The Future of the Foreign Exchange Market

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Abstract

This paper addresses the future of the foreign exchange market using two organizing (and provocative) ideas. One pertains to the market's institutional structure, the other to its information structure. The first organizing idea is that the structure of currency markets is driven primarily by the management of credit risk. This contrasts with drivers identified by microstructure theory (such as management of market risk, attenuation of asymmetric information, and entry barriers). The second organizing idea is that price variation in spot currency markets is driven primarily by dispersed information. This too contrasts with the orthodox view, under which exchange rates are determined from public information. Though provocative, these two ideas are vital to understanding this market's future. Based on drivers of the market's current structure, I propose three scenarios for future evolution. The scenario I consider most likely is one in which the current dealer structure is maintained through dealing banks' cross-subsidizing their liquidity provision using gains from superior order flow information.

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The Future of the Foreign Exchange Market

This paper addresses the future of the foreign exchange market using two organizing (and provocative) ideas. At the risk of jumping the gun, let me state them right off:

(1) Market Structure: Current organization of the largest spot currency markets is driven primarily by the management of credit risk, as opposed to drivers identified in microstructure theory (such as management of market risk, attenuation of asymmetric information, and entry barriers).

(2) Information Structure: Price variation in spot currency markets is driven primarily by dispersed information, as opposed to the orthodox assumption of public information.

Both ideas are vital to understanding the foreign exchange (FX) market's future evolution, as I shall endeavor to show.

Consider the first of these ideas and why I consider it provocative. (Whether it is true is addressed in the following section.) This requires some perspective on the field of microstructure finance. Market design is a central issue within this field, and, importantly, it is through the lens of microstructure finance that people address questions of market structure. Yet the field pays little attention to credit risk. It is focused instead, broadly speaking, along three main lines. The first line, predating even the "microstructure" label, borrows liberally from the field of industrial organization; emphasis in this line is on marketmaker cost structures, departures from perfect competition, and barriers to entry. The second line emerged in the 1970s and focuses on how marketmakers manage market risk (referred to as the inventory control). The third line emerged in the 1980s and focuses on how marketmakers respond to informational disadvantages (the asymmetric information line).[1] Given the field's structure, it is not surprising that researchers have looked for drivers of structure along these three lines. In none of them does credit risk play a central role, however, leaving management of credit risk largely overlooked.[2]

Consider now the second of the two organizing ideas and why it too is provocative. Every macroeconomic model in the vast literature on exchange rates

[1] For the first line see, e.g., Demsetz (1968) and more recently Domowitz and Steil (1999). For the second line see, e.g., Garman (1976), Amihud and Mendelson (1980) and Ho and Stoll (1981). For the third line see, e.g., Kyle (1985) and Glosten and Milgrom (1985).

[2] An exception in the broader microstructure literature is work on futures market clearinghouses (and more recent work on central counterparties; see, e.g., Moser 2000). But even in this case the focus is more on how an effective clearinghouse should be structured, as opposed to whether trading should take place with auctions or dealers. To my knowledge, credit risk has never been considered in the literature as a driver of the spot FX market's dealership structure, or as a driver of dealership structure in general for that matter.

is set within a rather special information environment, namely, one characterized by the presence of public information only. In these models, exchange rates are determined from public arrival of macroeconomic news (about interest rates, inflation rates, etc.). Because this information is publicly available, the trading process (or more specifically, order flow) is not needed to induce price movement—this information is impounded in price directly and instantaneously.[3] Ask a macroeconomist whether he believes there is private information in the foreign exchange market and he will answer no. What he probably has in mind is inside information about future variables, like interest rates, in the hands of one or a few individuals ("concentrated" private information). For everyday functioning of FX markets, this type of information is not terribly plausible, which makes private information models of FX trading naturally provocative. It is only when one considers another, complementary type of non-public information, namely dispersed information (about, for example, imports/exports, hedging demands, or risk preferences) that the notion of information aggregation in FX markets becomes less provocative.

Addressing the FX market using these two organizing ideas has several advantages. First, it allows a framing of the future-of-FX-markets question as something larger than a purely micro-institutional question. This is not to suggest that the institution dimension is not important in its own right. But macroeconomists (i.e., most people working in exchange rate economics) consider the institutional future of the FX market rather uninteresting. By introducing the second idea we can link both perspectives—micro and macro. Second, when the two ideas are treated jointly, one can appreciate their strong interaction. A later section of the paper addresses this "synthesis" and its implications for the future. Finally, these two organizing ideas provide a basis for understanding how FX markets differ from equity markets. This is valuable, particularly in a volume like this, since equity markets garner the lion's share of attention in discussions of the future of securities markets.

Though organizing this paper around two core ideas has advantages, it naturally also has some disadvantages. Importantly, though the two ideas allow a deeper drilling into key issues, they also limit the paper's scope. I will not address, for example, the issue of exchange rate regimes (e.g., floating rates versus currency unions versus some type of pegging regime in between). I am therefore abstracting from any policy effects on currency market structure that might arise from advances in our understanding of optimal currency regimes.[4] Another topic relevant to the future of currency markets is the growing importance of derivatives, particularly currency swaps. Here too my treatment is only tangential (for more, see BIS 1999 and BIS 2002).

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[3] The term order flow refers to signed transaction volume (e.g., a seller-initiated trade takes a negative sign). Within microstructure theory, order flow is the vehicle through which dispersed information is impounded in price. A large empirical literature verifies that signing trades based on the initiating direction has significant explanatory power for security returns (including equity markets, bond markets, and FX markets). See, e.g., the overview in Lyons (2001).

[4] These effects involve more than effects on return distributions in moving from fixed to floating rates (or vice versa). They also involve, for example, the effects on marketmaker hedging opportunities due to the disappearance of currencies (e.g., from currency unions; see Killeen, Hau, and Moore 2001).

Before moving on I should recognize that my use of the term "the" foreign exchange market is a rather sweeping generalization. There are in fact many different submarkets at work. For example, markets for developing-country currencies are often organized quite differently than the largest markets against the U.S. dollar (e.g., the euro, yen, Swiss franc, and pound sterling). Markets for fixed-rate currencies behave quite differently than markets for floating-rate currencies. Spot markets are typically organized differently than derivatives markets. And markets for trades between marketmakers (interdealer trades) are organized differently than markets for trades between marketmakers and (non-marketmaker) customers. This paper focuses on the largest spot markets, all of which involve currencies that float against the dollar. The reason for focusing on spot rather than derivatives markets is that it is in the spot market where most of the major currency trading and price discovery occurs (Evans and Lyons 2002).[5]

The remainder of the paper is organized in four sections. Section 1 makes the case for the first of our two organizing ideas—that the management of credit risk is crucial to understanding of currency market structure. Section 1 also constructs three scenarios based on the identified structural drivers. Section 2 makes the case for the second of our two organizing ideas—that variation in exchange rates is caused by the market arrival of dispersed information. Section 3 synthesizes the two organizing ideas and addresses implications of that synthesis. Section 4 provides concluding thoughts.

