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ABSTRACT

The paper has assessed market participants' confidence in the national currency of Latvia in the period between January 2001 and April 2003 using as the basis the position of the lats interest rates within the interest rate corridor. For the purpose of the study, the method of Lars E. O. Svensson was modified taking into account quoted interest rates and exchange rates as well as using the simple interest rate calculation. For the term of up to 1 year, arbitrage opportunities in Latvia's foreign exchange and money markets, likely to arise from the absence of money market participants' confidence in the existing foreign exchange corridor, have not been observed. The assessment of Latvia's money market participants does not signal any realignment possibility for the foreign exchange regime within the coming year.

Key words: *exchange rate target zone, credibility, market interest rate, arbitrage opportunities*

JEL classification codes: *D84, E43, E58, F31, G15*

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INTRODUCTION

Under the fixed foreign exchange rate regime with a limited target zone, the central bank sets margins for the exchange rate that cannot be exceeded. A restriction on the exchange rate affects domestic interest rates – they cannot exceed the interest rate corridor formed jointly by the foreign interest rates and potential exchange rate changes. Given a longer term, the potential annual exchange rate changes diminish, thereby the interest rate corridor narrows.

This study is based on an assumption of a free capital mobility and credibility of the national currency. Latvia does have a free capital flow needed to ensure realisation of the above condition. Provided that these conditions were effected and the interest rates of the national currency exceeded the interest rate corridor, sound arbitrage opportunities ensuring an inflow of a significant amount of capital into the domestic market would emerge. Consequently, when the interest rate of the national currency exceeds the upper (lower) margin of the interest rate corridor, the investor is encouraged to borrow (lend) abroad and lend (borrow) at home, thus making a risk-free profit. By contrast, under a theoretical arbitrage opportunity and with capital flows not eliminating it, one of the conditions is not met, i.e. either free capital mobility is absent, or there is an uncertainty regarding future sustainability of the central parity of the currency peg or the target zone.

In order to check whether interest rates of the national currency are within the interest rate corridor, a simple test for exchange rate credibility could be conducted. In case that under free capital movement interest rates go outside the limits of the corridor, the realignment of the exchange rate target zone is to be expected in the currency market.

The assumption that there is free capital mobility between Latvia on the one hand, and other countries across the globe on the other, stems from the increasingly strong growth of Latvia's financial market in which a major part of banks' equity is held by non-residents; this makes capital of the Latvian financial market easily accessible and enhances overall awareness of the foreign financial market participants of the conditions in Latvia's markets. The interest rate corridor can thus be used in testing credibility of the exchange rate target zone set by the Bank of Latvia. Capital inflows and outflows will be dealt with separately.

When analysing the relation between the Latvian foreign exchange and money markets, the testing of UIP (uncovered interest rate parity) should be conducted. The expected UIP exchange rate estimates can be obtained from the spot exchange rate and interest rates for the national and foreign currencies for a corresponding term. Whether interest rates in the national currency for the respective term are or are not within the interest rate corridor will be equivalent to whether the expected future exchange rate for the same term is within the exchange rate target zone. In such a

way, credibility of the exchange rate target zone where the projected future foreign exchange rate will be within the intervention target zone, or the money market interest rates for the national currency within the interest rate corridor, can be tested.

When the foreign exchange rate increases, the value of the national currency depreciates.[1] This, in turn, reduces returns from foreign investment made in the national currency, and both the upper and the lower margins of the interest rate corridor fall simultaneously. Speaking about Latvia, possible deviations from the parity level of the lats exchange rate against foreign currency (SDR) are ±1% irrespective of maturity. Consequently, the interest rate corridor narrows in the term, as with the extension of the term relative changes in the exchange rate imply a smaller relative change per unit of time. With the term growing, the upper value of the interest rate corridor decreases but the lower one increases.

The paper deals with interrelations ruling Latvia's foreign exchange and money markets, as well as examines arbitrage opportunities of these markets that emerge under the fixed foreign exchange rate regime with a narrow target zone. The method of Lars E. O. Svensson, adjusted to the nature and circumstances of the Latvian financial market, is used in this paper.(6) The equations used are likewise adjusted to allow the application of simple annual interest rate data of the Latvian money market. Being an important condition for seeking arbitrage opportunities, the differences in foreign exchange buying (bid) and selling (ask) prices have also been considered. Chapter 1 of the paper describes the foreign exchange regime in Latvia. Chapter 2 comprises theoretical calculations and tackles the interrelations of the foreign exchange and money markets on the basis of *The Simplest Test of Target Zone Credibility* presented by Lars E. O. Svensson. Chapter 3 gives an overview of the Latvian data used in the study. Chapter 4 deals with the empirical results. The findings of the study are summed up in the concluding chapter.

[1] The exchange rate of the lats is expressed as a number of lats per one unit of foreign currency, i.e. the smaller the number of lats needed to purchase one unit of foreign currency, the higher the value of the lats.

1. FOREIGN EXCHANGE RATE IN LATVIA

Since February 1994, the Bank of Latvia has adhered to the pegging of the lats to the SDR[1] basket of currencies at the rate which was valid on the day of pegging – February 12 (LVL 0.7997 for XDR 1[2]), setting the margins of the passive intervention target zone at ±1% (LVL ≃ 0.008). That implies that the Bank of Latvia quotes the exchange rate of the lats against the currencies of the SDR basket on a constant basis using the formula for calculating the SDR basket of currencies and the world foreign exchange rates. If a market participant wishes to engage in foreign exchange transactions at the bid or ask rate set by the Bank of Latvia, it can be done at the Bank of Latvia. The volume of such transactions is not limited. Consequently, foreign exchange transactions at rates that are outside the Bank of Latvia's target zone become unprofitable for participants of the currency market.

