.

The impulse-response functions suggest that dealers provide considerable liquidity services to commercial clients. While CD and FD clients also take offsetting positions (for up to 40 business days), the magnitudes of these positions are substantially smaller and not statistically significant. In contrast, in response to a CD impulse, CC customers are the predominant liquidity provider. Dealing institutions only provide liquidity for up to five days. Subsequent to an FD trade shock, both commercial clients and dealers provide significant levels of liquidity, though commercial clients dominate in this role. CC customers increase their supply of liquidity over time as dealers reduce their inventory-risk exposure.[21] These results are qualitatively similar to those of Bjønnes, Rime, and Solheim (2005). In particular, non-financial customers are found to provide liquidity to financial customers, both foreign and domestic.

Acting as intermediaries in the FX market, dealing banks have another important source of comparative advantage in the provision of interday liquidity. Financial institutions operate across asset markets with correlated returns. Naik and Yadav (2003) find that market intermediaries in U.K. bond markets actively use futures to hedge changes in their spot exposure. Drudi and Massa (2001) demonstrate that dealing banks participating in the Italian Treasury bond market exploit private information by trading in both primary and secondary markets and take advantage of differences in trade transparency between those markets. The Cao, Evans, and Lyons (2006) model can be further extended to include correlated assets. The model would allow for hedging, as well as informed speculation, across markets and over time, as long as differences existed in the speed with which order-flow information is made public.

Acting as intermediaries in the FX market, dealing banks have another important source of comparative advantage in the provision of interday liquidity.

The positions of each participant in FX spot and forward contract markets are also examined. Individual participants may use one market more than the other in their regular business operations. The statistics presented in Table 1 suggest that FD financial customers trade mostly in spot markets, while CC customers operate across both markets. The correlation between the spot and forward trade flows of market-making dealing institutions is large and negative. Dealer institutions acting as market-makers in both markets can reduce their inventory risk exposure in one market by having an offsetting position in another market.

In Chart 1, impulse-response functions associated with the positions of commercial clients and dealers in both spot and forward markets are plotted subsequent to a shock in the spot position of FD financial customers.[22] These trades are typically informative about future movements in the exchange rate. After an FD trade shock, dealers manage a short Canadian-dollar position in the spot market and a long Canadian-dollar position in the forward market.[23] The positions are not symmetrical. Dealers hold a larger negative position in the spot market. These institutions may attempt to use the information learned from FD trades in the spot market while taking a partially offsetting, or hedged, position in the forward market.

21. There is little evidence of statistically significant liquidity provision by any participant subsequent to a CB shock.

22. In line with the results presented earlier, test statistics indicate the presence of two cointegrating vectors in a specification that includes a deterministic trend in each cointegrating vector.

23. Dealing institutions use foreign exchange swaps (a combination of a spot and a forward trade) and domestic and international money market positions to hedge their exposure to exchange rate movements.

