Settlement Liquidity in SIC

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17th BoF Payment and Settlement System Simulator Seminar
Helsinki, 30 August 2019

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Agenda

1. What is the objective of this work and why is it relevant?
2. Capture settlement liquidity in RTGS with queuing with two models
3. Regression model 1: exploring explanatory factors for release time
4. Regression model 2: queuing duration and result
5. Forthcoming work and conclusion

Settlement liquidity in SIC – objectives and relevance for SIC

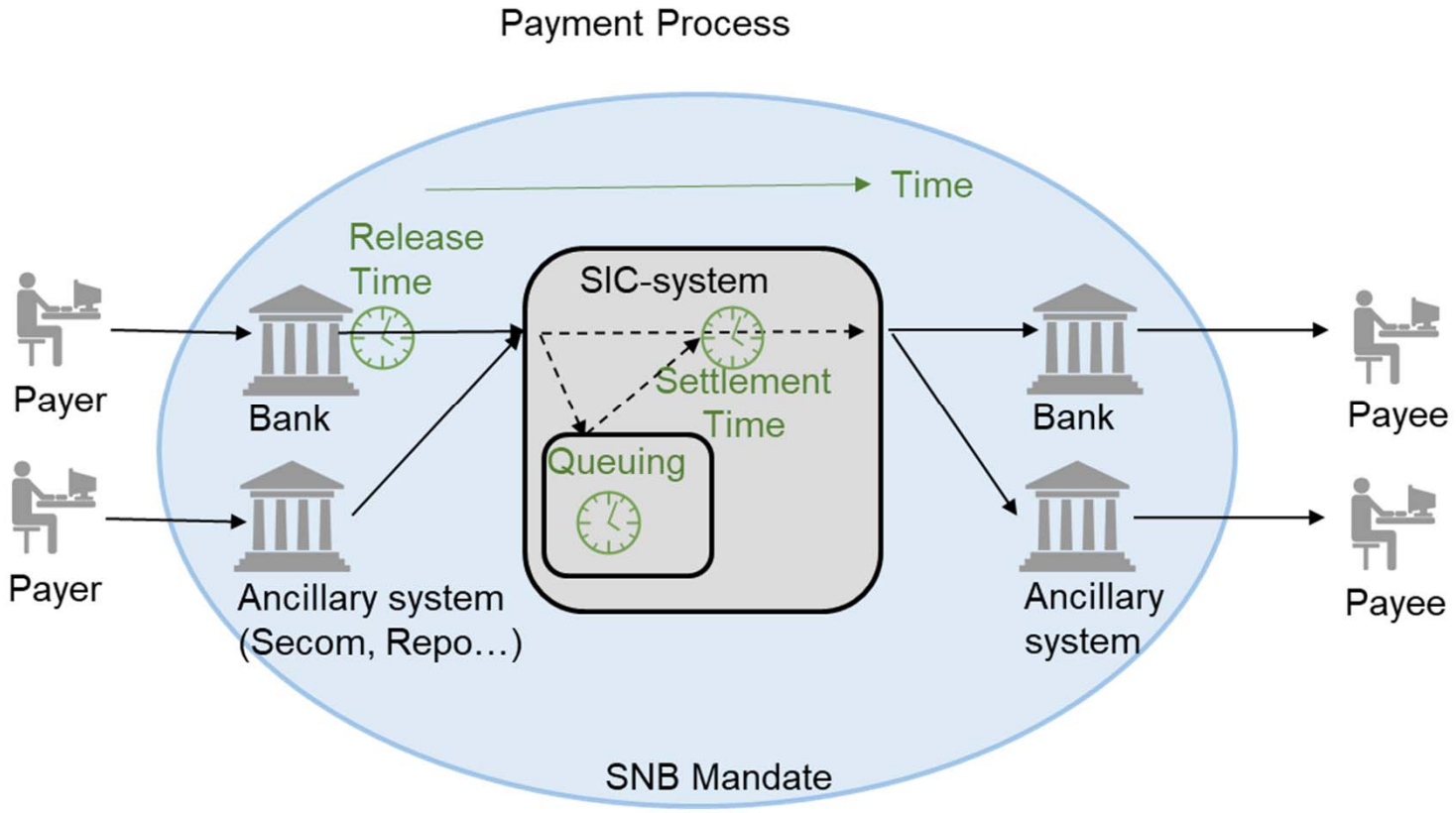
Objectives of this paper

- How can we measure (intraday) **settlement liquidity** in the Swiss RTGS?
- What **determines** settlement liquidity in SIC?

Relevance - helps to address policy issues

- Does the integration of **small payments** in the RTGS improve settlement?
- Do ancillary systems influence **release time**?
- Is it safe to **widen access** to RTGS systems?
- Is the current settlement algorithm suitable for real-time settlement, i.e. **instant payments**?

Cashless payments process – real-time gross settlement system (RTGS) with queuing



Research approach – release time (model 1) and queuing duration (model 2)

- *Settlement liquidity:* how easy can participants discharge due payments?
  →Literature: **Settlement Time (ST)** or **Queuing Duration (QD)** as proxies

- Fedwire 
  - First-In-First-Out/no central queuing
  - ***Release Time (RT) = Settlement Time*** (automated overdraft)

- SIC 
  - Fist-In-First-Out and priorities/central queuing (no netting on queues)
  - On-demand intraday liquidity
  - ***Release Time ≤ Settlement Time***
  - ***Release Time + Queuing Duration = Settlement Time***

→ ***Release Time and Queueing Duration*** *are separate, relevant proxies for queuing systems*

Hypotheses for settlement liquidity – model 1

***H1*: Increasing balances induce earlier release and settlement**

- Angelini (1998, 2000), Bech & Garratt (2003), Mills & Nesmith (2008), Martin & McAndrews (2008), Martin & Jurgilas (2013), …

***H2*: Central queuing and ample balances eliminate strategic payment management**

- Martin & McAndrews (2008), Martin & Jurgilas (2013), Armentier et al. (2008), Bech et al. (2012)

***H3*: Elevated default risk among participants induces later release**

- Mills & Nesmith (2008); Benos et al. (2014); literature on operational disruptions – risk management

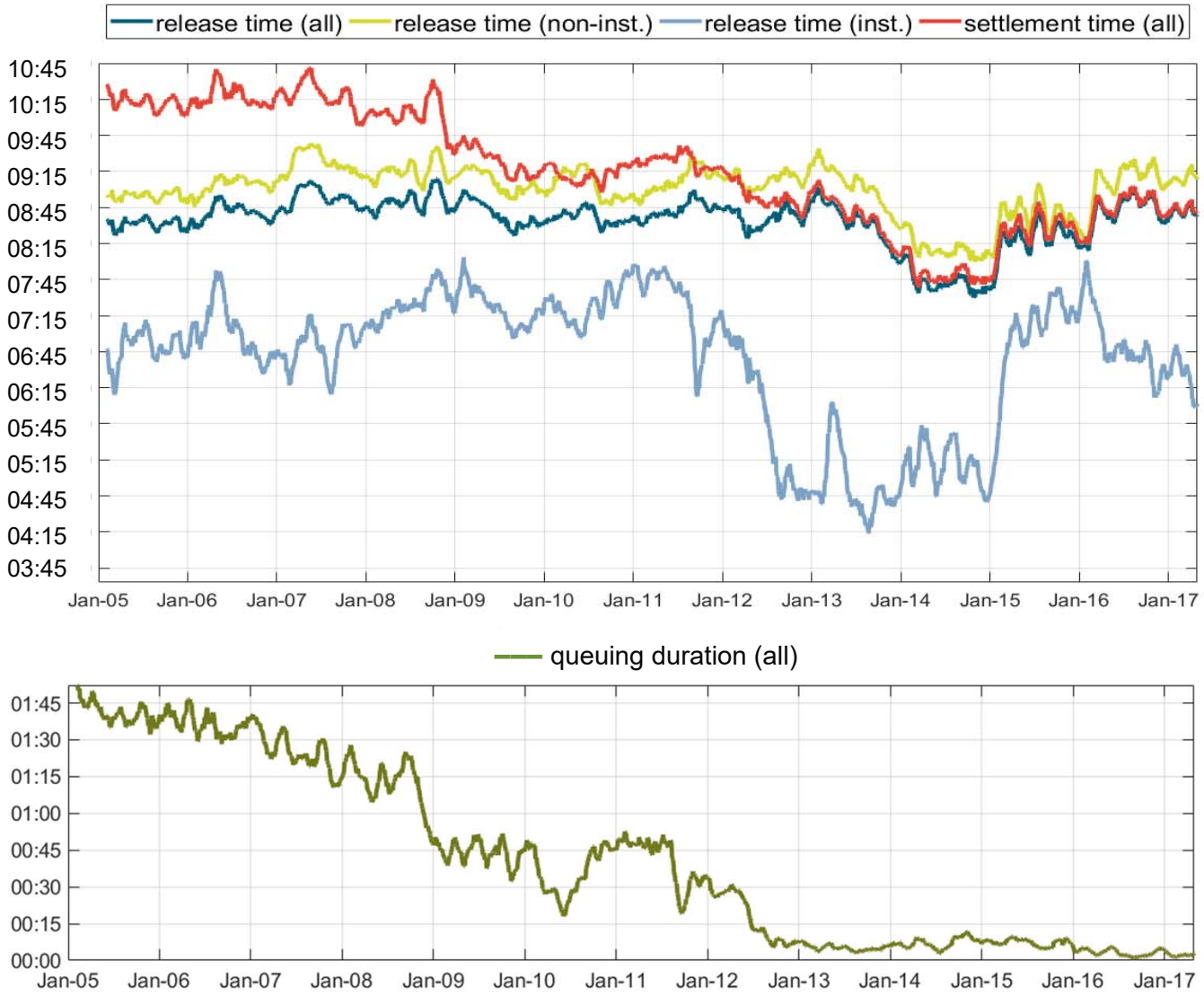
Hypotheses for settlement liquidity – model 2

