The effects of CBI's policy rate on interest rates in Iceland

A report to taskforce on reviewing Iceland's monetary and currency policies

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1 Introduction

A central bank uses its policy rate to affect interest rates and, hence, asset prices, exchange rates and aggregate demand in an economy. In this paper, we analyse the transmission of the Central Bank of Iceland's (CBI) policy rate through the financial system in Iceland, i.e. we analyse the effects of the policy rate on interest rates in Iceland. We use a structural vector autoregressive (SVAR) model of the Icelandic financial system and use it to identify shocks to the policy rate and analyse the effects of changes in it on other interest rates in Iceland.

Pétursson (2001) analyses the financial system transmission of the CBI's policy rate using a SVAR model of the Icelandic financial system using monthly data for 1993-2000. During this period, monetary policy in Iceland can be characterized by exchange rate targeting under capital controls. He finds that changes in the policy rate have statistically significant effects on the money market rate for up to three months while the effects on the indexed bond and loan market rates are statistically significant for up to eight and nine months.[1]

We apply the same methodology as in Pétursson (2001) and use monthly data for 2011-2018 (January 2011 - February 2018). During this period, monetary policy in Iceland can be described as inflation targeting under capital controls. We analyse separately the transmission of monetary policy into the bank loan market and the bonds market in Iceland.

The paper is organized as follows: The data is discussed in chapter 2 and the econometric model is discussed in chapter 3. Estimation of the model is discussed in chapter 4 and the results of simulations are given in chapter 5, which concludes the paper.

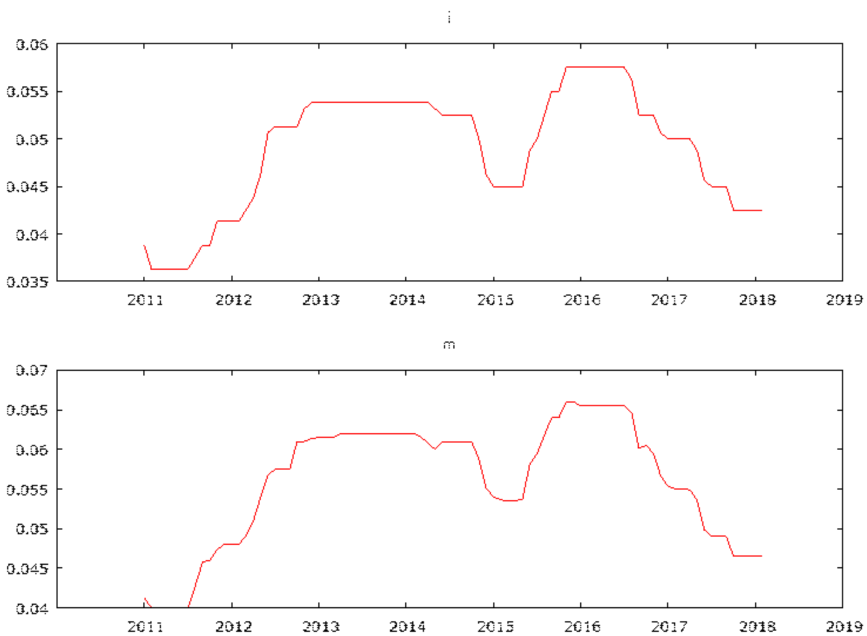
[1] The transmission of monetary policy is also a part of the CBI's QMM model (see QMM), which is a general equilibrium macroeconomic model of the Icelandic economy used in forecasting by the CBI. The point estimates in the model show that an increase in the policy rate results in the short nominal and long indexed interest rates increasing for approximately 20 months (5 quarters). There are, however, no confidence intervals given in their analysis and, hence, it is impossible to say whether the effects are statistically significant or not.

