Department of Mathematics
Faculty of Mechanical Engineering
Slovak University of Technology in Bratislava

4th International Conference
APLIMAT 2005

SOLVING PROBLEM OF TESTING TARGET ZONE CREDIBILITY IN CASE OF CHANGING PEG CURRENCY

AJEVSKIS Viktors, (LV), SINENKO Nadezhda, (LV)

Abstract. The purpose of the present work is testing of target zone credibility in case of planned change in exchange rate regime. By "changing of a currency regime" we mean switching of pegging from one currency to another at the fixed time moment t1. This corresponds to the situation in Latvia, where on January 1, 2005 fixing of Latvian currency - lat to euro will take place. Since 1994 and till 2005 lat has been fixed to the currency basket SDR. In the present article Svensson's Simplest Test of Target Zone Credibility was generalized for estimation of target zone credibility under condition of change in exchange rate regime. Involving three currencies in our calculations leaded to generalization of Uncovered Interest Parity for the case of three currencies and two time intervals and necessitates using of forward interest rates.

1 Introduction

One of the most important conditions for conducting by Central Bank of a successful monetary policy is to have information about expectations of economic agents. In particular, it is very important, whether financial market participants consider Central Bank monetary policy as credible or not. As one of the examples of such a policy we can consider supporting by CB of the exchange rate target zone, e.g. keeping some foreign currency (or currency basket) exchange rate within definite bounds about a parity value. In such a case credibility to CB policy means, that market participants do not expect in future a realignment of the exchange rate, e.g. they do not expect CB to change the parity value or bandwidth.

To evaluate economic agents expectations, information about assets prices on financial markets could be used. In the article [2], Svensson proposed the Simplest Test of target zone credibility. The test is based on uncovered interest rate parity (UIP) and condition of absence of an arbitrage opportunity. From the above conditions the bounds for the domestic interest rate are derived.

When central bank is planning to change exchange rate in some moment t in the future (for example, to change from pegging to floating regime or to change pegging from one currency to another) the problem of testing Target zone credibility becomes more complicated. The latter case corresponds to the situation in Latvia. Latvian currency- lat has been pegged to the SDR currency

basket with ±1% target zone since 1994. Due to intention of Latvian policymakers to join in 2008 the European Monetary Union, from January1, 2005 lat will be fixed to euro.
As far as we know, until now there were no investigations of target zone credibility under condition of change in exchange rate. In the presented article we have generalized Simple Test of testing target zone credibility for case of change of the peg currency. Because we used in our calculations three currencies, some generalization of the UIP for the case of three currencies and two time intervals was needed.

2 The Simplest Test of Target Zone Credibility under Condition of Change in the Exchange Rate Regime

An exchange rate target zone implies bounds on the amount of depreciation and appreciation of the exchange rate. Given foreign interest rates, these bounds imply bounds on domestic currency rates of return to foreign investment. Svensson in [2] proposed to test whether or not domestic interest rates are within the rate-of-return bands. If the interest rates fall outside the band it definitely follows that the target zone is not credible.

In this chapter we introduce a method of calculation of the rate-of-return band in case of change in a currency regime. We associate changing of a currency regime with switching of pegging from one currency to another at the fixed time moment.

