Settling Low Value Payments in Real Time: The experience of the Mexican RT“G”S

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* The views and conclusions presented in this presentation are exclusively the responsibility of the authors and do not necessarily reflect those of Banco de México.

Outline

- Introduction
- Performance measures
- Results
- Final Remarks

Introduction

- Payment systems have evolved over time;
- Changes driven by technology are observed in many aspects of the payment service industry;
- Ongoing innovation is likely to diversify payment types competing on consumer service level, whereas efficiency and cost reduction could be the main reasons for integration of payments processing and settlement;
- It could be that in a near future real time high-value payments, low value electronic payments and even card payments will be settled together;
- To achieve this, settlement engines need to incorporate a Liquidity Saving Mechanism, which allows settlement of a large number of low value payments with a minimum pressure on liquidity consumption.

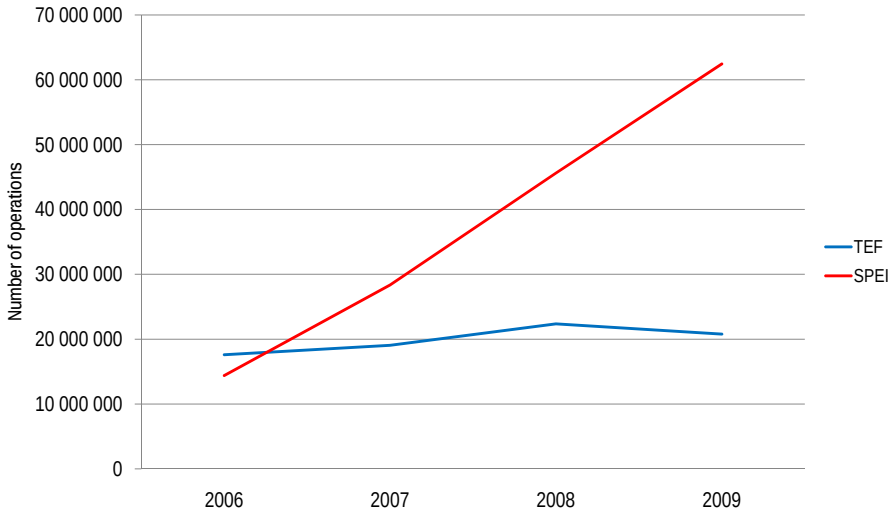
Introduction

- Swiss Interbank Clearing System, SIC, is the best known example of a Large Value Payment System (LVPS) that processes low value payments;
- Nevertheless, other countries like Czech Republic, Serbia, Slovakia, Turkey, Ukraine, Saudi Arabia and Mexico, which also use one system to settle wholesale payments and retail payments together;
- In the case of Mexico is the Real Time Settlement (RTS) Payment System, SPEI, which settle together high-value and low- value payments
  - It started operation on the 13th of August 2004 in order to settle Large Value Payments;
  - SPEI has integrated a Liquidity Saving Mechanism (LSM), which allows continuous netting of payments during the day;

The Mexican Case

- SPEI settles payment orders on real time and its operator, the Mexican Central Bank, charges less than a 0.05 USD per payment;
- SPEI settles on average around 300,000 operations daily.
  - More than 80% of the transactions are payments with value lower than 10,000 USD and,
  - only 1.3% of the transactions are above 1,000,000 USD
- Another way to send electronic transactions in Mexico is through Fund Electronic Transfer (TEF), which uses differed settlement (t+1) and is operated by Cecoban, S.A. de C.V. a company owned by banks;

Electronic Transactions



The study

- The present study evaluates the effect of settling in real time a large number of low-value payment transactions on the liquidity performance of SPEI when processing high-value payments;
- To that end, we create an artificial environment, in which we use historical data for 30 days and reproduce the operational conditions of SPEI;
- For each of these days, we structure the transactions in four sets, delimited according to their value:
  - Set one: all payments;
  - Set two: subset of payments with value higher than 100,000.00 MXN*;
  - Set three: subset of payments with value higher than 1,000,000.00 MXN;
  - Set four: subset of payments with value higher than 10,000,000.00 MXN;
- We measure two aspects of the performance of SPEI in two scenarios (described later): required participants' funds (liquidity consumption) and speed of settlement (measure in terms of amount paid multiplied by the time delay).