2 Data

We use data on CBI's policy rate (i_t), three month REIBOR rates (m_t), rates on bank loans (bn_t), rates on indexed bank loans (br_t), yield on government bonds (RIKB250612) (sn_t) and yield on indexed house financing bonds (sr_t) (HFF150644).[2] All data was obtained from the the CBI's Economic Indicators published on March 28th 2018 (see Economic Indicators).[3]

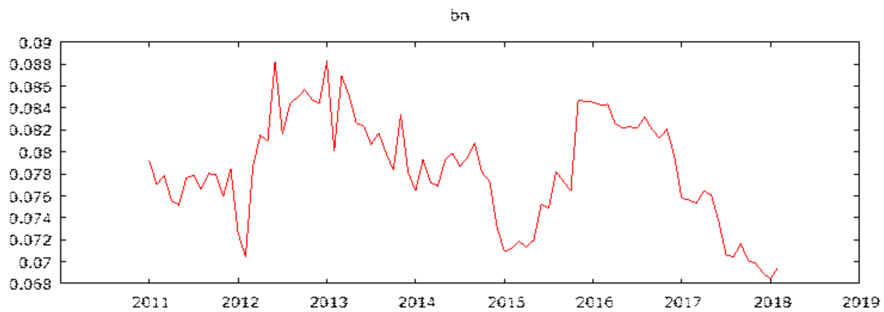
The data series are shown in the following figures:

Figure 1. The data series



[2]The lending rates on bank loans are average lending rates of commercial banks. The government bond expires in 2025 and the house financing bond in 2044.

[3]The data published in Economic Indicators are weekly. Monthly data were obtained be calculating monthly averages.


bn
0.09
0.088
0.086
0.084
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0.08
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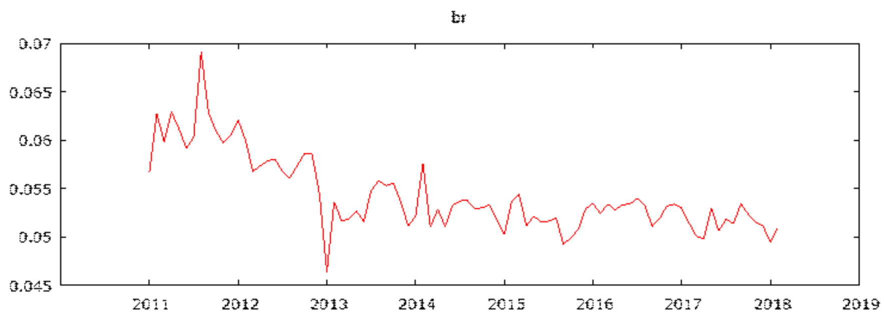
br
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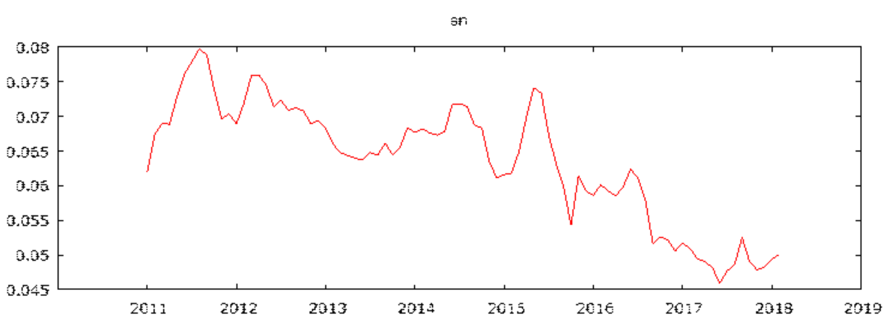
sn
0.08
0.075
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0.055
0.05
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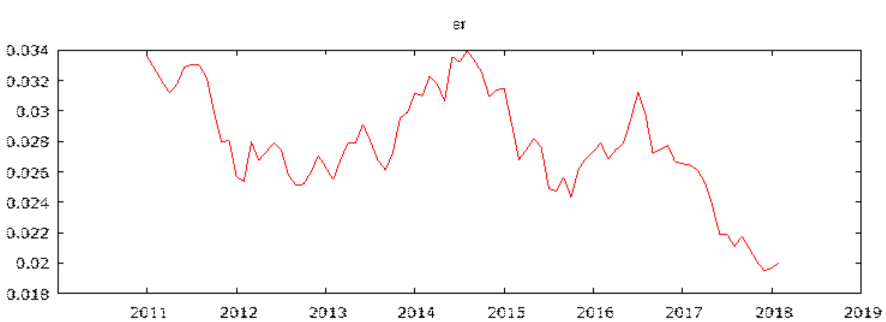

sr
0.034
0.032
0.03
0.028
0.026
0.024
0.022
0.02
0.018
2011
2012
2013
2014
2015
2016
2017
2018
2019

3 Model

We analyse the transmission of the policy rate into nominal (n_t) and real (r_t) rates in (i) the bank lending market (b) and (ii) the bonds market (s). Hence, we estimate two models - one for each market.