1. Organizing Idea One: Market Structure and Credit Risk

Before addressing future scenarios for currency market structure, let me first review the FX market's current institutions and how they have changed over last 10 years. The spot FX market is a decentralized (i.e., over the counter) dealership market with three participant types: customers, dealers, and inter-dealer brokers (IDBs).[6] The largest markets (e.g., $/€ and $/¥) trade through the full 24-hour day, though liquidity and trading volume vary across the day depending on the timing of the trading day in the three largest trading centers (London, New York, and Tokyo).[7] Volume on the largest spot market ($/€) is about $200 billion per day (BIS 2002). This total splits into three basic transaction types: customer-dealer trades, direct interdealer trades, and brokered interdealer trades.[8] In the latter half of the 1990s, the shares in total trading of these three

[5] Note too that in FX there is a pronounced transactions motivation (i.e., importing and exporting) for spot FX transactions relative to derivatives transactions.

[6] IDBs in FX markets play the same role as IDBs in other dealership markets (e.g., most bond markets). IDBs take no positions on their own account. Think of them rather as a bulletin board on which dealers can post firm quotes to other dealers on an ex-ante anonymous basis. In current FX markets these bulletin boards are now largely electronic.

[7] The most liquid period is the overlap between the London afternoon and the New York morning. The least liquid period is the hours between the end of the New York afternoon and the start of the Tokyo morning.

[8] Direct interdealer trading is trading initiated by one dealer calling another for a bilateral quote (i.e., the quote is unavailable to other dealers, which distinguishes it from a quote posted to an IDB).

transaction types were roughly 1/3, 1/3, and 1/3. Over the last couple of years, however, there has been a sharp shift in the two interdealer segments toward brokered trading and away from direct trading. Current estimates suggest that brokered interdealer trading has moved from half of interdealer trading to three quarters, and maybe more (see BIS 2001), putting current segment shares around 1/3, 1/6, and 1/2, for the customer-dealer, direct interdealer, and brokered interdealer trades, respectively.

This migration from direct interdealer trading to brokered interdealer trading is the most significant structural shift in this market over the last 10 years, so it deserves more attention. The underlying factor that precipitated the shift is the shift from voice-based IDBs (which broadcast dealer quotes orally over intercoms at dealers' desks) to electronic IDBs (which broadcast dealer quotes on screens). The underlying shift from voice to electronic IDBs occurred rather rapidly in the mid 1990s—the voice brokers could not match the liquidity provided by the electronic entrants (the electronic entrants being two different systems, one called EBS and the other called Dealing 2000-2). It was not until the late 90s, however, that the electronic IDBs began to take significant market share away from direct interdealer trading.

Despite the unchanging customer-dealer share in total trading of about 1/3, there have been developments in trading within this segment as well. The first development, which arose in earnest in the late 90s, was the offering of transaction services by new entrants in the form of crossing networks and, in some cases, open limit-order-book auctions.[9] The second development was a response to the first: the top dealing banks (e.g., Citibank, Deutschebank, J.P. Morgan Chase) retaliated by offering their larger customers a single screen on which firm quotes from all the participating banks would be posted, obviating the need for customers to shop for quotes bank by bank. The upshot is that the collective market share of the new entrants in the customer-trade segment is still quite small (less than 10 percent). At the same time, the share of customer trading over the Atriax system is also quite limited (based on conversations with dealing banks).

Auction Versus Dealer Markets

With the current structure of the spot markets described, let us turn to microstructure theory for guidance on the two basic market structure types and the circumstances under which one structure might be preferred over the other. As noted in the introduction, market design is a central issue within this field. Though microstructure finance has three main lines, most work on market design over the last ten years has focused on the asymmetric information line. (Recall

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Virtually all trades of this type in the major spot markets are executed using an electronic system called Dealing 2000-1 (Reuters).

[9] A crossing network does not determine the execution price from within its system, instead batching orders and executing them at prices determined elsewhere in the market. In a limit-order-book auction, sometimes referred to as a two-sided auction, execution price determination does occur within the system. These new entrants in the FX market included FXchange, FXconnect, Gain.com, and MatchbookFX.com. For more on the advent of electronic customer trading in FX, see Euromoney (2000). For equity markets, Institutional Investor (2000) is a nice treatment of the electronic-trading threat to more traditional trading methods.

that the three lines are the industrial organization line, the inventory control line, and the asymmetric information line.) Accordingly, I pay particular attention to how the two basic market structures differ in terms of the efficiency costs of asymmetric information. The inventory control line also provides powerful logic relevant for contrasting auction and dealer markets, so I touch on this line briefly below as well.

The presence of asymmetric information has its most acute efficiency implication in the dimension of market resiliency. By resiliency, I refer to a market's ability to withstand shocks of various types without undue reduction in trading opportunities and liquidity.[10] It has long been known that asymmetric information, when extreme, can cause a market to break down, in the sense that no trading takes place. This was first demonstrated in Akerlof's classic paper on the used car market (the market for "lemons"). The same type of market breakdown can occur in models of financial exchange.[11] Many authors have shown, however, that trading under an auction structure can still occur at times when dealership trading breaks down. The intuition has to do with the enhanced sharing of exposure to asymmetric information that occurs under an auction structure. Under a dealership structure, the quoting dealer alone faces the cost of trading with someone better informed, whereas under the auction structure, exposure to the adverse selection in individual trades is not borne by a single individual.[12]

The inventory control line from microstructure also provides a logic for preferring auction structures to dealer structures, particularly when flows are large. The reason is the following: Dealer structures tend to concentrate market risk in the hands of relatively few agents, at least temporarily. (Temporarily for FX dealers means intraday because spot FX dealers generally close their positions at the end of each trading day.) In contrast, auction markets facilitate more immediate sharing of market risk over a wide range of participant types.[13]

Puzzle of FX Dealership Structure

Why, given the nature of FX (relatively little asymmetric information and large, liquidity-motivated flows), should the FX market be organized as a dealership market? It appears to have precisely the characteristics that would make a

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[10] Consider, for example, the disruption of FX markets (particularly the $/¥ market) in October 1998, following the collapse of the hedge fund Long Term Capital Management. In a single day, the yen price of a dollar fell from above 130 to below 120 and trades were still being executed even with bid-ask spreads over twenty times their typical size (one yen versus a typical width around 0.03 yen).

[11] The lemons paper is Akerlof (1970). On market breakdowns in financial markets see, e.g., Bhattacharya and Spiegel (1991) and the paper on "no-trade" theorems by Milgrom and Stokey (1982).

