E-trading and the Foreign Exchange Hot Potato

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ABSTRACT

This paper applies order flow analysis and develops an n-dealer hot potato trading model that characterizes the microstructure of the foreign exchange market. The model demonstrates that there converges a multiplier effect on total trading volume as interbank dealers commonly adopt the hot potato strategy to avoid position risk. It also suggests that the recent emergence of e-trading by dealers be an inverse shock on trading intensity over time. The potential entry of nonbank participants into the market, and continual consolidation in the global banking sector, generate dynamics of market activities in opposite directions.

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1. Introduction

Microstructure studies in the foreign exchange (FX) market have emerged in literature over the past decade. This phenomenon is mainly due to the growing importance of the FX market under ongoing globalization and regionalization, as well as its institutional characteristics metamorphosed following spectacular technological progress since the late 1980s. Existing research, however, appears to primarily pay attention to the empirical aspect of the subject as long as FX trading data become increasingly, albeit so far limitedly, available. In addition, the analysis is mostly built on an intraday perspective\(^1\). This contrasts with microstructure studies in the stock market, which are comparatively balanced because of their earlier development.

Formal microstructure modeling that is specific to the FX market is being undertaken. Besides the agenda developed by Evans and Lyons (2002a; 2002b; 2004) and Lyons (1995; 1996; 1997; 2001b), theoretical attempts, inter alia, include Black (1991), Chakrabarti (2000), Flood (1994), Goldberg and Tenorio (1997), Hartmann (1998b), Hau, Killeen, and Moore (2002), Huang (2003), Naranjo and Nimalendran (2000), Perraudin and Vitale (1996), and Yao (1997a). But the focus placed by these models seems to be too diverse to be integrated. An analytical framework incorporating the key microstructural determinants in the FX market over various time spans remains to be called for.

It is in this spirit that the paper proposes a model that aims to serve as the starting point towards a generalized microstructure theory of the FX market. The model captures the quintessence of the contemporary FX market, distinct from other financial markets.

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\(^1\) With an extensive literature review, Huang (2003) brings to the fore such an empirical and temporal bias in this field.
in many aspects. Among others, the FX market is the largest market of the world in terms of trading volume. According to the estimation by the Bank for International Settlements (2002), the global monthly average of daily FX turnover reached 1.2 trillions of US dollars in traditional (spot, outright forward, and swap) FX markets in April 2001. This figure is almost 70 times the dollar value of total world merchandise trade (average of exports and imports) calculated on a daily basis. As pointed out by Burnham (1991), the enormous trading volume generated in the FX market results from three major factors.

Firstly, the “hot potato” trading, commonly conducted by interbank FX dealers, plays the central role of amplifying the trading volume in the FX market. The hot potato process depicts the situation where interbank dealers lay off unmatched buy or sell orders, i.e. the FX hot potato, to each other in order to avoid position risk. Its raison d’être actually results in a direct way from the microstructural specifics of the FX market, which are to be elucidated in Section 2. The FX hot potato, derived on the basis of initial FX orders, creates market-wide liquidity from which each dealer benefits in a decentralized trading environment. The microstructure model to be presented in Section 3 formalizes this phenomenon and shows that there exists a substantial multiplier effect which emerges during the hot potato process. This effect plausibly sheds light on the stylized fact cited above: the value of international trade is largely smaller than the FX trading volume.

Secondly, indirect cross-currency transactions double the trading volume under the prevailing asymmetric structure of exchange in the global FX market. The structure reflects the politico-economic reality that has existed since more than half a century ago:

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2 More details are to be presented in Section 2.
the role of vehicle currency played by the globally accepted US dollar. Most exchanges between nondollar currencies are practically conducted through the US dollar because of very little or zero liquidity in most FX submarkets, where the pair of currencies should be theoretically traded.

Thirdly, the FX turnover expands with the necessity of several FX contracts to achieve a single intertemporal transaction. In fact, intertemporal transactions involving nondollar currencies are confronted with the same problem of market depth as the cross-currency trading. For example, banks often resort to the FX swap in order to cover an outright forward position. Trading volume therefore increases as a swap combines a spot transaction and a forward transaction.\(^4\) Modeling of the second and third factors is beyond the scope of this paper, but it will be indispensable if we intend to build a theory that extends to the long-run microstructural dynamics of the FX market. Hartmann (1998b) proposes a paradigm that analyzes the role of vehicle currency in the FX market. Further works are entailed to fill the gap in this subject.

