BOFIT Research Seminar

Unbelievable balance sheets: Is it possible to estimate the size and real effects of hidden negative capital in banking?

(*preliminary results*)

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Motivation: Growing uncertainty in banking worldwide

- US, emerging markets, and EU, to lesser extent
- McKinsey (2009): "*the hunt for banking capital*" starting from the GR
  - Before GR: markets were expanding, capital was cheap
  - During and after GR: regulators force banks to deleverage
- Growing *negative net worth (NNW)* of banks
  - **US**: 403 banks over 2007-2013 were closed – 1 quarter before closure Positive NW ≈ 1.5%, but 1 quarter after it NNW ≈ 24% of their total assets (Balla et al., 2015; Cole, White, 2015; FDIC's estimates)
  - **Russia**: 259 banks' licenses withdrawals within 2013m1-2016m1, for 106 of which the Central Bank of Russia (CBR) revealed the NNW ≈ RUB 1186 bln. (≈ 48% of their total assets) 1 quarter after closure; yet, 1 quarter before it the Positive NW ≈ RUB 218 bln. (≈9% of their total assets)
- *The problem of growing importance*! The more the NNW, the less likely existing shareholders provide funds to increase capital and new investors have incentives to invest in banks. Bank failures *destruct relationship lending* and *decrease total supply of credit to the economy* (Bernanke, Blinder, 1992, *AER*; Ashcraft, 2005, *AER*)
- Empirical literature on NNW has been developed for US since 1980-s; however, for emerging markets the research is yet to be done

Literature review: in general

- Studies on **bank failures**
  - a bunch of papers for US (DeYoung, Torna, 2013, *JFI*; Cole, White, 2012, *JFSR*; Clearly, Hebb, 2016, *JBF*; among many others)
  - emerging markets (Mannasoo, Mayes, 2010, *JBF*; Fungacova, Weill, 2013, *ET*)
  - some for EU (Poghosyan, Cihak, 2011, *JFSR*; Betz et al., 2014, *JBF*)
- Meanwhile, the literature on **NNW (negative net worth)**
  - is much less developed and only for US (James, 1991, *JF*; Schaeck, 2008, *JFSR*; Bennet, Unal, 2014, JFS; Granja et al., 2014; Balla et al., 2015; Cole, White, 2015)
  - no studies for emerging markets revealed.

Literature review: in particular (Negative Net Worth of failed banks)

Method #1: Weighted OLS, only failed banks (sample of "1"):

- James (1991, *JF*): 791 banks failed during 1982-1988 (twice more than for the previous 40 years, losses = 30% of assets). Proposed an ad-hoc regression of FDIC losses on failing banks
  - 412 bank failures of 1985 through mid-1988
  - Dependent variable: Book value of assets (at the moment of closure) – Value of assets in an FDIC receivership *OR* Value of assets to an acquirer
  - 11 explanatory variables (income earned but not collected, book value of equity, core deposits, types of non-performing assets …)
  - No surviving banks (sample of "0") included, but no sample selection bias concerns as the purpose is to estimate the determinants of NNW under existing closure rules
  - Equity positively affected losses (NNWs) because of fraud and insider abuse was more prevalent in well capitalized banks
  - Value of assets is lower in FDIC receivership than in the private sector

Literature review: in particular (Negative Net Worth of failed banks)

Method #1: Weighted OLS, only failed banks (sample of "1"):

- James (1991, *JF*)'s followers – estimates of regulatory forbearance effects:
  - Osterberg and Thomson (1995)
    - Sample: 1429 failed banks within 1986-1992
    - Different lag structure of indep. vars was tested (4-6 months, 6-9, 12-15, 24-27, 36-39 …) to assess regulatory forbearance effect (eventually found it!)
    - Fraud is significant reason of failure (Graham and Honner, 1988, found the same for 35% of bank failures in 1979-1987)
  - Cole, White (2015)
    - Sample: 2007-2014, 433 failed commercial banks (FDIC costs = $ 50 bln.)
    - When capital adequacy falls below 2% (technical PCA failure), FDIC should close a bank, but it might not do that believing in near improvements – regulatory forbearance is estimated as much as 27% of $ 50 bln.
    - New independent variables: securities and real estate operations

Literature review: in particular (Negative Net Worth of failed banks)

Method #1: Weighted OLS, only failed banks (sample of "1"):