[12] For a theoretical treatment of whether centralized limit-order structures are likely to capture liquidity and thereby dominate trading, see Glosten (1994). That paper, like the literature generally, does not address the focus of my analysis, namely credit risk.

[13] The literature on auction versus dealer markets focuses on asymmetric information more than inventory control largely because dealers in models with asymmetric information are assumed to be risk neutral, so welfare effects of risk concentration are not present (in contrast to the importance of risk concentration in actual markets). This, I believe, is something of an oversight in the literature that derives from the technical convenience of assuming risk neutrality.

two-sided (limit-book) auction a welfare-dominating trading structure, at least from the perspective of FX customers.

Before addressing this question directly, it is useful to recall that while the FX market is organized as a dealership market from the perspective of FX customers, interdealer trading occurs two ways: under a dealership structure (direct trading) and under an auction structure (brokered trading). Competing mechanisms for trading are common in many financial markets (e.g., the electronic limit-order books—called ECNs—that compete in the U.S. with Nasdaq dealers). It is interesting to note that in both the case of Nasdaq stocks and interdealer FX, the auction structure has been winning significant market share from the dealership structure. (This tends to be true across security types—stocks, bonds, and FX, though there are certainly exceptions.) If auction trading in the interdealer FX market is winning over dealership trading, should we expect that the current two-stage structure of the FX market will give way to a one-stage auction structure, where participants—including what we currently call customers—provide one another liquidity on an equal footing?

Enter Counterparty Credit Risk

There are two important features of the FX market that I have not yet presented, both of which are important for constructing future market scenarios. First, relative to other security markets, in FX the key players (dealers) are all commercial banks, not investment banks. In bond and equity markets the top banks are names like Goldman Sachs, Salomon Brothers, and Merrill Lynch. These banks are all small players in FX next to commercial banks like Citibank, Deutschebank, and J.P. Morgan Chase. (True, the distinction between commercial and investment bank is increasingly blurred, but no one would argue that Goldman Sachs, Salomon Brothers, or Merrill Lynch have commercial banking operations that rival Citibank, Deutschebank, and J.P. Morgan Chase.)

The second important feature not yet presented is the importance of counterparty trading limits ("credit lines") in FX.[14] Even the largest banks will at times be unable to trade with one another because they have exhausted their bilateral credit lines. For smaller banks, credit lines between banks for FX trades are often not large enough to accommodate even a medium-sized individual trade. This is true for both direct and brokered interdealer trading. (Indeed, the screens of electronic FX brokers already have this network of bilateral credit lines programmed in: the screen shows each individual dealer both the best bid and offer prices in the whole system and the best bid and offer currently available to him. For smaller banks the gap can be significant.)

An important factor, then, in considering whether current FX customers would want to participate in an auction market (with all participants on equal footing) is whether they would be willing to assume the counterparty credit risk arising from trading bilaterally with other customers. Banks themselves are very

[14] Spot FX trades are generally settled two days forward, so a FX trade in practice involves a bilateral extension of credit. This is why banks are so careful to manage these bilateral trade limits (for prudential reasons as well as regulatory reasons). I will not go into the specifics as it takes us too far afield.

careful not to do this without managing the attendant exposures carefully. Non-financial institutions, or even financial institutions like pension funds, hedge funds, and mutual funds, are in general quite averse to assuming such risk. True, these institutions are familiar with trading currency futures, for which clearing-houses have been designed to mitigate this risk. But a clearinghouse system of sufficient size to handle the worldwide spot market and at the same time offer flexible access is unlikely to be economically practicable given the different national legal jurisdictions and concomitant legal risk.

Commercial banks, on the other hand, are particularly well suited to play this role. They have developed significant relationship capital in their links to institutional customers. Indeed, there is a long line of research in corporate finance based on banks' comparative advantage in monitoring the credit-worthyness and performance of their corporate customers (see, e.g., Allen and Gale 1997). This relationship capital, together with banks' expertise in managing credit risk, gives them an advantage that is, in my judgment, the key driver of the current bank-intermediated dealership structure.[15] It contributes substantially to bank dealers' ability to compete with the new, auction-based alternatives recently offered to FX customers by new entrants.[16]

Future Scenarios

With the above as background, let me offer three scenarios for the future of FX institutions. These three scenarios are not only the most likely (in my judgment), when considered jointly they also highlight the competitive forces at work. The time frame I have in mind is 10 years, roughly matching the time frame of my review above of institutional change in the 90s.

Future 1: Emergence of a centralized auction due to unbundling liquidity provision and credit-risk management.

Most readers of the previous paragraphs will have realized that banks are providing (at least) two distinct services when fulfilling their dealership function and that these services need not be bundled. Those two services are liquidity provision (i.e., low transaction costs) and counterparty credit-risk management.[17]

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[15] An important source of this expertise in managing credit risk may be banks' management of their own credit risk portfolios. Some have suggested that this credit management advantage may also stem from government guarantees in the commercial banking sector. For a theoretical paper that addresses whether two-stage structures (with bank dealers as the first stage, like in FX) might dominate a single-stage auction structure, see Viswanathan and Wang (1998). Their model does not include credit risk, so the tradeoffs they consider are the more traditional tradeoffs involving asymmetric information and inventory control.

[16] Another important factor that puts the new auction-based entrants at a disadvantage is the classic one: they lack sufficient scale to benefit from the network externalities inherent in concentrating liquidity. My own view is that the credit-risk factor is the more primitive: if it were not present then the network externalities would be much more easily achieved.

[17] Though less fundamental than these two basic services, there is a third service that dealing banks suggest is important to their customers—what I will call "transaction management." This includes advising customers on how to time trades to reduce execution costs and how to reduce the risk of

As has been happening across the banking industry for decades, unbundling is a viable alternative. Under this scenario, FX customers (and former dealers) would provide one another liquidity within a centralized auction structure. At a scale sufficient to benefit from network externalities in liquidity, this structure should have a comparative advantage in providing liquidity, both during normal market states and during times of market stress (resiliency). At the same time, all bilateral deals struck within this auction-market structure would then be routed through commercial banks who act as legal counterparties to both sides of the transaction (and are paid for the service). In principle, this arrangement concentrates provision of the separate services where comparative advantage is highest.[18]

Future 2: Continuation of dealer market with banks cross-subsidizing their disadvantage in liquidity provision (relative to the centralized auction with full network effects).

The top dealing banks have a vested interest in maintaining the current dealer structure. One way to do so is to keep customer transaction costs at such a level that auction-based alternatives are unable to establish a significant foothold, and are therefore unable to develop the network effects for lower-cost liquidity provision. Indeed, for the major currency markets, this second scenario is already emerging: bid-offer spreads are so razor thin—even those extended to customers—that currently banks are making little money directly from intermediation.

