The fountainhead: analyzing the impact of intraday liquidity on payment behavior

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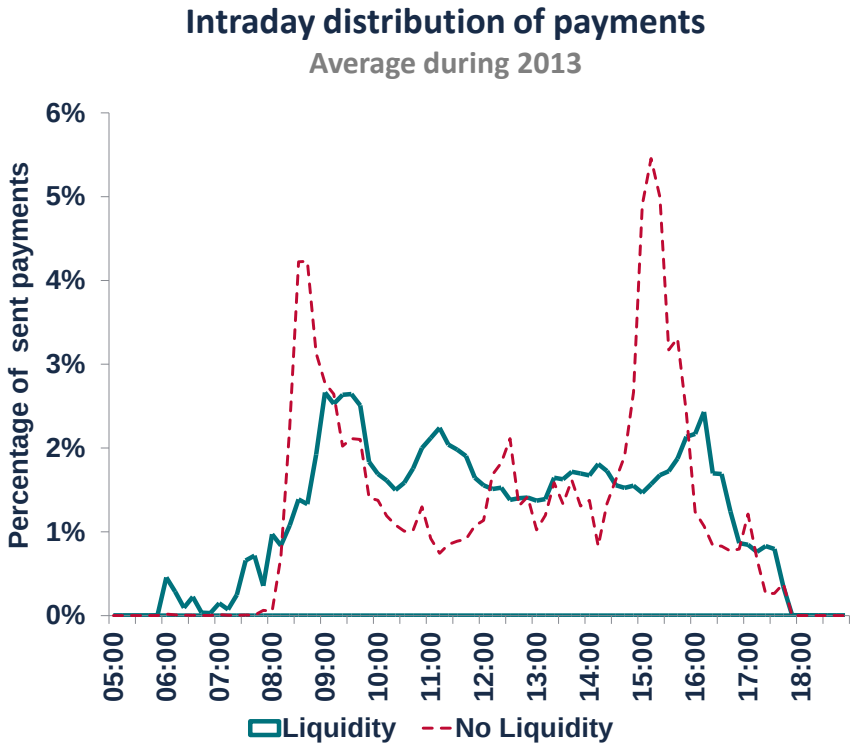
SPEI payments during the day

- SPEI participants with access to Bank of Mexico's daylight facility have a smoother intraday payment distribution.



Source: authors' own calculation with Bank of Mexico's data.

Why do we care about access to daylight liquidity?

- **Late settlement:**
  - time mismatch between incoming and outgoing payments
  - may affect participants + generates aggregate risk
  - caused by a non-cooperative equilibrium created by liquidity scarcity → *free-riding* on incoming payments

- Daylight liquidity mitigates this time mismatch (positive externality)

  → lowers liquidity risk, systemic risk, and benefits users

- Social MC of liquidity is smaller than that MC in the private market

- Central banks have comparative advantage in the provision of liquidity:

  → CB can supply it at the zero-interest rate that is required to achieve an efficient outcome (social MC = social MB)

What we know:

- A market for liquidity may not achieve efficiency, since the marginal cost of sending transfers is generally lower than the social cost of delaying payments → role for central banks (Martin 2004)

- Fed's provision of liquidity allowed institutions in Fedwire to function in an efficient way in the aftermath of Sep 11, 2001 (McAndrews & Potter 2002)

- Important increase in reserve balances toward the end of 2008 allowed Fedwire participants to settle their payments earlier, as they were able to use these balances as intraday liquidity (Bech *et al* 2012)

- With previous Fed policy, CHAPS members did not rely as heavily as Fedwire participants on incoming transfers to fund their payments: CHAPS members lack incentives to delay payments in order to save on liquidity costs, as opposed to Fedwire participants, who had to pay a minute rate for their overdrafts (Becher *et al* 2008)

What we do:

- Exploit SPEI participants cross-sectional and time variation in access to CB liquidity to estimate its effect on:
  - the responsiveness of outgoing payments to incoming payments and account balances
  - the intraday distribution of payments depends on participants' access to the central bank's liquidity

Preview of major empirical findings

- Outgoing payment dependency on incoming payments or account balances decreases with access to BoM's daylight facilities
  - The dependency on incoming transfers of an institution without access would fall by 43% and on its account balances by 56%, if access to both liquidity facilities were granted

- Liquidity provided by BoM contributes to an earlier settlement of payments
  - The first 90% of the total daily payments of an average participant would take place 11 min earlier if access to the intraday-repo facility were granted

Outline

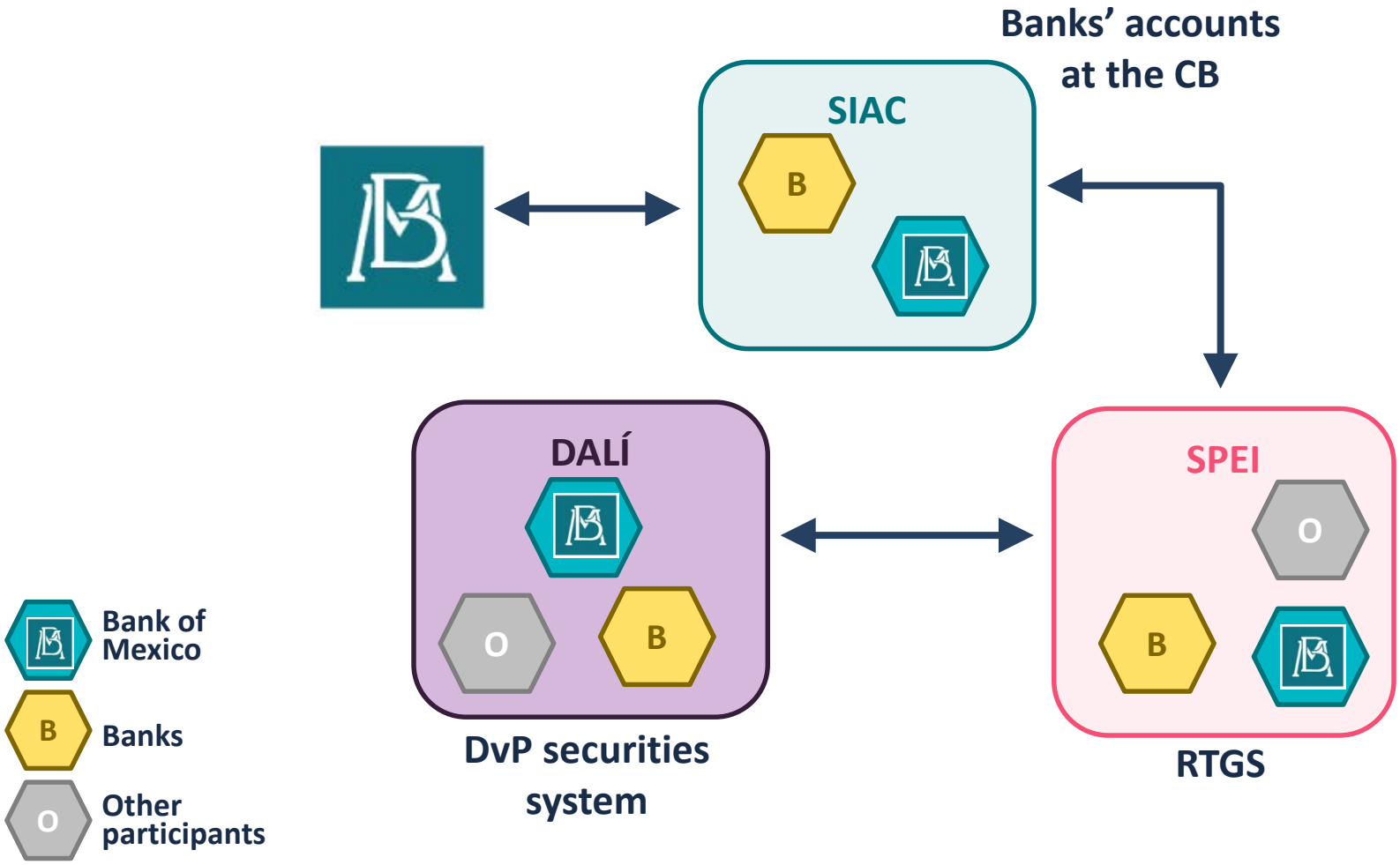
1. Daylight liquidity in the SPEI

2. Conceptual framework

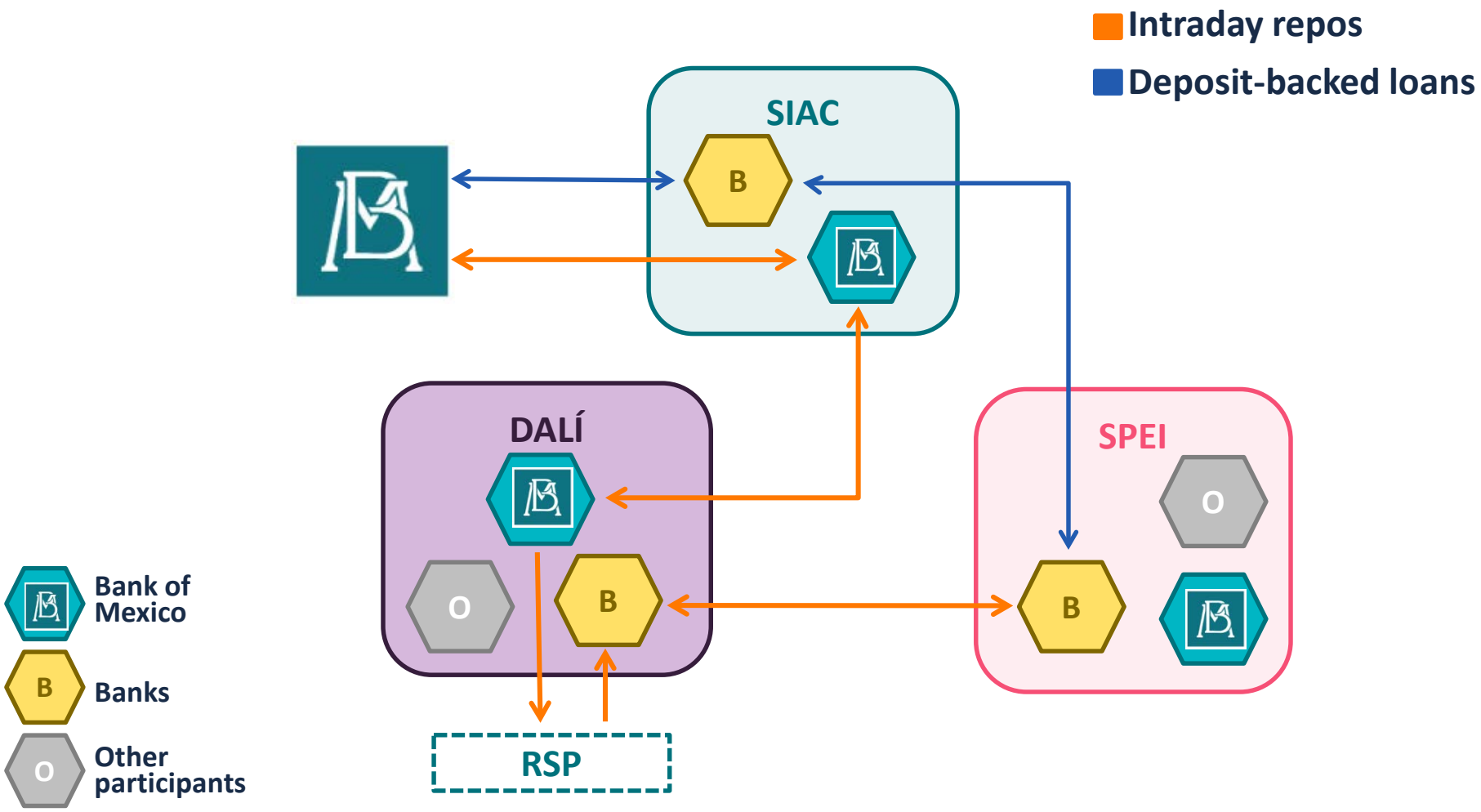
3. Empirical analysis
   - Payment dependency
   - Intraday payment distribution

