

Tatu Laine & Kasperi Korpinen
Bank of Finland

Welcome to the 14th Payment and Settlement system Simulation Seminar and workshop



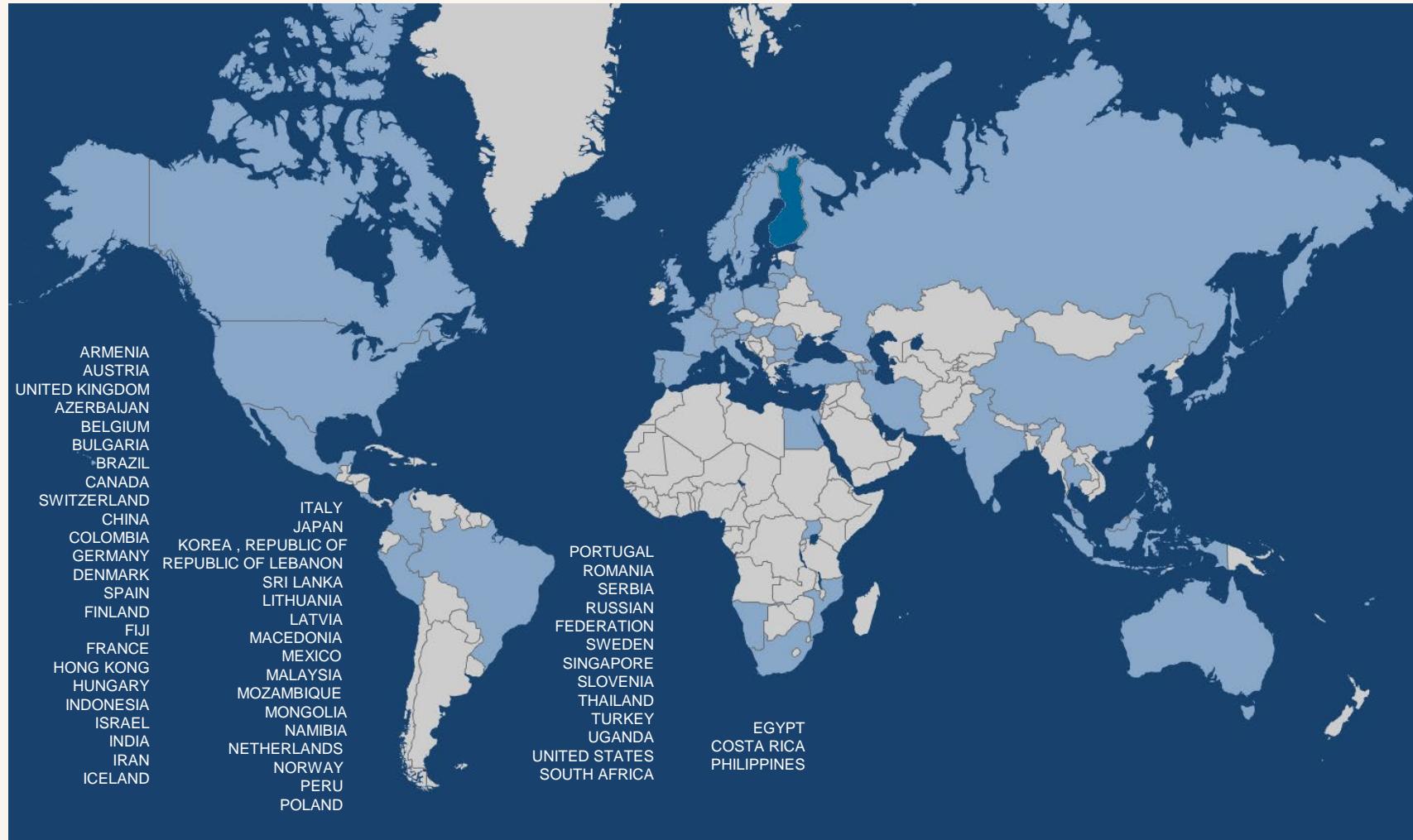
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BoF-PSS2 Situation today





BoF-PSS2 Distribution (August 2016)





BoF-PSS2 Simulator

- BoF-PSS2 simulator has a history of more than 10 years
- 101 granted licenses in August 2016
 - 56% in central banks, 23% in academic institutions, the rest in ACH's, CSD's, ECB, BIS...
- User network has been wide, but dispersed
- Annual simulator seminar is an important contact point
 - Bring new ideas and share them with the other simulator users
 - Get new ideas to implement in own simulator applications

Team behind the services

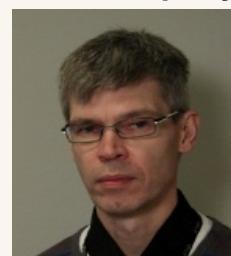
- Development of the simulator, support and analysis work
- Strong working experience in risk management and on quantitative tools for analysis of payment and settlement systems
- Academic experience in economics, computational analysis, computer science and physics



Tatu



Kasperi



Harri



Maarit



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BOF-PSS2, What For?

- Liquidity and credit risks in payment and securities settlement systems
 - Counterparty exposures, systemic effects, sufficiency of buffers...
- Assessment of critical counterparts
- Contagion effects inside and between FMI's
- System development and performance assessment
- Research
 - Behavioural incentives, other...



