

Credit risk and collateral demand in a retail payment system*

By: Hector Perez-Saiz & Gabriel Xerri



* Any opinions and conclusions expressed herein are those of the authors and do not necessarily represent the views of the Bank of Canada

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Presented by: Gabriel Xerri
Payment System Oversight
Financial Stability Department

Motivation

- Recent regulatory changes are influencing the design of existing and future payment systems
- ACSS:
 - Clearing system for retail payments in Canada
 - Owned and Operated by Payments Canada (formally known as the Canadian Payments Association)
 - Recently designated by the Bank of Canada as a Prominent Payment System (PPS) for Oversight
 - Uncollateralized deferred net settlement system
- PPS are subject to risk management standards based on the PFMIs:
Credit risk – Must cover single largest exposure in an extreme but plausible case

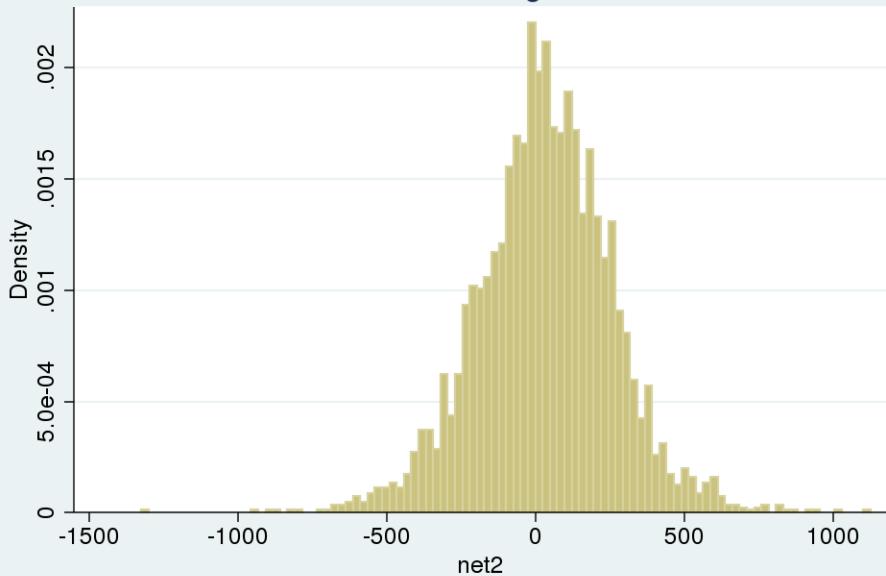
Question

- **Question:** What are the optimum arrangements for ACSS to mitigate overnight credit risk? What are the implications?
- Data: 12 years of historical ACSS daily payment flows between participants.
- Required collateral is calculated using a Cover 1 scheme:
 - Collateral pool to cover single largest debit position using a time window
- Some key variables are calculated to evaluate the performance:
 - Average collateral levels, and variability day to day
 - Shortfalls are calculated to determine adequacy of coverage

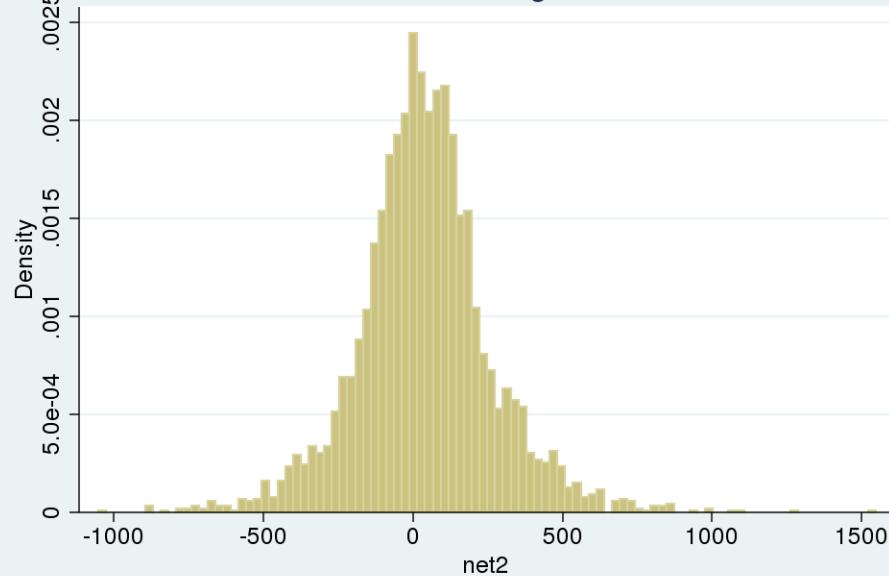
Credit risk and the ACSS

- Final settlement is determined T+1
- No collateral pledged in current configuration
- Although ACSS rules call for an additional settlement obligation for survivors in the event of a default, there are no ex-ante (pre-pledged) financial resources