But if banks are making little money, why are they so adamant about hanging on to the liquidity-provision part of the business? Why not just let Future 1 play itself out? The answer lies in the *indirect* profitability of FX liquidity provision. Banks—particularly the largest FX banks—now recognize an important additional source of indirect profits from intermediating flows, namely their ability to exploit information contained in those flows. Indeed, one of the factors that is depressing spreads so much for the largest, most coveted customers is the intense bidding for this flow information by dealing banks. The banks are, in a very real sense, investing in flow information by cross-subsidizing their comparative disadvantage in liquidity provision. (Note that this investment in informative orders is exactly the opposite story from the literature on so-called "payment for order flow"—in that literature dealers are paying to receive the *uninformative* orders, not the informative orders.)[19] The indirect profit derived from this flow information comes from two separate business models. The first is what one

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transaction cost overruns. Whether this service contributes substantially to the current dominance of the dealership structure remains to be seen. (After all, this service, too, can be unbundled and priced separately.)

[18] The immanence of this scenario for FX is suggested by a recent development in the U.S. bond market. In June of 2000, three investment banks (Goldman Sachs, Merrill Lynch, and Morgan Stanley Dean Witter) announced that they will launch an electronic auction system open to customers (for both government and corporate bonds). The current structure of the U.S. bond market shares many characteristics with FX markets. Though several equity and derivatives markets have already shifted to a centralized electronic auction, those markets do not share the same FX-market characteristics that the bond markets share, and are therefore not as appropriate as models.

[19] See, e.g., Kandel and Marx (1999).

would expect, namely proprietary trading. The second, less obvious business model involves banks' advisory business. Given the known horrible performance of macro models over horizons less than two years, advisory products based on public macroeconomic information have become an unattractive "commodity" business. But offer your customers advisory services based on proprietary order-flow data and the product suddenly becomes distinctive.[20]

Future 3: Emergence of centralized auction due to the opening of IDBs (e.g., EBS) to customers.

Futures 1 and 2 have already been set into motion. At present, Future 1 does not appear to be winning out, in part due to top-bank initiatives like Atriax and in part due to aggressive pricing of liquidity provision (as in Future 2). Nevertheless, if the top dealing banks sensed a Future-1 victory, in spite of their best efforts to encourage Future 2, I do not believe that Future 1 would be allowed to predominate. Almost surely, faced with such a threat the top banks would choose to open the dominant interdealer broker (EBS, which they own) to customers. This system would likely gather network effects very quickly. The customer relationships are there: the banks that own EBS are the same banks that have customer relationships via their dealing services. The technology is not a major hurdle: one could ape the auction technology that has been developed in the U.S. bond market for secondary-market customer trading (see footnote 17). From the EBS perspective, it would be essential to maintain the network liquidity effects in its favor—if the market were going in the direction of centralized customer trading, EBS could not afford to wait.[21]

2. Organizing Idea Two: The Role of Dispersed Information

An understanding of why FX order flow is "informative" is crucial for understanding the economic forces behind Future 2 (in which dealing banks are investing in flow information). This section is designed to provide that under-

[20] It is tempting to argue that this information would still be available to banks under Future 1 because they would still be privy to the trade and its particulars (via their ultimate role as legal counterparty). I find this uncompelling for two reasons. First, banks would find it difficult under Future 1 to maintain their existing FX customer bases purely on the basis of pricing the credit-risk management fee (i.e., existing relationship capital would be destroyed). Second, though banks would surely have access under Future 1 to trade details like size and price, they would not have access to other relevant information that they rely on when using order flow information (e.g., whether the transaction was an outright transaction or part of a swap).

[21] Though a conjecture, my own view is that Future 3 has served as an entry deterrent for start-up firms interested in seeing customer FX trading via a centralized auction: knowing that EBS has this business option makes launching a new centralized auction system much less attractive. At the same time, a countervailing factor deserves note, one that might retard EBS's competitive response to increasingly centralized customer trading. That is the fact that EBS is mutually owned by the top dealing banks. In other securities markets it appears that demutualization of trading mechanisms was an important precondition for strategic responsiveness (see Steil 2001).

standing. Before turning to the information environment within which currencies are traded and determined, however, let us take a step back for some perspective on our current knowledge of why exchange rates behave the way they do. Perhaps most informative in this respect is the kind of overarching perspective provided by recent surveys of exchange rate economics. Consider, for example, a quote from the *Handbook for International Economics*, an important reference for the field. In their survey for the handbook, Frankel and Rose (1995) write, "To repeat a central fact of life, there is remarkably little evidence that macroeconomic variables have consistent strong effects on floating exchange rates, except during extraordinary circumstances such as hyperinflations. Such negative findings have led the profession to a certain degree of pessimism vis-à-vis exchange-rate research." This is strong stuff indeed. All the more so given the nature of the publication and the consensual editorial process that underlies handbook surveys. Yet, as strong as it is, few researchers working on exchange rates would take issue with it.

Conceptual Room for Dispersed Information in FX Markets

For most financial economists, information comes in two forms, public and private. I would like to provide a bit more granularity to the private information category to help make conceptual room for the idea that types of private information in FX do exist. Specifically, private information can be split into the following 2x2 classification:

Private Information: A 2x2 Classification

	Payoffs	**Disc. Rates**
Concentrated		
Dispersed		

When people claim that private information in the FX market does not exist, they have the upper left-hand cell of this diagram in mind. (Payoffs in the case of a stock are the dividends, which in FX includes the interest differential; they are the "numerators" in discounted cash flow models of valuation. By concentrated, I mean information in the hands of one or a few individuals.) Indeed, it is hard to imagine concentrated inside information about future interest-rate movements ever manifesting as trading activity in the major FX markets.

The lower right-hand cell is where the action is likely to be in FX markets. (Information about discount rates—or "stochastic discount factors" to use the terms of modern asset pricing—relates to any variables that determine risk

premia.) This would include dispersed information about, for example, participants' risk aversions, hedging demands, money demands, or even transaction demands (all of which would affect the equilibrium exchange rate in traditional portfolio-balance models of risk premia).[22]

To reframe the issue, consider the following question: Does the foreign exchange market aggregate information? Surely it does: so many of the variables that drive pricing are dispersed throughout the economy. Indeed, aggregating dispersed information is one of asset markets' central functions.[23] Yet models of exchange rate determination abstract completely from information aggregation. These models (e.g., monetary models, portfolio balance models, new open-economy macro models) posit an information environment in which all relevant information is publicly known. This approach is sensible if the abstraction misses little, i.e., if dispersed information is rapidly summarized in the public macro variables we rely on to estimate our models. Only recently has this common assumption received any attention.