Despite continual expansion of trading activities in the FX market since the early 1990s, the turnover in April 2001 exhibits, as marked by Galati (2001), a significant 14% decline compared to that in April 1998 at constant exchange rates. Galati enumerates four main forces at work: the introduction of the euro that eliminates intra-EMS trading, consolidation in the global banking industry which reduces the need for interbank market-making, expansion of electronic broking that speeds the trading process, and contraction in trading between banks and non-financial customers under ongoing concentration in the international corporate sector.

\(^4\) The statistics released by the Bank for International Settlements (1999; 2002) show that the FX swap has covered more than 50% of the total activities in the traditional FX market since April 1998.
With the exception of the last factor that only affects the size of initial FX orders, the other three factors have a direct influence on the microstructure of the FX market, in particular, the magnitude of hot potato trading. However, the first two factors exert only a one-time impact in principle. In contrast, the e-broking, or the e-trading from a broader viewpoint, can generate dynamic effects on FX trading because of continual innovations in technology. The FX hot potato trading model in Section 3 is to be applied to investigate the prospects of such dynamics under the gradual proliferation of e-trading through new electronic dealing and broking systems, which interbank FX dealers have adopted since only a few years ago.

The remaining of the paper is organized as follows. Section 2 presents a succinct review of major specifics inherent in the microstructure of today’s FX market. A diagrammatical framework summarizes its trading mechanism as well as order flow patterns, and incorporates three analytical approaches applicable for the research on the subject. Section 3 develops a theoretical model that derives the total trading volume a representative FX dealer creates on the basis of hot potato operations. The model serves to explicate why the FX market is the largest one in the world by its turnover and how the emergence of e-trading affects its activities over time. Section 4 concludes.

2. Microstructure of the FX Market

In this section, we briefly review major microstructural specifics inherent to the FX market, and explore the role played by interbank dealers, which serves as foundations for our theoretical modeling to be undertaken in the following section.
2.1 Microstructural Specifics

The microstructure of today’s FX market can be characterized and differentiated from other markets by three dimensions: the market participants, places of exchange, and transactional rules. Diagram 1 in Appendix synthesizes these elements in an integrated framework.

2.1.1 Market Participants

In terms of market participants, the FX market is in essence international as it is involved with the exchange of two currencies and hence with participants from all over the world economy. Its prevailing mode of exchange is indirect and leads to its “double-market” nature. At the first level (the nonbank market), initial currency demanders and suppliers (tourists, exporters/importers, investors, central banks, etc.) turn to commercial banks’ customer dealers for currency exchange services. They can be wholesale or retail customers according to their order size. At the second level (the interbank market), banks’ interbank dealers manage aggregated customer orders by exchanging currencies among themselves, using services provided by brokers, or acting as market makers to create additional transactions, i.e. the FX hot potato. From this aspect, interbank dealers represent the major actors in the FX market, because they play not only the role of an intermediary between initial demanders and suppliers, but also the role of a customer among themselves in the interbank wholesale market.

With technological innovations, electronic dealing (e.g. Reuters Dealing 3000 Direct) and broking (e.g. EBS Spot and Reuters D2000-2) systems have been widely employed in the FX market and replace gradually services provided by traditional (voice) interbank dealers and brokers. In case that direct FX transactions are to be open to nonbank customers (initial currency demanders and suppliers) via internet, the major
players of the FX market risk further being of virtual nature. This perspective is to be investigated in Section 3 with our model.

### 2.1.2 Places of Exchange

In terms of places for currency exchanges, the “double-market” nature applies too. In the nonbank retail market, currency movements are physical because transactions are carried out in a tangible space, e.g. the bureau de change or FX desk at a bank. In the nonbank and interbank wholesale markets, however, currencies are exchanged virtually via telecommunication networks, with a simple debit or credit on accounts at correspondent banks. These wholesale markets, particularly the interbank market, are *de facto* integrated from the global perspective. Spatially, modern technology permits connection between demanders and suppliers of currencies from every part of the world through commercial banks; temporally, successive openings and closings of regional FX markets across various time zones lead to the continuously 24-hour functioning of the world FX market.

### 2.1.3 Transaction Rules

In terms of transactional rules, microstructural specifics that the FX market exhibits can be analyzed from two angles.