The most recent revision of the structure of the SDR basket of currencies and the value of the included currencies took place on January 1, 2001. As at January 1, 2001, the SDR basket of currencies included the US dollar – 45%, the euro – 29%, the Japanese yen – 15% and the British pound sterling – 11%. The International Monetary Fund carries out updating of the structure of the SDR basket of currencies once in five years, and the present formula for the calculation of the SDR's exchange rate is:

XDR 1 = USD 0.5770 + EUR 0.4260 + GBP 0.0984 + JPY 21.0.

The Bank of Latvia sets exchange rates for other convertible currencies using the lats rate against the US dollar and the rate of the latter against other currencies.

The lats peg to the SDR basket of currencies ensures smaller fluctuations of the lats against each currency of the basket than a possible peg to a single currency would ensure. It is determined by the value of the basket of currencies, which is the average weighted value of the currencies included in the basket; hence total changes in the SDR basket of currencies are less pronounced than those in each currency of the basket.

Market exchange rates of the lats against the SDR are calculated using the exchange rate of the lats against the US dollar and that of the US dollar against the other currencies of the SDR basket of currencies quoted by *Reuters*. The exchange rate of the SDR basket of currencies calculated on the basis of market participants' quotes may differ from that of the peg (XDR 1 = LVL 0.7997) by ±1%. However, the upper edge of the market-quoted SDR rate shall not exceed XDR 1 = LVL 0.8077 ($\overline{S}$), while the lower one shall not be below XDR 1 = LVL 0.7917 ($\underline{S}$). Upon the market

[1] SDR (Special Drawing Right) is a unit of account created in 1969 by the International Monetary Fund for the purpose of diversifying the range of the foreign exchange reserve accumulation instruments of its members. SDR is a synthetic currency existing only on bank accounts, not in cash (banknotes and coins).
[2] XDR is the code of the unit of account of the SDR basket of currencies in compliance with the ISO 4217 Codes for Representation of Currencies and Funds.

rate of a currency of the SDR basket of currencies reaching one of the edges of the Bank of Latvia's foreign exchange corridor – $\overline{S}$ or $\underline{S}$ –, currency exchange transactions with the Bank of Latvia (selling lats for currencies of the SDR basket for price $\underline{S}$, or buying them for price $\overline{S}$) become profitable for banks. Such transactions are known as passive interventions, while the interval of the SDR exchange rate changes from LVL 0.7917 to LVL 0.8077 for XDR 1 is called the target zone.

The term "target zones" used in the financial literature applies well to the Bank of Latvia's intervention corridor setting activities. Quite recently, the focus on this topic strengthened due to the target zone policy pursued by the Economic and Monetary Union (EMU) in respect of exchange rates of the EMU countries' currencies against the German mark. Theoretical and empirical studies show that the exchange rate target zone has a stabilising effect upon exchange rate deviations from the parity. Over a longer horison, the stabilising effect of the foreign exchange rate target zone depends on market participants who, driven by speculative motivations, sell national currency when its value appreciates, and are willing to buy it when its value depreciates within the target zone, thus attempting to bring the exchange rate back to the central parity.(3) The existence of the target zone, in turn, allows the central bank to enjoy monetary independence, which translates into an opportunity to affect, to a certain extent, the domestic interest rates. Countries with a strictly fixed exchange rate regime are deprived of such an opportunity.[1]

2. THE EXCHANGE RATE TARGET ZONE AND INTEREST RATE CORRIDOR

The following notations are used in the paper: S_t, i_t^{τ}, $i_t^{*\tau}$, where S_t is the exchange rate at the time t (in units of the domestic currency per unit of a foreign currency, in the case of Latvia – XDR 1), i_t^{τ} is the money market simple annual interest rate for domestic currency at the time t for the term τ, $i_t^{*\tau}$ is the money market simple annual interest rate for foreign currency (SDR) at the time t for the term τ. Nominal money market interest rates with the term τ up to 1 year (measuring τ in years) are used in the study.

For the sake of simplicity, the difference between the ask and bid foreign exchange rates, as well as the borrowing and lending rate spread will not be initially dealt with. The terms of interest rates will be up to 1 year, and the simple interest rate formula will be employed.

In the event of investing in a foreign currency, one unit of the domestic currency can be exchanged for $\left(\frac{1}{S_t}\right)$ foreign currency units at the time t. At the end of the term,

[1] Under the conditions of strictly fixed exchange rate regime (without the target zone), free capital mobility and complete credibility of the national currency, even a slight deviation of domestic market interest rates from interest rates of the global financial market would result in the emergence of arbitrage opportunities.

the resulting amount of foreign currency invested for the term τ, will produce $\left(1+i_t^{*\tau}\cdot\tau\right)\frac{1}{S_t}$ foreign currency units. Upon converting the given amount of foreign currency back into the national currency, $\left(1+i_t^{*\tau}\cdot\tau\right)\frac{S_{t+\tau}}{S_t}$ units of the national currency are obtained. The real return on the transaction R_t^{τ} is:

$$\left(1+R_t^{\tau}\cdot\tau\right)=\left(1+i_t^{*\tau}\cdot\tau\right)\frac{S_{t+\tau}}{S_t} \quad [1].$$

By solving equation [1], R_t^{τ} is expressed by:

$$R_t^{\tau}=\left(\frac{1}{\tau}+i_t^{*\tau}\right)\frac{S_{t+\tau}}{S_t}-\frac{1}{\tau} \quad [2].$$

It is assumed that exchange rate fluctuations occur within a specified target zone and capital mobility is free. As soon as the exchange rate goes outside the target zone, the exchange rate offered by the central bank becomes more attractive to market participants, and they will engage in foreign exchange with the central bank, as is the case in Latvia.