***H4*: Small payments in RTGS fosters settlement liquidity**

- Armentier et al. (2008) for Fedwire – reuse argument

Illustration for settlement liquidity

(value- weighted average Settlement Time(all), Release Time(i/ni) and Queuing Duration(all), 20-day moving-average)

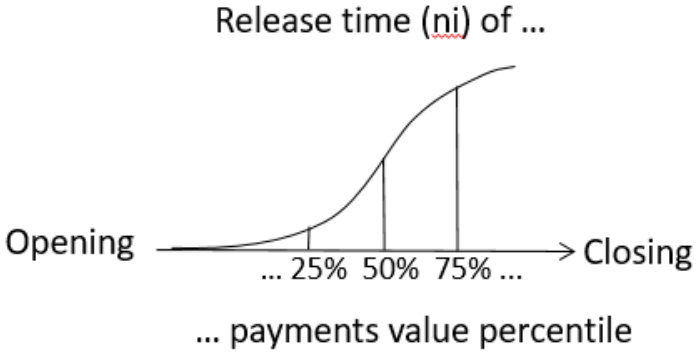


Data for model 1 – release time of each payments value percentile

- Daily payments data January 2005 – April 2017

- ***Release Time (RT)***
  - (**i**) Institutional payments: direct debit by ancillary systems (Secom, card payments, repo, …)
  - (**ni**) Non-institutional payments: subject to strategic delay

    → Release Time (non-institutional payments) of each value percentile
  - Settlement-value-weighted indicators for release and queuing



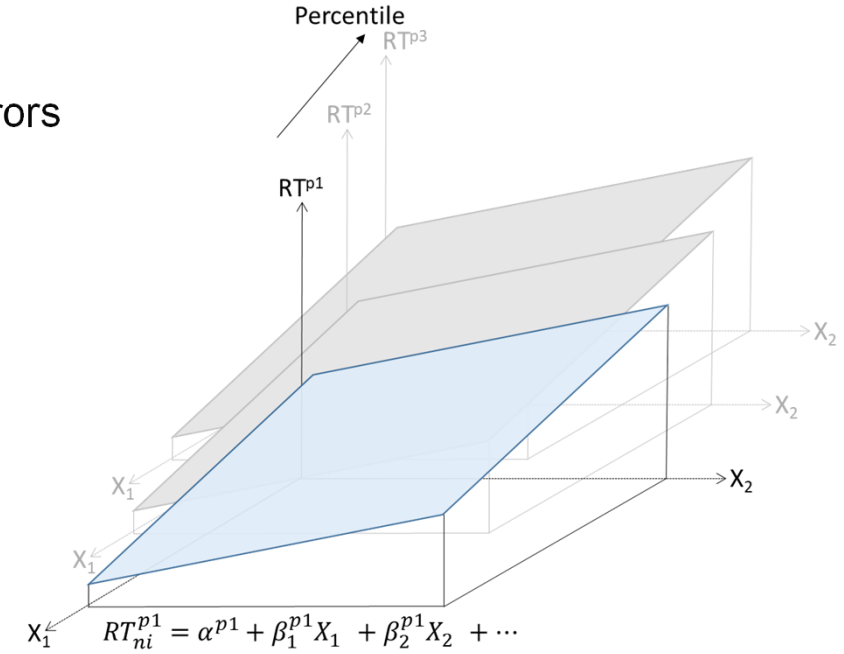
Data for model 2 – queuing duration of payments

- ***Queuing Duration (QD)***
  - Focus on all payments – average Queuing Duration (all payments)

- ***Excluded payments***
  - <CHF10’000, CLS, LCH, SNB, Mondays and settlement days after a banking holiday

Regression model 1 – 100 regressions per payments value percentile's release time

- **Dependent variable: Release Time (non-institutional payments)**
- **Methodology:** Armentier et al. (2008), applied by Bech et al. (2012) and McAndrews & Kroeger (2016)
  - Daily **100-OLS-regressions** (per payments value percentile's release time of non-institutional payments) for the whole sample
  - 1st differences
  - Newey-West corrected standard errors



Regression model 1 – influencing factors

Explanatory variables

- Settlement reserves, intraday credit, average Queuing Duration(all)
- Settlement Value, concentration measure: Herfindahl-Hirschman-Index (HHI)
- Average Release Time (institutional payments)
- Credit default swap above 150 for G-SIB-banks, negative-interest-rate regime dummy, reserves subject to negative interest rate
- Number of payments
- settlement value of unsecured and secured money markets

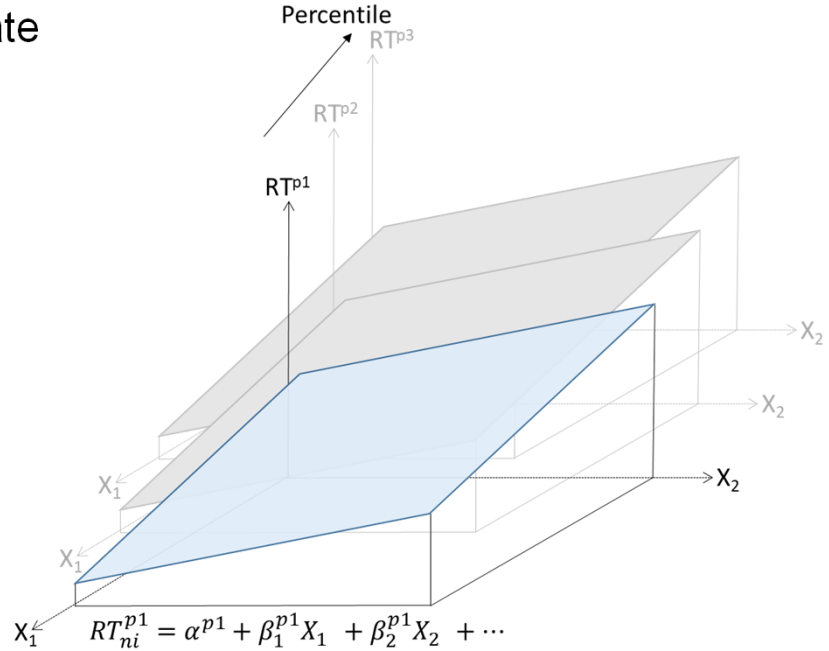
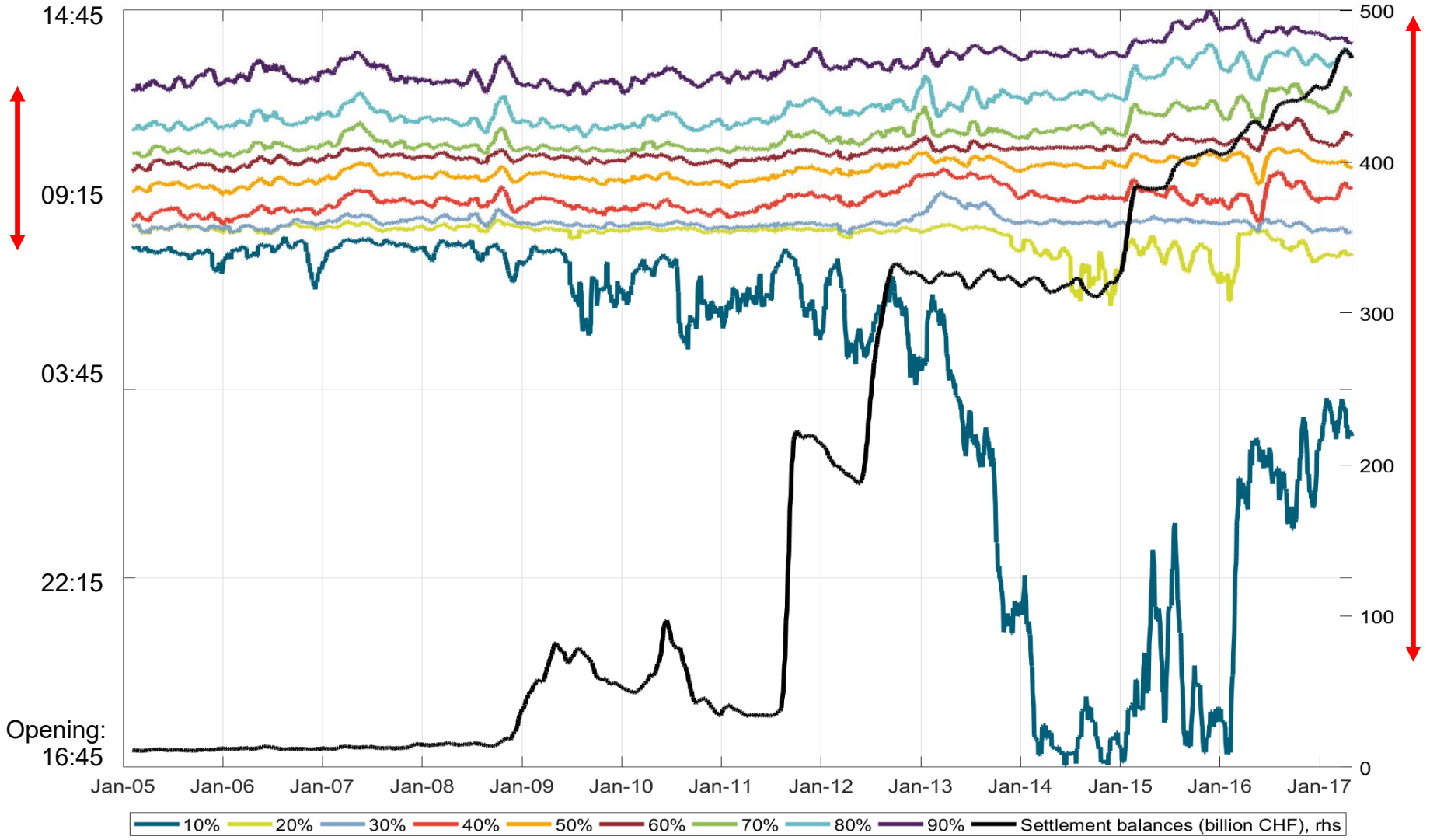