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Regulation is catching up

- CPSS-IOSCO (2012) Principles for financial market infrastructures
- BCBS (2008). Principles for Sound Liquidity Risk Management and Supervision (BIS)
- BCBS (2010). International framework for liquidity risk measurement, standards and monitoring (BIS)
- BCBS (2013). Monitoring tools for intraday liquidity management (BIS)



Global cooperation

- Sponsorships from BOE, BOC, FED
- Development of TARGET2 Simulator jointly provided by Deutsche Bundesbank, Banque de France, Banca d'Italia, and Bank of Finland for overseers and operators.
- Participation to ESCB working groups
- On site consultations





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Latest version 7.0.0





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Latest version 7.0.0

- Automated stress testing tool
 - New sql-filtering tool, indicators and ready-made reports
 - Less disk space needed
- New CCP (Central Counterparty) - simulation feature
 - Including: novation, netting and CSD settlement
- Prototype of a Task automation tool
- Support for newer and better performing MARIADB and MySQL versions
- Support for DVP and PVP settlement processes with more than two linked transaction legs



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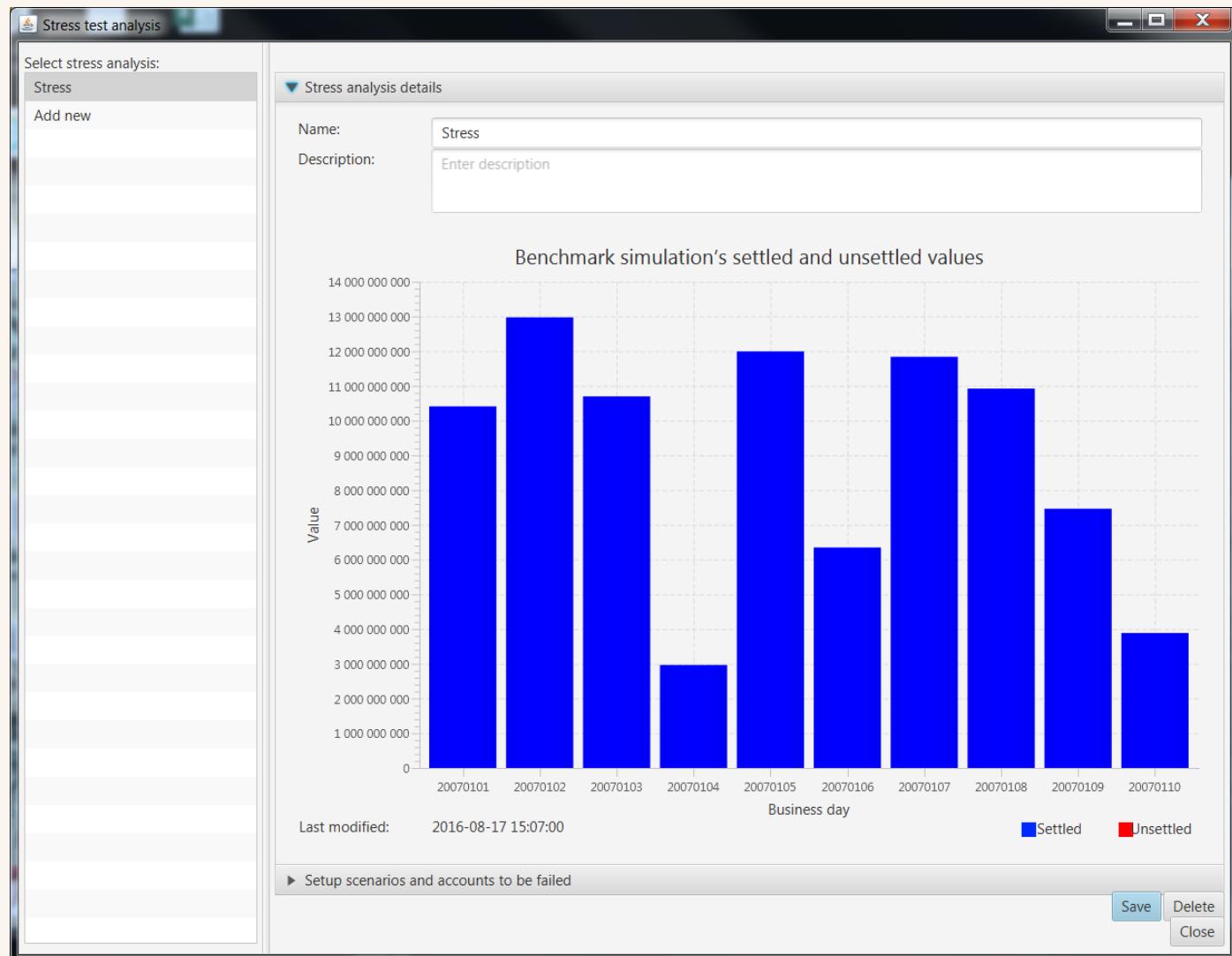
Automated stress testing tool

- Automatic generation and running of scenarios
- Enhanced reporting
- Automatic calculation of upper bounds, average sending times,...
- New indicators:
 - Liquidity deterioration
 - Maximum upperbound
 - Differences between benchmark and scenarios
- Significant savings in consumed storage space
 - Scenarios' input data is not anymore stored
- Possibility to modify the SQL-sentences used to filter the scenario data



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Automatic generation of scenarios





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Automatic running of scenarios

Stress test analysis

Select stress analysis:

- CCP analysis 2
- CCP analysis 45
- Add new

► Stress analysis details

▼ Setup scenarios and accounts to be failed

Bench simul... CSD1-B Last r... 2016-08-10 11:23:22 Log ...