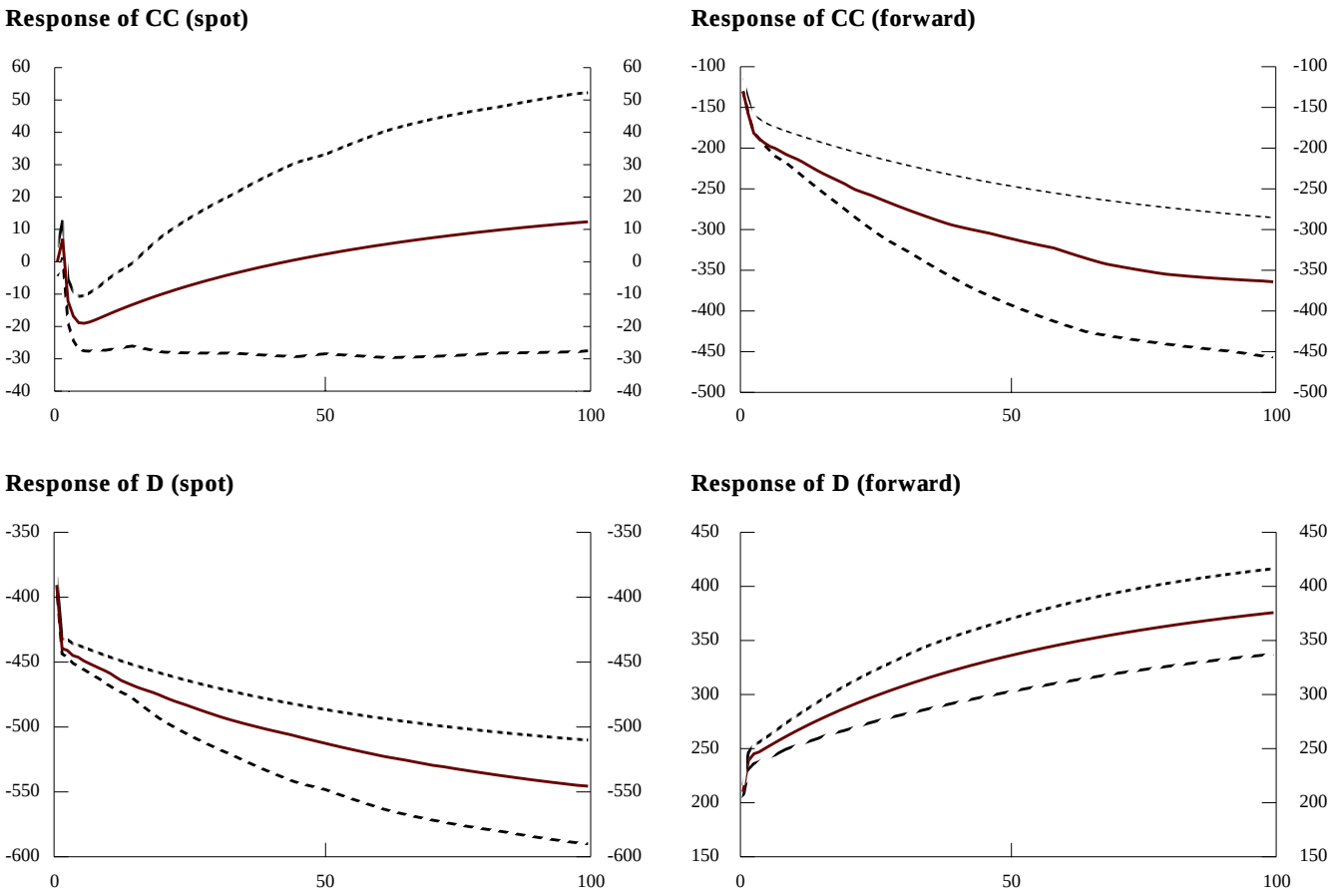
In contrast, CC customers, who are not privy to the information content of FD flows, provide ample levels of liquidity across total spot and forward markets. Over time, as dealers reduce their overall exposure, commercial clients increase their positions. In Chart 2, similar impulse-response functions are plotted subsequent to a trade shock in the spot position of CD financial customers. Results are considerably different. Dealers hold nearly offsetting positions across spot and forward markets. They sell Canadian dollars in the spot market and buy Canadian dollars in the forward market. The two positions are nearly identical in absolute value and not statistically different from zero over time. Commercial clients increasingly provide liquidity in both spot and forward markets over time.

Dealer institutions acting as market-makers in both markets can reduce their inventory risk exposure in one market by having an offsetting position in another market.

Dealers are well suited to provide interday liquidity in correlated markets. Depending on the information content of trades and the demands for liquidity in individual markets, dealers may speculate across markets while simultaneously providing liquidity.

Chart 1

Responses to an FD Shock in the Spot Market



Note: The dotted lines represent the upper and lower bounds associated with 95 per cent confidence intervals. Bootstrap methods with 200 replications are employed to calculate standard errors (Efron and Tibshirani 1993). CC = commercial-client flows; D = dealer flows; FD = foreign-domiciled investment flows.