The vector of interest rates is $y_t = (i_t, m_t, n_t, r_t)'$ and the Vector autoregressive (VAR) model can be written as (omitting constants, trend and dummy variables):

$$A(L)\,y_t = u_t \tag{1}$$

where $u_t = (u_{i,t}, u_{m,t}, u_{n,t}, u_{r,t})'$ is a vector of one period ahead forecast errors (innovations to the VAR model), each of which is independently and identically distributed with zero mean: $u_{j,t} \sim iid\,(0, \sigma_{jj})$ for $j = i, m, n, r$, $E(u_t) = 0$ (a (4×1) vector of zeros), $E(u_t u_t') = \Sigma$ where:

$$\Sigma = \begin{pmatrix} \sigma_{ii} & \sigma_{im} & \sigma_{in} & \sigma_{ir} \\ \sigma_{im} & \sigma_{mm} & \sigma_{mn} & \sigma_{mr} \\ \sigma_{in} & \sigma_{mn} & \sigma_{nn} & \sigma_{nr} \\ \sigma_{ir} & \sigma_{mr} & \sigma_{nr} & \sigma_{rr} \end{pmatrix}$$

and $A(L)$ is a vector of polynomials in L, L is a lag operator such that $L^s y_t = y_{t-s}$ and $A_0 = I$ ($A(L)$ for $s = 0$). Note that VAR innovations are interpreted as unforeseen development in the interest rates.

Following Pétursson (2001), contemporaneous part of the unforeseen development in the interest rates are assumed to follow the following processes:

$$\begin{aligned} u_{i,t} &= \varepsilon_{i,t} \\ u_{m,t} &= \gamma_{mi} u_{i,t} + \varepsilon_{m,t} \\ u_{n,t} &= \gamma_{ni} u_{i,t} + \gamma_{nm} u_{m,t} + \varepsilon_{n,t} \\ u_{r,t} &= \gamma_{ri} u_{i,t} + \gamma_{rm} u_{m,t} + \gamma_{rn} u_{n,t} + \varepsilon_{r,t} \end{aligned}$$

or:

$$\begin{pmatrix} 1 & 0 & 0 & 0 \\ -\gamma_{mi} & 1 & 0 & 0 \\ -\gamma_{ni} & -\gamma_{nm} & 1 & 0 \\ -\gamma_{ri} & -\gamma_{rm} & -\gamma_{rn} & 1 \end{pmatrix} u_t = \varepsilon_t \tag{2}$$

where $\varepsilon_t = (\varepsilon_{i,t}, \varepsilon_{m,t}, \varepsilon_{n,t}, \varepsilon_{r,t})'$ is a vector of structural shocks (behavioral shocks), each of which is independently and identically distributed with zero mean: $\varepsilon_{j,t} \sim iid\,(0, \omega_{jj})$ for $j = i, m, n, r$, $E(\varepsilon_t) = 0$ (a (4×1) vector of zeros), $E(\varepsilon_t \varepsilon_t') = \Omega$ where:

$$\Omega = \begin{pmatrix} \omega_{ii} & 0 & 0 & 0 \\ 0 & \omega_{mm} & 0 & 0 \\ 0 & 0 & \omega_{nn} & 0 \\ 0 & 0 & 0 & \omega_{rr} \end{pmatrix}$$

Note that while the structural shocks are independent of (orthogonal to) each other this does in general not hold for the VAR innovations.

4 Estimation

Since the (4×4) matrix in (2) is lower triangular, estimation of its parameters (the γ-as) as well as the variance of the structural shocks (the ω-as) can be obtained from estimating the VAR model in (1) (estimating the parameters in $A(L)$ and Σ), i.e. the structural model exactly identified. Here, we are mainly interested in identifying the structural shocks to be able to analyse their impulse responses.

We include five dummy variables when estimating the models below. Three of those are to account for the effects of various changes in rules set for implementing the capital controls in Iceland (March 2012, March 2015 and June 2016). The other two are to account for the effects of increased reserve requirements of commercial banks (October 2015) and the following decrease in the reserve requirements (December 2015). Further, we include a time trend in the bonds market model to account for the effects of decreasing time until maturity on the yield on the bonds used in the analysis.