Recent empirical work on exchange rates using what I call the "dispersed information approach" has enjoyed some success. This work relies on micro models of how, specifically, asset markets accomplish information aggregation. When coupled with the poor performance of public information models, these positive results imply that the above assumption—that dispersed information is rapidly summarized in public information—is dubious.

Order Flow: An Information Aggregator

When one moves from the public information approach to the dispersed information approach, a variable that plays no role in the former takes center stage: order flow. Understanding it is essential for appreciating how the dispersed information approach departs from the public information approach. Order flow is transaction volume that is *signed* (making it quite different from conventional, unsigned volume). For example, if you approach a dealer (marketmaker), and you decide to sell the dealer 10 units (shares, euros, etc.), then transaction volume is 10, but order flow is –10. Order flow takes a negative sign because you—the initiator of this transaction—are on the sell side. The quoting dealer is on the passive side.[24] (Trades are signed according to the active, or initiating side.) Over

[22] For a survey of the portfolio balance approach to exchange rates, see Branson and Henderson (1985).

[23] Nobel laureate Friedrich Hayek (1945) provides an early and powerful articulation of this point: "the problem of rational economic order is determined precisely by the fact that knowledge of the circumstances of which we must make use never exists in concentrated or integrated form, but solely as dispersed bits of incomplete and frequently contradictory knowledge which all the separate individuals possess. The economic problem of society is thus a problem of the utilization of knowledge not given to anyone in its totality."

[24] Measuring order flow is slightly different when trading takes place in an auction market (e.g., a "limit-order book") rather than through dealers. (An example of a limit order is "buy 10 units for me if the market reaches a price of 50.") Limit orders are collected in an electronic "book" and the most competitive of those orders define the best available bid and offer prices. When measuring order flow, limit orders are the passive side of any transaction, just as the quoting dealer is always on the passive side when trading involves dealers. When orders arrive that require immediate execution (e.g., an order

time, order flow is measured as the sum of signed buyer-initiated and seller-initiated orders. A negative sum means net selling over the period.

Order flow is a variant of another important term, "excess demand." It is a variant rather than a synonym for two reasons, the first relating to the "excess" part and the second relating to the "demand" part. For the excess part, note that excess demand equals zero in equilibrium by definition—there are two sides to every transaction. This is not of true order flow: in markets organized like foreign exchange, orders are initiated against a marketmaker, who (if properly compensated) stands ready to absorb imbalances between buyers and sellers. These "uninitiated" trades of the marketmaker drive a wedge between the two concepts, excess demand and order flow.[25] The second reason the two concepts differ is that order flow is in fact distinct from demand. Order flow measures actual transactions, whereas demand shifts need not induce transactions. For example, the demand shifts that move price in traditional exchange rate models (e.g., monetary models) are caused by the flow of public information, which moves rates without transactions ever needing to occur.

Order Flow and Exchange Rates Over Long Horizons

If order flow information were valuable to dealing banks only over very short horizons (e.g., intraday), then it would be hard to make a strong case for their interest in maintaining Future 2 by investing in this information. Though it is common to associate "microstructure analysis" with "high frequency," the association is deceptive. It is true that empirical work in microstructure finance is generally high frequency. But this does not imply that microstructure models are irrelevant to exchange rates at lower frequencies. Indeed, there are ample tools within the micro approach for addressing lower-frequency phenomena. And new tools continue to emerge, thanks in part to recognition within the broader microstructure literature that resource allocation warrants greater attention.

Regarding long-lived effects, recognize that when order flow conveys information, its effect on price *should* be long-lived. Indeed, a common assumption in empirical work for distinguishing information from pricing errors is that information's effects on price are permanent, whereas pricing errors are transitory (French and Roll 1986, Hasbrouck 1991). These long-lived effects are borne out in the data, in equity markets, bond markets, and FX markets. In FX, for example, Evans (1997), Evans and Lyons (2002), Payne (1999), and Rime (2000) show that order flow has significant effects on exchange rates that persist. Indeed, statistically these effects appear to be permanent (or at least very persistent). Among long-lived implications that can be addressed using microstructure models, this "information" channel is definitely the most fundamental.

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to "sell 10 units now at the best available price), these orders—called market orders—generate the signed order flow.

[25] In rational expectations (RE) models of trading, order flow is undefined because all transactions in that setting are symmetric. One might conclude from RE models that one could never usefully distinguish the "sign" of a trade between two willing counterparties. A large empirical literature in microstructure finance suggests otherwise (see the discussion in Lyons 2001).

An analogy may be helpful. The dispersed information approach may speak to longer-horizon exchange rates in much the same way that microscopes speak to pathologies with macro impact. In medicine, microscopes provide resolution at the appropriate level—the level at which the phenomenon emerges. This is true irrespective of whether the phenomenon also has macro impact. Resolution at this level is the key to our understanding. Similarly, tools from the dispersed information approach provide resolution at the level where its "phenomenon" emerges—the level where price is determined. What information do dealers have available to them, and what are the forces that influence their pricing decisions? (Whether we like it or not, it is a stubborn fact that in the major currency markets, *there is no exchange rate other than the price these people set.*) Answering these questions does indeed help explain exchange rates over longer horizons, as the next section shows.

Applying Microstructure Analysis to Exchange Rate Puzzles

To be a bit more concrete about these lasting order flow effects on exchange rates, let me review how order flow analysis has been used to address the biggest of the exchange rate puzzles—the determination puzzle.[26] The determination puzzle is the finding noted above that exchange-rate movements are virtually uncorrelated with concurrent macroeconomic fundamentals (at least over periods of less than about two years). This section addresses the determination puzzle by reviewing the approach and empirical results in Evans and Lyons (2002). Before describing their model, let me address two front-end considerations in modeling strategy. First, the determination puzzle concerns exchange-rate behavior over months and years, not minutes. Yet most empirical work in microstructure finance is estimated at the transaction frequency. The first order of business is to design a trading model that makes sense at lower frequencies. Several features of the Evans-Lyons model contribute to this (as will be noted specifically below, as the features are presented). Second, because interdealer flow is more transparent than customer-dealer order flow, it is more immediately relevant to FX price determination. The hybrid model should reflect this important institutional fact.

Evans-Lyons Model: A Sketch

Consider an infinitely-lived, pure-exchange economy with two assets, one riskless, and one with stochastic payoffs representing foreign exchange. The daily payoff on foreign exchange (i.e., interest differential), denoted R_t, is composed of a series of increments, so that

[26] Within international finance more broadly, there are four main puzzles: the determination puzzle, the "excess volatility" puzzle, the "forward bias" puzzle, and the "home bias" puzzle. (Forward bias refers to conditional bias—potentially due to a risk premium—in forward exchange rates, whereas home bias refers to investors under-investing internationally.) For applications of the dispersed information approach to these other puzzles see Lyons (2001). Note too that these four puzzles have analogues in other securities markets (for equities, see Roll 1988, Shiller 1981, Mehra and Prescott 1985, and Coval and Moskowitz 1999, respectively).