The exchange rate of the lats quoted by market participants may be within the following margins:

$$\underline{S}\le S_t\le\overline{S} \quad [3].$$

Consequently, in the foreign exchange market, exchange rate fluctuations of the lats are restricted within:

$$0.99\cdot 0.7997\le S_t\le 1.01\cdot 0.7997$$

or

$$0.7917\le S_t\le 0.8077.$$

As the exchange rate target zone imposes restrictions on the exchange rate expected in the future, the expected actual return on investment in foreign currency is respectively restricted:

$$\underline{R}_t^{\tau}\le R_t^{\tau}\le\overline{R}_t^{\tau} \quad [4].$$

From equations [2] and [4] follows that:

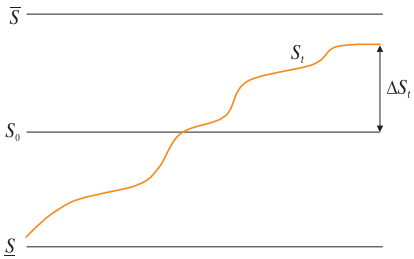
$$\underline{R}_t^{\tau} = \left(\frac{1}{\tau} + i_t^{*\tau}\right)\frac{\underline{S}}{S_t} - \frac{1}{\tau} \qquad [5a],$$

$$\overline{R}_t^{\tau} = \left(\frac{1}{\tau} + i_t^{*\tau}\right)\frac{\overline{S}}{S_t} - \frac{1}{\tau} \qquad [5b].$$

Lars E. O. Svensson calls the restrictions resulting from equations [4], [5a] and [5b] *the rate-of-return band*.

The interest rate and the rate-of-return band depend on the exchange rate at the time t. The exchange rate deviation from the parity is denoted as ΔS_t and the official central parity of the exchange rate as S_0:

$$\Delta S_t = S_t - S_0 \qquad [6].$$



Consequently, the exchange rate can also be expressed as the sum of the exchange rate central parity and the deviation from it:

$$S_t = S_0 + \Delta S_t \qquad [7].$$

Substituting equation [7] into equations [5a] and [5b], and taking into account the restrictions $\underline{S} = 0.99S_0$ and $\overline{S} = 1.01S_0$, we obtain:

$$\underline{R}_t^{\tau} = \left(\frac{1}{\tau} + i_t^{*\tau}\right)\frac{0.99S_0}{S_0 + \Delta S_t} - \frac{1}{\tau},$$

$$\overline{R}_t^{\tau} = \left(\frac{1}{\tau} + i_t^{*\tau}\right)\frac{1.01S_0}{S_0 + \Delta S_t} - \frac{1}{\tau}$$

or

$$\underline{R}_t^{\tau} = \left(\frac{1}{\tau} + i_t^{*\tau}\right)\frac{0.99S_0}{S_0\left(1 + \frac{\Delta S_t}{S_0}\right)} - \frac{1}{\tau},$$

$$\overline{R}_t^{\tau} = \left(\frac{1}{\tau} + i_t^{*\tau}\right)\frac{1.01S_0}{S_0\left(1+\frac{\Delta S_t}{S_0}\right)} - \frac{1}{\tau}.$$

Relative deviations of the exchange rate are denoted as $\delta S_t = \frac{\Delta S_t}{S_0}$, and we obtain:

$$\underline{R}_t^{\tau} = \left(\frac{1}{\tau} + i_t^{*\tau}\right)\frac{0.99}{1+\delta S_t} - \frac{1}{\tau} \qquad [8a],$$

$$\overline{R}_t^{\tau} = \left(\frac{1}{\tau} + i_t^{*\tau}\right)\frac{1.01}{1+\delta S_t} - \frac{1}{\tau} \qquad [8b].$$

Under the given exchange rate regime, relative deviations of the exchange rate are confined within the interval $-0.01 \le \delta S_t \le 0.01$. Substituting $\delta S_t = 0.01$ into equations [8a] and [8b], the lowest possible margins of the interest rate corridor are obtained. The lowest possible margin of the interest rate corridor is reached when the exchange rate is at the upper edge:

$$\underline{R}_{t\min}^{\tau} = \left(\frac{1}{\tau} + i_t^{*\tau}\right)\frac{0.99}{1.01} - \frac{1}{\tau} = 0.98 i_t^{*\tau} - 0.02\frac{1}{\tau} \qquad [9a],$$

$$\overline{R}_{t\min}^{\tau} = i_t^{*\tau} \qquad [9b].$$

Equation [9b] leads to the conclusion that in the event of SDR/LVL rate reaching the upper margin of the target zone, the upper interest rate margin of the national currency would coincide with interest rates of foreign currencies, and, consequently, the interest rates of the domestic currency would not necessarily be higher than those of foreign currencies. Provided that interest rates in the domestic money market were higher than those in foreign money markets, an opportunity of earning an assured profit (an arbitrage opportunity) would emerge without encountering an extra risk. Be it so, foreign currency could be borrowed, converted into lats and lent in the money market. As under such foreign exchange rate regime the exchange rate of the domestic currency could not fall further, the borrowing could later be fully repaid without any risk.