*The values of the lower bound of each subset of payments are chosen as a reference, without following any specific convention. The current exchange rates of the Mexican peso to an US dollar and to an Euro are 13.10MXN = 1USD and 16.70MXN = 1Euro respectively.

Operational rules of SPEI

- SPEI receives payment instructions continuously during the day, which are placed in a queue.
- Operation starts at 8:30 and closes at 17:00.
- During operation time, a settlement process (SP) is executed at the latest 20 seconds after receiving a new payment.
- Payment instructions not settled in a certain SP are kept in the queue and are considered for settlement in the subsequent processes.
- After execution of the last SP of the day, payments in the queue are canceled.

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Measuring the speed of settlement

- Notation
  - $\mathcal{P}$ is the set of payments received by SPEI in one day;
  - $\mathcal{I}$ is the set of participants in SPEI;
  - p_{ij} is a payment in $\mathcal{P}$, form participant i to participant j;
  - t'_p is the number of minutes from the first SP launched immediately after the reception of the payment instruction p, until its settlement;
  - ξ_p is the amount in MXP of p.

Measuring the speed of settlement

- Then the delay $\mathcal{V}$, which measures the speed of payments settlement during one day, is defined on the following way:

$$\mathcal{V} = \sum t'_p \xi_p$$

- Note: if liquidity is sufficient to settle every $p_{ij} \in \mathcal{P}$ in the next SP launched immediately after the reception of p_{ij}, then $\mathcal{V}$ =0.

Measuring liquidity consumption

- In Large Value Payment Systems, the term liquidity is used to define the funds that the participants have to cover their payment obligations;
- Those funds come primary from two sources:
  - Participants' resources from previous balances or received as electronic transactions from other payment systems and,
  - Payments received during the day from the rest of the participants
- For our study, the measure of liquidity consumption is related only to participants' resources

Measuring liquidity consumption

- $\mathcal{A}$ is the set of accounts of the direct participants in SPEI.
- ℓ_a is the level of own resources used in the account a during one day;
- $\forall\, i \in I$
  - the payment orders sent are presented as:
    $$\mathcal{P}env = \sum_{j \in I} p_{ij}$$
  - whereas the received payments are denoted as:
    $$\mathcal{P}rec = \sum_{j \in I} p_{ji}$$

Measuring liquidity consumption

- ℓ_a^{min} is the lower required level of liquidity for settlement during the day, which is determined as follows:
  $$\ell_a^{min} = min\{(\mathcal{P}env - \mathcal{P}rec), 0\}$$
- ℓ_a^{max} is the required level to have $\mathcal{V} = 0$.
- Therefore $\ell_a^{min} \leq \ell_a$ is a necessary condition in order to settle all payments with ℓ_a.
- In addition for any $\ell_a \geq \ell_a^{max}$, $\mathcal{V} = 0$.

Measuring liquidity consumption

- Then, $\mathcal{L}$ is the measure on the macro level of liquidity consumption, defined as:

$$\mathcal{L} = \frac{\sum_{a \in \mathcal{A}} \ell_a}{\sum_{p \in \mathcal{P}} \xi_p}$$

- This measure is applied here to the historical data tested in a simulated environment.

Outline

- Introduction
- Defining performance measures
- Results
- Final Remarks

The study

- We created an artificial environment, in which we use historical data from 30 days and reproduce the operational conditions of SPEI. We only included payments received in SPEI from 8:30 to 17:00
- For each of those days we structure the transactions in four sets, delimited according to their value:
  - Set one: all payments;
  - Set two: subset of payments with value higher than 100,000.00 MXN*;
  - Set three: subset of payments with value higher than 1,000,000.00 MXN;
  - Set four: subset of payments with value higher than 10,000,000.00 MXN;

*The values of the lower bound of each subset of payments are chosen as a reference, without following any specific convention. The current exchange rates of the Mexican peso to an US dollar and to an Euro are 13.10MXN = 1USD and 16.70MXN = 1Euro respectively.

The study

- In the first scenario: for each set of payments we obtain $\mathcal{L}_{min}$, the minimum amount for participants' funds for which all payments are settled;
  - Under this condition we calculate the delay $\mathcal{V}$.
- In the second scenario: for each set of payments, we calculate $\mathcal{L}_{max}$;
  - In this case delay $\mathcal{V} = 0$.
- For each scenario we compare the performance of SPEI with and without the settlement of low-value payments.