(1) $R_t = \sum_{t=1}^{t} \Delta R_t$ Fundamentals (daily FX payoff)

The increments ΔR_t are i.i.d. Normal$(0, s_R^2)$ and represent the flow of public macroeconomic information. For concreteness, one can think of this abstract payoff increment ΔR_t as changes in interest rates. Daily payoffs are realized at the beginning of each day t.

The foreign exchange market is organized as a dealership market with N dealers, indexed by i, and a continuum of non-dealer customers (the public). Dealers and customers all have identical negative exponential utility (constant absolute risk aversion). Within each day there are three rounds of trading:

Round 1: dealers trade with the public.
Round 2: dealers trade among themselves to share risk.
Round 3: dealers trade again with the public to share risk more broadly.

By assumption in this model, dealers hold positions only within the day; by the end of the day dealer positions are fully shared economy-wide (an assumption that squares well with reality).[27] The timing within each day is summarized in Figure 1.

The following six equations provide a compact summery of the model, where superscripts refer to rounds:

(2) $C_{it}^1 \sim \text{Normal}(0, s_C^2)$ Customer portfolio shift, round 1

(3) $C_t^1 \equiv \sum_{i=1}^{N} C_{it}^1$ Aggregate round-1 portfolio shift

(4) $C_t^3 = g\, E\left[\Delta P_{t+1}^3 + R_{t+1} \middle| \Omega_t^3\right]$ Agg. demand, round 3 (derived)

(5) $C_t^1 + C_t^3 = 0$ Market clearing, day t

(6) $T_{it} = a\, C_{it}^1$ Interdealer trade rule (derived)

(7) $X_t = \sum_{i=1}^{N} T_{it}$ Observed interdealer order flow

At the beginning of each day (round 1), each dealer receives a customer-order realization C_{it}^1 that is executed at his quoted price, where $C_{it}^1 < 0$ denotes a customer sale (dealer i purchase). Each of these N customer-order realizations is

[27] For evidence that FX dealers typically hold positions only intraday, see Lyons (1995) and Yao (1998).

distributed normally, per equation (2), and they are uncorrelated across dealers. Importantly, the C_{it}^1 realizations are not publicly observable. Equation (3) simply defines the aggregate customer demand in round 1 as the sum of the random customer orders received by the N dealers.

These round 1 customer orders are at the core of the model. Their realizations represent dispersed private information because each is observed only by the dealer who receives it and because each will have an effect on the market-clearing price. This effect on price is evident from equations (4) and (5): for this market to clear each day, speculators at the end of the day (round 3) must be induced to absorb the portfolio-shift order flow hitting the market at the beginning of the day. This requires a price adjustment (a changed risk premium) because the elasticity of aggregate speculative demand, γ in equation (4), is not infinite. (Unlike round 1, the public's trading in round 3 is non-stochastic.) Evans and Lyons do not take a stand on what specifically the beginning-of-day portfolio shifts represent, other than to model them as orthogonal to the stream of payoff increments ΔR_t. Under this specification, order flow cannot convey payoff information (arguably, a less controversial choice). Thus, the kind of information that order flow conveys in their model is discount-rate information. (These discount rate effects correspond to what macroeconomists call portfolio balance effects.) Per above, they could be modeled explicitly as arising from changing risk preferences, changing hedging demands, changing money demands, etc.

Also important to the model is that at the close of round 2 all dealers observe the order flow from interdealer trading that day, or X_t in equation (7). This order-flow information is important because it conveys the size and sign of the public order flow in round 1 (the pieces of which were not observable generally). To understand why, consider the interdealer trading rule derived by Evans and Lyons and shown in equation (6), where α is a constant coefficient. Each dealer's trade in round 2 is proportional to the customer order he receives in round 1. This implies that when dealers observe the interdealer order flow $X_t=\Sigma_i T_{it}=\alpha C_t^1$, they can infer the aggregate public order flow C_t^1 in round 1.

The Pricing Relation

Evans and Lyons show that the change in the price of foreign exchange from the end of day t-1 to the end of day t can be written as:[28]

(8) $$\Delta P_t = b_1 \Delta R_t + b_2 X_t$$

[28] Under the model's null hypothesis, causality runs strictly from order flow to price. Accordingly, under the null, their estimation is not subject to simultaneity bias. (Unlike the classic supply-demand identification problem, this is not simply a regression of price on quantity; quantity—i.e., volume—and order flow are fundamentally different concepts.) Within microstructure theory more broadly, this direction of causality holds in all the canonical models (i.e., the Kyle auction model and the sequential-trade model), despite the fact that price and order flow are determined simultaneously. In these models, price innovations are a function of order flow innovations, not the other way around. Put differently, order flow is indeed a cause of price changes, but only a proximate cause; the underlying cause is non-public information (about payoffs or about discount rates).

where β_2 is a positive constant (that depends on γ and α). It is not surprising that this price change includes the payoff increment ΔR_t: upon realization, the increment ΔR_t becomes a known (i.e., risk-free) component of the continuing daily payoff R_t, and its discounted value is impounded in price (β_1).

Let me provide some intuition for the portfolio-balance effect—the $\beta_2 X_t$ term. This term is the required price adjustment that induces re-absorption of the random order flow C_t^1 that occurred at the beginning of the day. The value of the parameter β_2 insures that at the round-3 price, markets clear per equation (5) (i.e., the dealers have no net overnight position). To understand the link to order flow, recall that the round-3 price depends on two things: the public's risk-bearing capacity (summarized by γ), and the total position that the public needs to absorb. As noted, dealers learn about the total position the public needs to absorb from interdealer order flow X_t. This produces the relation between the inter-dealer order flow and subsequent price adjustment.

Table 1 of Evans and Lyons (2002) presents estimates of the model using daily data for the DM/$ and ¥/$ exchange rates.[29] The coefficient β_2 on interdealer order flow X_t is correctly signed and significant, with t-statistics above 5 in both equations. The overall fit of the model is striking relative to traditional macro models, with R^2 statistics of 64 percent and 45 percent for the DM and yen equations, respectively. Moreover, the explanatory power of these regressions is wholly due to order flow X_t: regressing the daily exchange rate change on the change in interest differential alone, plus a constant, produces an R^2 statistic less than 1 percent in both equations, and coefficients on the change in interest differential that are insignificant at the 5 percent level.[30]

The resulting sensitivity of price to order flow is rather large. The coefficient on order flow in the DM equation, for example, implies the following:

- $1 billion of net dollar purchases raises the DM price of a dollar by 0.54%.

