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RE-OPENING OF BANKS' CERTIFICATES OF DEPOSIT MARKET*

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ABSTRACT

The paper analyzes the applicability of variable parameter models to examine the behaviour of the interest rates in the market for cd's on the first market day after the bank strike, 7.3.1990, and on the first "normal" Wednesday after the strike, 21.3.1990. The data is minute data and variable parameter models are used as a way to capture the impact of information processing by traders on the interest rates. The results indicate that variable parameter models give satisfactory results. According to the models, the behaviour of the interest rates was more erratic before the interventions by the the Bank of Finland on both days. The banks' receive information on their position vis à vis the Bank of Finland at noon. On the 7.3. this information seemed to surprise banks whereas on the 21.3. there is no evidence of this.

TIIVISTELMÄ

Selvityksessä tarkastellaan vaihtuvaparametrisen mallin avulla sijoitustodistusten korkojen määräytymistä ensimmäisenä pankkilakon jälkeisenä päivänä, 7.3.1990, ja ensimmäisenä lakon jälkeisenä "tavallisena" keskiviikkona, 21.3. Työssä estimoidaan koroille minuuttiaineistolla malli, jolla yritetään ottaa huomioon markkinoille tulevan uuden informaation prosessoinnin vaikutus korkoihin. Tulosten perusteella mallityyppi näyttää soveltuvan tämän kaltaisiin analyyseihin.

CONTENTS

1. INTRODUCTION

A lockout and a strike in the Finnish banking sector closed the banks' certificates of deposit market for 35 days in February-March. Certificates of deposit account for the bulk of the Finnish money market transactions. The market for short-term funds function efficiently under normal (non-strike) circumstances, with demand and supply determining the level of interest rates. The most important monetary policy instruments, Bank of Finland's open market operations are based on the sales and purchases of the certificates of deposits issued by certain banks and the central bank, and to a minor extent on Treasury bills.

During the labour market unrest the short-term interest rate, so called Helibor, which normally is calculated from the certificates of deposits, was set administratively at 16.01 per cent for the three months maturity and all the money market transactions with the banks were based on one month loans and deposits. The interest rate of these loans was 16 %. While the cd-market in Finland was closed, the foreign interest rates increased especially in the German money market but the convertible reserves of the Bank of Finland increased. This increase was enhanced by the introduction of a tax to foreign borrowing which came into force on February 1.

On the March 7th the market opened again in a situation where the banks did not have an estimation of their own or other banks liquidity position. (Usually the Bank of Finland gives an estimate of the call money exposure of the banks in the aggregate for the previous banking day (i.e. two days before the value date of the cd-market) at the Reuter's screen in the morning, but not this time. We assume that this uncertainty forced the banks to interprete each other's quotations at the screen as signals of the other banks' liquidity position.

The purpose of this paper is to examine how the model of signal extraction can be applied in the Finnish cd-market circumstances. The data was collected from the banks' quotations on the Reuter's screen (page SIJO). The model is presented in section 2. Estimates of the model are described in section 3 and our conclusions are presented in section 4.

2. THE MODEL

Let the supply of banks' cd's be in the morning

$$S(r_0, e_0), \tag{2.1}$$

where r0 is the interest rate of one-month cd and e_0 is a disturbance term.

The demand for cd's is given by

$$D(r_0, E[q_0], q, i_0), \tag{2.2}$$

where q is the banks' liquidity position and i_0 is the central bank's intervention.

At the equilibrium S = D and therefore the rate of cd in the morning is determined by

$$r_0 = r_0(E[q_0], q, i_0, e_0) \tag{2.3}$$

which is used as a basis for the extaction of the real q.

The liquidity required from the bank during the day is assumed to be unobservable to the bank in the morning. The liquidity requirement is a random variable v, which has an unknown distribution and a mean k. Once the market re-opens after the strike, the distribution is v_0 with an estimated mean k_0. A bank quotes a bid rate with this information and the market finds an equilibrium at the rate r_0. This equilibrium rate is a signal of the liquidity requirement and leads to a new estimate of the v' s distribution in the minute 1. Then the v1 is a random variable with a mean k1 and the market finds an equilibrium at the rate r_1.

The banks face during normal days but after the bank strike in particular the problem of knowing the intentions of the Bank of Finland. They have to extract this also from the market data. The

banks may also have uncertainty about the intervention bands of the Bank. In the after-strike day they naturally faced this problem but in addition they had to try to estimate the target level of interest rates the central bank had.