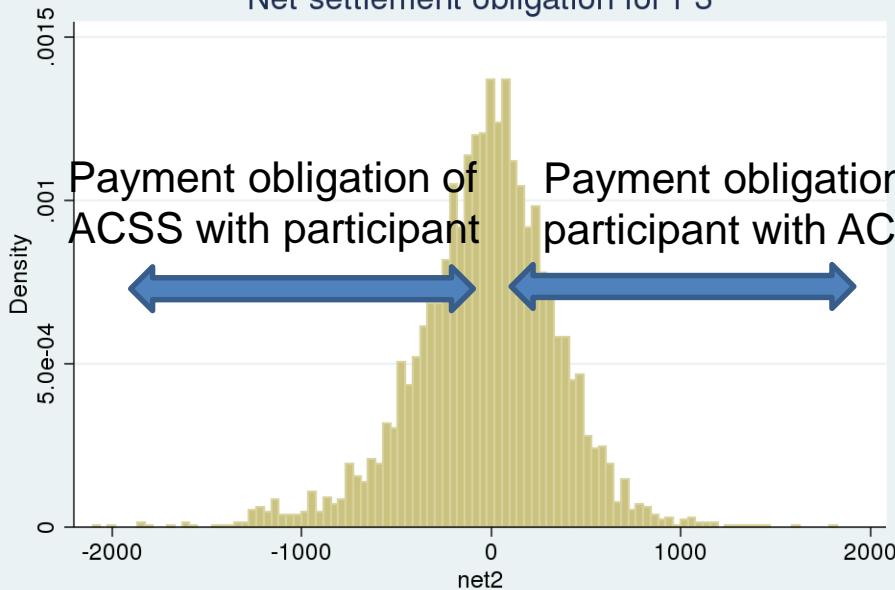
Net settlement obligation for P1



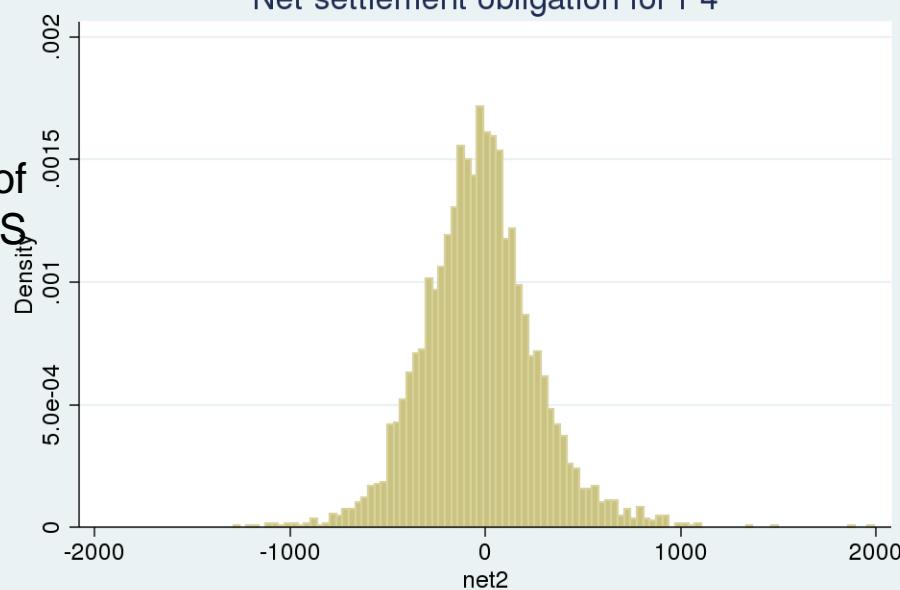
Net settlement obligation for P2



Net settlement obligation for P3



Net settlement obligation for P4





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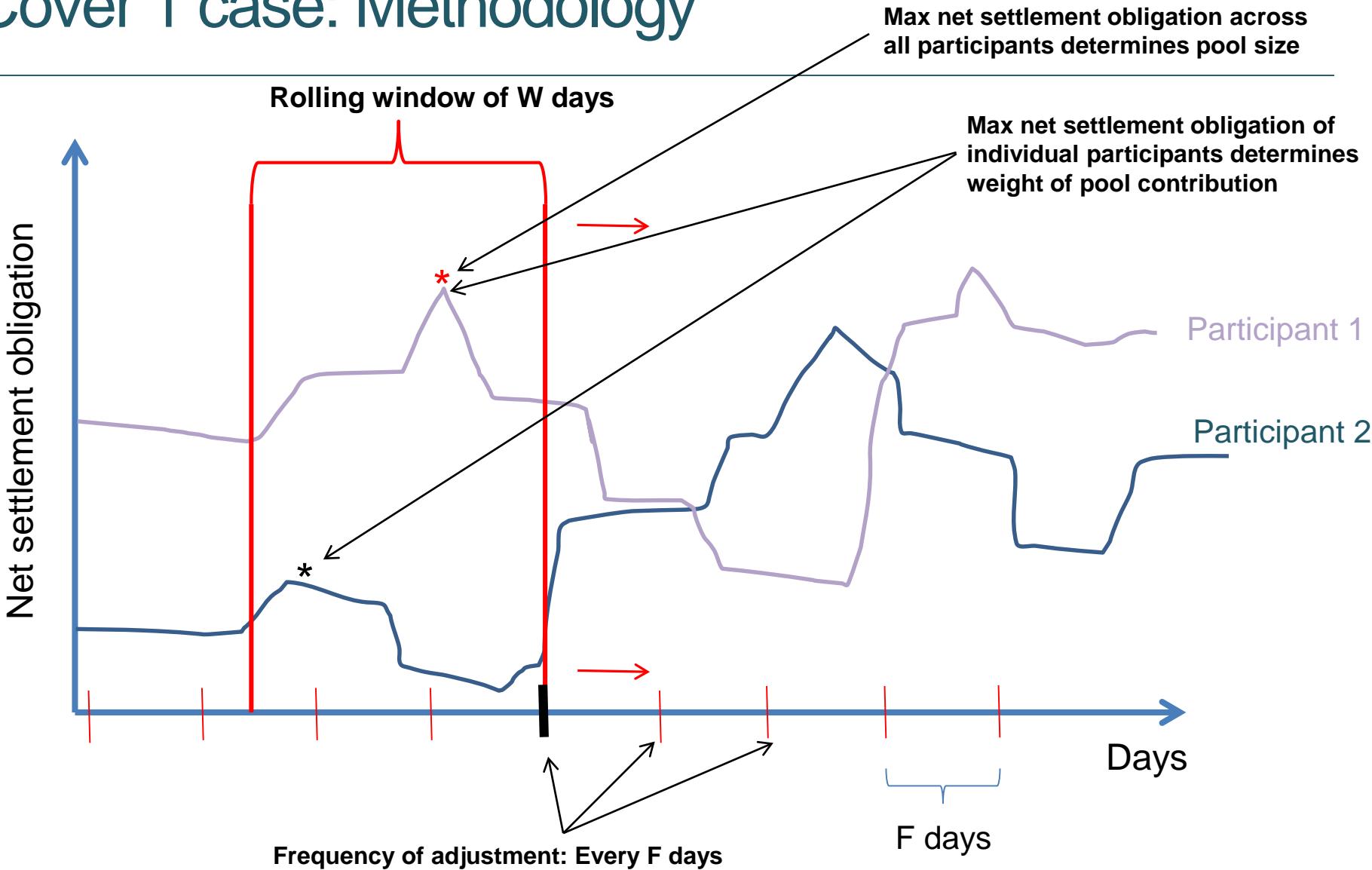
Cover 1 case



Cover 1 case: Methodology

- Collateral pool, with contributions of all participants
 - Historical flows used to find the largest debit position across banks in a time window
 - Pool size: Largest debit position across banks
 - Contributions to pool are based on largest obligations of participants in time window
- Key parameters:
 - Window size (W): Historical time period used to calculate pool size
 - Frequency of adjustment (F): How often we change the collateral pool

Cover 1 case: Methodology



Cover 1 case: Methodology

- Pool size $\bar{K}^P(W)$ is the largest debit position across banks within the window W:

$$\bar{K}^P(W) = \max_{b, t \in W} d_{b,t}$$

- Collateral is distributed among banks using weights that are calculated using the largest debit position for every bank within the window:

$$\omega_b = \frac{\bar{K}_b^P(W)}{\sum_b \bar{K}_b^P(W)}$$

$$\bar{K}_b^P(W) = \max_{t \in W} d_{b,t}$$

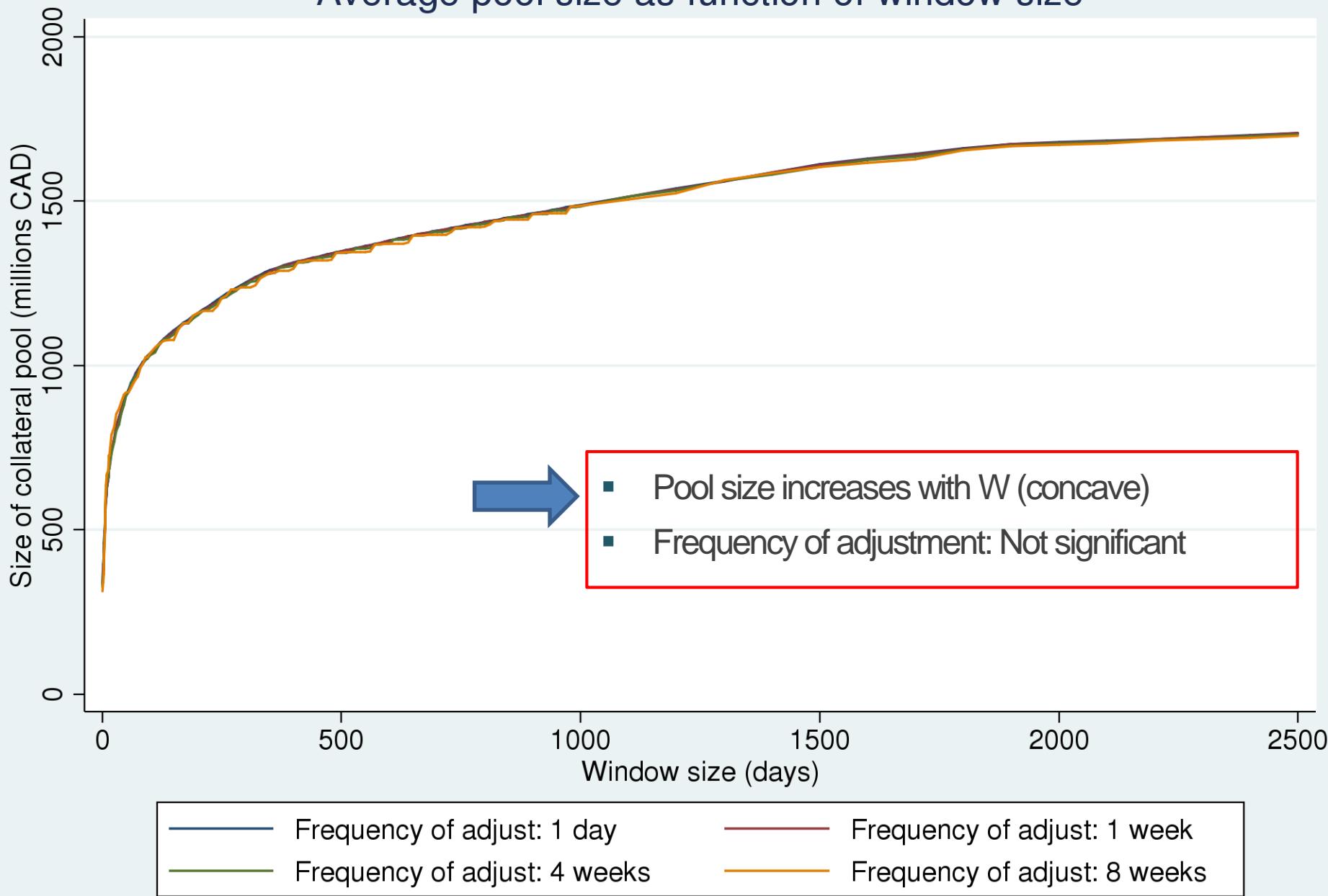
- And the collateral pledged by every bank is:

$$K_b^P(W) = \omega_b \cdot \bar{K}^P(W)$$

Cover 1 case: Summary of results

	Effect when window size (W) increases	Effect when number of days between adjustments (F) increase
Pool size and average collateral per bank	 (and concave)	Not significant
Variability of required collateral between days	 (and convex)	 (But becomes irrelevant when W is high)
Shortfall	 (and convex)	Not significant

Average pool size as function of window size



Average daily collateral (millions CAD)

	Cover 1 case, window size				
	1 day	10 days	100 days	500 days	1000 days
Pool size:	336.9	622.7	1,037.9	1,347.8	1,488.8
Collateral:					
P1	51.9	89.6	135.6	167.3	176.6
P2	52.5	93.0	151.7	188.1	211.4
P3	73.2	122.7	191.8	234.4	245.6
P4	48.8	103.7	177.3	214.8	218.1
P5	19.3	41.3	79.1	120.8	154.1
P6	30.1	62.1	110.8	154.4	176.7
P7	12.1	24.5	44.1	69.7	74.0
P8	13.2	18.0	25.1	32.1	38.2
P10	12.5	19.7	29.9	42.7	52.0
P11	11.1	22.9	45.0	62.3	73.5
P12	12.0	24.6	46.1	58.1	64.6

