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Incomplete solution to written exam for the M. Sc in Economics

Economics of Exchange Rates

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Number of questions: This exam consists of 2 questions.

1. (a)
   - The FX market is a two–tier market (retail and interbank markets), trading in each market is distinct in terms of participants and trading mechanisms
   - Dealers trade directly and indirectly in the interbank market and quote prices and initiate trades.
   - No dealer has complete information about the state of the interbank market and they do not observe the structure of limit orders that describe the liquidity on the market.
   - Brokers provide market–wide information on quotes and transaction prices.
   - Direct interdealer trading takes place simultaneously but dealers only have information about their own trades.
   - Dealers face constraints on both the duration and the size of their asset positions and overnight positions are typically zero or small.
   - Banks fill customer orders in the retail market.
   - Customer orders on the retail market provides important private information to dealers.
   - Dealers working at banks with large customer base and a worldwide reporting system have informational advantages over other market participants (cf. Cheung and Chinn).
   - Customer orders come from many different sources and may be generated by allocative, speculative and risk–management factors. Customer orders that is a function of current and past prices are termed feedback orders.
   - Market-makers (banks and investment banks) provide two-way bid and ask prices. This is the direct market or bank-to-bank market or bank-to-customer market.
   - No market-maker in brokered market or bank-to-broker.
   - The foreign exchange market consists of two markets, the retail market where investors and dealers trade and the interbank market where dealers and the broker trade. Each market has its own trading mechanism.

- Dealers trade directly and indirectly on the interbank market and quote prices and initiate trades.
- No dealer has complete information about the state of the interbank market whereas the broker does, they provide market–wide information on quotes and transaction prices. But dealers do not observe the structure of limit orders that describe market liquidity. Dealers only have information on their own trades and trade simultaneously.
- Dealers are constrained on both the duration and size of asset positions and their overnight position is small (or zero).

(b) All dealers quote the same spot price to both other dealers and to their customers (quotes are publicly announced) and we assume that the exchange rate is determined by fundamentals (as in most macro based models). s_t is the log price of currency quoted by all dealers, $0 < b < 1$ is a discount factor, f_{t+i} is the exchange rate fundamental at time $t+i$ and Ω_t^D is the information common to all dealers at the start of period t. The equation implies that the spot exchange rate is a function of discounted expected current and future fundamentals.

(c) Substitute forward to obtain solution. Details TBA.

The model implies that

$$\Delta s_{t+1} = \overbrace{\frac{1-b}{b}\left(s_t - \mathrm{E}\left[f_t \mid \Omega_t^D\right]\right)}^{\text{expected change}} + \overbrace{\varepsilon_{t+1}}^{\text{unexpected change}}$$

where the unexpected change is given by

$$\varepsilon_{t+1} = \frac{1-b}{b}\sum_{i=1}^{\infty} b^i \overbrace{\left(\mathrm{E}\left[f_{t+i} \mid \Omega_{t+1}^D\right] - \mathrm{E}\left[f_{t+i} \mid \Omega_t^D\right]\right)}^{\text{new information}}$$

- Our model above suggest that spot exchange rates are determined by current and future fundamentals. Therefore, spot rates must include forecasts of future fundamentals given common knowledge Ω_t^D.
- Our model suggest that order flows contain information about future fundamentals that is not public, i.e., not in Ω_t^D. Then order flows should predict future fundamentals beyond information contained in Ω_t^D! In other words, order flows should add to the forecasting power of all variables in Ω_t^D.
- Dealers period–t quote must be based on public information known at time t, i.e., $\mathrm{E}\left[\Delta s_{t+1} \mid \Omega_t^D\right]$.
- Unexpected changes reflect new information arriving between the start of period t and $t+1$. But new information is only important if it revises dealers forecast of the present value of fundamentals based on common information, i.e., $\mathrm{E}\left[f_{t+i} \mid \Omega_{t+1}^D\right] - \mathrm{E}\left[f_{t+i} \mid \Omega_t^D\right]$.

- Cheung and Chinn suggest that market participants are not all alike. Dealers may not respond in the same way to new information about fundamentals.
- Common knowledge (included in Ω_t^D) which is simultaneously observed by all dealers will immediately be incorporated into quoted prices. From Cheung and Chinn we know that it usually takes less than a minute before new information is reflected in the price.
- However, since market participants are not all alike, it may be that dealers interpret the common knowledge differently. Two dealers may not use the same model linking fundamentals to spot rates. This implies that new information which is common knowledge can be the source of dispersed information, i.e., be a source of customer order flows.
- Common knowledge (macro announcements) may operate both via the direct channel (common knowledge to all dealers) and via the indirect channel (dispersed information) through order flows.
- The equation illustrates that it is very difficult to forecast exchange rates since exchange rates are affected by news. News about fundamentals can reach dealers either directly (common knowledge) or indirectly through order flows (dispersed information about fundamentals).
- Order flows have no immediate effect on quotes because it is private information. But, if the order flow is public knowledge to all dealers, there will be an effect. How, then, is private information transmitted between dealers?
- Through interdealer orders. Dealers use private information to trade in the interbank market creating order flows between dealers which will transmit and make private information public (information aggregation).

(d) The Portfolio Shift model identifies two drivers of spot exchange rates:

1. Common Knowledge information transmitted via macroeconomic data releases and other new announcements, and
2. dispersed information transmitted via aggregate interdealer order flow.
   In the Portfolio Shift model, the dispersed information concerns the foreign income of investors, which is transmitted to the foreign exchange market via the customer orders received by individual dealers. This information is then disseminated across the market as dealers trade with each other.