There are no arbitrage opportunities for transactions consisting in borrowing funds in the domestic market for the purpose of currency conversion and lending abroad, if $\underline{R}_{t\min}^{\tau} \le 0$:

$$\underline{R}_{t\min}^{\tau} = 0.98 i_t^{*\tau} - 0.02\frac{1}{\tau} \le 0,$$

$$0.02\frac{1}{\tau} \geq 0.98 i_t^{*\tau},$$

$$\tau \leq \frac{0.02}{0.98 i_t^{*\tau}} = \frac{0.0204}{i_t^{*\tau}} \qquad [10].$$

For example, if the interest rate of a foreign currency is $i_t^{*\tau} \approx 2\%$ (interest rates for the SDR basket of currencies calculated on the basis of LIBOR at the end of 2002), in the term shorter than 1 year ($\tau \leq 1$) arbitrage opportunities for transactions of borrowing funds in the domestic market for the purpose of converting lats into a foreign currency and lending abroad are completely eliminated. Equation [10] can be used to obtain also a domain for SDR interest rates where arbitrage opportunities would not emerge:

$$i_t^{*\tau} \leq \frac{0.02}{0.98} \cdot \frac{1}{\tau} = 0.0204 \cdot \frac{1}{\tau} \qquad [11].$$

By subtracting equation [9a] from equation [9b], a function of the width of the interest rate corridor is obtained for the case where the exchange rate hits the upper margin of the target zone:

$$\overline{R}_{t\min}^{\tau} - \underline{R}_{t\min}^{\tau} = i_t^{*\tau} - \left(0.98 i_t^{*\tau} - 0.02\frac{1}{\tau}\right) = 0.02\left(i_t^{*\tau} + \frac{1}{\tau}\right) \qquad [12].$$

An opposite case with $\delta S_t = -0.01$ is described next, i.e. the national currency has appreciated maximally and reached the lower margin of the target zone. Substituting $\delta S_t = -0.01$ into equations [8a] and [8b] the following is derived:

$$\underline{R}_{t\max}^{\tau} = i_t^{*\tau} \qquad [13a],$$

$$\overline{R}_{t\max}^{\tau} = \left(\frac{1}{\tau} + i_t^{*\tau}\right)\frac{1.01}{0.99} - \frac{1}{\tau} = 1.0202 \cdot i_t^{*\tau} + 0.02 \cdot \frac{1}{\tau} \qquad [13b].$$

In this case, provided that the domestic money market interest rate is lower than the foreign money market interest rate $i_t^{*\tau}$, the national currency (lats) may be borrowed, exchanged for the currencies of the SDR basket at the rate $\underline{S}$, and lent for the term τ at the interest rate $i_t^{*\tau}$. As in such a case further appreciation of the lats would not be possible, the repayment of the borrowed funds will be safe and, in addition, a profit will be earned.

Equation [13b] leads to an assumption that with the term $\underline{R}_{t\max}^{\tau}$ shrinking, τ can be unlimited.

Equation [8a] is rewritten as:

$$\underline{R}_t^{\tau} = \frac{0.99}{1+\delta S_t} \cdot i_t^{*\tau} - \left(1 - \frac{0.99}{1+\delta S_t}\right)\frac{1}{\tau} = \frac{0.99}{1+\delta S_t} \cdot i_t^{*\tau} - \frac{0.01+\delta S_t}{1+\delta S_t} \cdot \frac{1}{\tau} \qquad [14].$$

If $\delta S_t \geq -0.01$, then $\frac{0.99}{1+\delta S_t} \leq 1$, which implies that the floor of the domestic money market interest rate corridor cannot be above the foreign money market interest rate $i_t^{*\tau}$. The interest rate cannot be negative, so an additional restriction shall be taken into account:

$$\frac{0.99}{1+\delta S_t} \cdot i_t^{*\tau} - \left(1 - \frac{0.99}{1+\delta S_t}\right)\frac{1}{\tau} \geq 0$$

or

$$\tau \geq \frac{0.01+\delta S_t}{0.99 \cdot i_t^{*\tau}} \qquad [15].$$

Equation [15] denotes the term domain in which arbitrage is possible, because for an arbitrage opportunity to emerge in a shorter term than indicated in equation [15], the domestic money market interest rates would have to be negative. This implies that no one would be interested to engage in lending, for the gains would be greater if money were not lent; hence under negative interest rates transactions cannot be conducted.