Scenario rule: fail by participant Data f... defaultFilter.sql Edit ...

Accounts available from bench:

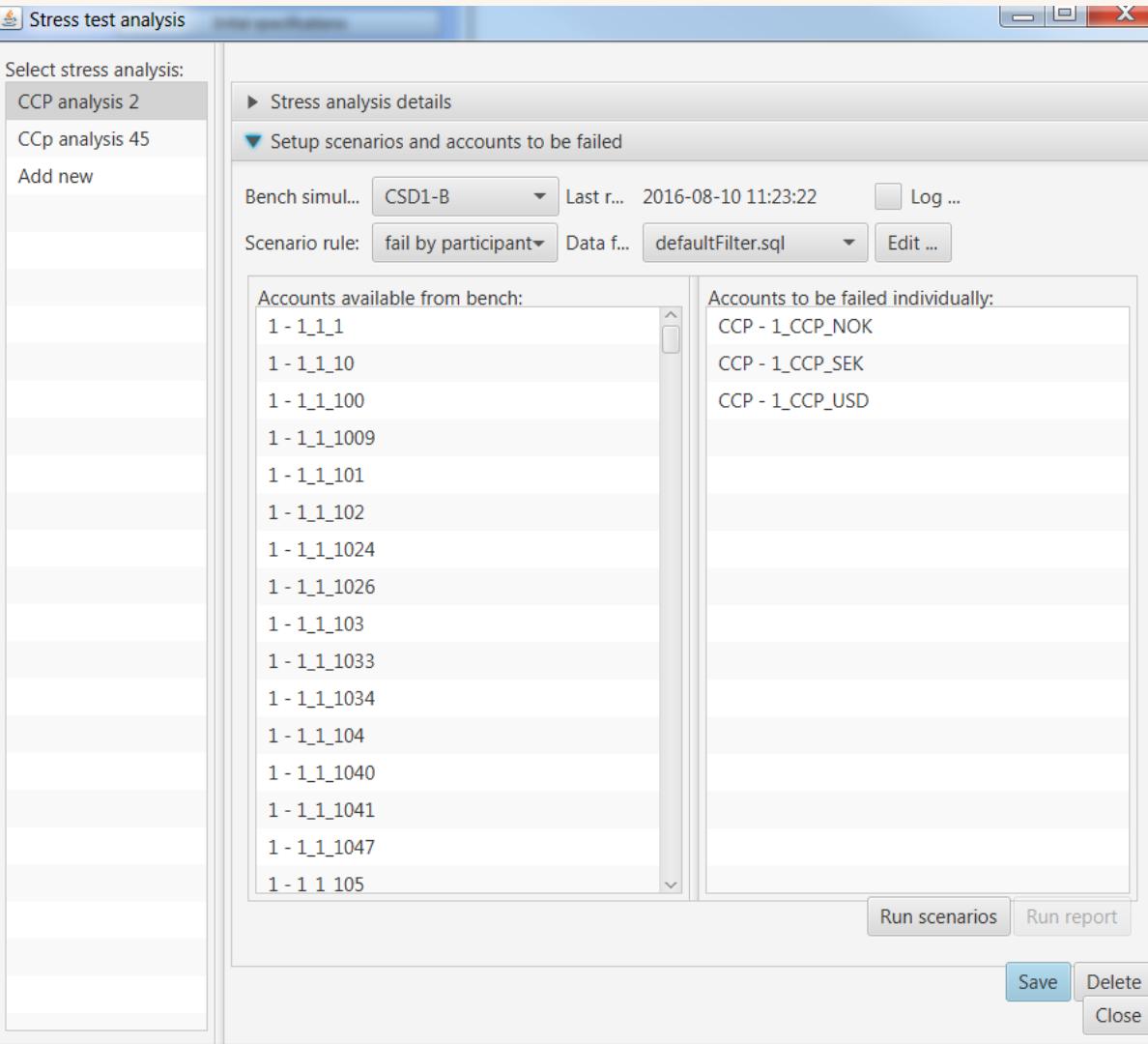
- 1 - 1_1_1
- 1 - 1_1_10
- 1 - 1_1_100
- 1 - 1_1_1009
- 1 - 1_1_101
- 1 - 1_1_102
- 1 - 1_1_1024
- 1 - 1_1_1026
- 1 - 1_1_103
- 1 - 1_1_1033
- 1 - 1_1_1034
- 1 - 1_1_104
- 1 - 1_1_1040
- 1 - 1_1_1041
- 1 - 1_1_1047
- 1 - 1_1_105

Accounts to be failed individually:

- CCP - 1_CCP_NOK
- CCP - 1_CCP_SEK
- CCP - 1_CCP_USD

Run scenarios Run report

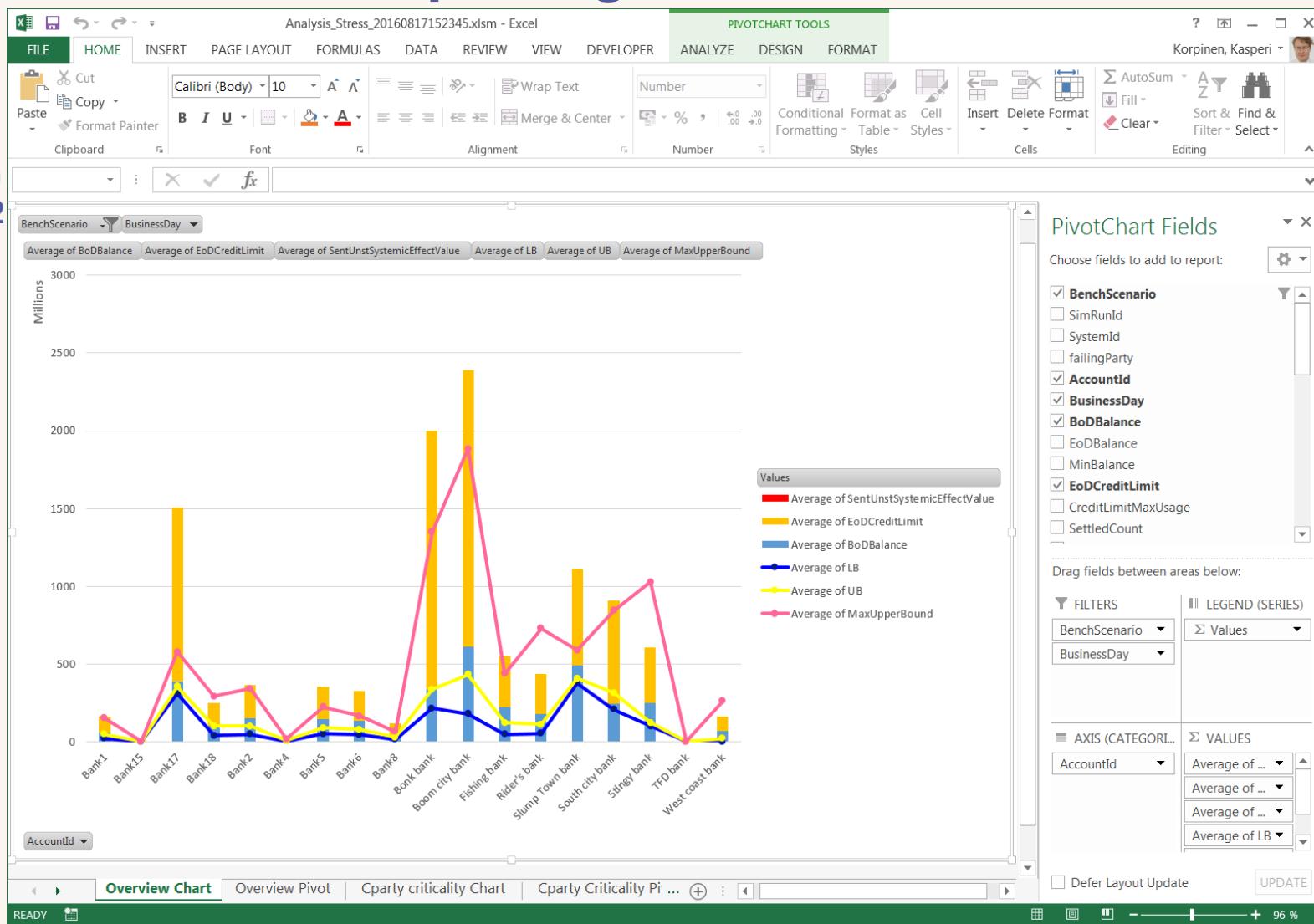
Save Delete Close





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Enhanced reporting based on Excel





New indicators on Account table

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Excel screenshot showing the 'Account' sheet. The title 'New indicators on Account table' is displayed prominently at the top.

The table contains numerous rows of data, each representing an account entry. The columns include:

- Banks: First column (e.g., Brach, CSOB)
- Accounts: Second column (e.g., L1, L2, L3, L4, etc.)
- Date: Third column (e.g., 25-07)
- Debit/Credit: Fourth column (e.g., -500.00, 500.00)
- Value: Fifth column (e.g., 0.00, 0.00)
- Indicators: A series of six colored cells in the sixth column indicating various status or calculation types (e.g., Bad, Good, Neutral).
- Notes: The last two columns provide detailed notes for each entry.