- James (1991, *JF*)'s followers – who acquires failing banks?
  - Granja, Matvos, and Seru (2014; NBER WP):
    - Sample: 2007-2013
    - Two independent steps of analysis: the probability of being acquired (*step 1*) and the determinants of costs of resolution (differ from NNW, *step 2*)
    - Possible source of bias due to James (1991)'s argument. That might be captured by *the treatment approach*

Literature review: in particular (Negative Net Worth of failed banks)

Method #2: Treatment approach, only failed banks (sample of "1"):

- Bennett and Unal (2014; JFS) – who acquires failing banks?
  - A troubled bank may be either liquidated by FDIC or acquired by the private sector – the costs for FDIC may be different – sample selection bias arises – propose to use the treatment regression following Maddala (1983)
  - Sample: 1244 cases of either bank failures or bank acquisition by private sector in US over 1988-2007
  - Empirical part: *step 1* – estimating the prob. of being acquired and creating a hazard dummy variable (1 is likely to be acquired and 0 otherwise) and *step 2* – ML-regression of losses on its determinants and just created hazard dummy
  - Proxy for fraud – loans to insiders (!)
  - Results: during a crisis time, the private sector resolution was costlier than liquidation (!); in normal times, the opposite was true. The more qualitative assets and higher franchise value (less brokered deposits and more branches), the higher the prob. that a failing bank will be acquired rather than liquidated

Literature review: in particular (Negative Net Worth of failed banks)

Method #3: Quantile regression, only failed banks (sample of "1"):

- Schaeck (2008; JFSR)
  - Regulators are concerned about high-cost failures
  - Factors driving high-cost and low-cost failures are different
  - The distribution of failures are left-skewed so that OLS might be biased in previous research (!)
  - Moreover, previous studies ignored the liability structure of failed banks despite it affects the market discipline and thus risk-taking
  - Independent variables are the same as in previous studies + demand deposits-to-assets ratio and time+savings deposits-to-assets ratio
  - Results: Use of brokered deposits, poor asset quality, uncollected income, and a weak macroeconomic environment increase losses for costly bank failures. Fed funds lead to the opposite for the same costly bank failures only.
  - Sample selection concerns are not addressed

Literature review: in particular (Negative Net Worth of failed banks)

Method #4: Heckman model, failed and surviving banks ("1" and "0"):

- Balla, Prescott and Walter (2015; Fed-Richmond WP)
  - Bank losses are observed only for banks that failed – some banks might not have failed yet, but already experience troubles (idea of DeYoung and Torna, 2013; *JFI*) – sample selection problem arises when ignoring it in estimating both the prob. of bank failures and determinants of NNW
  - Sample: 1986-1992 and 2007-2013, exclude *de novo* banks and large banks
  - Heckman model: 2 equations – (1) *the losses. Eq.* = size, securities, interest receivable, CLD lending, C&I lending, core deposits; (2) *the prob. Eq.* = [the losses. Eq.], equity-to-assets, earning ration, NPL, LLP, unemployment…
  - All independent variables are taken as of the 1985Q4 or 2006Q4 (!) as opposed to Cole, White (2015) failure-specific quarter lags usage
  - Cross-section rather than panel estimates because of problems with convergence. The later, in turn, may be caused by *the class imbalance problem*

Contribution

- Understanding the negative net worth (NNW) in emerging markets, the case of the Russian banking system
  - Introducing and testing new hypotheses regarding the causes of NNW
- No consensus in the literature on how to estimate the NNW determinants
  - Assessing and comparing in-sample and out-of-sample forecasting accuracy of different competing models / approaches used to predict the NNW (Weighted OLS, Tobit with hazard dummies as in logit estimates of DeYoung and Torna (2013), Treatment, and Heckman)
- New counterfactual exercises as compared to Balla et al. (2015) – *yet to be included …*
- Empirical evidence on credit slowdown due to growing NNW – *yet to be included …*