Equation [8b] is rewritten in a similar manner:

$$\overline{R}_t^{\tau} = \frac{1.01}{1+\delta S_t} \cdot i_t^{*\tau} + \left(\frac{1.01}{1+\delta S_t} - 1\right)\frac{1}{\tau} = \frac{1.01}{1+\delta S_t} \cdot i_t^{*\tau} + \frac{0.01-\delta S_t}{1+\delta S_t} \cdot \frac{1}{\tau} \qquad [16a].$$

This equation implies that with unlimited shrinking of the term τ the interest rate $\overline{R}_t^{\tau}$ may be unrestrictedly high:

$$\overline{R}_t^{\tau} \geq i_t^{*\tau} \qquad [16b].$$

In order to obtain the width of the interest rate corridor, equation [8a] is subtracted from equation [8b]:

$$\overline{R}_t^{\tau} - \underline{R}_t^{\tau} = \left(\frac{1}{\tau} + i_t^{*\tau}\right)\frac{1.01}{1+\delta S_t} - \left(\frac{1}{\tau} + i_t^{*\tau}\right)\frac{0.99}{1+\delta S_t} = \left(\frac{1}{\tau} + i_t^{*\tau}\right)\frac{0.02}{1+\delta S_t} \qquad [17].$$

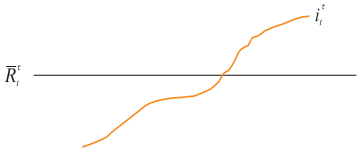
Equation [17] implies that the interest rate corridor is little affected by the initial position of the interest rate within the target zone. For example, if $\tau = 1$ and $i_t^{*1} = 4\%$, substituting the identity $\delta S_t = \pm 0.01$ into equation [17], we arrive at:

$$\delta S_t = -0.01: \quad (\overline{R}_t^{\tau} - \underline{R}_t^{\tau}) = (1 + 0.04) \cdot \frac{0.02}{1 - 0.01} = 0.02101 = 2.101\%,$$

$$\delta S_t = 0.01: \quad (\overline{R}_t^{\tau} - \underline{R}_t^{\tau}) = (1 + 0.04) \cdot \frac{0.02}{1 + 0.01} = 0.02059 = 2.059\%.$$

The difference (2.101 – 2.059 = 0.042) is only 4 basis points. For longer terms, the difference becomes even smaller.

In the event that exchange rate and the money market bid and ask interest rate spreads are taken into account, arbitrage conditions slightly change, thereby changing also equations [8a] and [8b]. Such a situation is considered in a greater detail. It is assumed that the domestic money market interest rate i_t^{τ} with the term τ exceeds a theoretically assumed maximum level $\overline{R}_t^{\tau}$.



In this case:
1) SDR 1 is borrowed at the interest rate i_{task}^{τ}, and at the end of the term τ, the amount repayable will be:

$$1 + i_{tbid}^{\tau} \cdot \tau \qquad [18];$$

2) SDR 1 is exchanged for lats at the rate S_{tbid}, and S_{tbid} lats are obtained;
3) lats are lent at the interest rate i_{tbid}^{τ}, and at the end of the term τ, $S_{tbid}(1 + i_{tbid}^{\tau} \cdot \tau)$ lats are obtained;
4) lats are re-exchanged for foreign currency and the amount obtained is at least:

$$S_{tbid}(1 + i_{tbid}^{\tau} \cdot \tau) \cdot \frac{1}{\overline{S}} \qquad [19].$$

Considering equations [18] and [19], the condition for the emergence of an arbitrage opportunity upon borrowing funds in foreign currency for the purpose of converting them into lats is:

$$(1+i^{\tau}_{tbid}\cdot\tau)\frac{S_{tbid}}{\overline{S}}>1+i^{*\tau}_{task}\cdot\tau$$

or

$$i^{\tau}_{tbid}>\left(\frac{1}{\tau}+i^{*\tau}_{task}\right)\frac{\overline{S}}{S_{tbid}}-\frac{1}{\tau} \qquad [20],$$

and a precise upper margin of the interest rate corridor shall be:

$$\overline{R}^{\tau}_{t}=\left(\frac{1}{\tau}+i^{*\tau}_{task}\right)\frac{\overline{S}}{S_{tbid}}-\frac{1}{\tau} \qquad [21].$$

The condition for the arbitrage opportunity not to emerge is:

$$i^{\tau}_{tbid}<\overline{R}^{\tau}_{t} \qquad [22].$$

Provided that there is no sound arbitrage opportunity for $i^{\tau}_{tbid}=\overline{R}^{\tau}_{t}$, the investor may still derive some benefit if exchange rate movements are favorable.

By contrast, reverse steps will be taken if the lats interest rates are below a theoretically assumed minimum interest rate $\underline{R}^{\tau}_{t}$:
1) LVL 1 is borrowed at the interest rate i^{τ}_{task} for the term τ. At the end of the term, payment on debt in the amount of $1\cdot\left(1+i^{\tau}_{task}\cdot\tau\right)$ lats will be made;
2) LVL 1 is exchanged for the SDR and $\frac{1}{S_{task}}$ SDR are obtained;
3) the obtained amount of the SDR is lent for the term τ, and at the end of it $\left(1+i^{*\tau}_{tbid}\cdot\tau\right)\frac{1}{S_{task}}$ are obtained;
4) the smallest amount of lats that can be obtained in the future is:
$\left(1+i^{*\tau}_{tbid}\cdot\tau\right)\frac{1}{S_{task}}\cdot\underline{S}$.

For arbitrage to emerge, the amount withdrawn in lats shall exceed the payable amount $1\cdot\left(1+i^{\tau}_{task}\cdot\tau\right)$.