(e)
- There is a strong positive contemporaneous correlation between daily changes in the price of FX and interdealer order flow. The correlation is robust to different forms of interdealer trading and appears across a wide cross-section of currencies.
- The contribution of interdealer order flows to daily changes in exchange rates is much higher than that found for any other macroeconomic or financial variables.
- The impact of order flows on exchange rates may depend on trading volume.

- The contemporaneous relationship between spot rate changes and order flow applies to both interdealer flows and customer flows.
- Customer flows disaggregated by customer type have more explanatorily power for ex- change rate returns than the aggregate flows received by individual banks.
- At the daily frequency, disaggregated flows can account for less of the variation in ex- change rate returns than aggregate interdealer order flows, but the explanatory power of customer and dealers flows are comparable at lower frequencies.

(f) TBA

2. (a) Official intervention serves as a signal of future monetary policy by providing the foreign exchange market with new relevant information. It is assumed that the current exchange rate is a function of current and discounted expected future fundamentals. An intervention on the FX market sends a signal to the market participants about future fundamentals. If future fundamentals change, the current exchange rate will also change. Sterilized interventions affect expectations about future movements in the relative money supply, income and interest rates with a feedback effect on the exchange rate. This effect also occurs in the monetary models, when foreign and domestic bonds are perfect substitutes. An underlying assumption is that the monetary authority has superior information and that they can reveal this information to the market by intervening on the foreign exchange market.

(b) This is a standard monetary model. Domestic (and foreign) real money balance is a function of output and interest rates. M_t is the money supply, P_t is the price level, Y is real output which is assumed to be exogenous (and constant) and r_t is the real interest rate. All variables are in logs. Note that we assume identical money demand functions in the two countries.

The third equation is UIP which is assumed to hold (no risk premium so domestic and foreign bonds are perfect substitutes).

The fourth equation is PPP which is assumed to hold instantaneously.

Further, it is assumed that households only hold their own currency. Since UIP holds we have ruled out portfolio balance effects. This setting also implies that sterilized interventions have no real effects.

(c) Solve for the price level in the two money demand functions and insert these solutions into the PPP relation and rearrange such that

$$S_t = M_t - M_t^* - \alpha_1(Y - Y^*) + \alpha_2(E_t S_{t+1} - S_t)$$

Rearrange this difference equation, substitute forward, assume no bubbles and collect terms to find the solution

$$S_t = \frac{1}{1+\alpha_2} \sum_{k=0}^{\infty} \left(\frac{\alpha_2}{1+\alpha_2} \right)^k E_t(M_{t+k} - M_{t+k}^* - \alpha_1(Y - Y^*))$$

The solution should include a statement about the no bubble assumption.

(d) Under the assumption that the money supplies and output levels remain constant for all time periods it is straightforward to use the solution above to find that

$$S_0 = M_0 - M_0^* + \alpha_1(Y - Y^*) \tag{1}$$

(e) We first must assume that the signal is perfectly credible. Agents know that the central bank will carry out the policy it has announced.

According to the hint in the question, $M_2 = M_0 + \gamma I$ and $M_2^* = M_0^* + \gamma I^*$. Under the assumption that monetary policy remain constant after period 2 we can use the exchange rate equation in 1(c) to find that

$$S_2 = (M_2 - M_2^*) + \alpha(Y - Y^*) \tag{2}$$

and using $M_2 = M_0 + \gamma I$ and $M_2^* = M_0^* + \gamma I^*$ we find that our period 1 expectation of the future exchange rate in period 2 is given by

$$E_1 S_2 = S_0 + \gamma(I - I^*) \tag{3}$$

Use the exchange rate equation in 1(c) for period 0 and insert (7) to find that

$$S_1 = S_0 + \frac{\alpha_2}{1 + \alpha_2}\gamma(I - I^*)$$

This equation shows that the exchange rate in period 1 has changed even though money supply is unchanged (to derive the expression above we have actually assumed that $M_1 = M_0$ and that $M_1^* = M_0^*$). The intervention in period 1 signals that monetary policy in period 2 and onwards has changed. Therefore there is an immediate effect on the exchange rate.

The reason why the exchange rate moves in period 1 is that households revise their expectations about future monetary policy (full knowledge about the model, central bank is credible).

Answers that include the following should get extra points. The model above implies that the exchange rate in period 1 moves in the same direction as the long-run solution but falls short of the entire long-run adjustment. Using the expression for S_2 above we find that

$$S_2 = S_0 + \gamma(I - I^*)$$

which is higher than S_1. The exchange rate changes in period 1 but not fully to S_2.

(f) TBA This is discussed in Reeves Appendix 1. Main point is that a risk premium will exacerbate the effects of signaling.

(g) This relates to the paper by Fratzscher. The first part is to use the equation in the question to illustrate how oral interventions work. The solution is along the following lines: In the portfolio balance channel, actual interventions between t and t +

1 alter the relative demand for domestic versus foreign bonds. Given the imperfect substitutability of these assets in the case of sterilized interventions, the actual interventions affect the spot rate by altering the foreign exchange risk premium. In the signaling channel, both oral interventions and actual interventions influence the spot rate by directly altering expectations about future fundamentals, i.e., the sum of current and expected future fundamentals on the right-hand side. The key feature of the model with regard to interventions is that the intervention signal is common knowledge and available to all agents in the market. Hence, actual and oral interventions constitute new information that leads to a revision of expectations by all agents. Fratzscher also discusses the coordination channel. TBA