Data on Russian banks

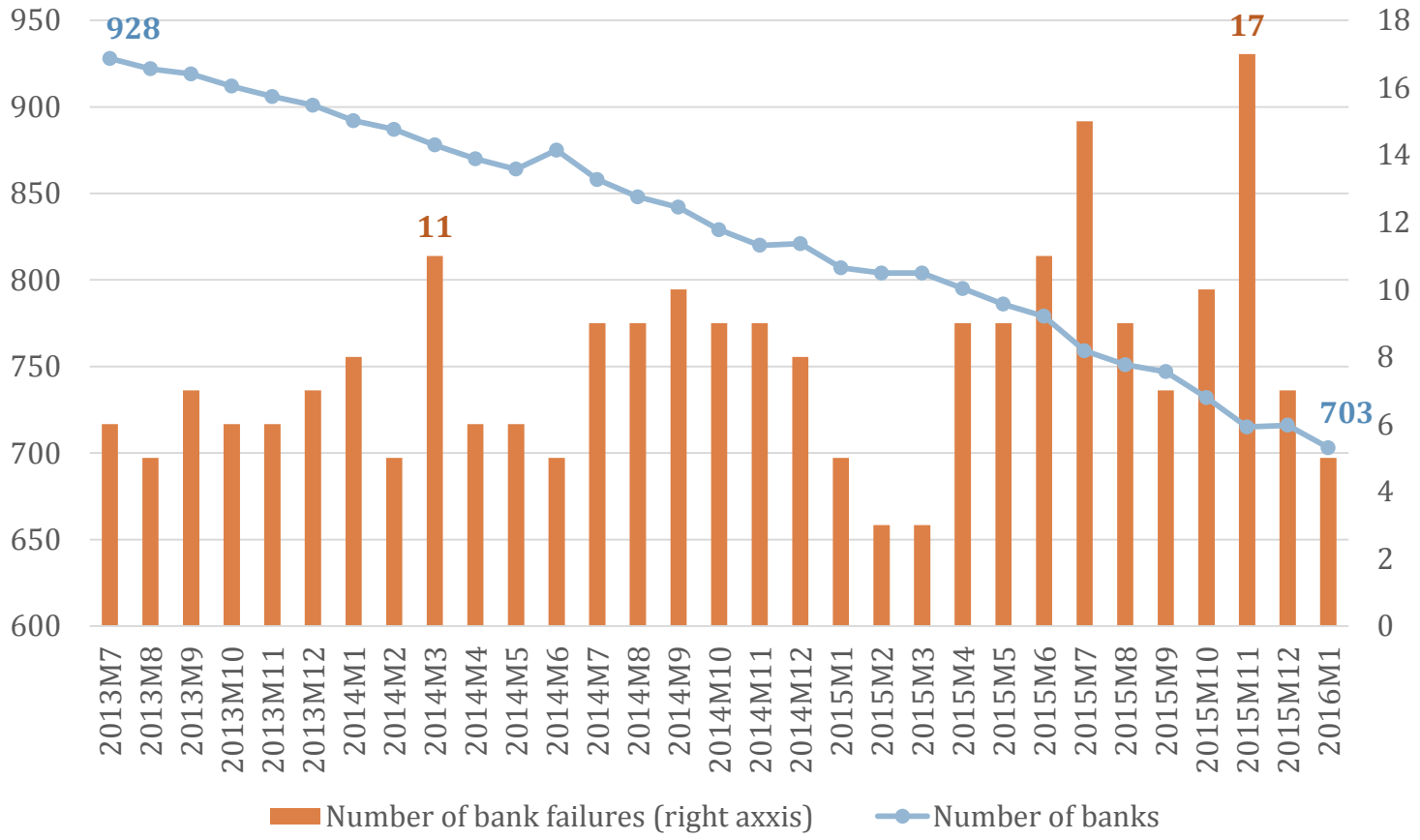
1. **Bank-specific factors (BSF)***:* The Central Bank of Russia web-site (www.cbr.ru)
   - monthly balance sheets of banks (Form 101, from 2004M1);
   - quarterly profit and loss accounts (Form 102, from 2004Q1);
   - monthly information on regulatory normatives (Form 135, from 2010M5), includes, among others, data on banks' investments in mutual funds;
   - irregular press releases of the CBR (*Vestnik Banka Rossii*) for data on negative net worth of failed banks estimated one quarter after failures

2. **Macroeconomic controls (MACRO)**: The Federal State Statistics Service web-site (www.gks.ru) – *yet to be included…*

3. **Time period**: 2013M6 – 2016M1 (since the Nabiullina's appointment as the Head of the Central Bank of Russia)

4. **Number of banks**: 928 at the beginning to 703 at the end of the sample

Data on Russian banks



Approx. *every fourth bank* left the market during the last 2.5 years (!)