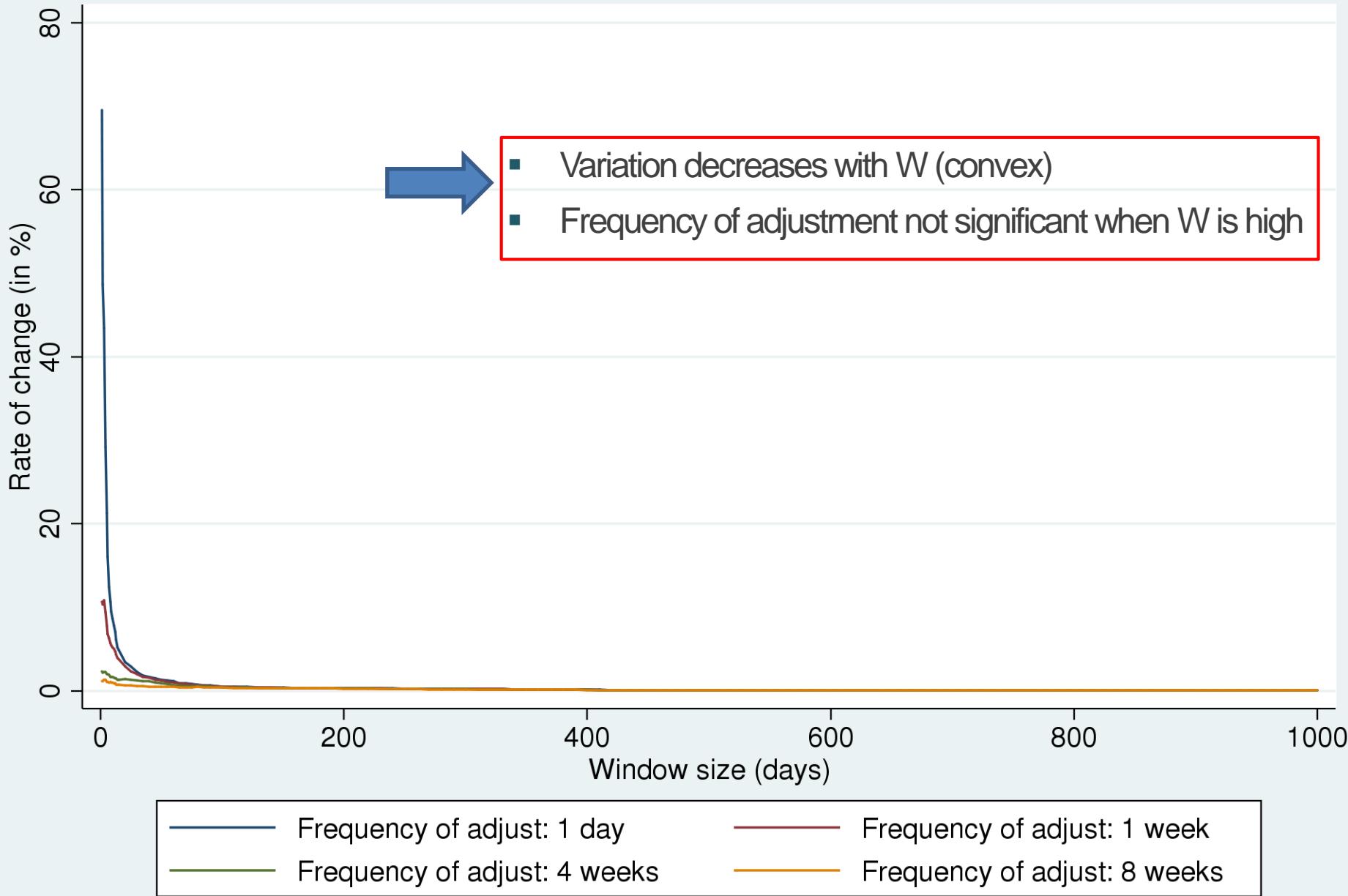
[Link to intuition 1](#)

Variability of collateral

- Definition:

$$Variability(t) = 100 \times \frac{abs[Collateral(t) - Collateral(t - 1)]}{Collateral(t - 1)}$$