For choosing the appropriate lag-length k we assume a maximum lag-length of six ($k = 6$) to have a fair number of degrees of freedom:

Table 1. Criterias for choosing the lag-length (k)

k	LogL[4]	AIC[5]	BIC[6]	HQC[7]	p-value[8]
		Bank lending market model−			
1	1665.53	−40.64	−39.45	−40.16	
2	1682.32	−40.66	−38.99	−39.99	0.01
3	1689.21	−40.43	−38.29	−39.57	0.62
4	1710.85	−40.57	−37.95	−39.52	0.00
5	1730.68	−40.66	−37.57	−39.42	0.00
6	1737.64	−40.44	−36.87	−39.01	0.59
		Bonds market model			
1	1759.31	−42.88	−41.57	−42.36	
2	1780.79	−43.02	−41.23	−42.30	0.00
3	1790.27	−42.86	−40.59	−41.95	0.27
4	1796.99	−42.62	−39.89	−41.53	0.64
5	1811.00	−42.57	−39.36	−41.29	0.03
6	1816.96	−42.32	−38.63	−40.84	0.75

The AIC criteria indicates that the appropriate lag-length is two or five in the bank lending market model and two in the bonds market model (the minimum

[4] The value of the maximized log-likelihood function.

[5] Akaike information criteria.

[6] Bayesian information criteria.

[7] Hannan-Quinn information criteria.

[8] p-value for a test of lag-length. The null hypothesis is that the lag-length is $k-1$ and the alternative is that the lag-length is at least k.

of the AIC) while the BIC and HQC criterias indicate that a lag-length of one is appropriate in both models (the minimum of the BIC and HQC). However, the p-value indicates a lag-lenght of five ($k = 5$) in both models, which is what we assume below.

The results of misspecification tests for (1) with $k = 5$ are given in the following table:

Table 2. Misspecification tests for (1) with $k = 5$

	Bank lending market	Bonds market
Test	p-value	
Autocorrelation[9]	0.77	0.19
Heteroscedasticity[10]	0.28	0.59
Normally distributed residuals[11]	0.00	0.07

The tests indicate no autocorrelation nor heteroscedasticity in the residuals of (1) for both models. The null hypothesis of normally distributed residuals is rejected for the bank lending model while the test is inconclusive for the bonds market model.

5 Results

The goal of this paper is to analyse how changes in the CBI's policy rates affects other interest rates and yields in the Icelandic economy. This is done by analysing how an unforeseen development in the policy rate ($u_{i,t} = \varepsilon_{i,t}$) affects these.

The following figures show impulse responses from a one standard deviation unforeseen increase in the policy rate in month 0 in the bank lending market model ($\Delta i_0 = u_{i,0} = \varepsilon_{i,0} = 0.0009 = 0.09\%$):[12]

[9] p-value for a test of autocorrelation of up to order 6 in the residuals ($AR(6)$). The null hypothesis is that there is no autocorrelation of order 6 or lower in the residuals and the alternative is that there is autocorrelation of order 6 or lower.

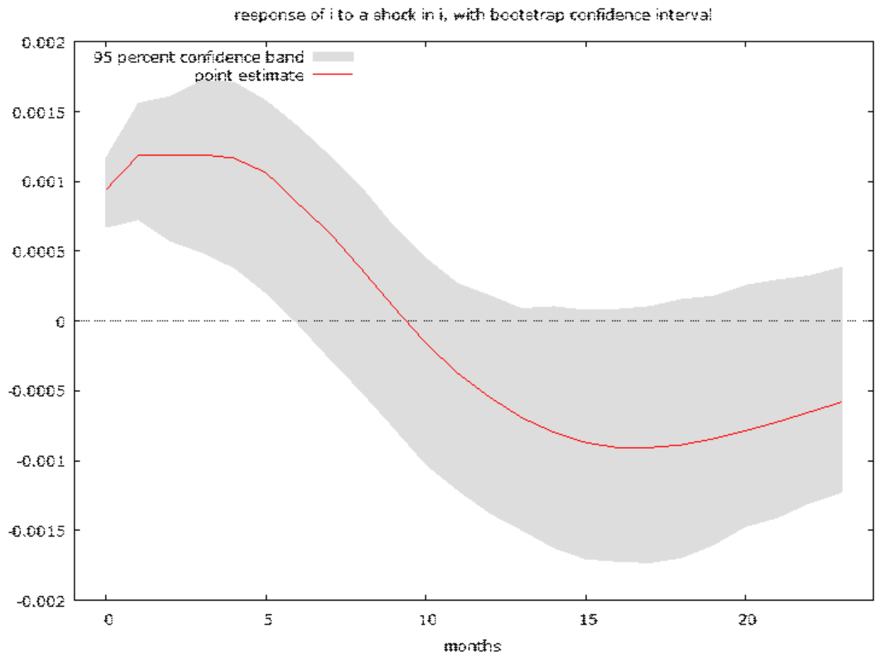
[10] p-value for a test of heteroscedasticity of up to order 6 ($ARCH(6)$) in the residuals. The null hypothesis is that there is no heteroscedasticity of order 6 or lower in the residuals and the alternative is that there is heteroscedasticity of order 6 or lower.