Preliminary statistics: “champions” in negative net worth (*top-20 out of 106 cases over the 2013M1-2016M1*)

Top-20 banks with negative net worth

№	Bank name	Date of withdrawal / sanation*	City	– Net worth, bln. rub.	The last positive value of capital (form 101),bln. rub.	Assets, bln. rub.
1	Mosoblbank	May-14*	Moscow	117.0	17.8	78.3
2	National Bank "TRUST"	December-14*	Moscow	116.0	16.2	302.6
3	Vneshprombank	January-16	Moscow	210.1	16.1	293.7
4	Rossiysky Kredit	July-15	Moscow	111.0	17.4	186.7
5	Interkommerz Bank	February-16	Moscow	60.0	6.9	110.0
6	Investbank	December-13	Moscow	44.5	6.1	78.0
7	Probiznesbank	August-15	Moscow	40.8	9.7	154.5
8	SB Bank (Shipbuilding bank)	February-15	Moscow	39.1	7.6	82.9
9	Nota-Bank	November-15	Moscow	35.5	10.9	78.0
10	Mosstroyeconombank (M Bank)	July-15	Moscow	28.3	3.4	49.0
11	Bank Transportny	May-15	Moscow	21.4	3.0	52.7
12	Master-bank	November-13	Moscow	17.2	9.1	85.8
13	Pervy Respublikansky Bank	May-14	Moscow	16.2	3.7	40.5
14	Tusar	September-15	Moscow	15.0	1.5	19.6
15	Narodny Kredit	October-14	Moscow	12.7	3.7	41.0
16	Bank Fininvest	July-14	St. Petersb.	12.7	1.7	20.1
17	Zapadny	April-14	Moscow	12.2	2.4	31.2
18	Ogni Moskvy	May-14	Moscow	12.2	1.3	21.5
19	Klientsky	July-15	Moscow	11.4	1.6	17.8
20	Pushkino	September-13	Pushkino	10.9	2.8	31.0

Empirical design

1. **Weighted OLS**: determinants of hidden negative capital

$$HNC_{it} = f(BSF_{it-k}, MACRO_{it-k}) + \varepsilon_{it}$$

where

t is failure-specific for the subsample of failed banks ("1")

HNC_{it} is hidden negative capital that was revealed by the CBR one quarter after each failure (% of disclosed capital before failure).
HNC = disclosed capital before failure – negative net worth (NNW)

BSF_{it-k} are bank-specific (as in Cole, White, 2015, as opposed to Balla et al., 2015) controls with $t - k$ month lag ($k = 0,1,2 \ldots 6$) and $MACRO_{t-k}$ are macroeconomic controls specific for each bank in "1"

ε_{it} is normal regression error

Empirical design

2. **Heckman**: hidden negative capital conditional on bank failure

Regression eq.: $HNC_{it} = f(BSF_{it-k}, MACRO_{it-k}) + \varepsilon_{1,it}$

Selection eq.: $D_{it}^{*} = probit(BSFaug_{it-k}, MACRO_{it-k})_{>50\%} + \varepsilon_{2,it}$

where t is failure-specific for the subsample of failed banks ("1") and the latest data available for existing banks (2016M1; for future predictions) or any data within 2013M6-2015M12 (for out-of-sample forecasts)

HNC_{it} is hidden negative capital that was revealed by the CBR one quarter after each failure (% of disclosed capital before failure).
HNC = disclosed capital before failure – negative net worth (NNW)

$BSFaug_{it-k}$ are augmented BSF (incl. those that do not affect the regression equation, ad-hoc yet!)

ε_{it} is normal regression error

Empirical design

3. **Tobit**: hidden negative capital

if $corr(\varepsilon_{1,it}, \varepsilon_{2,it})$ is not significant, than simple Tobit is applied:

Regression eq.: $HNC_{it} = f(BSF_{it-k}, MACRO_{it-k}) + \varepsilon_{1,it}$

where t is failure-specific for the subsample of failed banks ("1") and the latest data available for existing banks (2016M1; for future predictions) or any data within 2013M6-2015M12 (for out-of-sample forecasts)

HNC_{it} is hidden negative capital that was revealed by the CBR one quarter after failure (% of disclosed capital before failure).
HNC = disclosed capital before failure – negative net worth (NNW)