4. Concluding remarks

Flow of payments among real-time systems



Bank of Mexico's daylight liquidity in the SPEI



Daylight liquidity in SPEI

- Brokerage houses that sign contract with a bank may also use the RSP facility

- SPEI participants without direct access to BoM typically have credit lines with banks (no usage cost, just a 0.05%-0.20% p.a. fixed fee)

- However, non-banks tend to have access to intraday credit during fewer hours of the day

In short:

- The Bank of Mexico is the main supplier of daylight liquidity

- Liquidity provision is directly made through two channels only to a subset of payment system participants:

  1. daylight overdrafts backed by the DRM, a mandatory deposit that banks keep at BoM (banks)

  2. the RSP, an intraday-repo facility (banks and some brokerage houses)

- Banks are the distribution channel between the central bank's liquidity and the payment system

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Conceptual framework

- SPEI participant's decide at any given settlement cycle:
  - How much daylight liquidity to borrow
  - How many outgoing payments to post

- In order to:

  Maximize their reputation (i.e. minimize out-going payment delays), subject to:

  - Own liquidity
    - Incoming payments
    - Positive balances from previous cycles
  - External liquidity
    - Bank of Mexico's daylight credit
    - Bilateral credit lines
  - Beliefs about timing and size of incoming payments and payment requests

Conceptual framework

- Therefore, outgoing payments are a function of:
  - Incoming payments & account balances
  - External liquidity constraints
  - Delay costs: reputational costs + operational risk
  - Beliefs about the distribution of incoming payments and payment needs

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Data

- SPEI's transaction log from Jan 1, 2009 to May 21, 2014
  - 111 participants (banks, brokerage houses, pension funds, currency exchange firms)
  - Includes payments received from BoM, CLS, and DALÍ (securities system)

- 746 million payments… huge computational burden
  - Accumulate each participant's payments into 1-min intervals
  - Use only busiest part of the day (5.30 – 18.10)

Identification strategy

- Exploit SPEI participants' heterogeneous access to Bank of Mexico's daylight liquidity to learn its effect on payment behavior:
  - Daylight secured lending: 'exogenous' cross-bank variation in the size of eligible collateral (the DRM)
  - Intraday repos: all banks but only some brokerage houses may use them

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Payment dependency: econometric model

- Assume[1/] that P_t^{i*}, the value of payments that i wishes to send during minute t, can be written as follows:

Access effect on incoming-payment dependency

$$P_t^{i*} = \alpha^i + \beta R_t^i + \gamma AB_t^i + \delta_1 DRM_t^i + \delta_2 RSP_t^i + \delta_3 DRM_t^i \cdot R_t^i + \delta_4 RSP_t^i \cdot R_t^i + \delta_5 DRM_t^i \cdot AB_t^i + \delta_6 RSP_t^i \cdot AB_t^i + \boldsymbol{x}_t^{i\prime}\boldsymbol{\eta} + u_t^i$$

Access effect on balance dependency

where:

R_t^i : average amount of i's incoming payments 'roughly' at time t

AB_t^i : available account balances held by participant i at time t

DRM_t^i : maximum allowed overdraft backed by the DRM at the beginning of the day

RSP_t^i : dummy variable that indicates access to Bank of Mexico's intraday repo facility

$\boldsymbol{x}_t^i$: other time-varying observables affecting payment behaviour related to delay costs, distribution of incoming payments and payment requests & risk sentiment

1/ Based on McAndrews & Potter (2002).