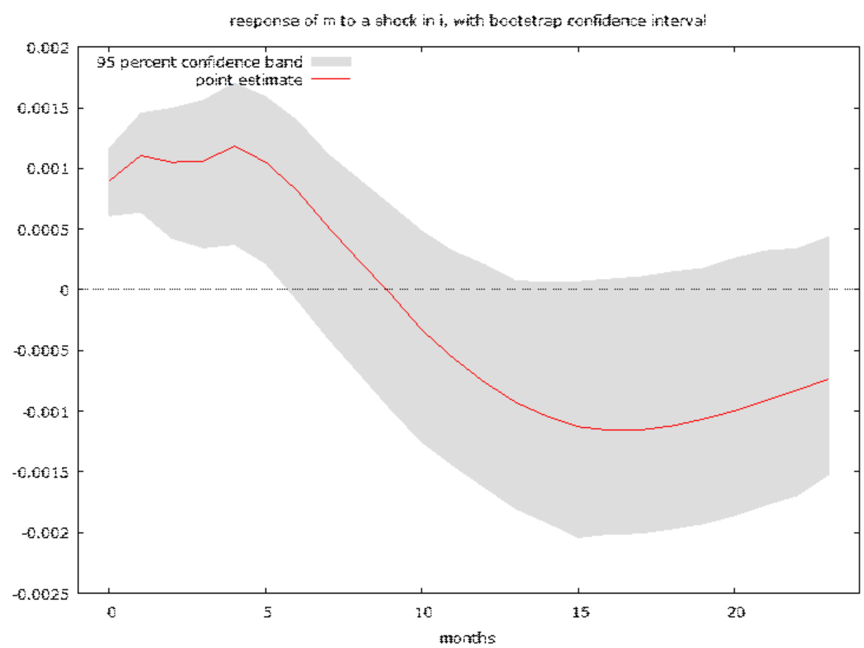
[11] p-value for a Doornik-Hansen test of normally distributed residuals. The null hypothesis is that the residuals are normally distributed and the alternative is that they are not normally distributed.

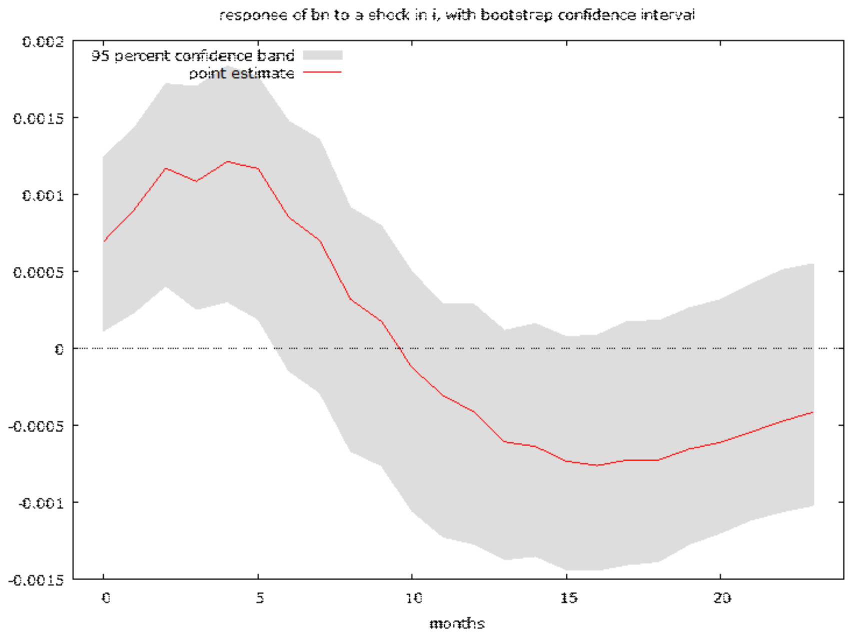
[12] A one-standard deviation change is a typical change according to the model.