Hence:

$$1+i^{\tau}_{task}\cdot\tau<(1+i^{*\tau}_{tbid}\cdot\tau)\frac{\underline{S}}{S_{task}}$$

or

$$i_{task}^{\tau} < \left(\frac{1}{\tau} + i_{tbid}^{*\tau}\right)\frac{\underline{S}}{S_{task}} - \frac{1}{\tau} \qquad [23].$$

The lower margin of the interest rate corridor is:

$$\underline{R}_t^{\tau} = \left(\frac{1}{\tau} + i_{tbid}^{*\tau}\right)\frac{\underline{S}}{S_{task}} - \frac{1}{\tau} \qquad [24].$$

The condition under which the arbitrage opportunity does not emerge is:

$$i_{task}^{\tau} > \underline{R}_t^{\tau} \qquad [25].$$

Under the fixed exchange rate regime with a target zone where there are no grounds to doubt the ability of the central bank to ensure a completely credible exchange rate regime and where there is free capital mobility, the domestic money market interest rates cannot exceed the following restrictions:

$$i_{tbid}^{\tau} < \overline{R}_t^{\tau},$$

$$i_{tbid}^{\tau} < \left(\frac{1}{\tau} + i_{task}^{*\tau}\right)\frac{\overline{S}}{S_{tbid}} - \frac{1}{\tau} \qquad [26],$$

$$i_{task}^{\tau} > \underline{R}_t^{\tau},$$

$$i_{task}^{\tau} > \left(\frac{1}{\tau} + i_{tbid}^{*\tau}\right)\frac{\underline{S}}{S_{task}} - \frac{1}{\tau} \qquad [27].$$

The absence of any of these relationships implies the lack of investors' confidence in the foreign exchange policy of the central bank or restricted nature of capital mobility, meaning that investors are likely to expect devaluation or revaluation of the central parity of the domestic currency, or that certain factors restricting capital mobility are in place.

In order to ascertain investors' confidence in currency stability, equations [26] and [27] are to be tested for various terms τ.

3. LATVIA'S DATA

The paper covers the period from January 2001 to April 2003 using monthly arithmetic mean of quoted interest rates for the SDR basket of currencies. The quoted SDR rates have been calculated using USD/LVL rate quoted by Latvia's banks and released by *Reuters*, as well as EUR/USD, USD/JPY and GBP/USD rates. Rates quoted

for the currencies of the SDR basket of currencies vary, hence the calculated SDR market rate also fluctuates within certain margins (±1%), despite the SDR rate set by the Bank of Latvia at LVL 0.7997 for XDR 1.

Simultaneously, for the purpose of analysis and the needs of this study, monthly arithmetic mean interest rates of the money market for lats and the SDR basket of currencies with 1-, 3-, 6- and 12-month terms have been collected. Similar to the SDR exchange rate, which is calculated on the basis of the basket currencies, the interest rates of the SDR basket of currencies have also been calculated using LIBOR and LIBID quotations for respective currencies of the basket:

$$r_{SDR} = \frac{0.577}{S_{SDR/USD}} \cdot r_{USD} + \frac{21}{S_{USD/JPY} \cdot S_{SDR/USD}} \cdot r_{JPY} + \frac{0.0984 \cdot S_{GBP/USD}}{S_{SDR/USD}} \cdot r_{GBP} + \frac{0.426 \cdot S_{EUR/USD}}{S_{SDR/USD}} \cdot r_{EUR},$$

where r is the interest rate of respective currencies, and S is the exchange rate of respective currencies.

RIGIBOR and RIGIBID quotations are used to represent interest rates of the Latvian money market.

4. EMPIRICAL RESULTS

The computed dynamics of the lats rate-of-return corridor, interest rates of the lats and the currencies of the SDR basket of currencies are given in Charts 1 to 4.

Chart 1 shows that the lats interest rates with a term of 1 month are inside the interest rate corridor. The lower margin of the interest rate has been negative for a prevailing period of time, implying that irrespective of the lats interest rates, almost no arbitrage transactions were possible in the money market when buying foreign currency; hence no risk related to depreciation of the lats against the SDR has practically been observed.

Chart 1

1-MONTH INTEREST RATES FOR THE MONEY MARKET AND THE INTEREST RATE CORRIDOR

(%)

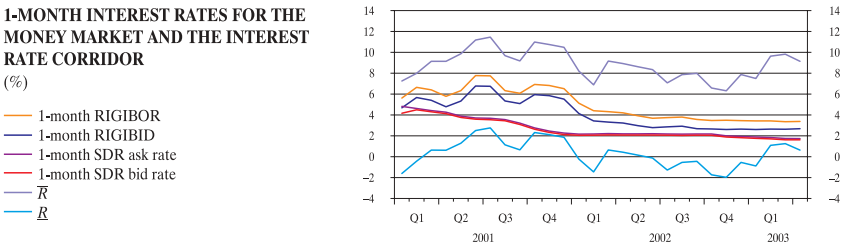


Chart 2 demonstrates that arbitrage of interest rates with a term of 3 months has not been observed.

Chart 2

3-MONTH INTEREST RATES FOR THE MONEY MARKET AND THE INTEREST RATE CORRIDOR
(%)

- 3-month RIGIBOR
- 3-month RIGIBID
- 3-month SDR ask rate
- $\overline{R}$
- $\underline{R}$

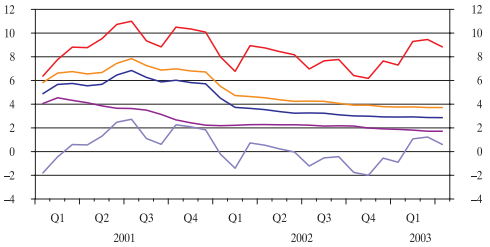


Chart 3 shows 6-month interest rate dynamics of the given period when similar to previously described interest rates almost no arbitrage opportunities were observed with an exception of September 2001 when the global economic growth was rather sluggish, and the terrorist attacks on the US on September 11 caused a steep fall in base rates of the major world currencies.