If, for example, this were applicable to central bank in their intervention operations, they would probably consider intervention a good deal more effective than they currently do: $20 billion would produce a lasting $10 percent move. The word lasting is important here. One reason Evans and Lyons estimate the model at the daily frequency is because at that frequency exchange rates are roughly a random walk. Accounting for the increments in a random walk is equivalent to accounting for the permanent components in the level of price. (Put differently,

[29] The Evans and Lyons (2002) evidence of the information content of FX order flow is one example among many in the empirical literature. See the survey of that evidence in Lyons (2001), pages 22-26.

[30] To check robustness, Evans and Lyons examine several obvious variations on the model. For example, they include a constant in the regression, even though the model does not call for one; the constant is insignificant for both currencies and has no substantive effect on the other coefficients. Second, in the spirit of Uncovered Interest Parity, they include the level of the interest differential in lieu of its change; the level of the differential is insignificant in both cases. They also test for non-linearities and state dependence in the coefficients (e.g., whether the coefficients depend on the level of gross trading volume). They do find some significance along these lines, but nothing that undermines the central role for order flow in price determination.

working with daily exchange rate changes effectively "integrates out" any mean reversion in the level of prices intraday.)

Isn't This Just Demand Increases Driving Price Increases?

At first blush, it might appear that these results are right out of Economics 101: of course when demand goes up, price goes up. But this misses the most important lesson. To understand why, consider the (correct) premise of textbook exchange-rate models that order flow is not necessary to push prices around. Rather, when public information arrives, rational markets adjust price instantaneously (i.e., excess demand from new information causes price to adjust without trading—order flow—needing to take place). That order flow explains such a large percentage of price moves underscores the inadequacy of this public-information framework. The information the FX market is aggregating is much subtler than textbook models assume. This we learn from our order flow regressions. To summarize, yes, it is demand, but it is demand of a very different nature than the demand in textbook models.

But What Drives Order Flow?

An important challenge for the dispersed information approach is determining what drives order flow, i.e., the first link in the information/order-flow/price chain. There are three promising strategies for shedding light on this essential question.

Strategy one: Disaggregate order flow to determine if all parts have the same price impact (i.e., same information content).

For example, interdealer order flow can be split into large banks versus small banks, or investment banks versus commercial banks. Data sets on customer order flow can be split into non-financial corporations, leveraged financial institutions (e.g., hedge funds), and unleveraged financial institutions (e.g., mutual and pension funds). Do all these trade types have the same price impact? Someone believing that order flow is just undifferentiated demand would predict that they do. In fact, they do not: certain types of orders (e.g., those from financial institutions) convey more information, and therefore have more price impact. People who view order flow as undifferentiated demand overlook this level of analysis, i.e., they overlook the fact that order flow is a vehicle for conveying information. Understanding the information intensity of different trade types gives us insights into this market's underlying information structure.

Strategy two: Determine whether order flow plays a smaller role in determining price at times when information flow is more likely to be public than private.

This approach to the what-drives-flow question focuses on periods encompassing scheduled macro announcements. Does order flow account for a smaller

share of the price variation within these periods (as macro models would predict)? Or is order flow an important driver of price even at these times, perhaps helping to reconcile differences in people's mapping from public data to price? Work along these lines, too, will shed light on the forces driving order flow.

Strategy three: Determine whether order flow forecasts macro variables.

A third approach to the what-drives-flow question is based on the view that order flow measures individuals' changing expectations. As a measure of expectations, it reflects a willingness to back one's beliefs with money—the backed-by-money expectational votes, if you will. Expectations measured from macro data, on the other hand, are slow moving and imprecise. If order flow is serving as an expectation proxy, then it should forecast surprises in important macroeconomic variables (like interest rates). New order-flow data sets that cover up to six years of FX trading provide enough statistical power to test this (see, e.g., the data sets used by Fan and Lyons 2001 and Froot and Ramadorai 2001). Note too that this line of research offers a possible explanation of the Meese and Rogoff (1983) findings. To understand why, write the price of foreign exchange, P_t, in the standard way as a function of current and expected future macro fundamentals: $P_t = g(f_t, f^e_{t+1})$. If (big if) the macro variables that order flow is forecasting are largely beyond the one-year horizon, then the empirical link between exchange rates and *current* macro variables f_t will be loose (which is the Meese-Rogoff finding). That macro empirical results are more positive at horizons beyond one year is consistent with this hypothesis.

3. Synthesizing the Two Organizing Ideas

The lessons reviewed in section 2 are important for appreciating why banks that have superior access to order flow information consider it valuable, and want to maintain the dealership structure that provides that access. That section is also important (in my judgment) for considering likely trends in exchange rate analysis. Let us now consider this paper's two organizing ideas jointly. In what ways can we expect these two forces—credit risk management and order flow information—to interact in the future?

An important source of interaction will likely relate to an order flow concept that I have not yet introduced, namely, customer orders submitted to banks but not executed. (This contrasts with the order flow information in the Evans and Lyons model, which involves post-trade flow measures.) Commercial banks receive two basic types of orders from their customers: orders for immediate execution (market orders) and orders for execution conditional on the market price reaching some limit (limit orders).[31] For the latter, each bank individually collects their customer limit orders in a book. If one could aggregate these separate limit-order books, one would have a picture of the customers' aggregate demand curve. But this is not possible (and is certainly not a regulatory require-

[31] See Osler (2001) for a more detailed treatment of these order types (and their implications for prices).

ment). Exactly how banks utilize this pre-trade order information is unclear. The widespread presence of it raises the worrisome prospect that some banks might engage in front running. In any event, note that any regulatory requirement that banks expose these orders to the broader market would alter the private value of their order flow information. If, as I have argued, order flow information—and the protection of that information—is one of the powerful drivers of the current market structure, regulatory changes along these lines would almost surely have consequences for that market structure.

Whether these orders should be more transparent is an interesting policy issue. (Some would argue that the lack of current regulation in spot FX makes it uninteresting, but I disagree.) Exposing limit orders was not required on the U.S. Nasdaq market either (also a dealer market) until the late 1990s. When the law came into force that required these equity limit orders to be exposed to the whole market (so-called "order handling rules"), transaction costs borne by limit-order traders were reduced (see, e.g., Weston 2000). Note, though that a shift in limit-order exposure need not arise from regulation: if customers are better off with exposed limit orders, then it is possible that a competing trading mechanism would arise—via market forces—that would provide this. At the end of the day, there are good arguments on both sides of the debate on pre-trade order transparency. For example, advocates argue that trade reporting can mitigate the effects of fragmentation. Opponents argue that transparency can stifle limit order placement and thereby reduce liquidity. See other papers in this volume for a deeper treatment of this issue (e.g., the chapter by Blume).