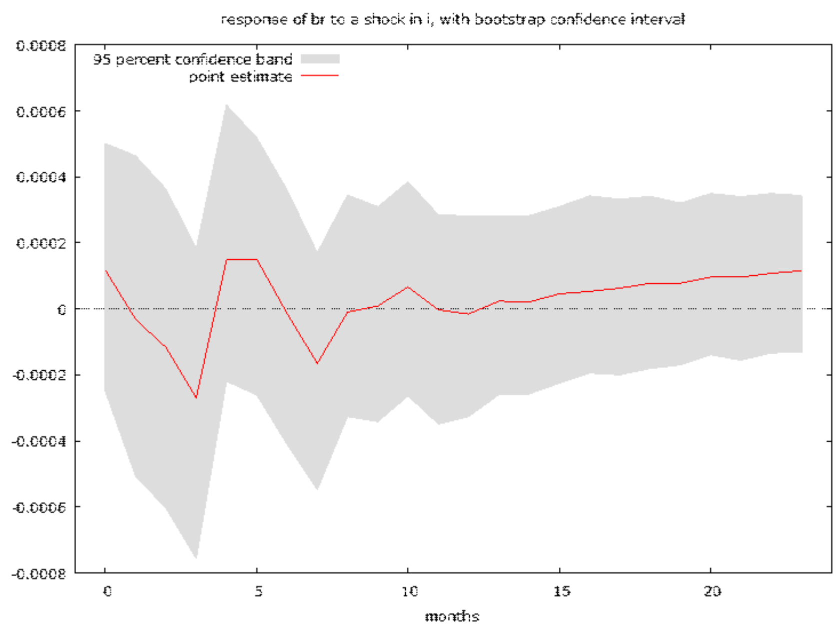
Note that since these are only unforeseen changes in the policy rate, the standard deviation is much smaller than that of changes in the policy rate itself (0.09% vs. 0.6%)

Figure 2. The effects of an increase in CBI's policy rate in the bank lending market model