Firstly, the FX market is composed of submarkets with divergent nature. Based on mutual agreement between dealers, exchanges in spot and forward (outright contract and FX swap) submarkets are of decentralized nature, i.e. OTC. In contrast, transactions in derivatives (such as FX options, currency swaps, etc.) submarkets appear to be more heterogeneous. For example, FX options are often standardized and negotiated in a centralized market setting.
Secondly, there exist two distinct conventions observed by FX market participants. The first practice concerns the double-price (bid price and ask price) quote. This convention results in the presence of the bid-ask spread, which is the source of profits for FX intermediaries. The level of one dealer’s spread reflects his “bargaining power” vis-à-vis customers. The second practice concerns the obligation for all market (in particular, the interbank market) intermediaries to quote prices that are valid for an immediate transaction when they are requested. One direct consequence from this implicit “code of practice” results in the attractiveness of hot potato trading for dealers. Another consequence is that one dealer, who is frequently reluctant to quote or to be not of his word, will be implicitly excluded from the market. He will find it difficult to obtain from other dealers liquidity, which is crucial for his role as intermediary. Under such permanent pressures on market intermediaries’ pricing behavior, one dealer/broker’s quotes require to be not only spontaneous and systematic (both bid and ask prices), but also competitive to the quotes of others. Over the time, such interdealer competition à la Bertrand leads to quote convergence at the market level.

2.1.4 Triple “Double Personality”

The microstructural specifics inherent to the FX market result in a trading environment characterized with a triple “double personality”, highlighted by light-gray textboxes in Diagram 1. Firstly, the market is composed of two distinct markets: the local nonbank/customer market subject to certain monopolistic competition versus the international wholesale interbank market subject to Bertrand competition. Secondly, the market has double price determination: bid price and ask price, along with the resultant

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5 Quotes of referential nature are anyhow common in the interbank market, particularly on electronic dealing and broking networks.
spread. Thirdly, interbank dealers play the double role of market makers and interbank customers among themselves, which creates the FX hot potato that constitutes a part of the trading flows presented in Diagram 1.

It is always important to remind that non-negligible cross-dealer heterogeneity exists in terms of their order flow management. Endogenously, FX dealers’ trading style, degree of risk aversion, and perception of market trend differ. Exogenously, diverse characteristics (size, customer composition, risk limiting policy, etc.) of the bank each dealer works for affect his position control. Diagram 1 provides only the general image of the FX market microstructure.

2.2 Order Flow Management

As clarified in Diagram 1, the management of stochastic (customer and interbank) order flows constitutes the key question in FX microstructure analysis. In one submarket, a representative interbank dealer’s daily order flow management can be illustrated by Figure 1 in Appendix.

Starting his working day with a zero inventory (currency) position \(C = 0\), the dealer encounters all along the day random orders of all kinds (purchase or sale, posed by customers or by other dealers) represented by black arrows in our figure. As the dealer’s primordial objective consists in acting as a market intermediary without running much price risk, he is obliged to prevent himself from being exposed to an open (non-zero) position for too long. He should rebalance his position back to (or around) zero not only at the end of the day, but also at certain intraday points. This implies that the dealer’s order flow management is characterized by several “cycles” that decompose the whole working day into various periods (denoted by \(p = 1, 2, \ldots, t, \ldots, T\) in Figure 1). Within each period \(p\), the dealer adjusts the level of his inventories \(C\) by purchasing
or selling currencies to other dealers. These currency purchases and sales are represented by gray arrows in Figure 1, and can be considered to be the dealer’s “anti-shock” strategies facing “shocks”, i.e. stochastic customer and interdealer orders.

The dealer’s order flow management is hence analogous to finding an adequate anti-shock strategy vis-à-vis every order. Under various circumstances, one dealer’s anti-shock strategies can be classified into five categories, as presented in Table 1 below. Concomitance of these five anti-shock strategies explains again why there exists endogenous and exogenous heterogeneity across interbank dealers, and confirms the complementary nature inherent with various analytical approaches (such as the inventory, information, and institution approaches presented in Diagram 1) to the microstructure of the FX market.

Table 1: Pros and Cons of One Dealer’s “Anti-shock” Strategies

<table>
<thead>
<tr>
<th>Strategy</th>
<th>Pros</th>
<th>Cons</th>
</tr>
</thead>
<tbody>
<tr>
<td>New Order to Another Interbank Dealer</td>
<td>Transactional Certainty and Rapidity</td>
<td>Transaction Cost (Half of the Spread); Possibly Unfavorable Price; Implicit Revelation of Private Information</td>
</tr>
<tr>
<td>New Order to a Broker</td>
<td>Advantageous Price; Transactional Discretion Allowing Exploitation of Private Information</td>
<td>Transaction Cost (Commissions); Order Execution Uncertainty and Slowness</td>
</tr>
<tr>
<td>Parallel Adjustment of Bid and Ask Prices</td>
<td>Automatic Position Rebalancing Mechanism</td>
<td>Explicit Revelation of Position; Risk of Undesired Position</td>
</tr>
<tr>
<td>Resort to Non-spot FX Markets</td>
<td>Dynamic and Flexible Position Readjustment in Case of Low Short-run Market Liquidity</td>
<td>Transaction Cost for the Concerned FX Operation</td>
</tr>
<tr>
<td>Speculation</td>
<td>Profits in Case of Favorable Price Movement</td>
<td>Increase of Position Risk</td>
</tr>
</tbody>
</table>