$BSFaug_{it-k}$ are augmented BSF (incl. those that do not affect the regression equation)

ε_{it} is normal regression error

Descriptive statistics

Bank-specific variable, %	*Obs*	*Mean*	*Std. Dev.*	*Min*	*Max*
Hidden negative capital (% of last reported capital)	106	5.1	3.9	1.1	32.3
Equity growth rates, over 12 months	106	2.5	109.7	-1046.1	152.3
Reserve assets to total assets, <=3% (*censored*)	106	0.8	1.1	0.0	3.0
Reserve assets to total assets, >=30% (*censored*)	106	1.5	7.7	0.0	52.3
Share of mutual funds in assets, %	106	1.6	5.8	0.0	41.6
Turnover on corresponding accounts in the CBR to total assets ratio	106	106.9	179.6	0.0	1141.5
Turnover on cash to total assets ratio	106	37.9	183.0	0.0	1857.7
Corporate loans to total assets ratio	106	48.5	26.5	0.0	96.2
Turnover on corporate securities to total corporate securities	106	5.8	35.4	0.0	265.7
Turnover on corporate securities to total assets ratio	106	1.0	4.0	0.0	25.3
Turnover on corresponding accounts in foreign banks to total corresponding accounts in foreign banks ratio	106	36238.5	318021.0	0.0	3224286.0
Turnover on overdue corporate loans to total corporate loans ratio	106	2.3	19.4	0.0	200.0
(ROEadj – ROEadjSYS)<0*(EQ – EQadjSYS)>0	106	-0.01	0.12	-1.28	0.00
(DEPhh – DEPhhSYS)>0*(LNScorp – LNScorpSYS)>0	101	492.3	681.8	0.0	2976.2
Retail deposit rate – Retail deposit rate SYS > 0	93	3.6	2.6	0.0	22.5
Corporate lending rate – Corporate lending rate SYS >0	100	7.5	12.3	0.0	86.6
Size (share of total assets in total banking system assets)	106	0.0	0.1	0.0	0.4

Estimation results #1: Weighted OLS

Indep. vars with	*lag = 0*		*lag = 1*		*lag = 3*		*lag = 6*	
	Coef-t	t-stat	Coef-t	t-stat	Coef-t	t-stat	Coef-t	t-stat
Equity growth rates, over 12 months	-0.002*	-1.82	0	0.1	0.002	0.41	0.017	1.66
Reserve assets to total assets, <=3%	-0.496	-1.37	0.622*	1.94	0.157	0.4	0.27	0.32
Reserve assets to total assets, >=30%	0.138***	6.45	-0.006	-0.26	0.014	0.24	-0.006	-0.14
Share of mutual funds in assets, %	0.042	1.26	0.014	0.47	0.014	0.36	-0.001	-0.03
Turnover on corresponding accounts in the CBR to total assets	-0.003	-1.66	-0.002*	-1.85	0	-0.09	0.003	0.7
Turnover on cash to total assets	0.007*	1.75	-0.104**	-2.12	-0.065	-1.05	0.015	0.17
Corporate loans to assets	0.008	0.56	-0.027	-0.82	-0.027	-0.6	-0.033	-0.75
Turnover on corporate securities to the amount of corporate securities	0.009**	2.12	0.024***	4.31	0	0.08	-0.006	-0.14
Turnover on corporate securities to assets	0.026	0.78	0.023	0.56	-0.041	-0.67	-0.181*	-1.85
Turnover on corresponding accounts in foreign banks to the stock of corresponding accounts	0.000***	4.52	0.000***	4.67	0.000*	1.91	0.000**	2.43
Turnover on overdue corporate loans to the stock of corporate loans	-0.028***	-10.67	-0.289	-1.05	0.607	0.9	-0.005	-0.21
(ROEadj – ROEadjSYS)<0*(EQ-EQadjSYS)>0	2.01*	1.93	-92.5***	-6.01	1.163	1.11	-0.013	-0.03
(DEPhh – DEPhhSYS)>0*(LNScorp-LNScorpSYS)>0	0.002**	2.48	0.002**	2.66	0.002**	2.47	0.002***	2.96
Deposit rate – Deposit rate SYS >0	-0.037	-0.34	0.127	0.82	-0.004	-0.02	0.104	0.62
Lending rate – Lending rate SYS >0	0.097	0.86	0.078	0.69	0.083	0.58	-0.023	-0.23
Size (TA in TA SYS)	16.255***	5.05	9.13**	2.04	14.95**	2.24	14.077*	1.84
_cons	3.288***	3.76	5.368**	2.61	5.127*	1.74	4.277**	2.48
Number of obs	90		90		90		91	
R-squared	0.234		0.290		0.177		0.177	