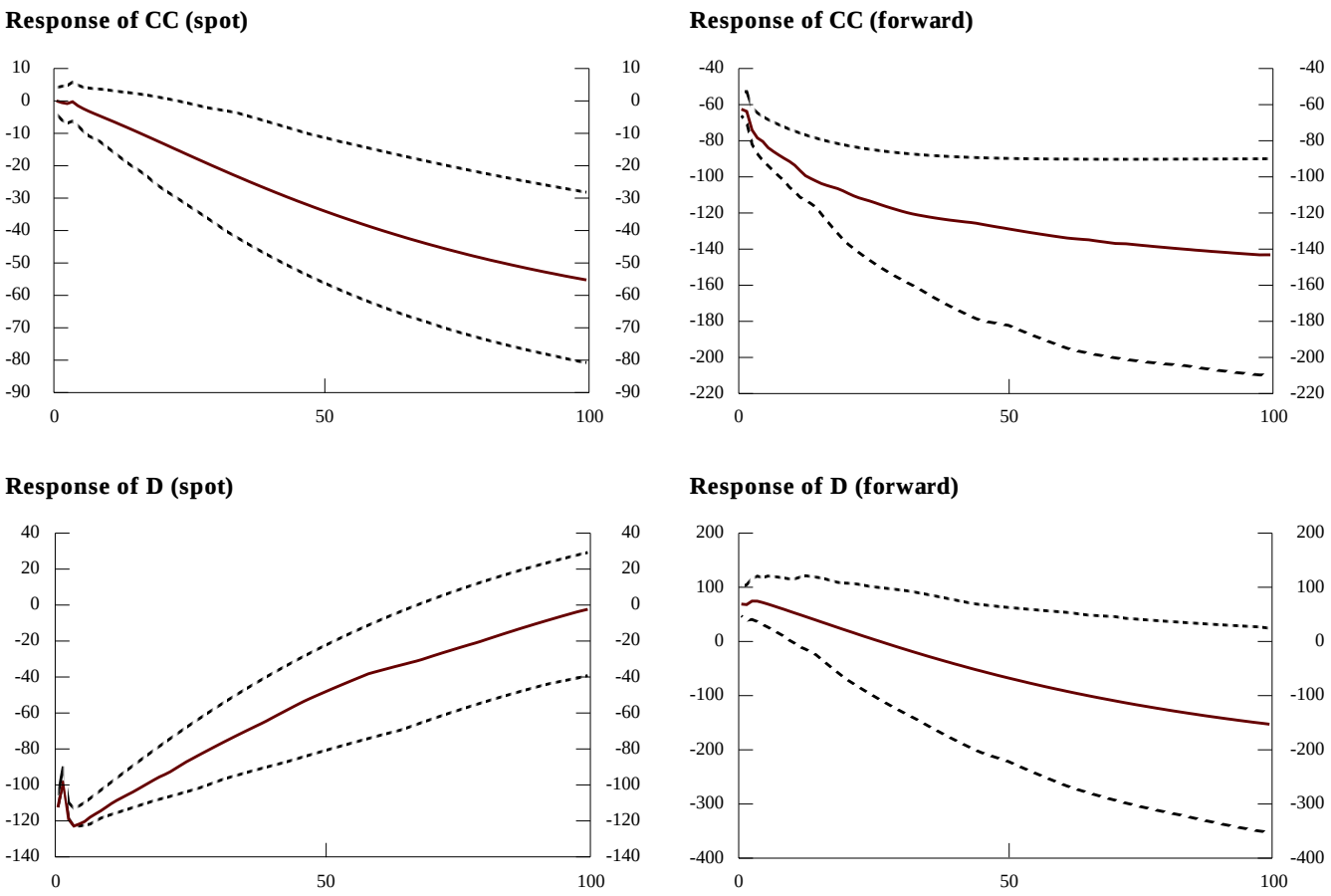
Overall, results suggest that the relationship between the positions of commercial clients and market-makers, and the role played by dealers in interday liquidity provision, has been understated. There is considerable evidence that not all customer trades are equal. In particular, market-makers are quick to provide liquidity to FD customers, possibly in an attempt to capture any fundamental information contained in these trades. Over time, dealers will off-load their positions to commercial clients as the information becomes stale, or as the risks associated with holding these undesired balances becomes too costly.

Conclusion

Our current understanding of interday liquidity provision in FX markets is incomplete. In the past, anecdotal and empirical evidence based on the datasets of individual participants has suggested that dealers in the FX market are not involved. This is not the case for Canadian financial institutions operating in the U.S. dollar-Canadian dollar market. With a finer disaggregation of trades than provided in previous research, both in terms of the types of customers that trade with dealers and a breakdown of positions across spot and forward contract markets, additional insight is gained about why, when, and how dealing financial institutions provide liquidity services.

Chart 2

Responses to a CD Shock in the Spot Market



Note: The dotted lines represent the upper and lower bounds associated with 95 per cent confidence intervals. Bootstrap methods with 200 replications are employed to calculate standard errors (Efron and Tibshirani 1993).
CC = commercial-client flows; CD = Canadian-domiciled investment flows; D = dealer flows.

