

## **Exchange risk management of the Czech Koruna in the process of joining the Euro area**

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This project has investigated the ability of a monetary authority to extract information from the currency market, especially at the time of exchange rate regime changes. (This is particularly relevant if something like joining the exchange rate mechanism of the ERM2 type or adoption of the euro is being considered.) To address this problem, the microstructure finance approach has been selected. The market mechanism that we focus on is that of an order-driven (brokered) FX market, since, nowadays, it dominates forex trading in terms of volume and accessibility, at the same time offering a certain degree of transparency. Specifically, electronic brokerage constitutes the most important segment of the Czech koruna/euro currency pair market. The results should facilitate the interpretation of quotes and trades in an electronically brokered market to be used by a monetary authority as a policy support.

Studying the named subject is important for both academic and applied reasons. Namely,

1. Electronic brokerage gains an increasing importance for trade in freely floating currencies (as well as in many other securities). However, its theory, particularly one that would be able to explain price formation, is insufficiently developed. The reason might be a high level of analytical requirements involved.
2. In the order-driven (brokered) market context, it has not been yet understood whether the so-called “flow-centric” view of many microstructure theorists is valid or not. Namely, the question whether signed trades (order flow) carry the same information as prices has been at most addressed empirically with very little formal foundation.
3. Given the lack of a single physical or virtual venue for the forex and the general opacity of this market, its brokered segment offers at least a partial transparency and (although mostly hypothetical) possibility to access data on past trades. Policymakers, particularly those in central banks that follow other than fixed exchange rate regimes, would benefit from a “user manual” helping them to interpret the available information read off FX broker screens. Among other things, such a set of guidelines might assist at times when FX intervention or transition to a new regime is being considered.

The present project approached the above problems by constructing a model of small (compared to the size of the market) FX traders with a non-trivial distribution of private values a foreign currency as well as heterogeneous information about the parameters of this distribution across traders. We derive the basic relationships between the limit order book, market sell and market buy order flow distributions, expected market order execution prices and the probabilities of a limit order execution at a given price, all as functions of private information. There is no pre-defined “fundamental” value benchmark for the asset, the standing bid and ask prices arise endogenously as an outcome of simultaneous rational decisions of all traders. In short, our model has been constructed to explain how a collection of private values is transformed by a broker into a public price.

The model is able to illustrate, for a given private value, the dependence of trader welfare on the quality of information. Finally, the model can incorporate such a “soft” factor as market sentiment into the traditional trade/price equivalence concept of microstructure finance.

We use available data (courtesy of Reuters Czech Republic, s.r.o.) on 6 months of trading in the Czech koruna against the euro in the years 2003-4 through the electronic brokerage platform Reuters Dealing 3000 to construct typical limit order books and intraday trading frequency profiles. This allows us to narrow the set of meaningful calibrations of the model and offer a method of selecting the best calibration based on actual trading data.

In principle, the proposed model allows for application to real FX quote data at practically any frequency, although the one-shot game that we analyze is more suitable as an instrument for an instantaneous capture of trader attitudes than a framework for generalizations over longer periods. In the former capacity, the model offers a potential policy tool for traders and risk managers (e.g. at a central bank) in real time, suited to assess the unobserved distribution of the actual market valuations of the currency across traders.

Our findings with regard to the three areas of interest named earlier are the following.

Ad 1 The constructed model satisfies the requirement of mapping private values and information into the price one sees on an FX broker’s screen. It is able to generate an equilibrium limit order book with realistic properties. The model belongs to the simultaneous trade category. Regardless of the degree of realism with which the present model captures the specifics of brokered trading in fast markets, it contributes to the microstructure finance literature by providing an order-driven counterpart to simultaneous trade dealership models. Accordingly, the insights on the (in)sufficiency of order flow statistics for price determination by a broker may cast a new light on the similar proposition discussed in the context of dealer markets. Specifically, if a limit order book looks differently under the same values but different common biases in beliefs, could it be that also dealer quotes react differently to the same incoming order flow under different opinions the dealer might share with her customers? The answer appears to be positive at least for a dealer whom one is able to incorporate in the present setting as a competitor to the broker.

Ad 2 Although the model contains the usual attribute of microstructure models - a map from trades into price - it also provides an important qualifier. Namely, it shows that orders (and, consequently, trades, since every order is a trade at least potentially) are transmitted into price differently depending on informational parameters of the investor population. That is, any common element in the trader beliefs co-determines the price. This common element can be just the sentiment in conventional sense, but it can also reflect attitudes with a fundamental background. The brokerage mechanism that we model indeed channels order flow into the pair of inside prices. However, the buy and the sell market order flows alone are insufficient to fully explain those prices. This can be considered an innovative contribution of this paper to the “flow-centrist” vs. “fundamentalist” debate of the present day finance literature.

Ad 3 The model suggests that when a central bank evaluates survival chances of a freshly introduced exchange rate regime (say, a fluctuation band for the CZK/EUR rate within ERM2), it may not be enough just to follow the standing currency price in the market. Our model can be used to generate examples of one and the same exchange rate being generated with an underlying “bearish”, “bullish” or neutral distribution of preferences for the national currency among the investors. With the model, we provide a more refined means of

interpreting the observed bid and offer prices on a broker's screen. So, a policymaker can extract information about the underlying private currency value profile, which should be helpful particularly in short-term considerations about hidden one-sided pressures on the currency. However, to be able to do this, the monetary authority would have to invest in an in-depth monitoring of the brokered FX trading, which includes not just standing prices and market order flows, but all available bits of information on the limit order book evolution as well. Namely, our results suggest that the market order flow does not necessarily carry the same information as prices (unless one artificially restricts attention to very special cases of private asset values and information endowments). In the model, there exist parameters describing the trader population (including one that we may loosely identify with the popular notion of "market sentiment") which influence the price, making it indeterminate for any given market order flow value. Formally, we have attached the meaning of market sentiment to the initial bias in the investor private information. Therefore, even though trades do transmit preferences into prices, they alone are not enough to pin down the price uniquely. Selecting a particular calibration of the model so as to approximate an actually observed limit order book, one can remove the indeterminacies, including the one linked to the "sentiment". Accordingly, whether the observed price movements reflect fundamental or transient factors appears to be an empirical question.

Two general conclusions to be made from our current understanding of the electronic FX brokerage are that

- it is sufficiently representative for the FX market of a given currency pair to justify continuous detailed observation by the central banks who intend to actively manage their currencies
- the exchange rate generated in a brokered FX market is very sensitive to changes in the underlying private value distribution among traders; therefore, assessing the main features of this distribution may be the key element in the policy that strives to prevent one-sided pressures on a currency under managed float or more explicit regimes.