Illustration – release time per payments val. percentile

(Value percentiles of released non-institutional payments; 20-day moving-average)

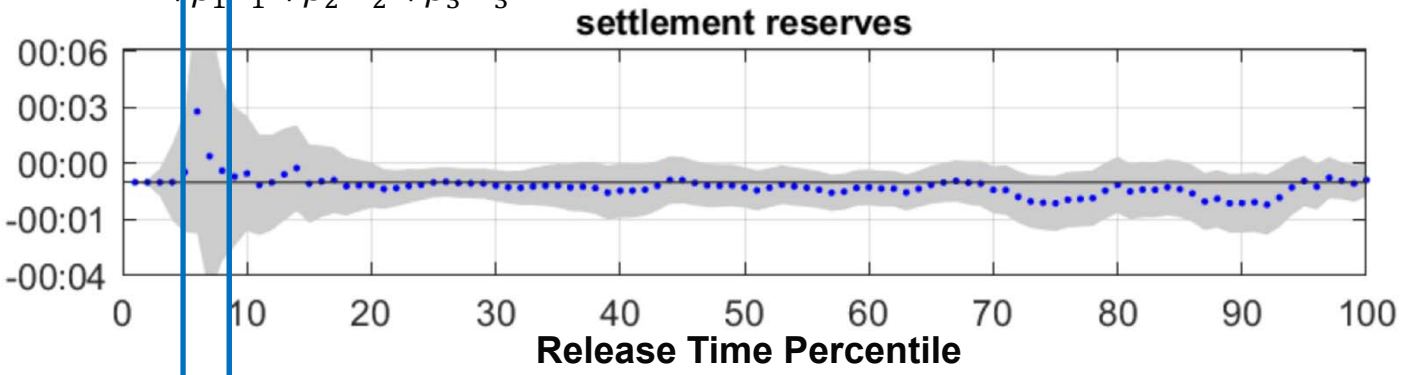


Model 1 results – 100 coefficients for each explanatory variable

H1: Increasing balances induce earlier release and settlement

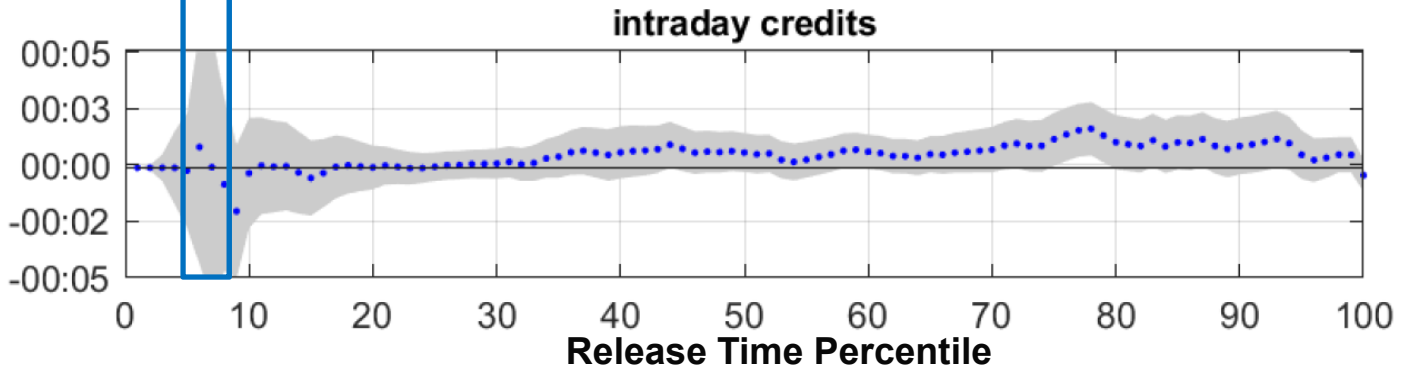
Not in line with H1:
Settlement balances and *Release Time* are **unrelated**

$RT^{p6} = \propto + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 \ldots$



Not in line with H1:
Intraday credits and *Release Time* are **unrelated**

$RT^{p6} = \propto + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 \ldots$



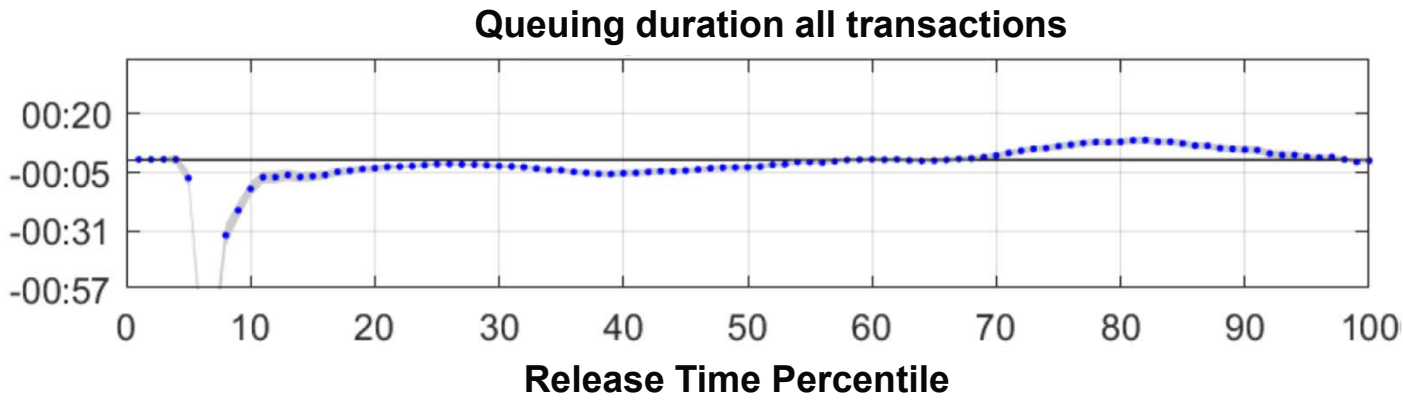
- Confidence band (grey area): 5% significance level
- Standardized coefficients: changes in minutes
- Positive coefficients indicate later and negative coefficients indicate earlier Release Times(ni)
- More results: in the paper

Model 1 results - coefficients not in line with H1

H1: Increasing settlement balances induce earlier release and settlement

Not in line with H1:

Queuing Duration and *Release Time* are **negatively related**

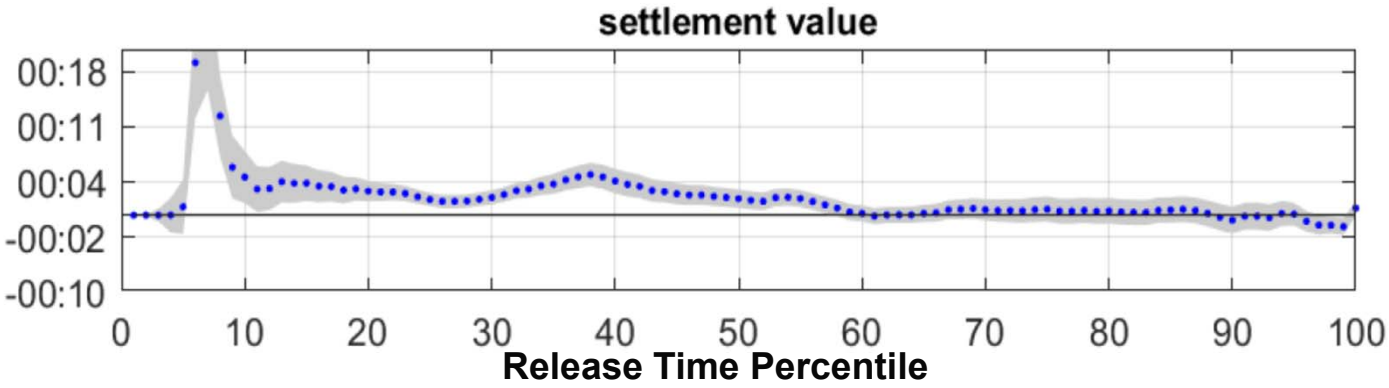


→ **Shorter queuing duration** induces later release, offsets the positive effects of abundant reserves

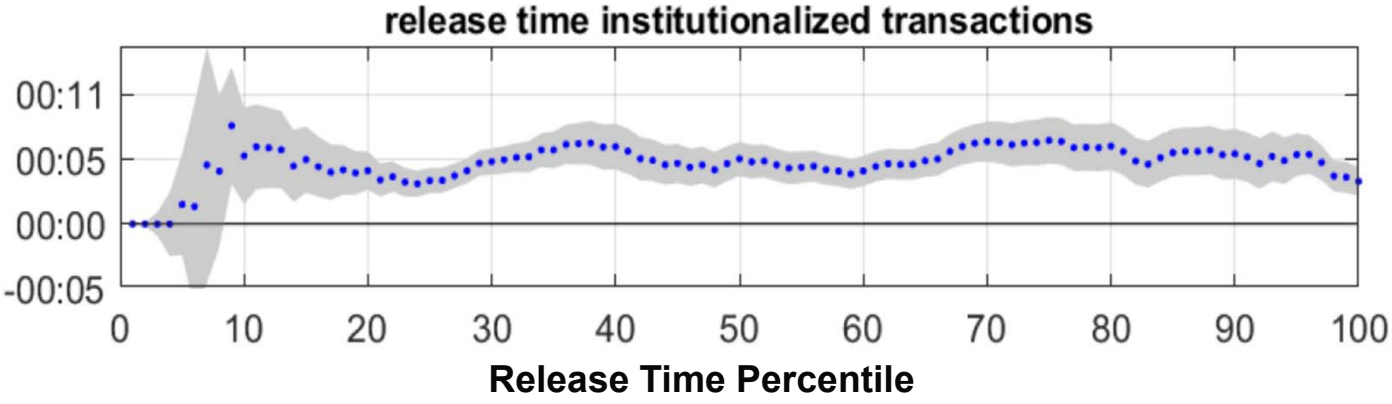
Model 1 results – coefficients not in line with H2

H2: Central queuing and ample balances eliminate strategic payment management

Not in line with H2:
Settlement value and
Release Time are
positively related



Not in line with H2:
Release Time(i) and
Release Time(ni) are
positively related



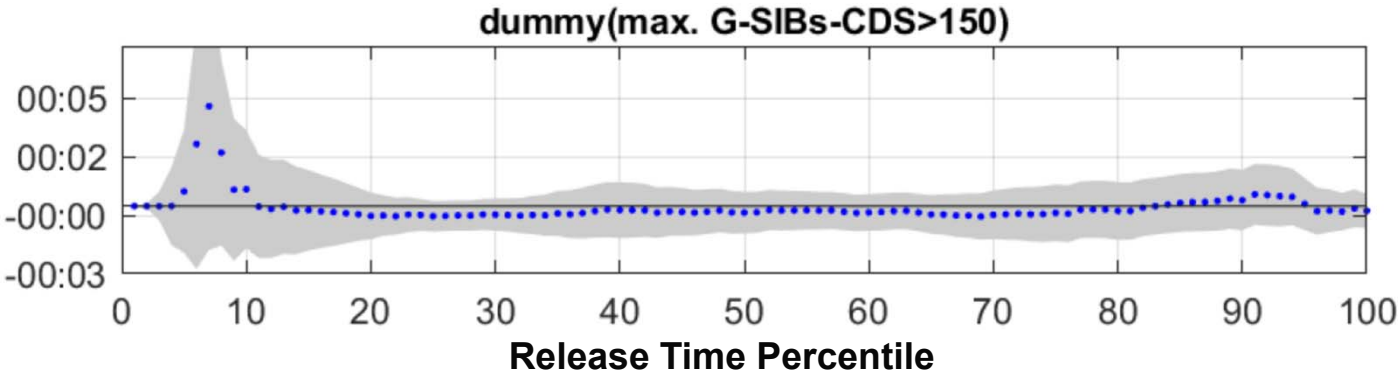
→ **Release management:** despite *central queuing* and ample *settlement balances*

Model 1 results – coefficients not in line with H3

H3: Elevated default risk among participants induces later release

Not in line with H3:

Credit default swap for G-SIB-banks above 150 and *Release Time* are **unrelated**



Regression model 2 – queuing duration

- What influences average **Queuing Duration (all payments)?**
  - **Dependent variable:** Queuing Duration
  - **Explanatory variables:** settlement balance, settlement value, number of transactions, Release Time
  - Queuing Duration close but >0 for the full sample

- **Regression** represents mechanical relationship
  - Newey-West corrected standard errors
  - Log of 1st differences

- **Control variables**:
  - Concentration measure: Herfindahl-Hirschman-Index, share on secured and unsecured money market, share of large transactions, 1st priority etc.

Model 2 results – coefficient in line with H4

All variables: ΔIn	Coeff.	Std. Err.	p-value
Settlement balances	- 0.189	0.084	0.024
HHI:settlement balances	- 0.069	0.035	0.047
Settlement value	0.327	0.048	0.000
HHI:settlement value	- 0.122	0.075	0.106
H4 Number of transactions	- 0.100	0.044	0.022
HHI:number of transactions	- 0.026	0.124	0.835
Release time (all)	- 1.613	0.271	0.000
Share unsecured money market	0.100	0.023	0.000
Share secured money market	0.047	0.008	0.000
Share x-large transactions	0.142	0.052	0.006
Share large transactions	0.856	0.289	0.003
Share 1st prio transactions	0.071	0.030	0.018
constant	- 0.000	0.007	0.992
No. of observations	1646		
R^2	0.095		

- **More** *settlement balances* **reduce** *Queueing Time (all)* to "almost" zero
  - But substantial balances required to **eliminate** queuing
- *Number of payments* and *Queuing Duration* **negatively related**
  - **In line with H4: More** *small payments* **smooth** settlement of *large payments*
- Otherwise expected signs

Forthcoming work– settlement time (model 0) and SUR (model 3)

- **Settlement time** of *all payments* (model 0) - 100 regressions per payments value percentile's settlement time

- Receipt **reactive release time** (model 3) – to capture influence of *intraday effects* on release time
  - Value of **queued payments** *at release times* of each payments value percentile
  - **Settlement value** *between each release time* of payments value percentile
  - 100 - *Seemingly unrelated regressions* (due to different explanatory variables)

Conclusion

– *Release Time* and *Queuing Duration* (instead of Settlement Time / Queuing Duration only) allow **more differentiated picture** of *settlement liquidity*

– Findings suggest **differences** between *RTGS without queuing* and *RTGS with queuing*

– Greater **focus on** *Release Time of institutional and non-institutional payments*

– Open whether it **applies** for *other RTGS* with queuing

Policy implications

- **Small payments help:** *Small payments* **foster** *settlement liquidity*
- **Coordination exists:** It matters which *ancillary system obtains access* and how participants **respond** with their *Release Times (ni)* to *Release Times (ancillary system)*
- **Access policy:** Default risk has no negative impact on settlement discipline. Is it safe to widen access to RTGS systems?
- **Instant payments needs separate treatment for real-time settlement:** Current RTGS algorithm **not suitable** for *instant payments* (queuing duration > zero)

Thank you for your attention!