Let t_0 denote the initial moment of time (current moment). Let τ_1 denote time interval from the current moment up to the moment of change of the currency regime, and τ_2 denote remaining interval from the moment of changing of the currency regime to the moment of maturity.
We shall denote domestic currency as d (lat in our case), currency of pegging up to the moment $t_0 + \tau_1$ as c_1 (SDR basket in our case), currency of pegging after that moment as c_2 (euro in our case). Let $S^t_{i/j}$, $i^{d,\tau}_t$, $i^{c_1,\tau}_t$ and $i^{c_2,\tau}_t$ denote, respectively, the spot exchange rate in period t (in units of i-currency per unit of j-currency, i, j=d, c1, c2), the domestic-currency interest rate in period t for term τ loans in domestic currency, the c1-currency interest rate in period t for term- τ loans in c1-currency, the c2-currency interest rate in period t for term- τ loans in c2-currency. Let us measure the term τ in years.
Let us explain how interest rate target zone is formed, in case of change in the currency regime. Assume, that at time t_0 we exchange 1 unit of domestic currency d for $\left(\frac{1}{S^{t_0}_{d/c_1}}\right)$ units of currency c1.
The obtained sum in c1 we invest under the interest rate $i^{c_1,\tau_1}_{t_0}$. After the period τ_1 we will have $\left(\frac{1}{S^{t_0}_{d/c_1}}\right)\cdot\left(1+i^{c_1,\tau_1}_{t_0}\cdot\tau_1\right)$ units of currency c_1. At time $t_0 + \tau_1$ we exchange this sum at rate $\left(\frac{1}{S^{t_0+\tau_1}_{c_1/c_2}}\right)$ and we receive the sum $\left(\frac{1}{S^{t_0}_{d/c_1}}\right)\cdot\left(1+i^{c_1,\tau_1}_{t_0}\cdot\tau_1\right)\cdot\left(\frac{1}{S^{t_0+\tau_1}_{c_1/c_2}}\right)$ in currency c_2. Further we will invest this sum on the remaining term τ_2 under future interest rate $i^{c_2,\tau_2}_{t_0+\tau_1}$. At time $t_0 + \tau_1 + \tau_2$ we will have sum of $\left(\frac{1}{S^{t_0}_{d/c_1}}\right)\cdot\left(1+i^{c_1,\tau_1}_{t_0}\cdot\tau_1\right)\cdot\left(\frac{1}{S^{t_0+\tau_1}_{c_1/c_2}}\right)\cdot\left(1+i^{c_2,\tau_2}_{t_0+\tau_1}\cdot\tau_2\right)$ units of currency c_2. Finally the last sum we will convert in domestic currency at the rate $S^{t_0+\tau_1+\tau_2}_{d/c_2}$. As a result we will have sum of

$\left(\frac{1}{S_{d/c_1}^{t_0}}\right)\cdot\left(1+i_{t_0}^{c_1,\tau_1}\cdot\tau_1\right)\cdot\left(\frac{1}{S_{c_1/c_2}^{t_0+\tau_1}}\right)\cdot\left(1+i_{t_0+\tau_1}^{c_2,\tau_2}\cdot\tau_2\right)\cdot S_{d/c_2}^{t_0+\tau_1+\tau_2}$ in domestic currency d. We can calculate domestic currency rate of return for such a strategy using the following equality:

$$\left(1+R_{t_0}^{\tau_1+\tau_2}\cdot(\tau_1+\tau_2)\right)=\left(\frac{1}{S_{d/c_1}^{t_0}}\right)\cdot\left(1+i_{t_0}^{c_1,\tau_1}\cdot\tau_1\right)\cdot\left(\frac{1}{S_{c_1/c_2}^{t_0+\tau_1}}\right)\cdot\left(1+i_{t_0+\tau_1}^{c_2,\tau_2}\cdot\tau_2\right)\cdot S_{d/c_2}^{t_0+\tau_1+\tau_2},$$

where $R_{t_0}^{\tau_1+\tau_2}$ is domestic currency rate of annual return, which imply

$$R_{t_0}^{\tau_1+\tau_2}=\frac{1}{(\tau_1+\tau_2)}\cdot\left(\left(\frac{1}{S_{d/c_1}^{t_0}}\right)\cdot\left(1+i_{t_0}^{c_1,\tau_1}\cdot\tau_1\right)\cdot\left(\frac{1}{S_{c_1/c_2}^{t_0+\tau_1}}\right)\cdot\left(1+i_{t_0+\tau_1}^{c_2,\tau_2}\cdot\tau_2\right)\cdot S_{d/c_2}^{t_0+\tau_1+\tau_2}-1\right) \tag{1}$$

The future peg rate $S_{0,d/c_2}$ depends on market exchange rate at the moment $t_0+\tau_1$:

$$S_{0,d/c_2}=S_{0,d/c_1}\cdot S_{c_1/c_2}^{t_0+\tau_1}=0.7997\cdot S_{c_1/c_2}^{t_0+\tau_1}, \tag{2}$$

where $S_{0,d/c_1}$ is domestic currency peg rate to currency c_1 up to the moment $t_0+\tau_1$, but $S_{0,d/c_2}$ is domestic currency peg rate to currency c_2 after the moment $t_0+\tau_1$. In the case of Latvia currency peg rate up to year 2005 is $S_{0,d/c_1}=0.7997$ lats for 1 unit of SDR currency, but lat peg rate to euro will be known only after lat is fixed to euro.

Here we assume that exchange of SDR for euro and change of a currency regime occur simultaneously.