Another example of interaction between credit risk management and order flow informativeness relates to a point made in section 1 when outlining Future 1 (the future under which credit risk management is unbundled and priced separately). Specifically, recall that banks acting as legal counterparty to FX deals struck in a centralized auction would still have access to flow information. (Think, for example, of the order flow information currently owned by the largest custodian bank in the U.S., State Street.) Nevertheless, the nature of that information would differ from that currently available to dealing banks (e.g., it may be unclear which of the two parties was the aggressor).

Might market-structure change eliminate the informational importance of order flow? No. The role of order flow in conveying information transcends market structure. And the types of information that order flow conveys—particularly the types with persistent price effects—are not likely to change radically when (if) the FX market structure changes in the future. Put another way, the underlying information structure of this market has more to do with the properties of the asset being traded—foreign exchange—than it does with the market structure per se. Order flow will continue to tell us something about participants' views on how publicly available data should be mapped into price. It will continue to tell us something about current risk preferences and endowments. In short, it will continue to convey dispersed information that needs to be aggregated in price.

But can we expect order flow to lose all its forecasting power as more banks collect and exploit it? At first blush it might appear that the answer to this question is yes. I do not believe so, however. The forecasting power of FX order flow would only disappear if the information contained in each bank's order flow

slice is the same (e.g., the order flows received by different banks are perfectly correlated). This is almost surely not the case (and is definitely not the case in the Evans-Lyons model sketched in the last section). That said, customer order flows received by different banks are very likely correlated (though not perfectly), which means that there will be an element of competition when exploiting it. Even if some forecasting power is dissipated, however, the explanatory power of order flow—i.e., its power to account for exchange rates *contemporaneously*—will remain, and should even increase. Thus, the danger of more aggressive exploitation of order flow information is less to those researching these markets (who are concerned more with contemporaneous links) than to those trading in them.

4. Conclusion

I addressed the future of the foreign exchange market using two organizing ideas. The first idea is that management of credit risk is an important driver currency market structure (contrary to traditional drivers from microstructure finance). The second idea is that asymmetric information of a particular type is present in FX markets and is promoting the current dealer structure. Though provocative, these two ideas are vital to understanding this market's future.

The idea that credit risk drives equilibrium market structure toward a dealership structure is new (to the best of my knowledge). Other things equal, FX is exactly the type of security that one would expect to be most efficiently traded with an auction structure (open limit-order book). Though interbank (interdealer) trading in this market has evolved substantially in the direction of an auction structure, customer trading has not. Opportunities to trade via auctions are now available to customers, but they are not choosing to do so, causing these trading platforms to languish. Customers do not want to retain counterparty risk and the current auction-market solutions to this (e.g., margin postings) have not been attractive enough to induce sufficient pooling of liquidity and network effects to reduce transaction costs.

In addressing the future of the FX market's structure, I outlined three specific scenarios. Under the first, a centralized auction emerges due to an unbundling by the dealing banks of liquidity provision and credit-risk management. Bilateral deals struck within this auction-market structure would then be routed through commercial banks to act as legal counterparties to both sides of the transaction (and those banks would be paid for the service). In principle, this arrangement concentrates provision of the two separate services where comparative advantage is highest. (As in the text, I mean here that dealers have a comparative disadvantage in liquidity provision relative to a centralized auction with full network effects.) Under the second scenario, the current dealership structure continues, with banks cross-subsidizing their disadvantage in liquidity provision. This scenario would require banks to keep customer transaction costs at such a level that auction-based alternatives are unable to establish a significant foothold, and are therefore unable to develop the network effects for lower-cost liquidity provision. The rationale for why banks would want to do this lies in the *indirect* profitability of FX liquidity provision: banks—particularly the largest FX

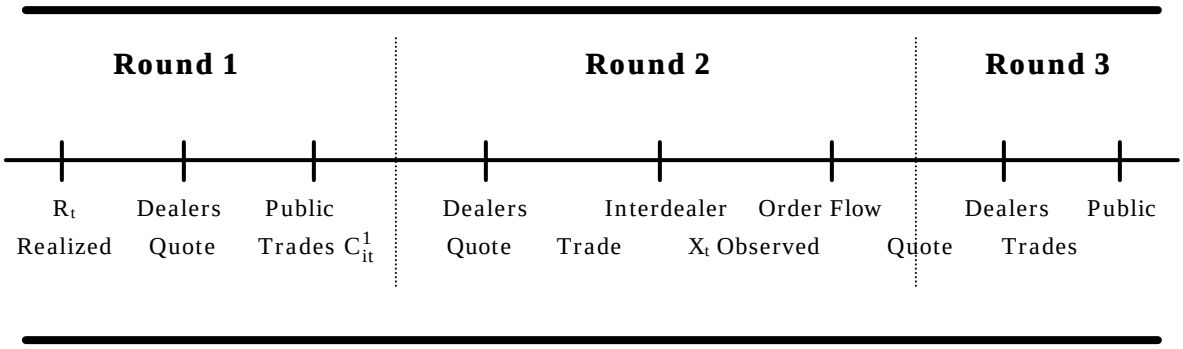
banks—now capture an important additional source of indirect profits from intermediating flows, namely their ability to exploit information contained in those flows. Under the third scenario, the centralized auction emerges, but for a reason quite different than under the first scenario: the interdealer brokerage system EBS is opened to non-dealer customers.

I consider the second of these scenarios the most likely at a horizon of 10 years. If the first scenario should begin to materialize, I expect the third scenario to play out rapidly (i.e., EBS will be opened to non-dealer customers). Whatever the ultimate result, though, the value of order flow information will certainly play a central role, as will the management of counter-party credit risk. That order flow contains information is outside the current macro framework used to understand exchange rates. I expect flow's clear empirical importance as an information vehicle to attract researchers to new approaches to exchange rate determination in future work.

Let me close by touching briefly on the relevance of this paper's analysis for other markets. Of immediate importance is institution design for trading FX in emerging markets. In this context both the credit risk and asymmetric information issues are more acute. (Indeed, concentrated private information about payoffs becomes a real possibility.) Also true is that in most of these countries the current market structure is less the product of market forces than is the case for the major FX markets I address here. These factors would need to be addressed before the scenarios considered here could be considered applicable. Beyond emerging market FX, also interesting are the currency and interest-rate swap markets. Many of the driving forces identified here are also acting in these markets and may be useful for mapping their futures. On the flip side, closer examination of these markets may bring insights useful for mapping the FX market's future. Finally, consider the government bond markets. Given their structure is often quite similar to that in FX (e.g., the U.S. Treasury market), why don't commercial banks have a similarly dominant role in dealing? Is it because trade sizes (and therefore credit exposures) are much smaller? Or because non-financial corporations (with which commercial banks have especially strong relationships) are much less important in trading? These are open questions I will have to leave to future research.

Figure 1

Daily Timing in the Evans-Lyons Model



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