These signal extraction processes lead to the following alternative dynamic model specifications:

$$r_t = a(t)r_{t-1} + b(t)i_t + e_t, \tag{2.4}$$

$$Dr_t = a(t)Dr_{t-1} + b(t)i_t + e_t, \tag{2.5}$$

where a and b are time varying regression coefficients due to the revision based on signal extraction and D denotes the first difference.[1] We shall also allow for the possibility that the signal extraction is associated with the interventions only. In this case we use variants of equations (2.4) and (2.5) where the intervention variable is unity from the minute the intervention is made up to the next intervention. This allows for a "slow" impact of the intervention on the interest rates.

The model can be estimated using the EM algorithm designed for the estimation of models with unobserved components (see Engle and Watson (1983)).

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[1]Schinasi and Swamy (1989) have examined the performance of models of exchange determination with variable coefficients. They found that when coefficients are allowed to change, many conventional models of exchange rates can outperform forecasts of a random walk model. They rationalize the use of time varying coefficients model in a way we do. In addition they observe that not all the agents are simultaneously in the market so that some heterogeneity among traders may make the assumption of variable parameters reasonable. This is true in our case also since the minute by minute quotations come from separate banks.

3. DATA

The data was obtained from Reuters page SIJO, which shows the bid/offer rates for certificates of deposits. The rates are quoted on the screen by 10 Finnish banks for maturities of 1 to 6 months. The quotations are indicative, real transactions are based on phone calls. Our time series consist of minute by minute snapshots, the rates were collected at the end of each minute on two days, March 7th and 21st. The average of the bid rates of the 10 banks was used in the estimations. (The bid/offer rate is always 5 bp, so the results would not change if we used offer rates). Transactions in the Finnish cd-market are made between 10 a.m. and 3 p.m..

The maturity of one month was used in the estimations as it was the maturity for which the rates on the screen changed most often (31 times on 7. March and 27 times on 21. March).

The data on interventions is confidential and for the use in the Bank of Finland only, therefore we give no details of it here.

4. THE ESTIMATION RESULTS

The results of estimations of equation (2.4) where the regression coefficient of the lagged endogenous variable was allowed to vary were very poor and are thus not reported. The changes in the rates of interest were so small that the impact through the level of interest rates is small. In fact, to the idea of signal extraction it is the changes in the rates of interest rate which are important. Thus one may expect that estimation of (2.5) gives better results. This expectation is at least partially confirmed:

1. Endogenous variable Dr_t

	7.3. coeff.	7.3. std.err.	21.3. coeff.	21.3. std.err.
Dr_{t-1}	a(t)			
Infol	-.000000037	.0038	-.000000027	.0026
Id73	.0012	.0067		
Id1			-.00499	.00261
Id3			-.017	.00376
Id4			-.000000027	.0026

Endogenous variable a(t)

	7.3. coeff.	7.3. std.err.	21.3. coeff.	21.3. std.err.
a(t-1)	.2044	.265	.390	.188
R^2	0.0		.17	
F(7,292)			8.44	
Ljung-Box	30.87	(Chisq(13))	19.07	(Chisq(11))
D-W	1.8		1.95	
Log.lik.h.	1499.86		1617.08	

Here Id73 is the impulse dummy variable for the only intervention made on 7.3., Id1 is the impulse dummy for the first intervention on 21.3., Id3 and Id4 the impulse dummies for the third and fourth intervention. We report here the results for using intervention dummies. The results from using the actual intervention data were not different. The second intervention on 21.3. was small and it did not seem to have any effect on the market. Infol is the impulse dummy for the 12 o'clock information banks receive on their previous day net position vis a vis the Bank of Finland.

The equation for 7.3. performs rather badly, even though all the variables have received the expected signs. The results were not better when the coefficient of the lagged enogenous variable was constrained to be constant. The results for 21.3. are more encouraging, however. The equation performs reasonably well by the standard criteria. The coefficient of the lagged endogenous variable appears to possess a significant AR(1) structure. This would seem to confirm the hypothesis that interest rate changes carry informa-tion which is filtered forward and thus the impact should vary with time. One should be careful in drawing any far reaching conclusions, however. As the estimated a(t) coefficient is examined together with the endogenous variable, it seems that a(t) changes very much in conform with the interest rate and returns converge fast after the change towards 0. The estimated AR-coefficient of the a(t)-process seems to indicate that most of the information coming to markets and filtered from changes in the interest rates has only a temporary impact on the interest rates, only a small fraction has a lasting effect during the day.