Market SDR/euro exchange rate at moment of changing of peg could be expressed as exchange rate ratio:

$$S_{c_1/c_2}^{t_0+\tau_1}=\frac{S_{0,d/c_2}}{S_{0,d/c_1}}=\frac{S_{0,d/c_2}}{0.7997} \tag{3}$$

Now we substitute (3) in (1):

$$R_{t_0}^{\tau_1+\tau_2}=\frac{1}{(\tau_1+\tau_2)}\cdot\left(\left(\frac{1}{S_{d/c_1}^{t_0}}\right)\cdot\left(1+i_{t_0}^{c_1,\tau_1}\cdot\tau_1\right)\cdot\left(\frac{1}{\frac{S_{0,d/c_2}}{S_{0,d/c_1}}}\right)\cdot\left(1+i_{t_0+\tau_1}^{c_2,\tau_2}\cdot\tau_2\right)\cdot S_{d/c_2}^{t_0+\tau_1+\tau_2}-1\right)=$$

$$=\frac{1}{(\tau_1+\tau_2)}\cdot\left(\left(\frac{1}{S_{d/c_1}^{t_0}}\right)\cdot\left(1+i_{t_0}^{c_1,\tau_1}\cdot\tau_1\right)\cdot\left(\frac{S_{0,d/c_1}}{S_{0,d/c_2}}\right)\cdot\left(1+i_{t_0+\tau_1}^{c_2,\tau_2}\cdot\tau_2\right)\cdot S_{d/c_2}^{t_0+\tau_1+\tau_2}-1\right) \tag{4}$$

After fixing of lat/euro parity, intervention corridor of 1% will be kept, so that market SDR/euro exchange rate at moment $t_0+\tau_1+\tau_2$ will be allowed to fluctuate within bounds:

$0.99\cdot S_{0,d/c_2}=\underline{S}\le S_{d/c_2}^{t_0+\tau_1+\tau_2}\le\overline{S}=1.01\cdot S_{0,d/c_2}$

Exchange rate corridor bounds imply bounds on domestic currency rate of return for observed strategy:

$$\underline{R}_{t_0}^{\tau_1+\tau_2}\le R_{t_0}^{\tau_1+\tau_2}\le\overline{R}_{t_0}^{\tau_1+\tau_2}$$

Substituting upper and lower exchange rate bounds in (4) we obtain bounds for interest rate:

$$\overline{R}_{t_0}^{\tau_1+\tau_2} = \frac{1}{(\tau_1+\tau_2)} \cdot \left(\left(\frac{1}{S_{d/c_1}^{t_0}} \right) \cdot \left(1 + i_{t_0}^{c_1,\tau_1} \cdot \tau_1\right) \cdot \left(\frac{S_{0,d/c_1}}{S_{0,d/c_2}} \right) \cdot \left(1 + i_{t_0+\tau_1}^{c_2,\tau_2} \cdot \tau_2\right) \cdot \overline{S} - 1 \right) =$$

$$= \frac{1}{(\tau_1+\tau_2)} \cdot \left(\left(\frac{1}{S_{d/c_1}^{t_0}} \right) \cdot \left(1 + i_{t_0}^{c_1,\tau_1} \cdot \tau_1\right) \cdot \left(\frac{S_{0,d/c_1}}{S_{0,d/c_2}} \right) \cdot \left(1 + i_{t_0+\tau_1}^{c_2,\tau_2} \cdot \tau_2\right) \cdot 1.01 \cdot S_{0,d/c_2} - 1 \right) =$$

$$= \frac{1}{(\tau_1+\tau_2)} \cdot \left(\frac{1.01 \cdot S_{0,d/c_1} \cdot \left(1 + i_{t_0}^{c_1,\tau_1} \cdot \tau_1\right) \cdot \left(1 + i_{t_0+\tau_1}^{c_2,\tau_2} \cdot \tau_2\right)}{S_{d/c_1}^{t}} - 1 \right) \tag{5}$$

$$\underline{R}_{t_0}^{\tau_1+\tau_2} = \frac{1}{(\tau_1+\tau_2)} \cdot \left(\left(\frac{1}{S_{d/c_1}^{t_0}} \right) \cdot \left(1 + i_{t_0}^{c_1,\tau_1} \cdot \tau_1\right) \cdot \left(\frac{S_{0,d/c_1}}{S_{0,d/c_2}} \right) \cdot \left(1 + i_{t_0+\tau_1}^{c_2,\tau_2} \cdot \tau_2\right) \cdot \underline{S} - 1 \right) =$$