The first anti-shock strategy is an opposite (from the viewpoint of the dealer himself) operation of the order the dealer receives. As it involves an immediate transmission of the “shock” to other dealers, it is referred to as hot potato trading in literature. This strategy is most commonly adopted by interbank dealers because it is the least risky among the five options. The second strategy appears to be a more appropriate alternative when the “shock” the dealer encounters conveys important information. The
third strategy is based on fundamental demand-supply adjustment through price mechanism. However, it should be noted that evolution of global demand and supply at the market level may not match exactly demand and supply at the single dealer’s level. This strategy may therefore risk intensifying the dealer’s position imbalance in case of excessive currency demand or supply on the market scale. The fourth strategy is of intertemporal nature that permits one dealer to obtain liquidity from the forward/swap or FX option markets.

Finally, the most risky speculative strategy deliberately maintains an open position, expecting profits when the price moves in the favorable direction. There has been a debate on the use of this strategy, which some\(^6\) attribute as the principle cause of excessive volatility in the FX market. From a single dealer’s view point, Yao (1997a; 1997b) and Lyons (1998) find that speculation is not profitable for an interbank dealer from the long-run perspective. Excessive FX trading volume and consequent volatility is mainly due to mutual hot potato trading, i.e. the first anti-shock strategy, among dealers. This finding echoes our previous analysis and is to be reexamined from a theoretical aspect in the following section.

3. Order Flow Model of FX Trading

In this section, we present a FX trading model based on the idea of hot potato. The model, inspired by Lyons (1996) and elaborated from Huang (2003), adopts the order flow analysis that focuses on the daily trading activities by a representative interbank FX dealer in a submarket. In this market, a pair of currencies, i.e. the home currency and the FX which is regarded as goods, are traded. We assume that there exist \( n \) interbank dealers in the submarket.

\(^6\) Among others, Frankel & Froot (1990).
3.1 Nature of Initial Orders

Each dealer $i$ receives, on Day $t$, nonbank/customer orders (CO) from both buy and sell sides. The one-side volume of CO is normalized to one unit of home currency for simplicity. CO represent the initial orders that originate from both retail and wholesale customer markets, and aim at settling cross-currency transactions recorded in the balance of payments. More specifically, such transactions involve international trade that appears in the current account, international transfers that appear in the capital account, foreign direct, portfolio, and other investments that appear in the financial account, and FX interventions by central banks. The nature and size of CO are essentially determined by factors inherent in the global economy and hence considered to be exogenous in our model. These factors include both microeconomic and macroeconomic fundamentals as trade policy, interest rates, and other non-interest-rate variables in international finance.

It should be pointed out that the size of CO is the buy-side trading volume as well as the sell-side trading volume because we assume that each risk-averse dealer $i$ must “square” his FX position at the end of Day $t$. However, position imbalances are not unusual since the global economy is confronted with new shocks every day. To let the market be cleared and thus the position be back to zero at the closing of the market, additional orders are required to absorb imbalances between buyers and sellers of FX. In other words, there must be certain “clearing orders” that eliminate the ex post excess demand or supply\(^7\). In practice, these orders are involved with FX speculation by risk-loving investors and with intertemporal FX transactions as swaps and futures. Since

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\(^7\) Lyons (2002) underlines the nuance between unbalanced order flows and excess demand (or supply). The former results from actual transactions, while the latter need not induce real transactions because of the price adjustment. In this regard, the imbalance of order flows is present ex post, whereas the excess demand (or supply) is rather a concept ex ante.
the aspect of exchange rate dynamics is not of the first order in our trading model, the following analysis is not to distinguish the “initial” CO from the “compensating” CO, nor to differentiate, as Evans and Lyons (2002a), the timing at which dealers receive these orders with a view to being concentrated on the effect of the FX hot potato.