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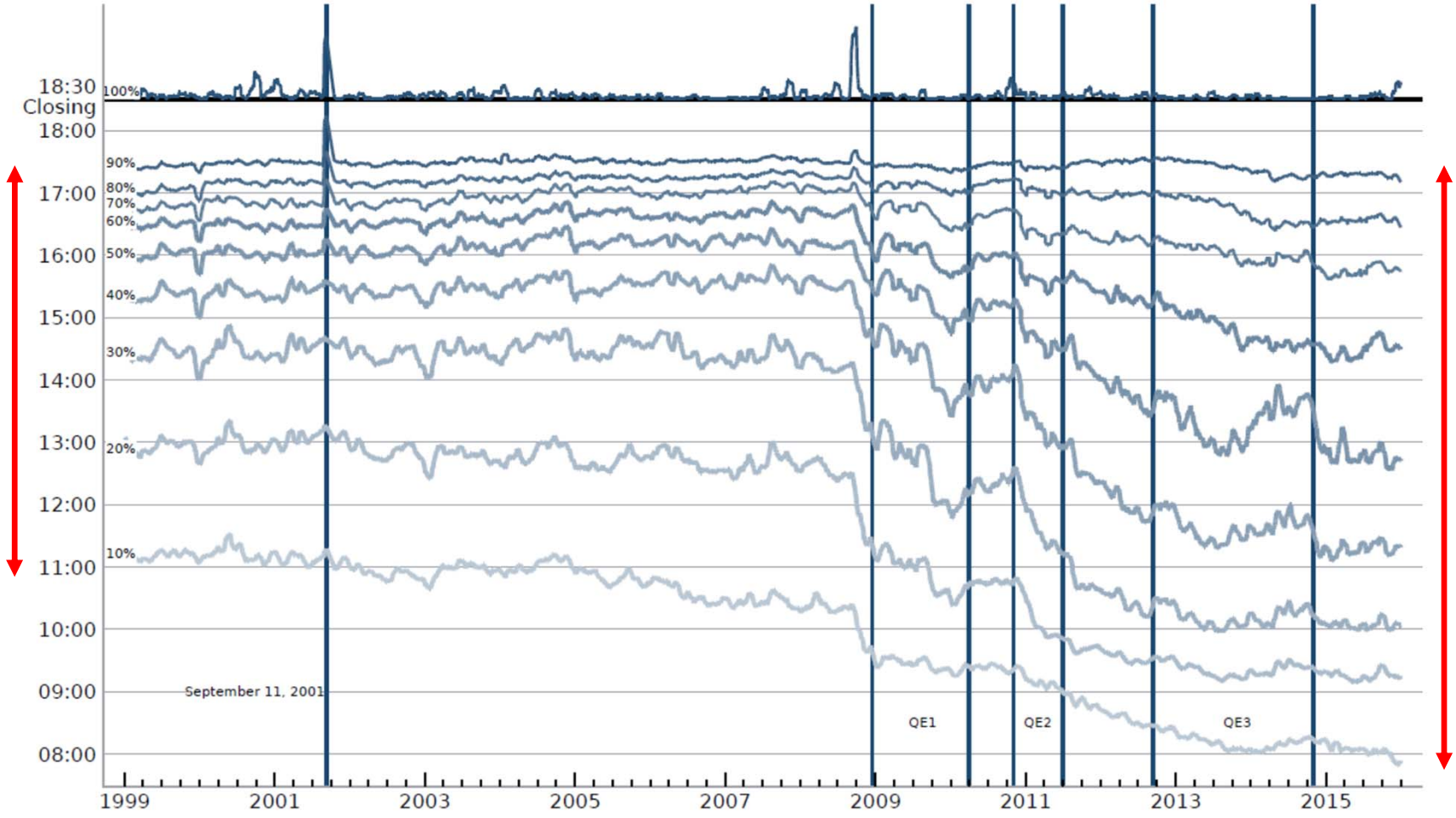
Settlement liquidity Fedwire: Settlement = Release time

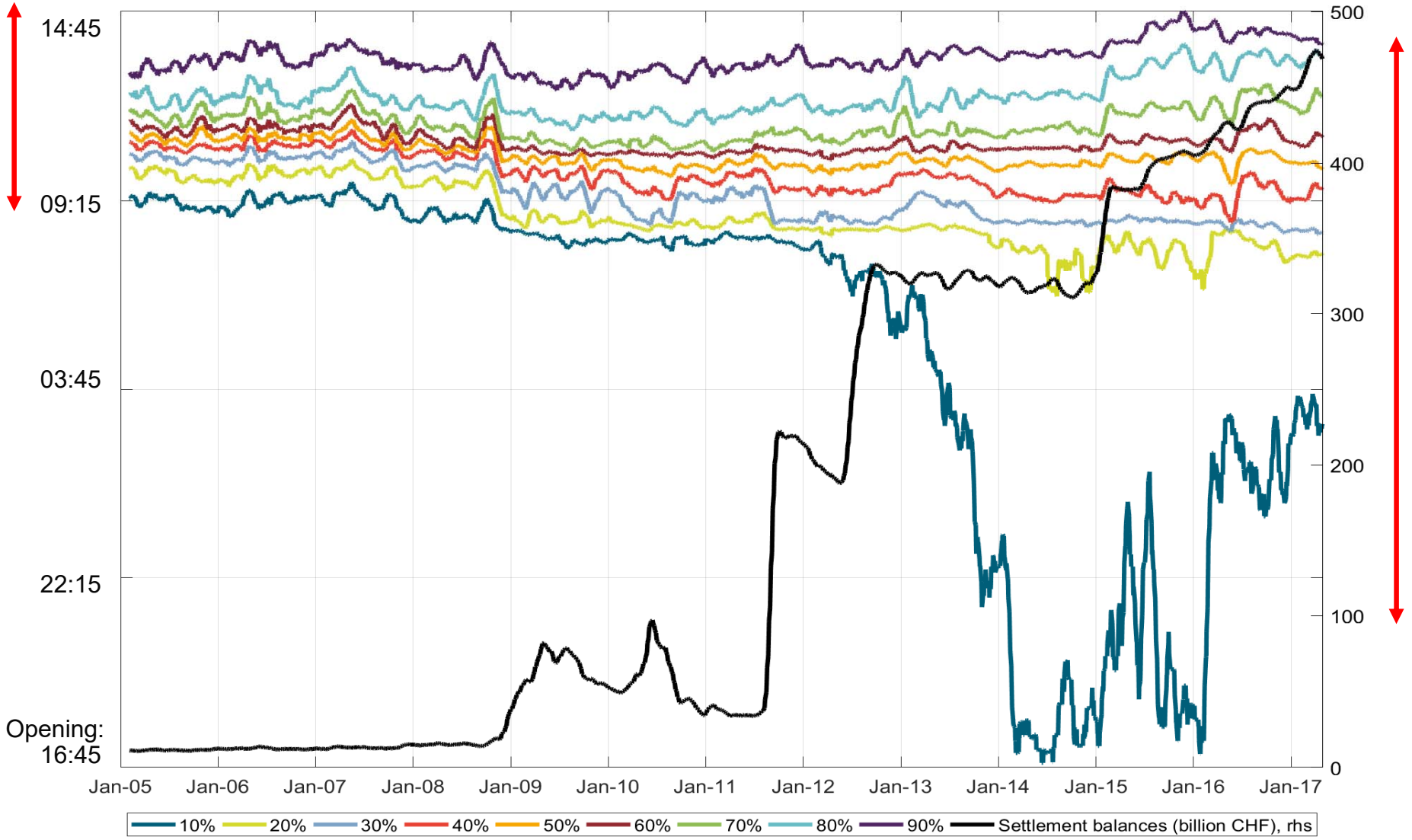
Figure 1: Time Series of Settlement Liquidity



Notes: Twenty-one-day centered moving average.
Values exclude payments related to CHIPS, CLS, DTC, and P&I payment funding.
Sources: Federal Reserve Bank of New York, Authors' calculations.

Settlement time per payments value percentile

(Value percentiles of settled ni payments; 20-day moving-average)



Regression models: release time + queuing duration

– Model 1: Release Time

$$\triangle r_{p,t}^{ni,all} = \begin{cases} \alpha_p + \beta_p^1 \Delta sr_t + \beta_p^2 \Delta ic_t + \beta_p^3 \Delta HHIsb_t + \beta_p^4 \Delta sv_t + \\ \beta_p^5 \Delta HHIsv_t + \beta_p^6 \Delta n_t + \beta_p^7 \Delta HHIn_t + \beta_p^8 \Delta umm_t + \\ \beta_p^9 \Delta smm_t + \beta_p^{10} \Delta \bar{r}_t^i + \beta_p^{11} \Delta \bar{q}_t^{all} + \beta_p^{12} dr_t + \\ \beta_p^{13} NIR_t + \beta_p^{14} \Delta RS2N_t + \varepsilon_{p,t} \end{cases}$$