Unsettled Payments by Value (Systemic)

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Average of SentUnstSyste Column Labels

Row Labels	Bank1	Bank15	Bank17	Bank18	Bank2	Bank4	Bank5	Bank6	Bank8	Bonk bank	Boom city bank	Fishing bank	Rider's bank	Slump Town bank	Town bank	South city bank	Stingy bank	TFD bank	West coast bank
Bank1		0	0	200000000	96370935,4	0	9046,3	13376123,6	6723411,7	45607014,4	30986748,8	0	24444610,5	959019,8	4114508,1	4962929,8	0	0	
Bank15	21313178,9		3081665,4	0	40407856,1	0	0	7789103,4	4092699,2	44948903,2	18163540,1	1830488,5	11447789	959019,8	6479456,6	4336834,3	0	0	
Bank17	0	0	0	0	0	0	0	1506,9	0	0	283169,7	165461,1	0	0	0	0	0	0	
Bank18	22035744,9	20000000	3081665,4	0	20320985	0	0	40856902,8	1457941,9	143016,3	52694152,9	29755828,7	1830488,5	1125831,7	3755828,2	9643744,2	5613313,2	0	0
Bank2	20105205,4	20000000	3081665,4	20320985	0	0	0	40344729,6	143016,3	3242210,1	13349251,3	1830488,5	842833,2	1419141,8	10198052,1	1465877,9	0	0	
Bank4	20000000	20000000	3081665,4	20158080,3	0	0	0	135983,6	4092699,2	37863161	9701363,6	1830488,5	1738300,9	959019,8	6479456,6	0	0	0	
Bank5	20280193,7	20000000	7841252,2	21535737,5	20978157,1	763398,4	0	135983,6	44092699,2	58671539,8	18615148,4	1830488,5	3099230,5	959019,8	12096990	1079585,4	3048575,7	0	
Bank6	20000000	20000000	3081665,4	20158080,3	0	8390618,8	0	4092699,2	276126890,4	9244453,3	1830488,5	1343497,8	959019,8	6479456,6	0	46509071,2	0	0	
Bank8	20000000	32458,3	25648431,4	20089308,8	0	0	0	1506,9	35332505	10295934,1	9472058,3	0	5859019,8	10552429,2	0	4093471,7	6000000	0	
Bonk bank	20000000	20000000	3081665,4	20158080,3	0	0	0	135983,6	3949682,9	5113717,2	1830488,5	1343497,8	0	5200000	0	0	0	0	
Boom city bank	21857164,4	0	4901400,9	20000000	60827304,1	0	749	8146123,3	3949682,9	9804264,1	6113150,5	14071720	4900000	6479456,6	4336834,3	0	0	0	
Fishing bank	130000000	60000000	86486277,7	63252234,5	24737762,3	0	1667644,3	3903479,8	4092699,2	53537821,4	54982483,6	15430185,9	26976395,6	89234174,7	6168734,5	11213453	0	0	
Rider's bank	23875657,4	0	3935727,8	0	5680268	0	0	9883759,6	143016,3	38143452,5	54480017,6	8306657,2	7062400,4	10497837	0	20000000	23990944	0	
Slump Town bank	0	0	2040138,5	0	0	0	0	1506,9	143016,3	35144639,1	4497447,5	1141887,5	0	0	0	0	0	0	
South city bank	0	0	0	0	0	0	0	1506,9	0	0	0	0	0	0	0	0	0	0	
Stingy bank	95000000	20096310,8	20844927,1	20309338,9	132293,6	0	749	135983,6	4092699,2	37246964,4	28202525,5	53359474,2	1343497,8	20559019,8	23416461,3	0	20000000	0	0
TFD bank	40000000	20000000	10151789,5	40158080,3	0	0	2254,5	136735,6	4092699,2	37863161	16509979,8	17897369,1	1738300,9	10759019,8	11679456,6	0	0	0	0
West coast bank	0	100000000	0	118374528	22842545,8	0	2807737,5	4725558,4	4092699,2	56891401,1	29885429,5	0	17211458,2	1408935,6	4723166,6	2395382,1	0	0	0



New ready-made reports on Excel: Counterparty Exposure Matrix In Terms of Liquidity Deterioration