3.2 Hot Potato Strategy

As shown previously in Table 1, hot potato trading represents the most attractive anti-shock strategy for interbank dealers regarding their position control as well as production of additional liquidity to the market. The role played by brokers, voice or electronic, is merely a means of matching orders in the hot potato process. It is sensible to assume that the electronic broking systems as EBS Spot or Reuters D2000-2 speed the whole process compared to traditional voice brokers. Similarly, the electronic dealing systems as Reuters Dealing 3000 Direct also quicken the trading process. Transactions conducted through both dealing and broking systems are hence referred to as “e-trading” in the following model. The transactions that are matched through direct interdealer vocal communications are to be treated as the benchmark for examining the impact that e-trading exerts on FX trading.

For each dealer \( i \), CO are order flows of incoming nature. However, each buy order may not exactly match each sell order, in terms of both size and timing. Such non-synchronization of order flows is common in the real world but is particularly a crucial problem that an FX dealer must resolve in order to avoid too great an open position and hence too high a price risk. As hot potato trading is the major anti-shock strategy for the dealer vis-à-vis the shock created by CO, we define \( h \) as the ratio of which incoming buy (sell) orders cannot be offset by incoming sell (buy) orders within a time span that the dealer sets for rebalancing his position. The ratio \( h \) is by definition
between zero and one, and represents the expected daily average. Since the market is to 
be cleared over the trading day, it is reasonable to assume that the ratio is the same on 
the buy side as on the sell side. It should be noted that \( h \) may partly reflect the degree of 
risk aversion of the dealer. The less the dealer is tolerant with a persistent open position, 
the higher the implied \( h \) is, and more hot potato trading occurs. The term \( h \cdot CO \) 
represents the additional trading volume that the dealer generates because of 
non-synchronized order flows. It is the very FX hot potato that corresponds to the 
interdealer buy and sell orders of outgoing nature and serves to offset unsynchronized 
buy and sell CO respectively\(^8\).

The ratio \((1 - h)\) defined in our model can be interpreted from five angles. Firstly, 
it is the overall market liquidity that the dealer faces. Secondly, it reflects the normal 
market depth under non-synchronization of order flows. Thirdly, it measures the degree 
of synchronization (or matching) of orders over the time span within which the dealer 
rebalances his position. Fourthly, it reflects the dealer’s ability and speed of 
accommodating incoming orders, closely linked with his customer base in the nonbank 
FX market. And finally, the ratio can be regarded as the expected (or average) 
probability of offsetting simultaneously (or very quickly) a stochastic order with its 
counterpart in the FX market.

### 3.3 Multiplier Effect on Trading Volume

With the above setting, we proceed to calculate the total trading volume that the 
dealer \( i \) generates on Day \( t \) with the hot potato strategy as the major order flow 
management tool. Figures 2-1 and 2-2 in Appendix facilitate the task. The two figures 
illustrate essentially the same structure of FX trading but concern respectively the

\(^8\) The terms “buy” and “sell” are employed from the viewpoint of the dealer himself.
representative dealer $i$ and one of the other $(n - 1)$ dealers $j$ with $j \neq i$. The typical lifecycle of CO normalized to the one-dollar value in the interbank FX market is summarized. As $1$ of CO enters the interbank market, $$(1 - h)$$ can be matched and therefore “ends” its life as presented by the dotted lines. The remaining $h$, now transformed as the FX hot potato, is laid off to the other $(n - 1)$ dealers in the market. We assume that it is uniformly distributed in order to simplify the following analysis.

Receiving the first-round hot potato, the $(n - 1)$ dealers respectively match a $(1 - h)$ part of these incoming interbank orders and release the other $h$ part as the second-round hot potato. It should be reminded that some first-round hot potato created by the dealer $i$ returns to him because the second-round hot potato, released by the other $(n - 1)$ dealers, is simply redistributed into the market without being labeled by its “origin”. The whole hot potato process goes on until when there are no more “excess” orders.

The total volume of the FX hot potato generated on the basis of $1$ of CO received by each dealer should be calculated at multiple levels. At first, it concerns the hot potato initially derived from the $n$-$1$ of CO. The sum of the subtotals in Figure 2-1 represents the trading volume based on the dealer $i$’s $1$ of CO. It includes both the initial orders ($1$) and all the derived interbank orders posed by the other $(n - 1)$ dealers as in (1).

$$1 + \{[(n - 1) \cdot [h/(n - 1)]^2 + (n - 1)\cdot (n - 2) \cdot [h/(n - 1)]^3 + (n - 1)\cdot (n - 2) \cdot [h/(n - 1)]^4 + \ldots] = 1 + M,$$

where $M = [h^2/(n - 1)] \cdot [1 + h \cdot (n - 2)/(n - 1) + h^2 \cdot (n - 2)^2/(n - 1)^2 + \ldots]
= [h^2/(n - 1)] \cdot \{1/[1 - h \cdot (n - 2)/(n - 1)]\}
= h^2/[(n - 1) - h \cdot (n - 2)]$ since $0 < h \cdot (n - 2)/(n - 1) < 1$.