Dealers use their own customer trades as a source of private information that imparts a temporary opportunity to make higher expected returns. Once the private information has been acted upon or becomes stale, dealers attempt to off-load their undesired positions to other participants in the market. Unlike domestic financial customer trades, dealers find foreign-domiciled financial customer trades to be informative about future movements in the exchange rate. Results presented in this article suggest that, when trades are more informative, dealers act more aggressively in the provision of liquidity. Consistent with Bjønnes, Rime, and Solheim (2005), there is ample evidence of a long-run relationship between the financial and non-financial customers of dealers in the demand and supply of liquidity. This article finds that market-making firms intermediate between these two participants over periods of time longer than a single day.

Taken together, these results suggest that the role of dealers in the provision of interday liquidity should not be discounted. While Bjønnes, Rime, and Solheim find support for the view that non-financial firms are the main providers of liquidity, the findings reported here suggest that dealing institutions act as interday intermediaries in the overall search process, and they may hold on to risky positions for longer periods of time than suggested by the existing literature. The overall results support arguments by Stulz (1996) and Froot and Stein (1998) that the amount of hedging will depend on a firm's comparative advantage in bearing risk. In the FX market, a dealing institution's source of comparative advantage stems not just from its capacity to bear risk, but also from its role as intermediary in the interday market and its ability to observe customer and market-wide order flow.

Dealing banks operating in the FX market have many potential sources of comparative advantage that provide them with incentives to hold risky interday positions. For example, dealing institutions have in the past negotiated bilateral quoting agreements in order to guarantee access to minimum amounts of liquidity throughout the day. Electronic trading platforms such as EBS and Reuters now provide dealers with this kind of insurance.[24] Currently, non-market-making participants in the FX market do not have direct access to these electronic brokers. Further, since financial institutions allocate risk capital strategically across correlated business lines and have a larger capital base, they may have a higher tolerance for risk than other market participants. D'Souza and Lai (2006) illustrate how market-making is influenced by the risk-bearing capacity of a dealer, which is itself determined by the amount of risk capital allocated to the activity.

24. These platforms also reduce search costs while ensuring anonymity.

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Appendix: Empirical Methodology

Many financial time series contain a unit root. In this article, for example, there is very little evidence that participant inventories or exchange rates revert to some long-run equilibrium level. If a linear combination of two or more non-stationary series is stationary, the time series are said to be cointegrated. The linear combination can be interpreted as a long-run-equilibrium relationship among the variables involved.

A vector autoregression (VAR) is a linear specification in which each variable is regressed against lags of all variables.[1] Let z_t denote the vector of variables,

$$z_t = [c_{1t}, \ldots c_{mt}, r_t], \qquad (1)$$

where c_{it} is the inventory position of the i'th customer type (where $i = 1 \ldots m$) and r_t is the exchange rate level at the close of trading on day t. The VAR specification can be written as:

$$z_t = A_1 z_{t-1} + A_2 z_{t-2} \ldots + A_p z_{t-p} + v_t, \qquad (2)$$

where p is the maximum lag length, and v_t is a column vector of serially uncorrelated disturbances with variance-covariance matrix Σ. It is possible to rewrite the VAR as a vector error-correction model (VECM):

$$\Delta z_t = \Pi y_{t-1} + A_1 \Delta z_{t-1} A_2 \Delta z_{t-2} \ldots + A_{p-1} \Delta z_{t-(p-1)} + v_t. \qquad (3)$$

Granger's representation theorem asserts that if the coefficient matrix Π has reduced rank associated with the r equilibrium relationships, then there exist matrices α and β each with rank r such that $\Pi = \alpha\beta'$ and $\beta' y_t$ is stationary. Johansen's method is used to estimate the matrix Π from the unrestricted VAR.

The VECM model captures the dynamic relationships between all variables, including any long-run relationships. Impulse-response functions represent the expected future values of z_i conditional on an initial disturbance, v_t, and can be computed recursively from equation (3):

$$E[z_{it} + z_{it+1} + \ldots z_{it+T} | v_t].$$

The long-run impact of a shock in each type of customer trade on cumulative exchange rate returns is a measure of the information content of that customer trade. The effect of a trade shock initiated by customer type j on customer i's FX position provides a summary estimate of the degree to which participant type i is a liquidity provider to j over time:

$$E[c_{it} + c_{it+1} + \ldots c_{it+T} | v_{jt}].^{2}$$

1. See Hamilton (1994) for a complete discussion.

2. Generalized impulse-response functions are calculated (Pesaran and Shin 1997).