$$= \frac{1}{(\tau_1+\tau_2)} \cdot \left(\left(\frac{1}{S_{d/c_1}^{t_0}} \right) \cdot \left(1 + i_{t_0}^{c_1,\tau_1} \cdot \tau_1\right) \cdot \left(\frac{S_{0,d/c_1}}{S_{0,d/c_2}} \right) \cdot \left(1 + i_{t_0+\tau_1}^{c_2,\tau_2} \cdot \tau_2\right) \cdot 0.99 \cdot S_{0,d/c_2} - 1 \right) =$$

$$= \frac{1}{(\tau_1+\tau_2)} \cdot \left(\frac{0.99 \cdot S_{0,d/c_1} \cdot \left(1 + i_{t_0}^{c_1,\tau_1} \cdot \tau_1\right) \cdot \left(1 + i_{t_0+\tau_1}^{c_2,\tau_2} \cdot \tau_2\right)}{S_{d/c_1}^{t}} - 1 \right) \tag{6}$$

Domestic interest rates should keep inside these bands if sufficiently free capital mobility is supposed and domestic currency is not expected to depreciate or appreciate.

Market exchange rate $S_{d/c_1}^{t_0}$ can be expressed through official peg rate in the following way:

$$S_{d/c_1}^{t_0} = S_{0,d/c_1} + \Delta S_{t_0} = S_{0,d/c_1} \cdot \left(1 + \frac{\Delta S_{t_0}}{S_{0,d/c_1}} \right) = S_{0,d/c_1} \cdot \left(1 + \delta S_{t_0}\right) \tag{7}$$

where $\delta S_{t_0} = \dfrac{\Delta S_{t_0}}{S_{0,d/c_1}}$ is relative deviation of the exchange rate from the peg rate.

Substituting (7) in (5) and (6) we can simplify expressions for interest rate corridor boundaries:

$$\overline{R}_{t_0}^{\tau_1+\tau_2} = \frac{1}{(\tau_1+\tau_2)} \cdot \left(\frac{1.01 \cdot S_{0,d/c_1} \cdot \left(1 + i_{t_0}^{c_1,\tau_1} \cdot \tau_1\right) \cdot \left(1 + i_{t_0+\tau_1}^{c_2,\tau_2} \cdot \tau_2\right)}{S_{0,d/c_1} \cdot \left(1 + \delta S_{t_0}\right)} - 1 \right) =$$

$$= \frac{1}{(\tau_1+\tau_2)} \cdot \left(\frac{1.01 \cdot \left(1 + i_{t_0}^{c_1,\tau_1} \cdot \tau_1\right) \cdot \left(1 + i_{t_0+\tau_1}^{c_2,\tau_2} \cdot \tau_2\right)}{1 + \delta S_{t_0}} - 1 \right) \qquad (8),$$

$$\underline{R}_{t_0}^{\tau_1+\tau_2} = \frac{1}{(\tau_1+\tau_2)} \cdot \left(\frac{0.99 \cdot S_{0,d/c_1} \cdot \left(1 + i_{t_0}^{c_1,\tau_1} \cdot \tau_1\right) \cdot \left(1 + i_{t_0+\tau_1}^{c_2,\tau_2} \cdot \tau_2\right)}{S_{0,d/c_1} \cdot \left(1 + \delta S_{t_0}\right)} - 1 \right) =$$

$$= \frac{1}{(\tau_1+\tau_2)} \cdot \left(\frac{0.99 \cdot \left(1 + i_{t_0}^{c_1,\tau_1} \cdot \tau_1\right) \cdot \left(1 + i_{t_0+\tau_1}^{c_2,\tau_2} \cdot \tau_2\right)}{1 + \delta S_{t_0}} - 1 \right) \tag{9}$$

From the formulas (8) and (9) we can see that the boundaries of the interest rate corridor do not depend on exchange rates at the moment of change of a currency regime, but depend on the initial exchange rate $S_{0,d/c_1}$, it deviation from peg rate, initial interest rate $i_{t_0}^{c_1,\tau_1}$ and future interest rate $i_{t_0+\tau_1}^{c_2,\tau_2}$. Future interest rate is not known at time moment t_0, but as euro derivative market is extensive and liquid, it is possible to determine future interest rate through futures and forwards. For our calculations as interest rates $i_{t_0+\tau_1}^{c_2,\tau_2}$ we can use not only the rates, quoted on financial market, but also implied forward rates.