The term $M$ is the core of our hot potato trading model. It can actually be regarded as a hot potato multiplier based on $1$ of incoming orders. As long as $n > 2$, which is a
realistic assumption, the multiplier $M$ lies between zero and one because $0 < h < 1$. In a similar fashion, the sum of the subtotals in Figure 2-2 represents the hot potato released to the dealer $i$ by the dealer $j$ based on his $1$ of CO as in (2).

$$\frac{h}{n-1} + \frac{(n-2)}{[\frac{h}{n-1}]} + \frac{(n-2)}{[\frac{h}{n-1}]^2} + \cdots = \frac{M}{h}.$$ (2)

We label the original $1$ of CO received by the dealer $i$ as his level-0 trading volume symbolized as $V_0 = 1$. Then by (1) and (2), we obtain the total FX hot potato created from the $n$-$1$ of initial orders in the submarket, which equals $M + (n-1)\cdot\frac{M}{h}$. This amount is labeled as $V_1$, the dealer $i$’s level-1 trading volume of hot potato nature. The level-1 hot potato now becomes new interbank orders that the dealer $i$ has to deal with by the hot potato strategy again. This leads to the additional $M\cdot[\frac{M}{h} + (n-1)\cdot\frac{M}{h}]$ of interbank orders that he will get back from the other $(n-1)$ dealers following the hot potato process.

Meanwhile, the dealer $i$’s original $1$ of CO also produces the FX hot potato that represents new outgoing orders to his $(n-1)$ colleagues. Observing Figures 2-2 with $j$ replaced by $i$, we perceive that each of the $(n-1)$ dealers receives a total volume of $\frac{M}{h}$ from the dealer $i$. Symmetrically, these $(n-1)$ dealers also receive the FX hot potato of $\frac{M}{h}$ from the other $(n-2)$ colleagues because of their initial $1$ of CO. These cross-transactions then produce $[(1 + (n-2))\cdot\frac{M}{h}]$ of interbank orders to each dealer $j$, who in turn lays off $(n-1)\cdot\frac{M^2}{h^2}$ of FX hot potato to the dealer $i$. The total trading volume at the level 2 for the dealer $i$, denoted by $V_2$, equals consequently the sum of all the hot potato of feedback nature from the level-1 trading by the dealer $i$ as well as from

\[ (n-1) - h\cdot(n-2) = (n-1)\cdot(1-h) + h > 0; \quad h^2 - [(n-1) - h\cdot(n-2)] = -(n-1 + h)\cdot(1-h) < 0. \]
transactions among the $n$ interbank dealers, i.e. $M \cdot [\$M + (n - 1) \cdot \$M/h] + (n - 1)^2 \cdot \$M^2/h^2$.

Observing the whole process, we can derive the sum of trading volume at all levels for the dealer $i$ on Day $t$, $V_{it}$, by symbolizing the term $[(n - 1) \cdot \$M/h]$ as $B$. This is expressed in (3) below, without adding the dollar sign for clarity.

$$V_{it} = V_0 + V_1 + V_2 + V_3 + \ldots$$
$$= 1 + (M + B) + [M \cdot (M + B) + B^2] + \{M \cdot [M \cdot (M + B) + B^2] + B^3\} + \ldots$$
$$= 1 + (M + B) + (M^2 + MB + B^2) + (M^3 + M^2B + MB^2 + MB^2 + B^3) + \ldots$$
$$= (1 + B) + (M + B^2) + [(M^2 + MB) + (MB^2 + B^3)] + \{[M^3 + M^2B + MB^2 + \ldots]\} + \ldots$$
$$= (1 + B) + (M + B^2) + (M + B^2)\cdot (M + B) + (M + B^2)\cdot (M^2 + MB + B^2) + \ldots$$
$$= (1 + B) + [(M + B^2)\cdot [1 + (M + B) + (M^2 + MB + B^2) + \ldots]]$$
$$= (1 + B) + (M + B^2)\cdot V_{it}.$$

Rearranging (3) yields (4), the final result derived from our model that sums up a single dealer’s daily trading volume, $V_{it}$, following the hot potato process.

$$V_{it} = \frac{1+B}{1-M-B^2}.$$  

(4)