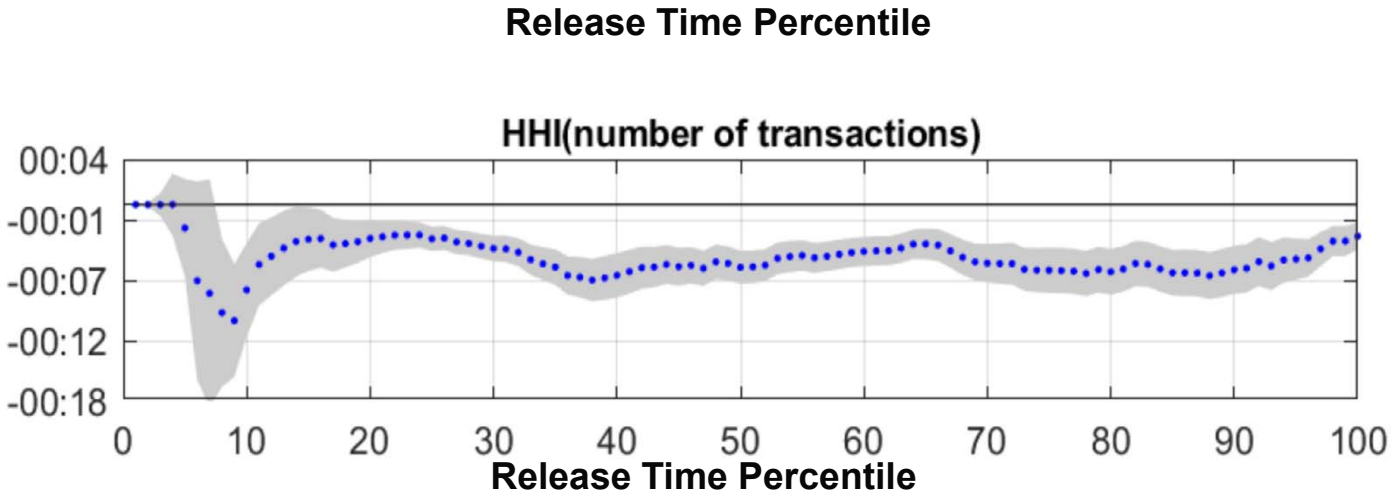
– Model 2: Queuing Duration

$$\Delta ln\bar{q}_t = \begin{cases} \alpha + \beta_1 \Delta ln(sb_t) + \beta_2 \Delta ln(HHIsb_t) + \beta_3 \Delta ln(sv_t) + \\ \beta_4 \Delta ln(HHIsv_t) + \beta_5 \Delta ln(n_t) + \beta_6 \Delta ln(HHIn_t) + \\ \beta_7 \Delta ln(\bar{r}_t^{all}) + \beta_8 \Delta ln(summ_t) + \beta_9 \Delta ln(ssmm_t) + \\ \beta_{10} \Delta ln(sxl_t) + \beta_{11} \Delta ln(sl_t) + \beta_{12} \Delta ln(s1_t) + \varepsilon_t \end{cases}$$

Model 1 results – coefficients not in line with H2

H2: Central queuing and ample balances eliminate strategic payment management

Not in line with H2: *HHI(n)* and *Release Time* are **negatively related**

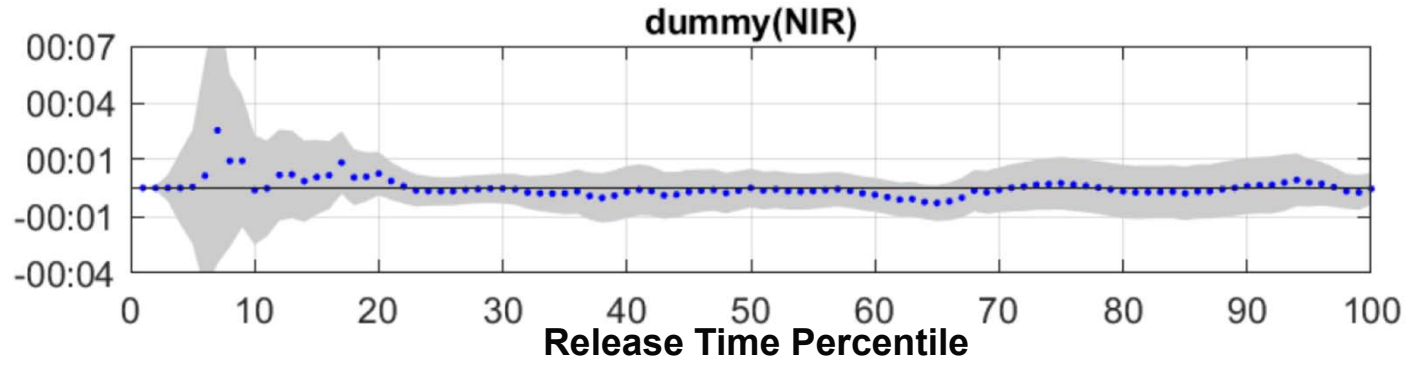


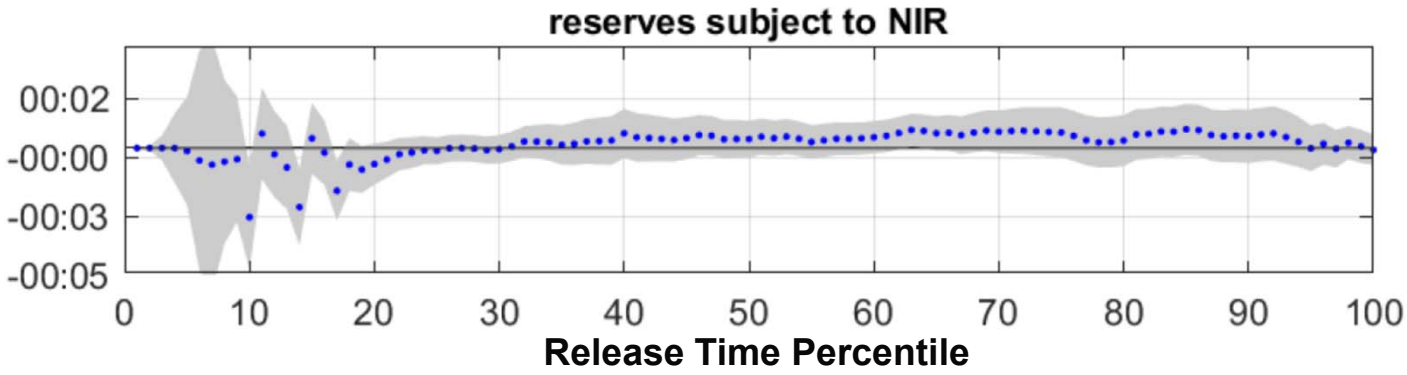
→ **Release management:** despite *central queuing* and ample *settlement balances*

Model 1 results – coefficients not in line with H5

H5: Negative-interest-rate regime raises settlement liquidity

Not in line with H5:
Both *negative interest rate variables* and *Release Time* are **unrelated**