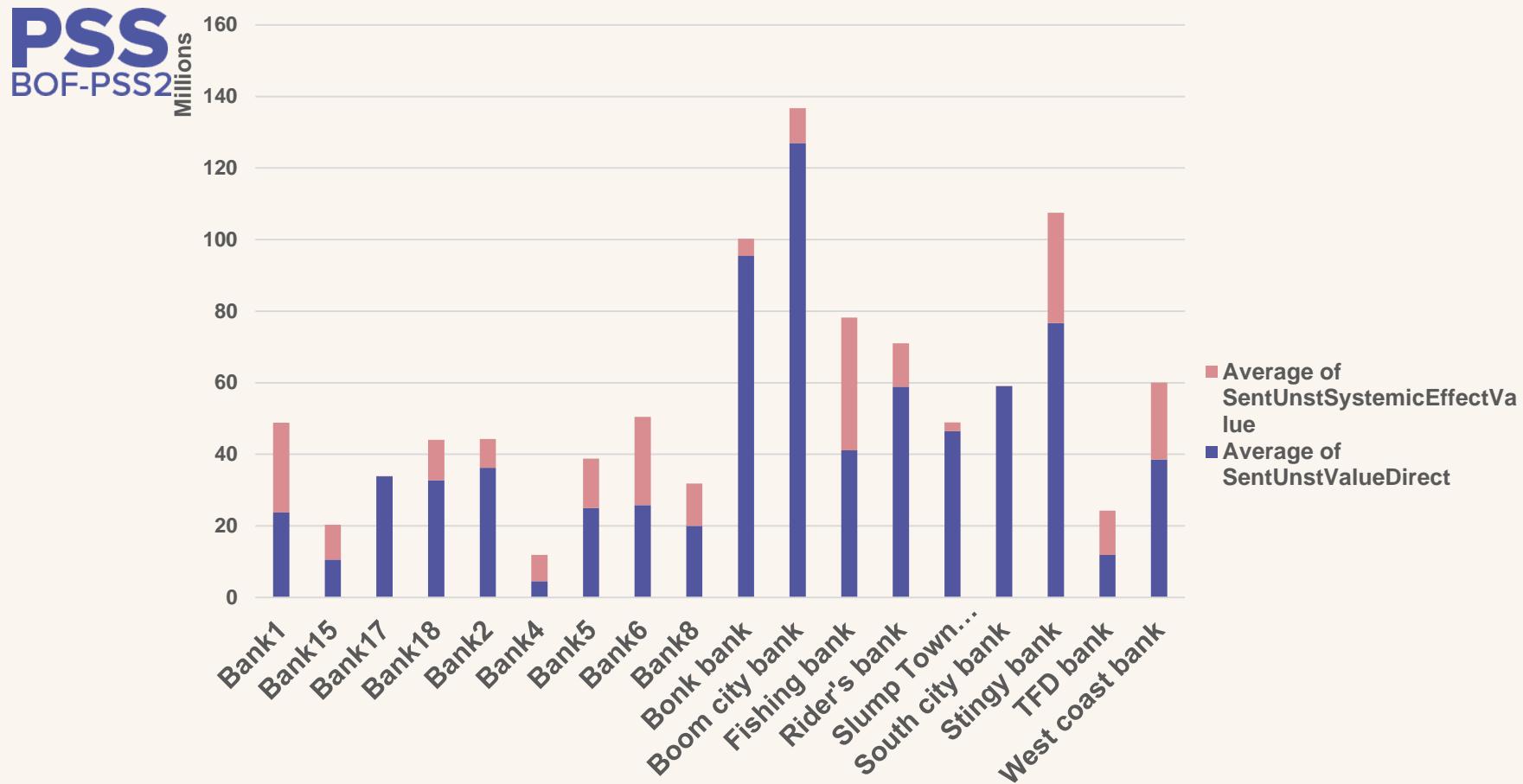
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Average of MaxLiqui Column Labels