Variation of pool size between days (in %) as function of window size



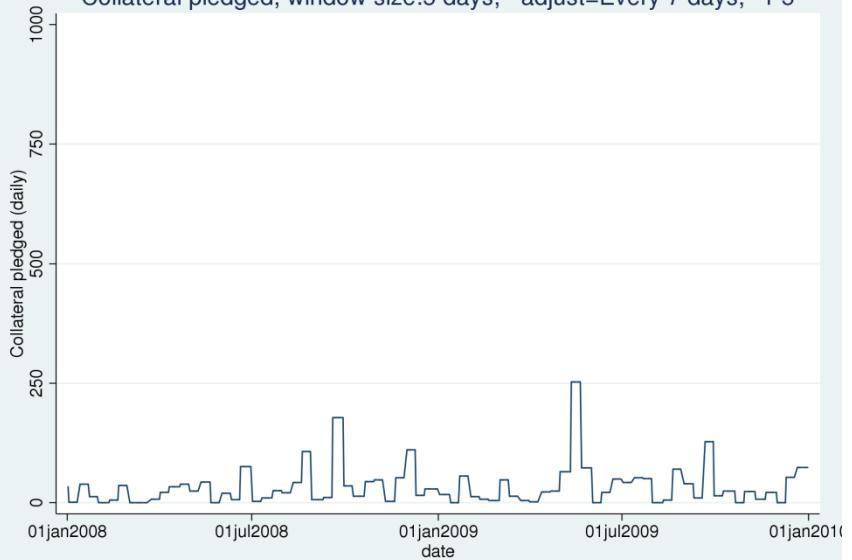
Variability of collateral between days

	Cover 1 case, window size				
	2 days	10 days	100 days	500 days	1000 days
Pool size:	10.32%	5.16%	0.47%	0.08%	0.06%
Collateral:					
P1	36.35%	19.34%	1.05%	0.21%	0.09%
P2	42.18%	12.66%	1.00%	0.24%	0.14%
P3	57.83%	14.11%	1.08%	0.20%	0.13%
P4	30.17%	18.12%	1.34%	0.22%	0.12%
P5	60.46%	18.33%	1.63%	0.34%	0.22%
P6	22.32%	15.91%	1.24%	0.28%	0.11%
P7	27.53%	27.12%	1.31%	0.37%	0.21%
P8	63.44%	19.44%	1.11%	0.28%	0.18%
P10	33.42%	8.54%	1.17%	0.37%	0.16%
P11	35.14%	16.77%	1.36%	0.32%	0.10%
P12	33.36%	30.91%	1.30%	0.24%	0.17%

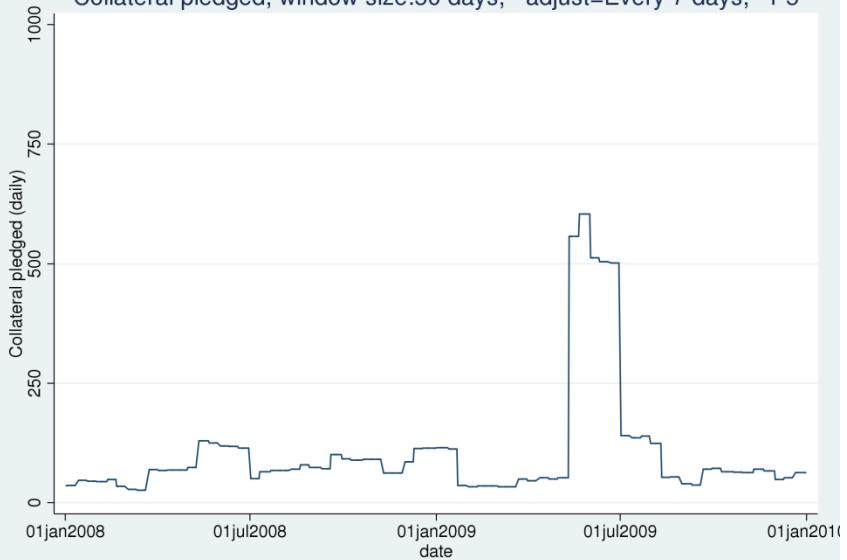


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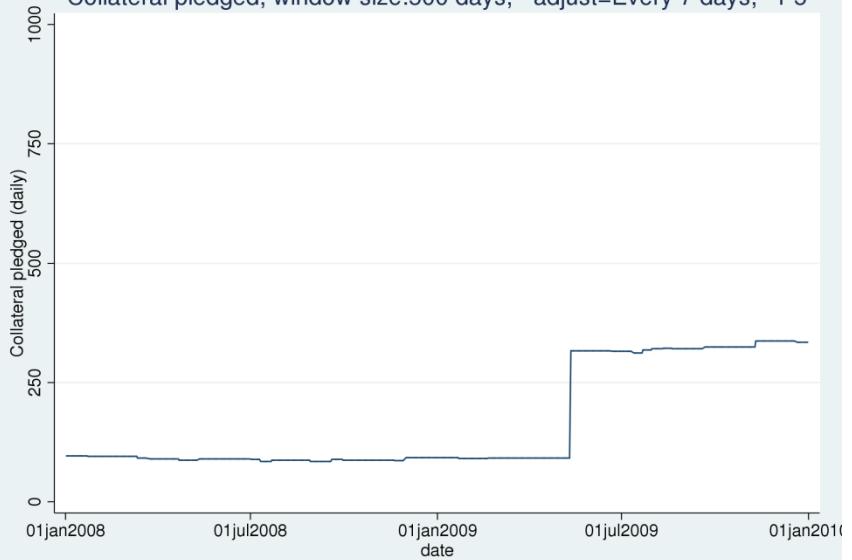
Collateral pledged, window size:5 days, adjust=Every 7 days, P5