2. Endogenous variable r_t

	7.3.		21.3.	
	coeff.	std.err	coeff.	std.err.
r_{t-1}	.99992	.000019696	.99997	.000017958
info73				
info213			-.000273	.00070592
idi73	$b_2(t)$			
idi1213			$b_3(t)$	
idi3213			$b_4(t)$	
idi4213			.0002175	.00035314
m			$b_5(t)$	
Endogenous variable $b_i(t)$				
$b_1(t-1)$	.32427	.32804		
$b_2(t-1)$	.98601	.0039038		
$b_3(t-1)$			1.000	5.1264
$b_4(t-1)$			.89752	.089060
$b_5(t-1)$			.68384	.15927
R^2	.996375		.997826	
F	F(6,294) 13469.15		F(10,290) 13308.75	
Ljung-Box	20.29 (Chisq(12))		12.91 (Chisq(8))	
D-W	1.79		1.82	
Log.lk.h	1526.256		1634.092	

Here info73 has the value of unity until the first intervention on the 7.3. and info213 is the corresponding variable for the 21.3.. Id73 receives the value unity from the time of the intervention on the 7.3. until the end of the day, idi1213, idi3213, and idi4213 are the corresponding intervention variables for the 21.3., they have the value unity until the the next intervention. m is equal to unity on the 21.3. from the beginning of trading up to mid-day to catch the fact that banks receive preliminary information on their position from the Bank of Finland. On the 7.3. this information was not released.

The equations perform reasonably well except for the fact that the coefficient for the lagged endogenous variable does not differ significantly from 1 on 21.3. On 7.3. the AR process for the intervention is significant. The AR coefficient is high indicating that mostly all the information received after the information was interpreted by the market as implying a permanent change in the interest rate. On this day the dealers may have just wanted to get the interest rates right and the intervention by the Bank of Finland then settled the proper level. The coefficient for the 12 o'clock information does not differ significantly from 0.

The Forecastmaster -program used in the estimation was not able to handle more than 3 variable parameter exogenous variables. For the 21.3. we decided to report the results for the experiments were the 12 o'clock information variable and the last intervention variable had constant coefficients because the resulting equation performed best on conventional standards. The results are interesting in that the third intervention variable has a significant AR-process as well as the morning information variable. The AR-parameter of the intervention variable is larger than that of the morning information variable. This could be interpreted as indicating that according to the model the events in afternoon had a more permanent impact on the interest rate than events in the morning.

3. The program was not able to estimate equations for the change in the rate of interest where the lagged endogenous variable appears either with constant or variable coefficients. It gave a notice of

near singularity in both cases. Thus we present the last results with only the intervention and information parameters as explanatory variables:

	7.3.		21.3.	
Endogenous variable Dr_t	coeff.	std.err	coeff.	std.err.
info73	$b_1(t)$			
idi73	$b_2(t)$			
info213			-.00033254	.00060170
idi1213			$b_3(t)$	
idi3213			$b_4(t)$	
idi4213			-.00023709	.00020239
m			$b_5(t)$	
Endogenous variable $b_i(t)$				
$b_1(t-1)$	.88275	.16445		
$b_2(t-1)$	.98198	.10785		
$b_3(t-1)$			.66275	.3184
$b_4(t-1)$			.54994	.1571
$b_5(t-1)$			.25708	.2379
R^2	0		.017	
F			F(9,291) 1.589	
Ljung-Box	38.19 (Chisq(13))		19.822 (Chisq(9))	
D-W	1.695		1.689	
Log.lk.h	1512.677		1637.336	

Even though the "explanatory power" of the equation for the 7.3. is poor it works well in terms of the results for the variable coefficients. Both the 12 o'clock information and intervention variables obtain significant AR-processes with the AR-coefficient so high that most of the changes are interpreted as permanent. This accords well with the hypothesis above that on that day the markets just tried to find a reasonable level for the interest rates.

The results for the 21.3. also broadly conform with those reached above. According to the model in the afternoon the interest rate changes after interventions were mostly regarded as permanent and the changes in the morning as temporary. The dichotomy is not so strong as above but it still seeems to hold.

5. CONCLUSIONS

The equation using the changes in the rates of interest performed satisfactorily in the estimations, whereas the results of the equations whith lagged enogenous variable were poor. According to the results of the estimations the cd-market stabilized surprisingly soon after the strike even though the uncertainty initially was much larger than normally.

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