The term $V_{it}$ must be positive so that the model is valid. This implies that $M + B^2 < 1$, or alternatively, $B^2 < 1 - M$. Since it has been demonstrated in Footnote 9 that $0 < M < 1$, the condition that $0 < B < 1$ need be satisfied since $B = (n - 1) \cdot \$M/h > 0$. This results in the conclusion that $V_{it}$ converges to a positive number over the hot potato process if and only if $h < 0.5^{10}$. Moreover, this positive number is greater than unity because the denominator in $V_{it}$, $1 - M - B^2$, is smaller than one. The total trading volume therefore exceeds the value of initial customer orders. This demonstrates that the FX hot potato plays a crucial role of creating, through the multiplier effect, significant trading intensity

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$^{10}$ Recall that $B = (n - 1) \cdot \$M/h = h(n - 1)/[(n - 1) - h(n - 2)]$. $B < 1$ requires that $h(n - 1) - [(n - 1) - h(n - 2)] = (2h - 1)(n - 1) - h < 0$, which implies $h < 0.5$. 

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in the FX market, and confirms in part the stylized fact that the FX market has substantial trading activities compared to other markets.

The conclusion derived above echoes Lyons (1996), who discriminates two views of trading intensity in the FX market. The first is referred to as the event-uncertainty view while the second the hot potato view. By the former, trades are more informative when trading intensity is high, whereas by the latter trades are more informative when trading intensity is low because the high turnover in the FX trading is mainly resulted from dealers’ repeated inventory layoffs labeled as the hot potato trading. The multiplier effect demonstrated by our model appears to suggest that the proliferated number of trades in the FX market is mainly supported by the hot potato view.

3.4 Structural Dynamics

On the basis of our hot potato trading model, several types of dynamics following structural changes can be examined.

The analysis starts by reviewing the “double-market” nature that the FX market exhibits. By (4), we obtain the weight respectively for the nonbank/customer market and for the interbank/dealer market within a submarket in terms of trading volume. As CO have been normalized to one, the “market share” for the former, labeled as $v_{tc}$, is given by (5). Similarly, the weight for the latter, labeled as $v_{td}$, is given by (6).

\[
\begin{align*}
v_{tc} &= \frac{1}{V_d} = \frac{1 - M - B^2}{1 + B} \\
v_{td} &= 1 - v_{tc} = \frac{M + B + B^2}{1 + B}
\end{align*}
\]  

We now proceed to examine how changes in the trading environment may lead to dynamic innovations in the microstructure of the FX market. The first concerns the
proliferation of e-trading by interbank dealers in the market. It is logical to assume that
the technological progress serves to speed trading among dealers, not only in terms of
order processing, but also in terms of order matching. It is therefore sensible to
investigate its impact on FX trading by considering the emergence of e-trading as a
continual decrease in \( h \), which measures the importance of hot potato operations in the
whole market. Given the same initial customer orders, a fall in \( h \) leads to a decline in
total trading volume according to (7), and a rise (fall) of the ratio of customer (dealer)
orders by (5) and (6). In other words, e-trading improves the synchronization between
orders and therefore reduces dealers’ need for the hot potato strategy against shocks that
originated from stochastic orders.

\[
\frac{\partial V}{\partial h} = \left[ \frac{\partial B}{\partial h} \cdot (1 - M - B^2) - (1 + B) \cdot \left( - \frac{\partial M}{\partial h} - 2B \cdot \frac{\partial B}{\partial h} \right) \right]/(1 - M - B^2)^2 > 0, \quad (7)
\]
given

\[
\frac{\partial M}{\partial h} = \frac{2h \cdot [(n - 1) - h \cdot (n - 2)] - h^2 \cdot [-(n - 2)]}{[(n - 1) - h \cdot (n - 2)]^2} > 0,
\]
and

\[
\frac{\partial B}{\partial h} = \frac{(n - 1) \cdot [(n - 1) - h \cdot (n - 2)] - h \cdot (n - 1) \cdot [-(n - 2)]}{[(n - 1) - h \cdot (n - 2)]^2} > 0.
\]

A second type of structural dynamics generated by e-trading concerns the
possibility of allowing nonbank customers to participate directly in the FX market via
internet in the future. This will increase the number of total market players inside the
same submarket. Its impact on FX trading can be envisaged by (8).

\[
\frac{\partial V}{\partial n} = \left[ \frac{\partial B}{\partial n} \cdot (1 - M - B^2) - (1 + B) \cdot \left( - \frac{\partial M}{\partial n} - 2B \cdot \frac{\partial B}{\partial n} \right) \right]/(1 - M - B^2)^2 > 0, \quad (8)
\]
given

\[
\frac{\partial M}{\partial n} = \left[ (n - 1) - h \cdot (n - 2) \right] - (1 - h) \cdot \frac{(1 - h) \cdot (n - 2) + h}{[(n - 1) - h \cdot (n - 2)]^2} > 0,
\]
and \[
\frac{\partial B}{\partial n} = \frac{h \cdot [(n-1) - h \cdot (n-2)] - h \cdot (n-1) \cdot (1-h)}{[(n-1) - h \cdot (n-2)]^2} = \frac{(n-1) + h}{[(n-1) - h \cdot (n-2)]^2} > 0.
\]