Chart 3

6-MONTH INTEREST RATES FOR THE MONEY MARKET AND THE INTEREST RATE CORRIDOR
(%)

- 6-month RIGIBOR
- 6-month RIGIBID
- 6-month SDR ask rate
- $\overline{R}$
- $\underline{R}$

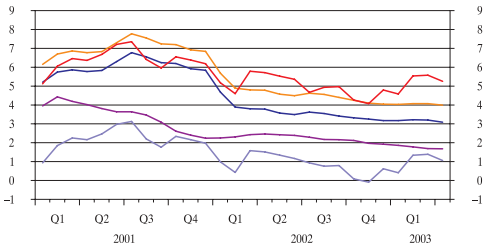
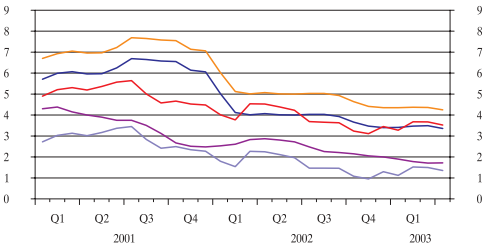


Chart 4 shows that between January 2001 and February 2002, and July 2002 and December 2002, arbitrage was possible for 12-month interest rates. Arbitrage opportunities seem to have existed only theoretically most likely due to low liquidity of transactions with this term (generally almost no transactions of this kind are conducted in the interbank market).

Chart 4

12-MONTH INTEREST RATES FOR THE MONEY MARKET AND THE INTEREST RATE CORRIDOR
(%)

- 12-month RIGIBOR
- 12-month RIGIBID
- 12-month SDR ask rate
- $\overline{R}$
- $\underline{R}$



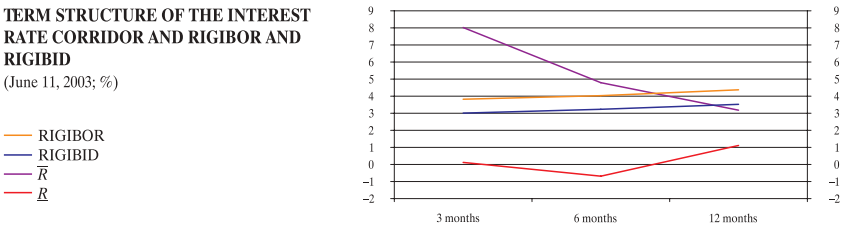
Theoretically, when dealing with interest rates in various countries, risk-free interest rates, such as interest rates on government debt instruments, should be compared. As

such rates with the term of up to 1 year are not available, the money market indices are used instead. It should be noted, however, that the credit rating of Latvia's banks is lower than the rating of banks that are able to obtain funds at quoted LIBOR rates. Consequently, as RIGIBOR rates have to include also the credit risk premium, they would have to surpass LIBOR rates and, thus, be closer to the upper margin of the interest rate corridor, if it is assumed that the deviation from the fixed peg is close to zero.

Chart 5 shows the term structure of the interest rate corridor as well as RIGIBOR and RIGIBID as at June 11, 2003. As is seen from the Chart, arbitrage opportunities have emerged only for the term of 1 year; in addition, the difference $i^1_{bid} - \overline{R}^1_t = 3.52\% - 3.18\% = 0.34\%$ is quite insignificant. In order to use the theoretical arbitrage opportunity described above, the funding of the SDR basket of currencies using LIBOR rates is needed, which, however, is unattainable for the majority of participants in Latvia's money market. Consequently, arbitrage opportunities are unlikely to emerge due to costs related to such a financing scheme. However, for foreign investors with an access to cheaper funds, the scope of the Latvian financial market is not large enough. Moreover, to follow arbitrage opportunities in Latvia, investors would have to devise a special model of the SDR basket and interest rates of its currencies, which is not the practice of other European countries.

Chart 5

TERM STRUCTURE OF THE INTEREST RATE CORRIDOR AND RIGIBOR AND RIGIBID
(June 11, 2003; %)



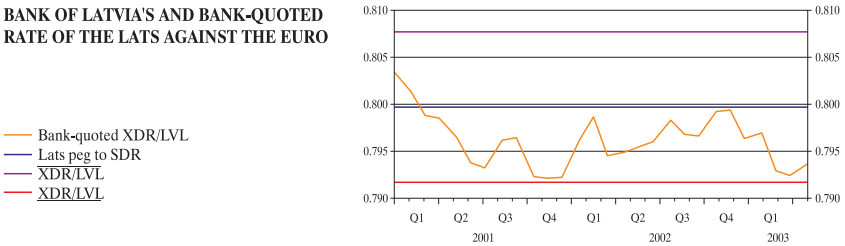
The absence of arbitrage opportunities in the reporting period suggests that the Latvian financial market is effective or close to effective. It is likewise clear that within the coming 12 months the market participants' confidence in the national currency will remain broadly unchanged (no revaluation or devaluation is expected).