Forward rates, implied by money market, could be calculated as follows:

$$f_{t_0,\tau_1}^{c_2,\tau_2}=\frac{\dfrac{\left(1+i_{t_0}^{c_2,\tau_1+\tau_2}\cdot(\tau_1+\tau_2)\right)}{\left(1+i_{t_0}^{c_2,\tau_1}\cdot\tau_1\right)}-1}{\tau_2}=\frac{i_{t_0}^{c_2,\tau_1+\tau_2}\cdot(\tau_1+\tau_2)-i_{t_0}^{c_2,\tau_1}\cdot\tau_1}{\tau_2\cdot\left(1+i^{c_2,\tau_1}\cdot\tau_1\right)} \tag{10}$$

Substituting in (8) and (9) implied forward rates in place of $i_{t_0+\tau_1}^{c_2,\tau_2}$, we obtain the following expressions for interest rate corridor boundaries:

$$\overline{R}_{t_0}^{\tau_1+\tau_2}=\frac{1}{(\tau_1+\tau_2)}\cdot\left(\frac{1.01\cdot\left(1+i_{t_0}^{c_1,\tau_1}\cdot\tau_1\right)\cdot\left(1+i_{t_0}^{c_2,\tau_1+\tau_2}\cdot(\tau_1+\tau_2)-i_{t_0}^{c_2,\tau_1}\cdot\tau_1\right)}{\left(1+\delta S_{t_0}\right)\cdot\left(1+i_{t_0}^{c_2,\tau_1}\cdot\tau_1\right)}-1\right) \tag{11}$$

$$\underline{R}_{t_0}^{\tau_1+\tau_2}=\frac{1}{(\tau_1+\tau_2)}\cdot\left(\frac{0.99\cdot\left(1+i_{t_0}^{c_1,\tau_1}\cdot\tau_1\right)\cdot\left(1+i_{t_0}^{c_2,\tau_1+\tau_2}\cdot(\tau_1+\tau_2)-i_{t_0}^{c_2,\tau_1}\cdot\tau_1\right)}{\left(1+\delta S_{t_0}\right)\cdot\left(1+i_{t_0}^{c_2,\tau_1}\cdot\tau_1\right)}-1\right) \tag{12}$$

Taking into account, that the interest rates and δS_{t_0} are small, and representing 0,99 as (1-0,01), and 1,01 as (1+0,01), the first term of the Taylor series will provide sufficiently good approximation for boundary values:

$$\overline{R}_{t_0}^{\tau_1+\tau_2}=\frac{1}{(\tau_1+\tau_2)}\cdot\left(i_{t_0}^{c_2,\tau_1+\tau_2}\cdot(\tau_1+\tau_2)+0.01-\delta S_{t_0}+\left(i_{t_0}^{c_1,\tau_1}-i_{t_0}^{c_2,\tau_1}\right)\cdot\tau_1\right)=$$

$$\overline{R}_{t_0}^{\tau_1+\tau_2}=\left(i_{t_0}^{c_2,\tau_1+\tau_2}+\frac{0.01-\delta S_{t_0}}{(\tau_1+\tau_2)}\right)+\frac{\left(i_{t_0}^{c_1,\tau_1}-i_{t_0}^{c_2,\tau_1}\right)\cdot\tau_1}{(\tau_1+\tau_2)} \tag{13}$$

$$\underline{R}_{t_0}^{\tau_1+\tau_2}=\frac{1}{(\tau_1+\tau_2)}\cdot\left(i_{t_0}^{c_2,\tau_1+\tau_2}\cdot(\tau_1+\tau_2)-0.01-\delta S_{t_0}+\left(i_{t_0}^{c_1,\tau_1}-i_{t_0}^{c_2,\tau_1}\right)\cdot\tau_1\right)=$$

$$\underline{R}_{t_0}^{\tau_1+\tau_2}=\left(i_{t_0}^{c_2,\tau_1+\tau_2}-\frac{0.01+\delta S_{t_0}}{(\tau_1+\tau_2)}\right)+\frac{\left(i_{t_0}^{c_1,\tau_1}-i_{t_0}^{c_2,\tau_1}\right)\cdot\tau_1}{(\tau_1+\tau_2)} \tag{14}$$

Let's notice, that expressions, given in parentheses in formulas (13) and (14) are similar to the formulas, obtained in [1] for testing of target zone credibility in case of absence of change in a currency regime. In the latter case interest rate corridor upper bound is determined by interest rate of pegging currency plus return from change of exchange rate within currency corridor bounds. Interest rate corridor lower bound is determined by interest rate of pegging currency minus return from change of exchange rate within currency corridor bounds.