Collateral pledged, window size:50 days, adjust=Every 7 days, P5



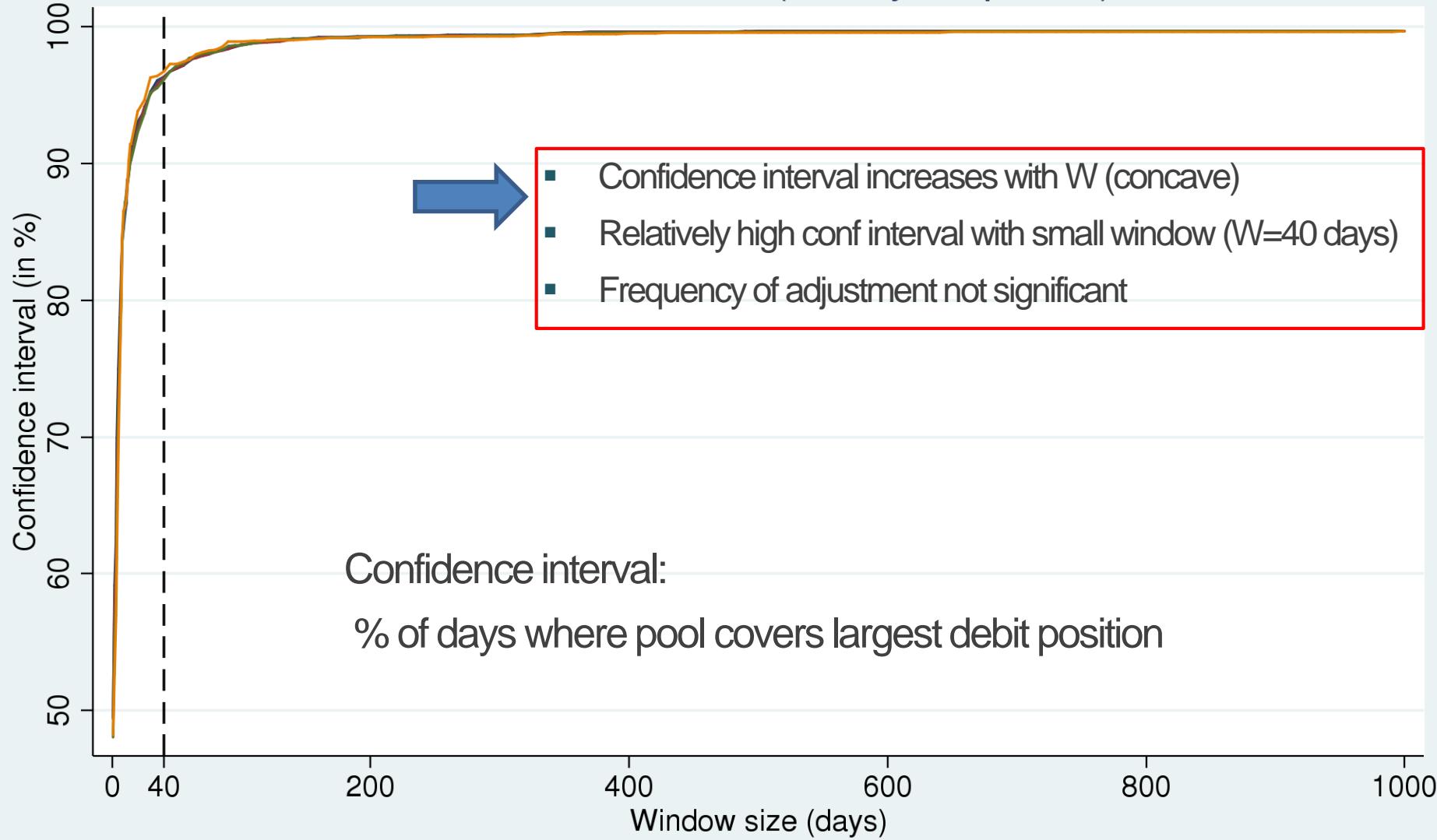
Collateral pledged, window size:500 days, adjust=Every 7 days, P5



Collateral pledged, window size:1000 days, adjust=Every 7 days, P5



Confidence interval (in 12 year period)



- Confidence interval increases with W (concave)
- Relatively high conf interval with small window (W=40 days)
- Frequency of adjustment not significant