Chart 6 shows the dynamics of the calculated SDR interbank foreign exchange rate for the reporting period within the target zone set by the Bank of Latvia. It demonstrates that the SDR rate calculated after March 2001 fluctuated at the lower margin of the target zone, and it confirms market participants' confidence in the lats.

As has already been noted, the domestic interbank credit market with the term longer than 3 months cannot be taken as adequately liquid – the forward exchange rates market is considered to be more liquid. Using covered interest parity, it is possible to

Chart 6

BANK OF LATVIA'S AND BANK-QUOTED RATE OF THE LATS AGAINST THE EURO



calculate interest rates for lats on the basis of USD/LVL forward rates quoted by *Reuters*. The covered interest parity leads to the following formula:

$$1 + i_t^{\tau} \cdot \tau = \frac{(1 + i_t^{*\tau} \cdot \tau) \cdot f_t^{\tau}}{S_t},$$

where f_t^{τ} is the forward exchange rate for the future date τ in the time *t*.

With due account taken of the high liquidity of foreign exchange markets, such information would more adequately reflect the lats interest rates for the term exceeding 3 months. According to a bank survey, however, forward and swap transactions are also most often conducted with a term of up to 3 months, which requires a more cautious assessment of the results for the term exceeding 3 months.

If a swap deal takes place, e.g. lats are sold for US dollars at the spot ask exchange rate, the obtained foreign currency is then lent at LIBID rate for US dollars, and after the term *t* the foreign currency is exchanged for lats at the forward exchange rate f_{tbid}^{τ}, such operation shall be considered equivalent to lending in lats. The lats interest rate will be as follows:

$$i_t^{\tau} = \frac{1}{\tau}\left(\frac{(1 + i_{tbid}^{*\tau} \cdot \tau)}{S_{task}} \cdot f_{tbid}^{\tau} - 1\right) \qquad [28].$$

For the purpose of comparison, reference shall again be made to the interest rate quotations of June 11, 2003 when the bank quoted USD/LVL spot rate was 0.5592/0.5597, whereas quotations of forward deals with the term of 1 year were +118.5/+174.2. This implies that forward contracts with the term of 1 year were estimated at the exchange rate 0.57105/0.57712, i.e. 0.5592 + 0.01185/0.5597 + 0.01742. LIBOR and LIBID for US dollars, at the same time, were 1.09% and 0.97%, respectively.

Substituting the respective values into equation [28], the following is obtained:

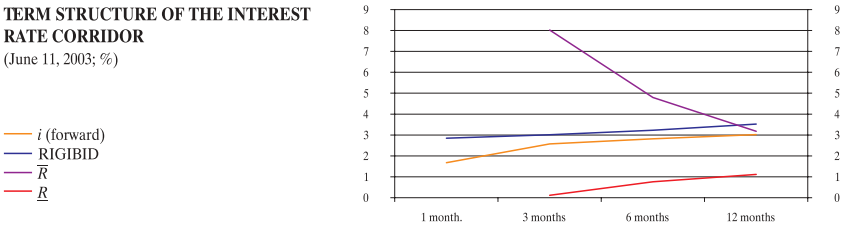
$$i_t^1 = \frac{(1 + 0.0097)}{0.5597} \cdot 0.57105 - 1 = 0.0302 = 3.02\%.$$

It is below the computed upper margin of the interest rate corridor for the term of 1 year (3.18%). It can, consequently, be asserted that for the term of up to 1 year the interbank credit market does not encounter arbitrage opportunities if money market rates are used. It suggests that the market is in equilibrium, which, in turn, confirms stability of the exchange rate regime of Latvia. It further implies that, according to the assessment of market participants, the central parity realignment possibility of the exchange rate (devaluation or revaluation of the lats) for the term of up to 1 year is not likely to occur.

Chart 7 shows the term structure of interest rates, which is based on bank-quoted bid rates and calculated using equation [28], taking into account bank forward exchange rate quotes as at June 11, 2003. The interest rate corridor for the terms of 3, 6 and 12 months is also given. The corridor calculated for shorter term interest rates becomes extremely wide; hence arbitrage opportunities disappear completely. At the same time, the Chart shows that with the term increasing, the bank-quoted interest rates approach the upper margin of the calculated interest rate corridor, which, however, points to an unfounded rise above the equilibrium level in longer term interest rates for the lats.

Chart 7

TERM STRUCTURE OF THE INTEREST RATE CORRIDOR
(June 11, 2003; %)



CONCLUSIONS

The paper has assessed market participants' confidence in the national currency of Latvia in the period between January 2001 and April 2003, using the position of the lats interest rates inside the interest rate corridor as the basis. For the purpose of the study, the method of Lars E. O. Svensson was modified taking into account quoted interest rates and exchange rates, and using the simple interest rate calculation. Via modeling of capital mobility and arbitrage opportunities, credibility of the foreign exchange target zone has been tested, and findings regarding positioning of the lats – Latvia's national currency – interest rates for various terms outside the interest rate corridor have been assessed.

Conclusions resulting from the study

1. For the term of up to 1 year, arbitrage opportunities in Latvia's foreign exchange and money markets, likely to arise from the absence of money market participants' confidence in the existing foreign exchange corridor, have not been observed.

2. For terms of up to 1 year, Latvia's foreign exchange and money markets are in equilibrium.

3. The assessment (quotations) of Latvia's money market participants does not signal any realignment possibility for the foreign exchange regime (devaluation or revaluation of the lats) within the coming year.

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