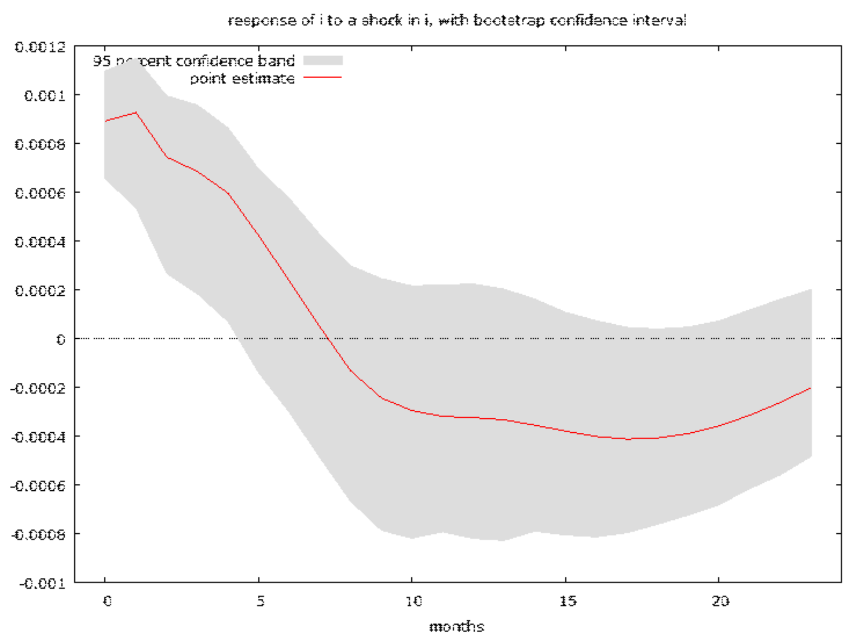


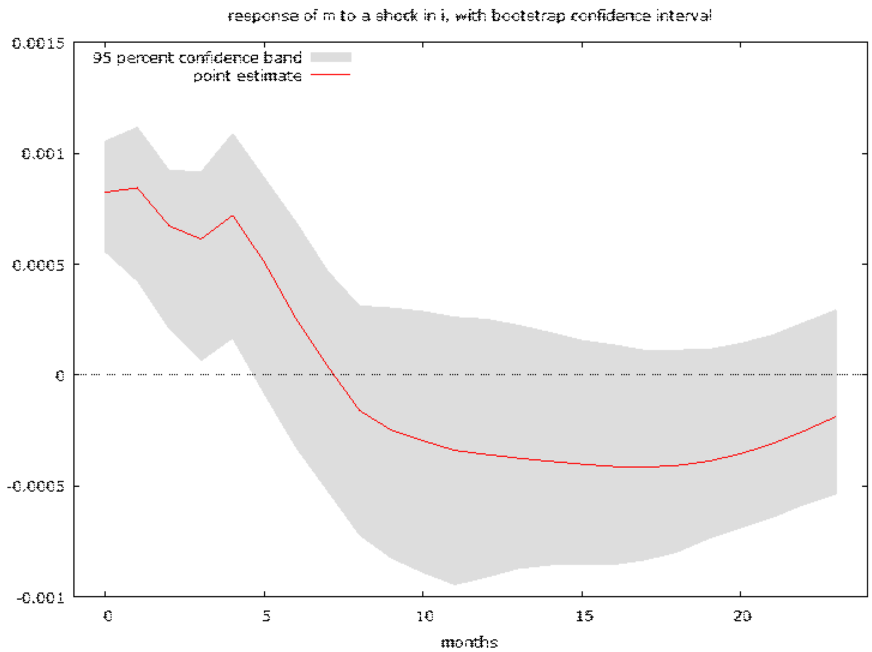
The figures above show the effects of a 0.09% increase in the policy rate (i_t) (monetary tightening) on itself, the money market rate (m_t), the bank loan rate (bn_t) and the indexed bank loan rate (br_t). The red lines give the point estimates of the effects and the gray area gives the 95% confidence interval for the effects. Note that since the policy rate is a stochastic variable in the model, its path following an increase in it is a stochastic variable (hence the confidence interval).

The first three parts of figure 2 show that an increase in the policy rate results in a statistically significant increase in the policy rate, the money market rate and the bank loan rate for approximately six months (the gray area is above the zero (horizontal) line for five months). The effects on the policy rate itself reflect that it tends to be significantly higher for approximately six months following an increase in it. The fourth part of the figure shows that the effects on the indexed bank loan rate are not statistically significant.

The following figures show impulse responses from a one standard deviation unforeseen increase in the policy rate in month 0 in the bonds market model ($\Delta i_0 = u_{i,0} = \varepsilon_{i,0} = 0.0009 = 0.09\%$):

Figure 3. The effects of an increase in CBI's policy rate in the bonds market model




response of m to a shock in i, with bootstrap confidence interval
95 percent confidence band
point estimate
0.0015
0.001
0.0005
0
-0.0005
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10
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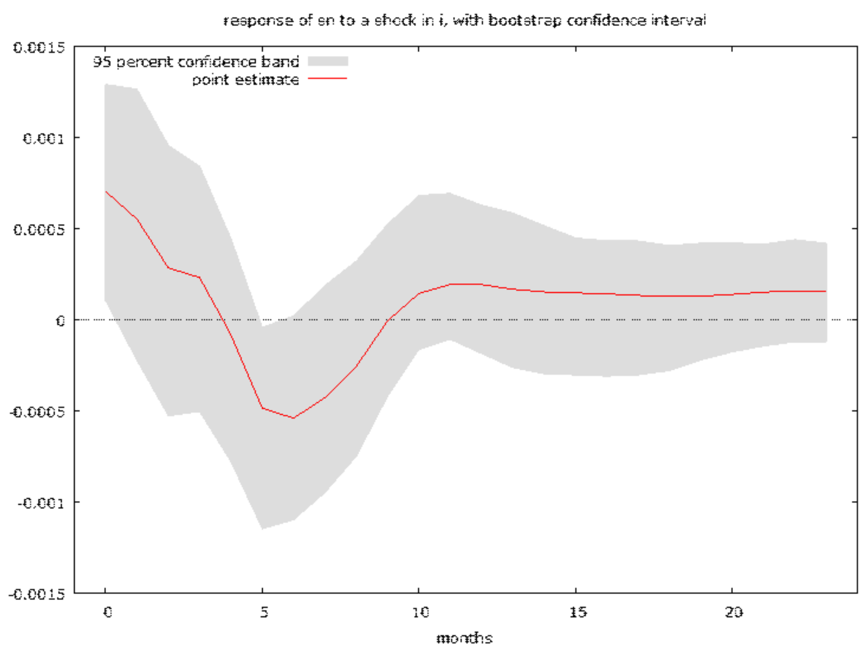
months