From the above, we can deduce that in case one of the three double personalities inherent in the FX market, i.e. the “double-market” nature, was to be metamorphosed, there would be an expansion of the market size as long as trading keeps being conducted in a decentralized manner. The structural dynamics implied by (8), however, can work in an opposite direction. This is involved with continual bank consolidation on a global scale, which reduces the number of interbank dealers on the network. As a result, the total trading volume is lowered because of contraction of activities in the interbank sector and hence reduction of hot potato trading intensity in the FX market. The net effect depends, over time, on the magnitude of each type of structural changes in the world economy.

4. Conclusion

In this paper, we apply the order flow analysis and present a hot potato trading model that characterizes the quintessence of the contemporary FX market. Because of the triple “double personality” as well as specific transactional rules inherent in the market, hot potato trading serves as a low-cost tool for sharing position risk among interbank dealers, and as a self-correcting mechanism for amortizing shocks that originate from initial customer orders of stochastic nature.

Our analysis shows that the decentralized trading patterns in the FX market logically oblige interbank dealers to frequently resort to the hot potato strategy, which induces, with initial exogenous nonbank/customer orders, a multiplier effect on the total trading volume. The multiplier effect our model derives substantiates the stylized fact that the FX market represents the largest market in the world in terms of its trading
activities. Our model demonstrates that the rising trend of e-trading among interbank dealers leads to a fall in the FX hot potato because of better matching between stochastic orders. It also shows that the dynamics of total market trading volume depend on the number of participants in the interbank market. This suggests that, on one hand, the potential entry of nonbank players into the market be a positive shock on FX trading intensity, and on the other hand, the ongoing consolidation in the global banking sector reduce the magnitude of the FX hot potato and hence the overall activities.

Before closing our discussion, it is worth remarking that the model developed in Section 3 aims at being the starting point for future extensions that eventually contribute to a general analytical framework specific to the microstructure of the FX market. These extensions can be initiated along the following, albeit not exhaustive, axes of research.

Firstly, appropriate differentiation of CO for each of the $n$ dealers in our model is desirable as long as it keeps the model being elegant. As highlighted by Diagram 1, each bank that dealers work for exerts a certain degree of monopoly power in the local retail and wholesale customer markets. Endowed with various market shares in the global FX market, each dealer’s pricing policy may diverge despite the fact that the practice of mutual quote leads to a market outcome analogous to the Bertrand competition. In terms of trading volume, however, customer-base heterogeneity across dealers affects in principle only the technical aspect of our model. More specifically, it simply modifies the magnitude but not the nature of the multiplier effect in the hot potato process.

A second crucial point that is to be elaborated concerns the price effect under hot potato trading. The spirit of the works by Evans and Lyons (2002a; 2002b; 2004) and Lyons (1995; 1996; 1997; 2001b) fits in with the microstructure effect our model focuses on. The price effect can be explored at two levels. At the first level, the analysis of order flows takes into account not only their size as our study does, but also their sign,
which reflects the direction of price pressures driven by information innovations in the FX market. This serves to explain the phenomenon of excess volatility closely linked with the microstructural specifics that the FX market exhibits. At the second level, modeling of daily order flows leads to determining short-run dynamics of the spread and exchange rates in the FX market. This is certainly one of the promising paradigms in current research on international finance.

Finally, the model can be augmented into an $n$-currency setting, i.e. in a structure that is comprised of all theoretical submarkets in the global economy. This axis of extension explores the long-run aspect of the microstructural dynamics in the FX market by distinguishing the structure of payment in the international real sector from the structure of exchange in the international monetary sector. Attention paid to such cross-currency transactions helps to assess the prospects of major key currencies, e.g. the US dollar or euro, in the world economy.
References


Appendix

Diagram 1: Microstructure of the Foreign Exchange Market
Figure 1: A Representative Interbank Dealer’s Daily Order Flow Management

Figure 2-1: Hot Potato Received by Dealer $i$ on the Basis of His Initial $\$1$ of CO

Figure 2-2: Hot Potato Received by Dealer $i$ on the Basis of Dealer $j$’s Initial $\$1$ of CO