Row Labels	Bank1	Bank15	Bank17	Bank18	Bank2	Bank4	Bank5	Bank6	Bank8	Bonk bank	Boom city bank	Fishing bank	Rider's bank	Slump Town bank	South city bank	Stingy bank	TFD bank	West coast bank
Bank1		1 080 065 330,80	-88 869 131,00	1 139 248 796,30	110 457 627,40	0,00	-246 471,80	12 864 273,60	2 630 712,50	23 102 408,00	-41 139 646,20	1 607 044,80	17 945 235,30	-43 000 258,00	-67 108 011,50	-17 144 148,90	0,00	-533 072 996,40
Bank15	-241 600 543,50		-3 437 533,30	536 112 125,00	65 908 513,10	0,00	9 046,30	7 662 895,70	0,00	7 085 742,20	8 462 176,50	3 437 533,30	11 273 671,90	3 321 219,50	-1 074 928,80	4 336 834,30	-96 310,80	0,00
Bank17	-62 913 722,40	-20 000 000,00		-23 458 048,10	0,00	-60 000 000,00	0,00	-19 165 521,10	-4 092 699,20	-462 854 755,10	-7 163 970,70	245 832 523,80	44 682 692,70	-6 569 376,60	-325 019 471,80	62 682 745,40	0,00	-74 722 009,70
Bank18	-105 672 325,90	-200 000 755,10	-3 437 533,30		962 502 730,30	0,00	49 826 452,60	87 796 866,20	63 450 488,80	83 791 352,20	-154 273 796,30	3 437 533,30	52 412 601,90	24 128 121,30	-29 115 470,50	32 407 573,70	-184 290,40	0,00
Bank2	3 340 284,00	0,00	-1 788 288,40	-286 802 916,30		0,00	585 989 889,10	175 272 170,30	32 913 784,20	238 918 692,50	84 316 009,80	3 437 533,30	-38 891 923,90	-53 221 715,40	-15 902 949,30	-29 401 801,70	0,00	-561 630,80
Bank4	0,00	0,00	56 562 466,70	0,00	0,00		0,00	0,00	-12 203 929,40	0,00	5 016 023,70	-56 562 466,70	0,00	0,00	0,00	-5 733 047,90	11 609 733,00	0,00
Bank5	-251 997,80	-9 801,40	1 322 053,50	29 058 367,00	-179 562 369,80	763 398,40		589 254 030,00	309 652 530,60	14 606 228,50	6 693 725,80	3 437 533,30	9 306 559,00	-19 471 905,10	30 089 550,30	27 090 039,30	3 048 575,70	0,00
Bank6	-272 776,50	-10 531,00	15 593 511,10	-19 902 590,50	-66 362 722,50	8 788 382,00	-196 924 413,90		1 812 290 203,00	855 603 726,90	-43 725 904,80	3 437 533,30	10 745 622,60	21 703 718,80	60 747 614,90	-11 986 789,30	46 509 071,20	0,00
Bank8	26 804 442,80	60 036 993,50	19 129 232,70	-1 886 360,10	0,00	219 531 008,80	6 858 153,20	-275 134 476,70		833 676 779,80	-13 937 517,00	11 079 103,10	6 429 511,30	26 603 718,80	37 078 220,50	0,00	298 859 222,80	127 740 256,20
Bonk bank	-80 430 286,00	0,00	104 153 559,90	-24 976 433,10	-65 731 668,60	0,00	23 834 215,10	14 368 214,70	-218 307 923,30		21 459 264,90	3 437 533,30	-124 521 057,80	250 838 046,20	30 743 135,80	61 624 632,90	-733 648,40	0,00
Boom city bank	1 604 290,40	60 004 535,20	-128 043 061,60	599 395 061,40	-25 057 737,70	-5 016 023,70	-20 859 100,10	19 272 539,50	-143 016,30	-392 029 089,30		304 623 044,90	275 652 793,80	86 336 149,20	-218 279 627,10	-236 636 330,50	-250 231,60	180 670 254,50
Fishing bank	221 142 463,10	100 003 775,30	-231 562 766,90	84 226 881,00	24 737 762,30	513 235 989,80	1 667 644,30	3 767 496,20	0,00	-14 823 334,50	-314 034 063,50		241 420 105,40	29 338 595,30	76 047 437,20	-26 368 852,90	11 213 453,00	864 243 070,30
Rider's bank	12 722 374,30	-20 000 000,00	-162 286 529,30	-77 782 789,00	41 713 928,60	0,00	222 182,80	171 534,10	-3 949 682,90	-152 100 192,80	-287 644 588,90	-180 983 645,40		-86 294 632,90	50 501 060,90	708 299 128,90	40 150 815,60	54 838 917,30
Slump Town bank	13 228 078,70	-20 000 000,00	-88 945 774,90	-20 158 080,30	82 576 490,50	0,00	38 175 555,80	-134 476,70	-3 949 682,90	-334 706 514,90	-162 666 146,90	2 748 932,30	78 761 047,20		519 434 666,40	132 024 158,70	0,00	-58 674 645,80
South city bank	-24 360 731,20	-20 000 000,00	430 956 231,60	-3 496 546,70	18 079 349,30	0,00	-24 485 060,40	-6 940 039,10	106 322 006,70	-32 363 727,20	126 374 480,50	13 233 659,60	-53 252 623,30	-347 026 355,60		27 484 804,30	-488 778,30	-363 370 740,30
Stingy bank	137 342 461,40	20 098 550,90	-132 823 731,70	-29 942 969,70	30 999 973,20	5 733 047,90	-25 767 621,10	11 986 789,30	0,00	-310 058 875,10	138 477 814,50	91 411 621,50	-418 965 049,70	-113 623 614,30	-38 734 560,00		1 107 475 500,70	1 201 883 995,20
TFD bank	45 555 523,20	80 101 574,40	3 632 590,80	33 481 520,90	0,00	-11 609 733,00	2 254,50	752,00	-52 607 557,10	733 648,40	-685 799,90	19 504 413,90	0,00	9 800 000,00	5 688 778,30	-200 000 000,00	398 560 972,10	
West coast bank	1 208 312 319,50	520 035 383,20	51 064 221,00	464 217 300,60	78 239 275,90	0,00	3 184 777,00	29 465 468,70	15 763 153,40	36 418 043,10	1 461 769,70	-215 257 542,00	25 123 493,90	75 155 596,90	101 087 051,00	-90 235 326,50	-200 000 000,00	