Estimation results #1: Weighted OLS

Hidden negative capital (% of capital)	Obs	Mean	Std. Dev.	Min	Max
Actual	106	5.1	3.9	1.1	32.3
Fitted in models with indep. Vars taken with					
lag = 0	90	5.484	1.93	2.22	12.88
lag = 1	90	5.483	2.15	-1.05	14.51
lag = 3	90	5.483	1.68	0.07	10.71
lag = 6	91	5.454	1.67	1.98	11.83

Estimation results #2: Heckman

Indep. vars with	*Regression Eq.*		*Selection Eq.*	
	Coef-t	z-stat	Coef-t	z-stat
Retail deposits-to-total assets ratio	0.027*	1.65	0.019***	3.87
(DEPrate-DEPrate SYS)>0*(LNSrate-LNSrate SYS)<0	-0.402**	-1.96	0.005	0.26
(ROEadj – ROEadjSYS)<0*(EQ-EQadjSYS)>0	3.074***	4.42	1.609**	2.44
LLP-to-NPL ratio	-0.0008***	-2.82	0.0002	1.40
Turnover on cash to total cash ratio	-0.009**	-2.11	-0.003	-0.98
Turnover on cash to total assets ratio	0.005	0.72	0.050***	4.05
Total cash to total assets ratio	0.093	0.96	0.087***	3.30
Turnover on corresponding accounts in foreign banks to total assets ratio	-0.046	-1.51	-0.007	-1.43
Turnover on corresponding accounts in foreign banks to the stock of corresponding accounts	0.000*	1.64	0.0005*	1.88
Corresponding accounts in foreign banks to total assets ratio	0.337**	1.97	0.035**	1.98
Corporate securities to total assets ratio			0.153***	4.14
Turnover on overdue corporate loans to total assets ratio			0.018	0.77
Turnover on overdue corporate loans to overdue corporate loans			1.248	1.47
Overdue corporate loans to total assets ratio			0.022***	3.67
Share of mutual funds in assets, %			0.012	0.49
Reserve assets to total assets ratio			-0.047***	-2.63
_cons	4.939	5.10	-3.519***	-9.40
Number of obs (censored / uncensored)	643 (553 / 90)			
Corr(e_reg, e_selec)	-0.249**			

Comparing estimation results: Weighted OLS vs Tobit vs Heckman

Hidden negative capital (% of capital)	Obs	Mean	Std. Dev.	Min	Max
Actual	106	5.1	3.9	1.1	32.3
Fitted in models (indep. vars taken with lag = 0)					
Weighted OLS	90	5.484	1.93	2.22	12.88
Tobit	92	-3.835	6.97	-14.44	22.68
Heckman	90	6.438	1.28	1.85	11.29

Robustness check: yet to be included …

Checking the robustness of the findings by

- re-estimating Weighted OLS and Heckman model
  - with additional set of controls;
- estimating Tobit
- estimating treatment models

Conclusions

- More research needs to be done on **the determinants of negative net worth (NNW)** of banks in emerging countries, including Russia
- Negative net worth seems to *continue increasing in near future* while the Russian economy is suffering deeper recession and markets slowdown
- *Compare competing models* (Weighted OLS, Tobit, Treatment, Heckman) of NNW and their in-sample and out-of-sample forecasting accuracy
- Yet, for the in-sample analysis Weighted OLS seems to better fit the actual values of hidden negative capital of Russian banks, Heckman – a bit worse, and Tobit failed (*sample selection does really matter*!)
- First attempts to produce *out-of-sample forecasts* have shown that **about 250 of still surviving credit institutions in Russia falsify their balance sheets** so far; the estimated out-of-sample forecast of their cumulative negative capital amounts to RUB 900 bln. Importantly, if these banks leave the credit market, the non-financial firms and households will lose approximately RUB 4500 bln. of credit resources
- *Next steps* – improving models and their respective out-of-sample forecasts; producing counterfactual simulations

THANK YOU FOR YOUR ATTENTION!

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