Payment dependency: econometric model

$\boldsymbol{x}_t^i$:

- Delay costs
  - 'Visibility': geometric average of an institution's in-degree and out-degree, both normalised by the number of participating institutions and weighted by the value of payment transfers

- Distribution of incoming payments and payment requests
  - HH index of payments throughout the day (proxy of payment coordination)
  - Standard deviation of received payments
  - Total amount of sent payments during the day
  - Timing skew of payments received during the day

$$Skew^i = \frac{1}{T-1}\sum_{t=1}^{T}\left(1 - \%\ of\ cumulative\ payments_t^i\right) \in [0,1]$$

All payments received at the **end** of the day

All payments received at the **beginning** of the day

- Risk sentiment
  - Mexico's sovereign 5-year CDS
  - VIX

Payment dependency: estimation results

- Estimate observed payments $P_t^i = \max(0, P_t^{i*})$ using an unobserved-effect Tobit (Wooldridge 2002) to account for payment censoring at zero and for unobserved participants' heterogeneity

- Access to Bank of Mexico's intraday facilities speeds up payments by reducing their dependency on incoming funds or available balances

Payment dependency estimation results

Variable	
Received Payments	1.791***
	(0.072)
DRM	0.010***
	(0.001)
RSP	0.468***
	(0.023)
Account Balance	0.037***
	(0.002)
Received Payments · DRM	-0.023***
	(0.001)
Received Payments · RSP	-0.634***
	(0.059)
Account Balance · DRM	-0.001***
	(0.000)
Account Balance · RSP	-0.015***
	(0.001)
CDS	-0.012***
	(0.003)
VIX	0.000**
	(0.000)
HHI	-0.529***
	(0.044)
Visibility	0.635***
	(0.143)
Timing Skewness	-0.027**
	(0.013)
Received Payments Std. Dev.	-0.022***
	(0.006)
Observations	80,699,484

Standard errors clustered by day in parentheses. ***p<0.01, **p<0.05, *p<0.1. Sent Payments, Received Payments, DRM, Account Balance, Received Payments Std. Dev. and Daily Sent Payments are in billions of pesos