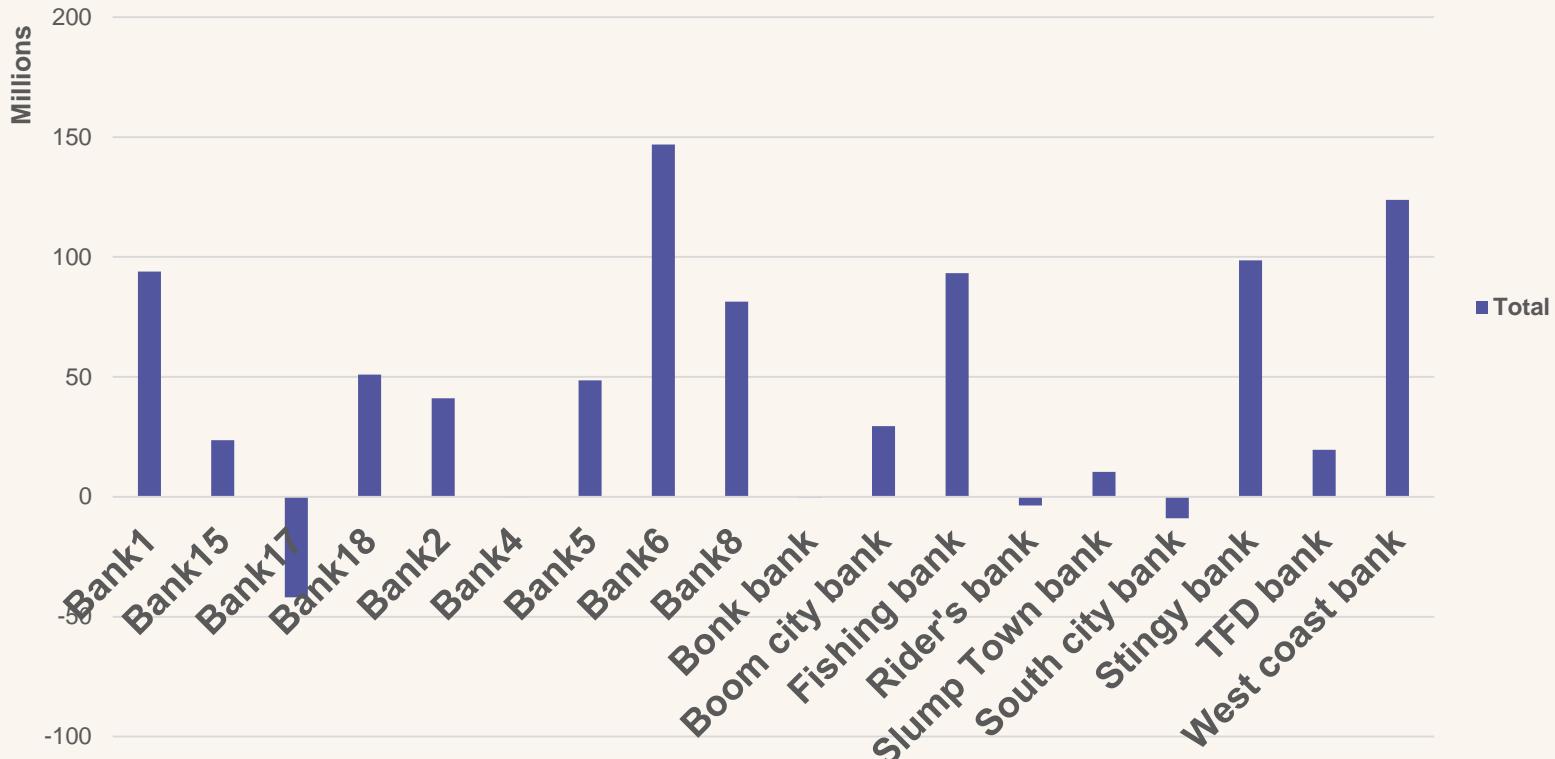


Unsettled Transaction Volumes by Failing Banks





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New CCP simulation feature

- Task automation tool for executing different steps consecutively and automatically
- The tool performs novation and netting of trades
- If needed, the tool generates the participant data and initial daily balances based on upper and lower bounds of liquidity calculated from the trade data.
- The tool can split the trade data according to the CSD's where the equities are meant to be settled
- Simulations are set up automatically according to the trade data



New task automation tools for preparing CCP data suitable for simulations

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Task automation tools

Select task set:
CCP tasks -

Select tran data set:
1

Tasks:

Task	Description	Run
Add CCP transacti...	Perform CCP novation of trades / trades are novated and the CCP is added as counterparty	<input checked="" type="checkbox"/>
Net CCP data	Perform CCP netting and generate cash legs / trades are netted by CSD, CCY, ISIN and cash legs by CSD, CCY	<input checked="" type="checkbox"/>
Create participant ...	Create participant data from source transaction data set	<input checked="" type="checkbox"/>
Create CSD syste...	Create CSD benchmark simulations / create CSD systems setups and benchmark simulations	<input checked="" type="checkbox"/>
Create CSD DBAL ...	Create both upper and lower bound DBAL data sets for all CSDs from bench simulation account statistics	<input checked="" type="checkbox"/>

Run Close



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Availability

- Version 7.0.0 is released and available for all the interested institutions as free of charge
- Software is applicable for research, oversight work and operative monitoring

Contact

BOF-PSS@bof.fi

Visit

www.bof.fi/sc/bof-pss



Services for BoF-PSS2 users

- Training courses
 - General Training course
 - TARGET2 Simulator course
 - Tailored on site trainings
- User Support
 - Help desk service
 - Extranet workspace for larger projects (confidential area)
 - Consultation and advisory services
- Feature Development
 - Project estimation
 - Change implementation



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Overall agenda of the 14th simulator seminar

Day 1	Day 2
Simulator team overview	
Presentations 1 – 4	Presentations 8 - 12
Lunch	Lunch
Presentations 5 – 7	Presentations 13 - 15
Evening at BoF Villa	Farewell cocktails

- Everyone is invited to the dinner this evening at the Bank of Finland's Villa

- Payment system features, liquidity studies, network studies, new indicators, performance improvem.
- 15 interesting presentations





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Seminar participants

- Areas of interest match the seminar themes
- Diversified global participation:
 - 21 nationalities
 - 5 continents
 - 44 from CB's, 4 from private side and 3 with research affiliation.
- Users of the BoF-PSS2 simulator
 - 55% are already familiar

Topic	Number of votes (max 51)
System design	42
Contagion, cross-system analysis, networks	37
Indicators based on Payment system data	30
Stress testing	29
Liquidity saving mechanism	23
Agent Based modelling	22

Welcome!