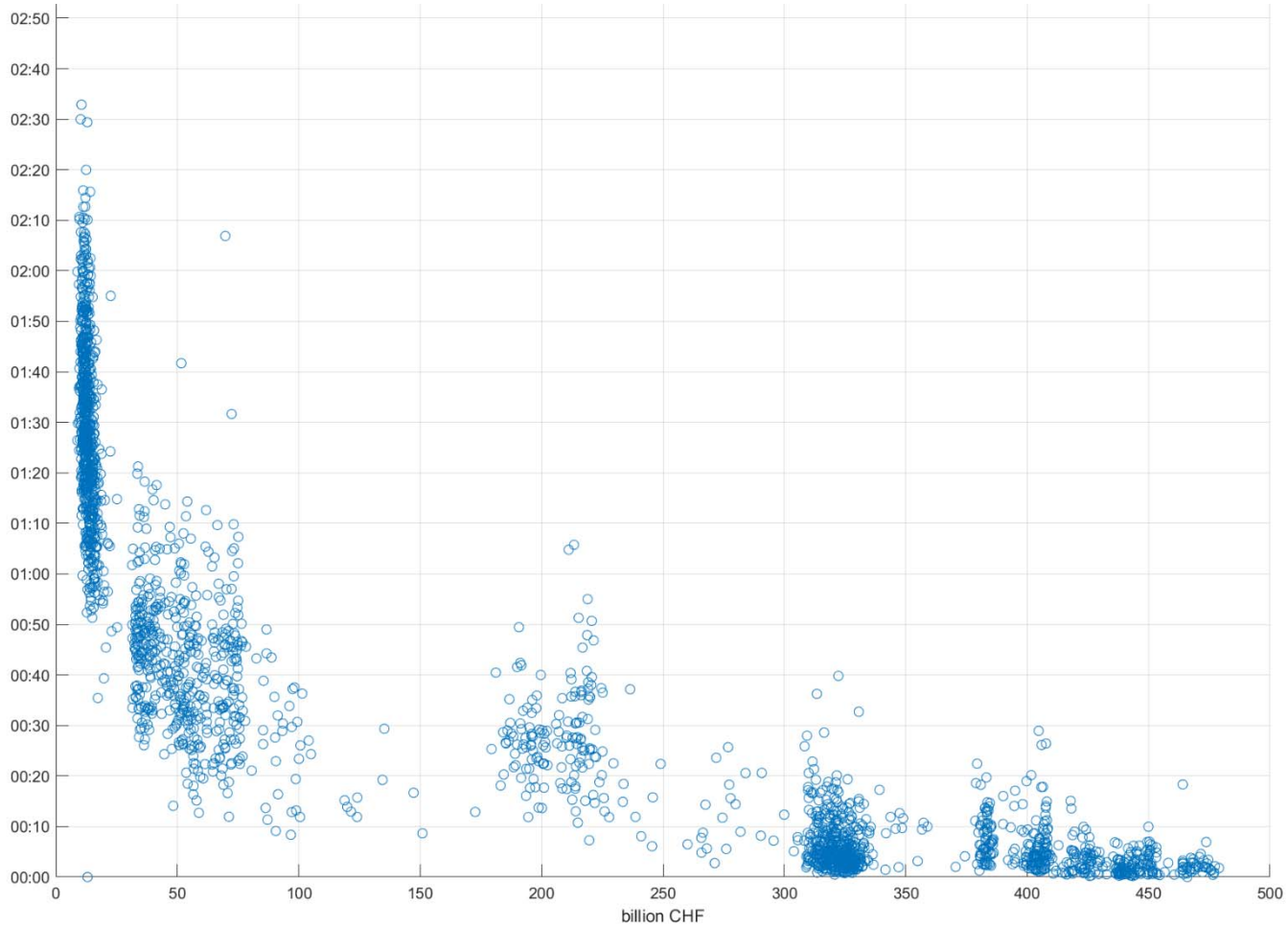


Results for release times robust to model 1 variation

- Results remain qualitatively unchanged for the following robustness checks
  - ***Value-weighted Release Times(ni)***
    - *Other **default risk** dummies: **CDSX** /* LB2UBS / CDS
    - *Combination or single **negative-interest-rate** regime variable**: NIR and RS2N** /* NIR / RS2N
    - Only **Mondays** are considered
    - **Settlement balance** used instead of settlement reserves and intraday credits individually
  - ***Unweighted Release Times(ni,all)***

Queuing duration and settlement balance

(average settlement value-weighted queuing duration(all) in hours:minutes; settlement balances in billion CHF)

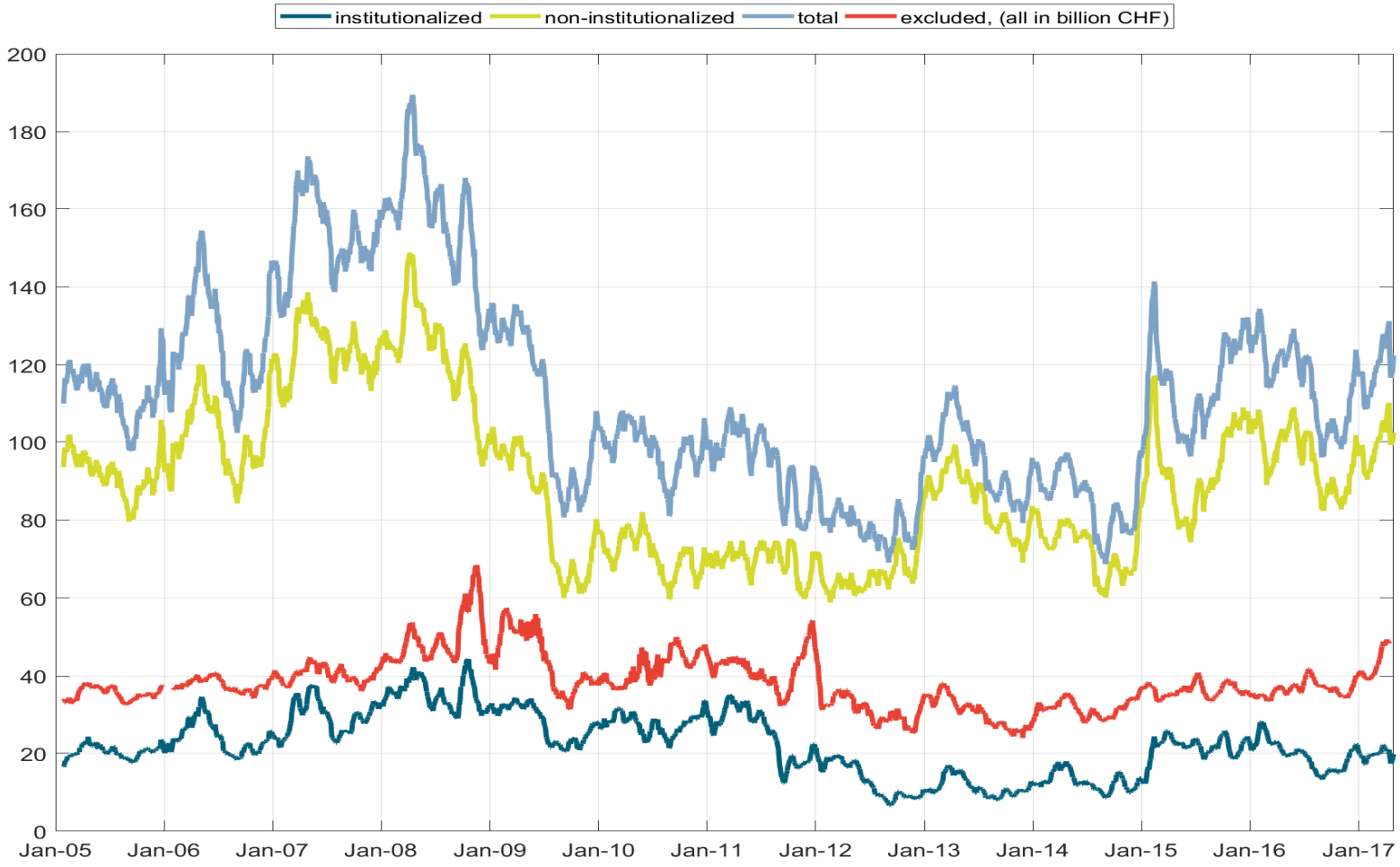


Results for queuing duration robust to model 2 variation

- Results remain qualitatively unchanged for the following robustness checks
  - ***Value-weighted Queuing Duration(all)***
    - Only Mondays are considered – n stays negative but turns out to be insignificant
    - Replace Release Times(all) with Release Times(ni)
  - ***Unweighted Queuing Duration(ni,all)***

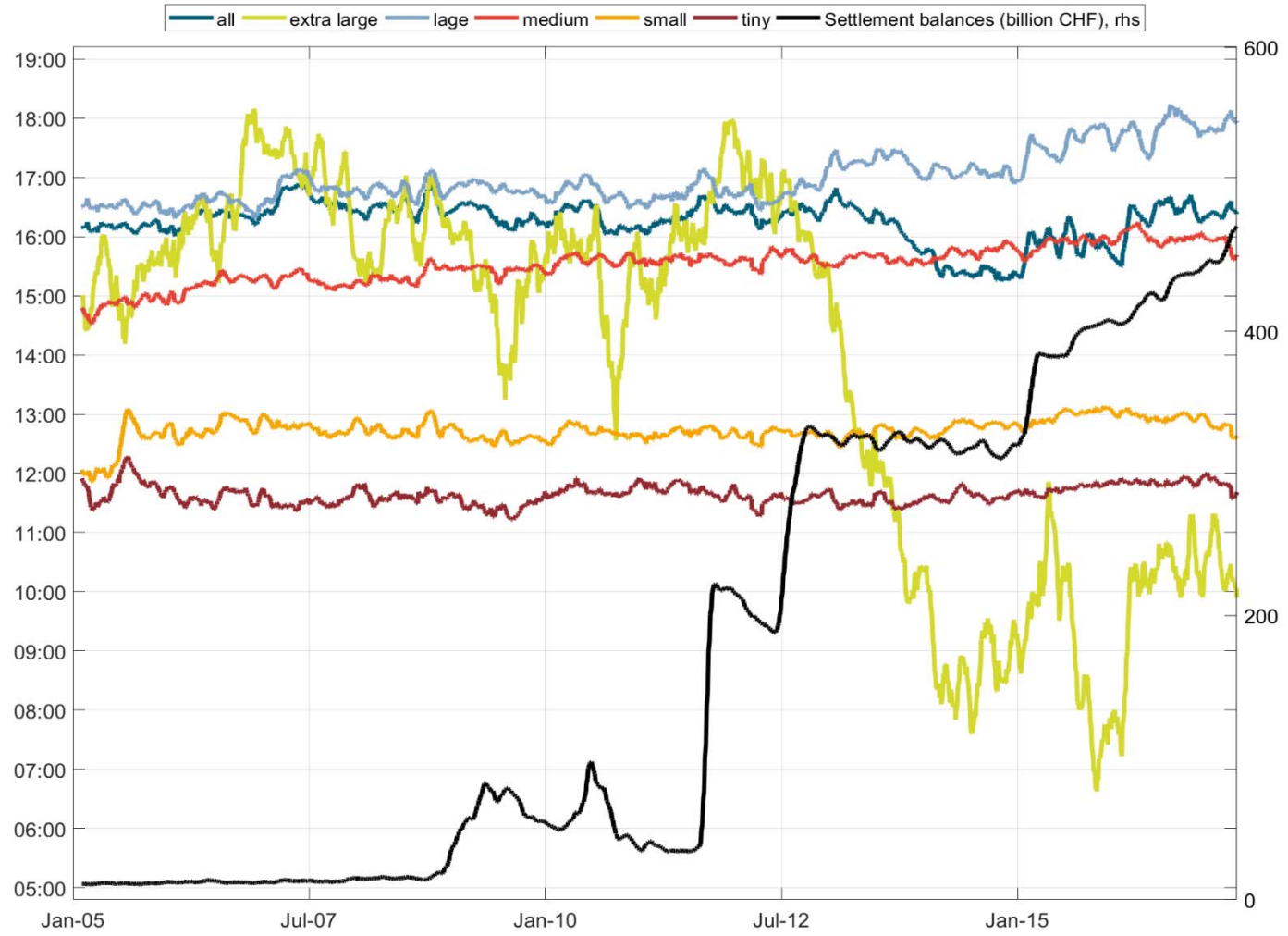
Payments values – per payment type

Settlement value of payment types (all, ni, I, excluded) in billions CHF, 20-day moving-average)