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Implications

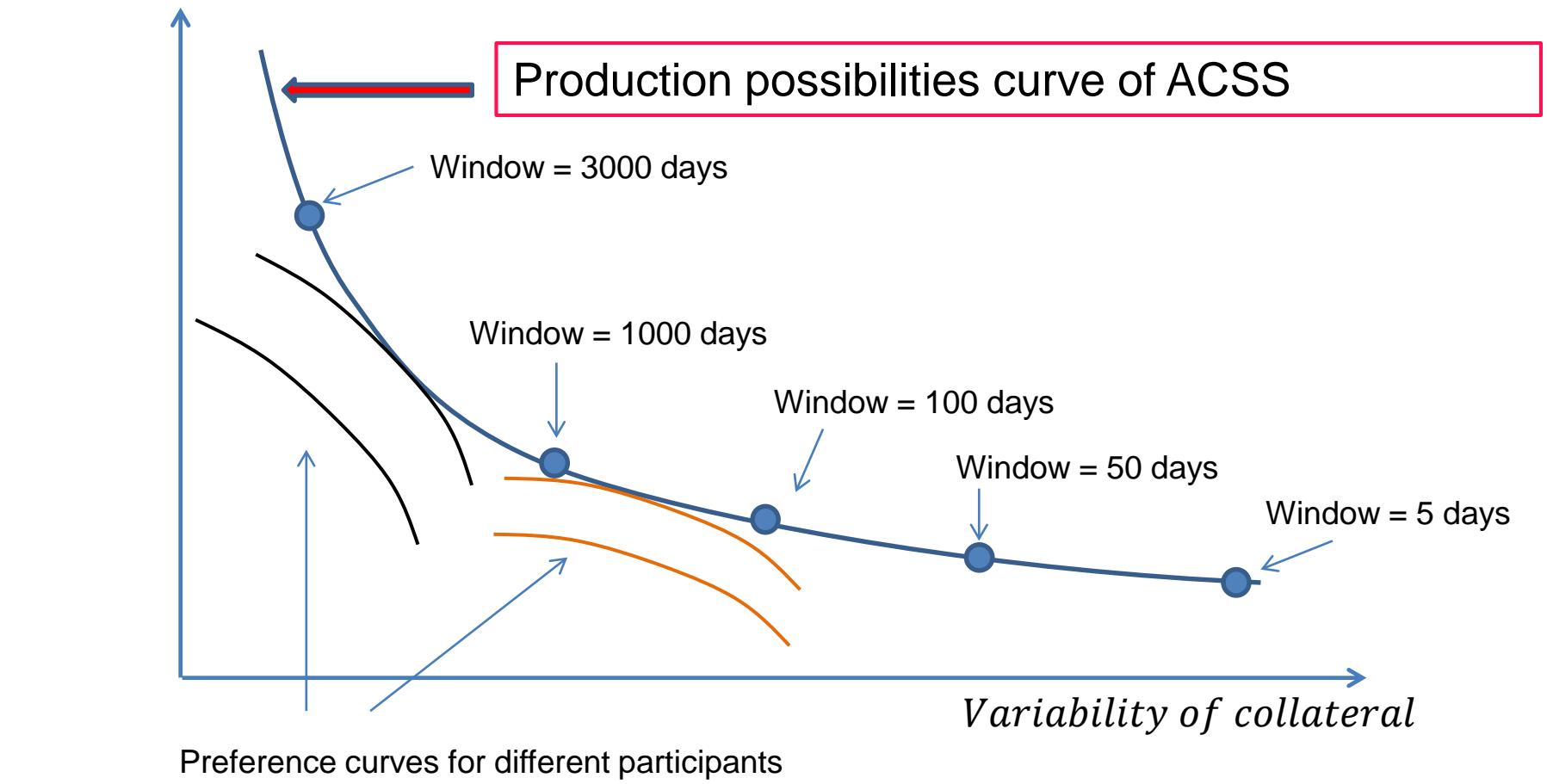


Some implications (I)

- Interesting trade-off exists:
 - Level of collateral vs variation day to day
- High level and high variability of collateral is costly for banks:
 - Collateral is scarce resource
 - Moving/obtaining large amounts of collateral between days can be very costly
- Some empirical evidence found in LVTS:
 - Banks hold high excess collateral
 - Bilateral credit limits (BCLs), net debit caps (NDC) rarely change and are larger than needed

Some implications (III): Optimum for participants

Average collateral = $E[K]$



Conclusions

- For cover 1 case, we find an interesting trade-off between level of collateral and variability day to day
- This trade-off provides interesting implications for the participants' payoffs
- Window size is the key parameter. Frequency of adjustment is not significant
- Implications for design of ACSS and Next Generation of Payment Systems

Next Steps

- Estimate the tail distribution of exposures in ACSS to give us a sense of extreme but plausible events to adequately collateralize the system

Threshold

95%