In case of planned change in currency regime the summand $\frac{\left(i_{t_0}^{c_1,\tau_1}-i_{t_0}^{c_2,\tau_1}\right)\cdot\tau_1}{(\tau_1+\tau_2)}$ appears. This term reduces width of the corridor, if the interest rate of currency of initial peg is below interest rate of the future pegging currency. In case of Latvia at present moment euro interest rates exceed SDR interest rates, thus this summand will be negative.
It is intuitively clear that significance of interest rate of currency of future peg increases, as moment of pegging change approaches. The same we can see in the formulas: when τ_2 increases, compared with $\tau_1+\tau_2$, the difference between future interest rates of currencies of peg becomes more significant. When $\tau_2=0$, we obtain the same results as in case, when change of a currency regime hasn't been planned.

Comparing equations (3) with (5) and (4) with (6) we can see that expressions are quite similar as for the interest rate upper bound:

$$\overline{R}_{t_0}^{\tau_1+\tau_2}=\left(i_{t_0}^{c_2,\tau_1+\tau_2}+\frac{0.01-\delta S_{t_0}}{(\tau_1+\tau_2)}\right)+\frac{\left(i_{t_0}^{c_1,\tau_1}-i_{t_0}^{c_2,\tau_1}\right)\cdot\tau_1}{(\tau_1+\tau_2)}\quad\text{and}$$

$$\overline{R}_{t_0}^{\tau_1+\tau_2}=\left(i_{t_0}^{c_1,\tau_1+\tau_2}+\frac{0.01-\delta S_{t_0}}{(\tau_1+\tau_2)}\right)+\frac{\left(f_{t_0,\tau_1}^{c_2,\tau_2}-f_{t_0,\tau_1}^{c_1,\tau_2}\right)\cdot\tau_2}{(\tau_1+\tau_2)},$$

as for the rate upper bound:

$$\underline{R}_{t_0}^{\tau_1+\tau_2}=\left(i_{t_0}^{c_2,\tau_1+\tau_2}-\frac{0.01+\delta S_{t_0}}{(\tau_1+\tau_2)}\right)+\frac{\left(i_{t_0}^{c_1,\tau_1}-i_{t_0}^{c_2,\tau_1}\right)\cdot\tau_1}{(\tau_1+\tau_2)}\quad\text{and}$$

$$\underline{R}_{t_0}^{\tau_1+\tau_2}=\left(i_{t_0}^{c_1,\tau_1+\tau_2}-\frac{0.01+\delta S_{t_0}}{(\tau_1+\tau_2)}\right)+\frac{\left(f_{t_0,\tau_1}^{c_2,\tau_2}-f_{t_0,\tau_1}^{c_1,\tau_2}\right)\cdot\tau_2}{(\tau_1+\tau_2)}.$$

Equations first terms (enclosed in parenthes) differ in the applied interst rates: in the first case interest rate of the currency of future pegging was used, whereis in the second case interest rate of the currency of initial pegging was applied. Equations second terms differs in that differences between spot or future interest rates of both currencies of pegging were used.

References

[1.] AJEVSKIS, V., POGULIS, A., BĒRZIŅŠ G., Foreign Exchange and Money Market in the Context of the Exchange Rate Target Zone. Latvijā. – Rīga: Latvijas Banka, 2004.
[2.] SVENSSON, L.E.O., 1991. "The Simplest Test of Target Zone Credibility", *IMF Staff Papers*, Vol. 38, pp. 655-665.

Current address

Dr. Math. Viktors Ajevskis Riga, LV-1010, Kr.Valdemara 2a, e-mail: ajevsky@latnet.lv

Dr. Math. Nadezhda Sinenko, Latvian University, Department of mathematical analysis, Zellu str.8, Riga, LV-1002, Latvia, e-mail: nadezdas@navigator.lv