response of en to a shock in i, with bootstrap confidence interval
95 percent confidence band
point estimate
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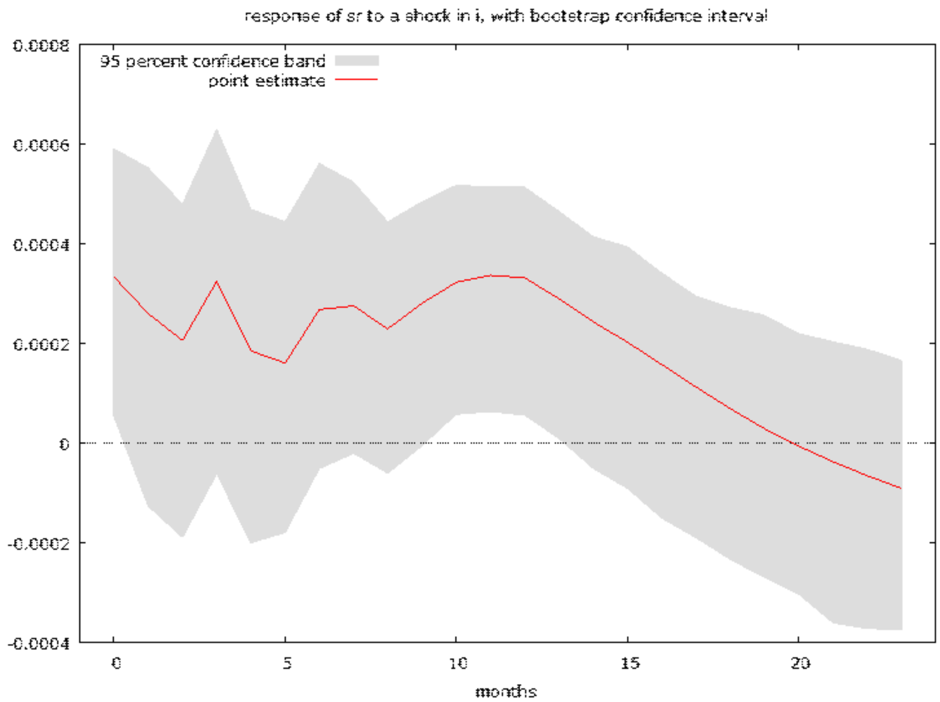
months



The figures above show the effects of a 0.09% increase in the policy rate (i_t) on itself, the money market rate (m_t), the bond yield (sn_t) and the indexed bond yield (sr_t). The effects on the on the policy rate itself and the money market rate are statistically significant for appoximately five months (vs. 6 months in the bank lending market model). The effects on the bond yield and the indexed bond yield are statistically significant in the same period as the increase in the policy rate occurs. Further, there are some indications of statistically significant effects on the indexed bond yield approximately ten months after the increase in the policy rate.

References

[1] Economic Indicators: https://www.cb.is/publications/publications/publication/2018/03/28/Economic-Indicators-28-March-2018/

[2] Pétursson, Thórarinn G. (2001), The Transmission Mechanism of Monetary Policy: Analysing the Financial Market Pass-Through, Central Bank of Iceland's Working Paper No. 14.

[3] QMM: https://www.cb.is/publications/publications/publication/2015/12/01/Working-Paper-no.-71-QMM-A-Quarterly-Macroeconomic-Model-of-the-Icelandic-Economy/