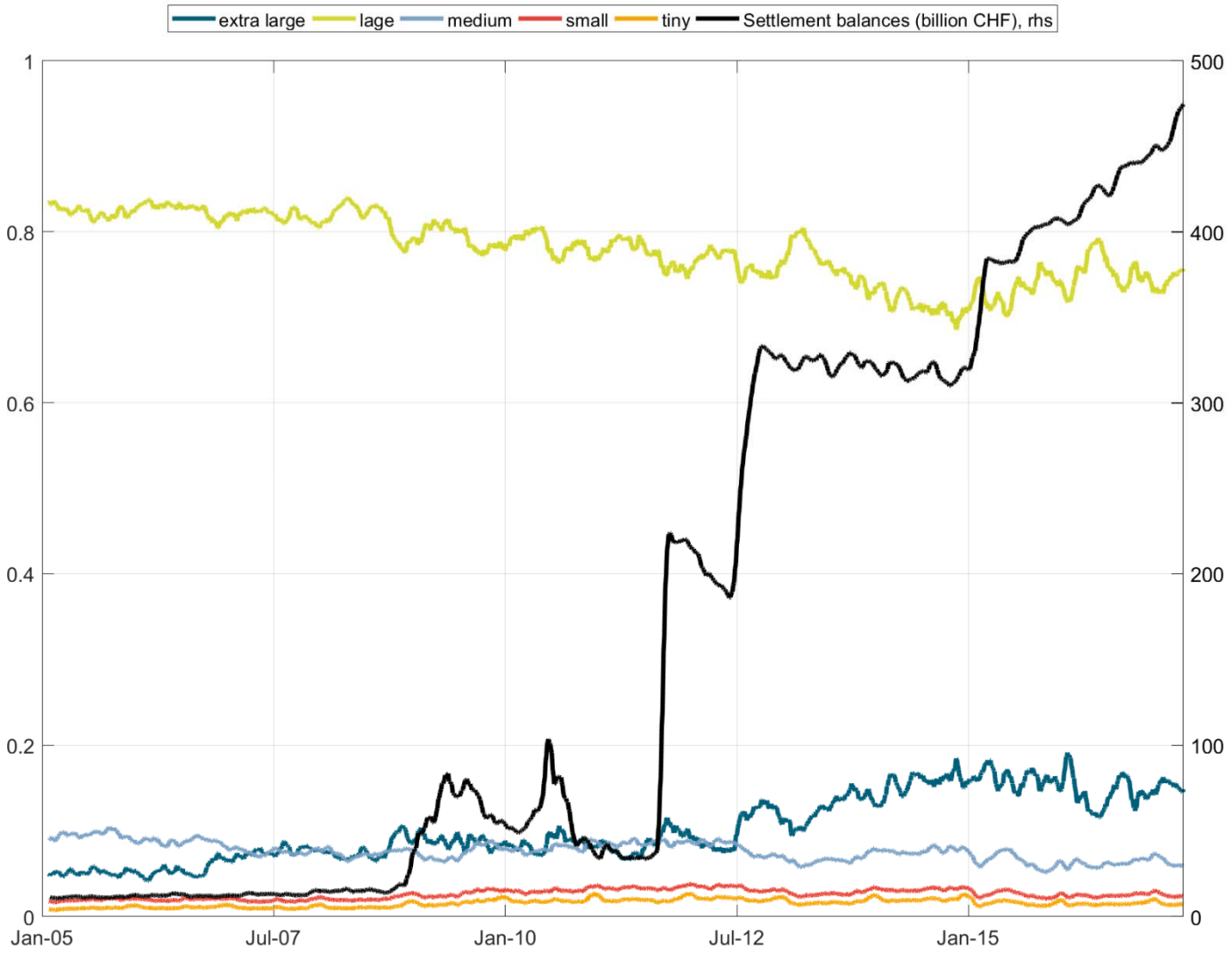
Release time – of size-subcategories

(Settlement-value-weighted Release Times(ni; all/tiny/small/medium/large/x-large) in hours:minutes after start of SIC day, 20-day moving-average)



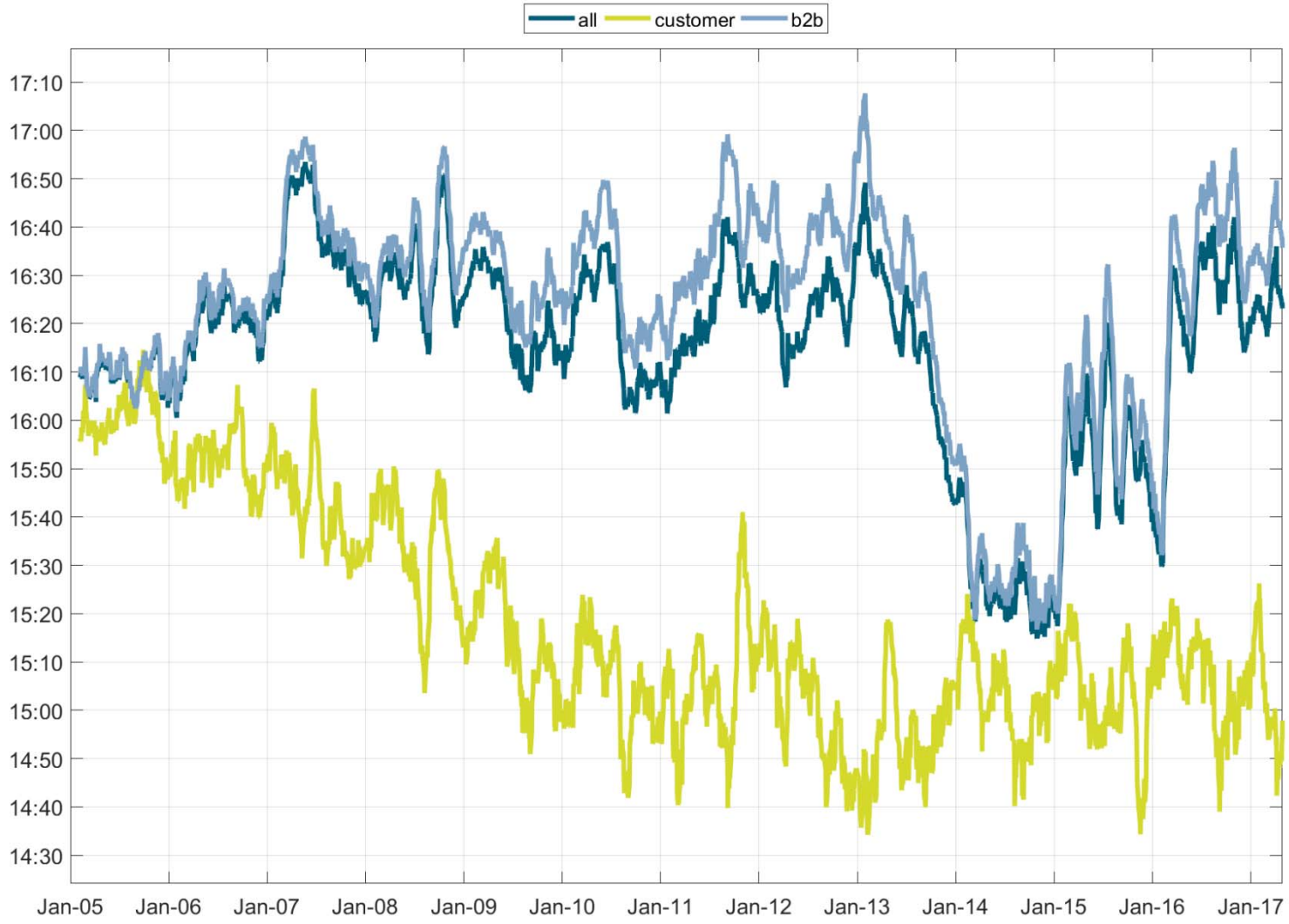
Payments value shares of size-subcategories

(Percentage of settlement value of non-institutional payment size-categories, 20-day moving-average)



Release time – of purpose-subcategories

(Settlement-value-weighted Release Times(customer/bank2bank) in hours after start of SIC day, 20-day moving-average)



Release time - of priority-subcategories

(Settlement-value-weighted Release Times(1st priority/2nd priority/3rd priority) in hours after start of SIC day, 20-day moving-average)