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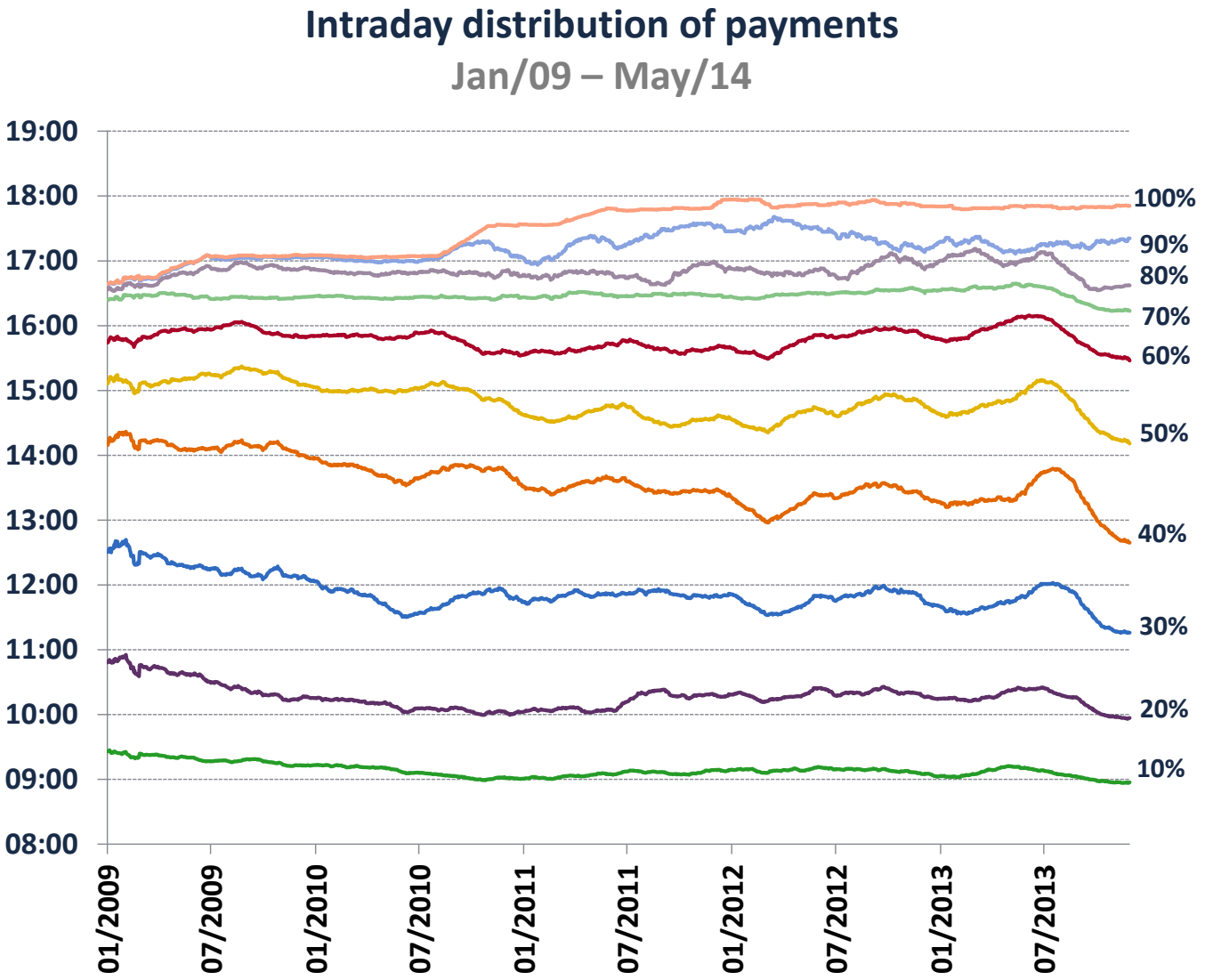
Intraday payment distribution



Intraday payment distribution: econometric model

- Definition:

  d_{it}^{j}: settlement time of decile j of institution i's total payments during day t

- Variable d_{it}^{j} is modelled as follows:[1/]

$$d_{it}^{j} = \alpha^{ij} + \psi^{j} R_{it}^{j} + \xi^{j} AB_{it}^{j} + \lambda_1^{j} DRM_{it} + \lambda_2^{j} RSP_{it} + \boldsymbol{x}_{it}^{j\,\prime} \boldsymbol{\zeta}^{\boldsymbol{j}} + u_t^{ij}$$

Access effect on settlement time

where:

R_{it}^{j}: average amount of i's incoming payments 'roughly' at time t

AB_t^i : available account balances held by participant i 16-min before time t

DRM_t^i : maximum allowed overdraft backed by the DRM at the beginning of the day

RSP_t^i : dummy variable that indicates access to Bank of Mexico's intraday repo facility

$\boldsymbol{x}_{\boldsymbol{it}}^{j}$: other time-varying observables affecting payment behaviour related to delay costs, distribution of incoming payments and payment requests & risk sentiment

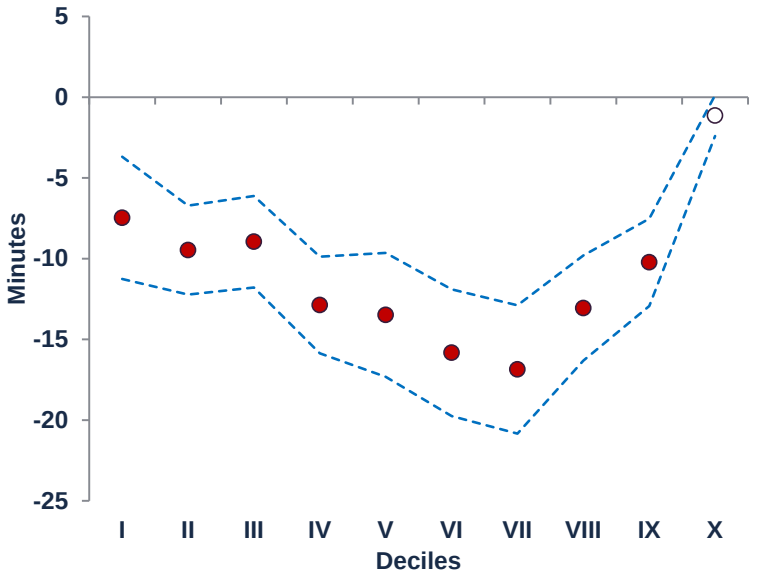
1/ Based on Bech *et al* (2012).

Intraday payment distribution: estimation results

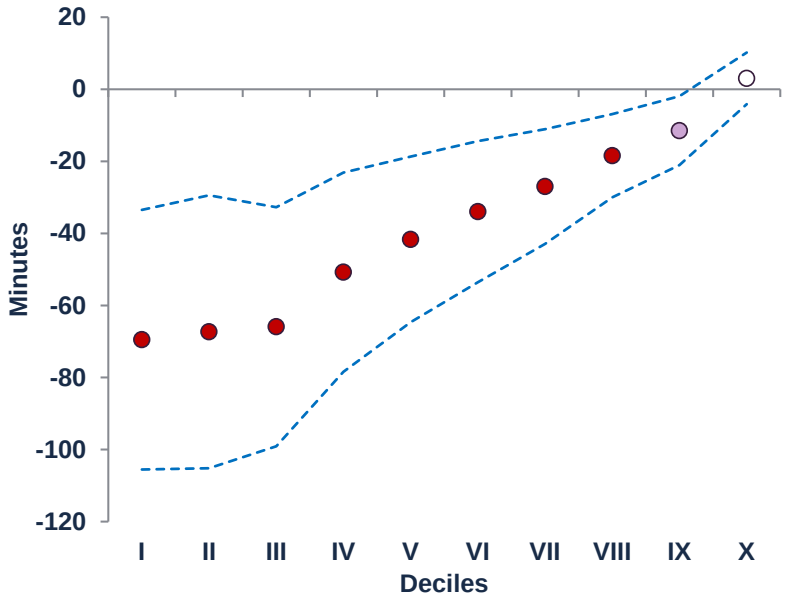
- Estimate d_{it}^{j} using standard fixed effects

Estimated marginal effect on the intraday payment distribution of having access to the Bank of Mexico's intraday facilities

Additional MX$10 bill in DRM



Opportunity to use the RSP (intraday repos)



Dotted lines delimit 95% CI

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Concluding remarks

- In spite of existing unsecured credit lines between certain participants, we find empirical evidence that the intraday liquidity provided by the Bank of Mexico speeds up payments in SPEI

- Back-of-the-envelope calculation:

  Granting a participant access to intraday repos would:

  - shift the first 50% of their payments forward by 42 minutes
  - reduce on average dependency on received payments by 35% and on account balances by 41%

- Caveat: our findings might be conservative because they ignore the general equilibrium effects of extending liquidity provision to other participants

- Work in progress: currently working on a general equilibrium version of the model that takes into account the indirect effect of the response of other participants' actions in the equilibrium

Thank you!


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