Historical Data

Day	Number of SP executions	All payments	Payments with Value > 100,000	Payments with Value > 1,000,000	Payments with Value > 10,000,000
07.04.2010	1463	195,637	31,280	7,116	2,136
08.04.2010	1518	195,578	33,211	7,563	2,318
09.04.2010	1569	277,326	41,367	8,559	2,608
12.04.2010	1475	202,695	33,616	8,556	2,758
13.04.2010	1492	179,899	31,728	8,140	2,577
14.04.2010	1511	229,436	36,093	8,219	2,322
15.04.2010	1560	279,731	38,203	8,481	2,526
16.04.2010	1608	305,347	43,045	8,876	2,621
19.04.2010	1488	205,322	36,703	9,363	2,981
20.04.2010	1437	181,098	30,611	7,804	2,999
21.04.2010	1459	174,978	30,525	7,464	2,633
22.04.2010	1485	193,068	35,190	9,041	3,215
23.04.2010	1564	274,774	42,249	8,861	2,792
26.04.2010	1500	198,330	34,711	8,760	3,061
27.04.2010	1462	182,009	32,532	8,020	2,645
28.04.2010	1495	196,682	35,879	8,562	2,692
29.04.2010	1554	269,387	44,756	10,374	3,572
30.04.2010	1677	416,860	59,374	12,853	4,023
03.05.2010	1545	195,294	31,954	8,601	2,807
04.05.2010	1486	184,136	30,388	7,952	2,823
05.05.2010	1448	217,316	39,758	9,845	2,836
06.05.2010	1497	208,648	34,747	8,706	3,047
07.05.2010	1562	290,832	43,507	10,082	3,665

Liquidity consumption

		All Payments	Payments > 100,000	Payments > 1,000,000	Payments > 10,000,000
	Average	0.0725	0.0695	0.0708	0.0740
$\mathcal{L}_{min}$	Variance	0.000621422	0.00054627	0.000579069	0.000642138
	Est. Div.	0.024928333	0.02337239	0.024063843	0.025340441
	Average	0.2257	0.2234	0.2275	0.2365
$\mathcal{L}_{max}$	Variance	0.000649935	0.00062056	0.000655832	0.000729333
	Est. Div.	0.025493816	0.02491114	0.025609211	0.027006157

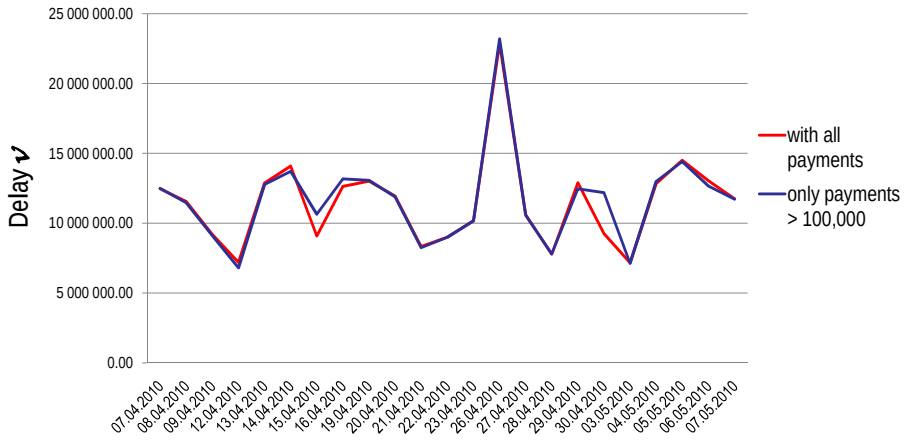
Settlement delay*

		Payments >100,000		Payments >1,000,000		Payments >10,000,000	
		Settled with all payments	Settled separately	Settled with all payments	Settled separately	Settled with all payments	Settled separately
v	Average	11,486,688.94	11,636,391.30	11,178,739.47	11,198,127.10	11,138,082.84	11,099,999.17
	Est. Div.	3,330,635.68	3,327,719.89	3,496,912.01	3,591,699.74	3,493,366.75	3,321,372.47

*The settlement delay is presented in terms of 1,000,000.00 Mexican pesos in one minute

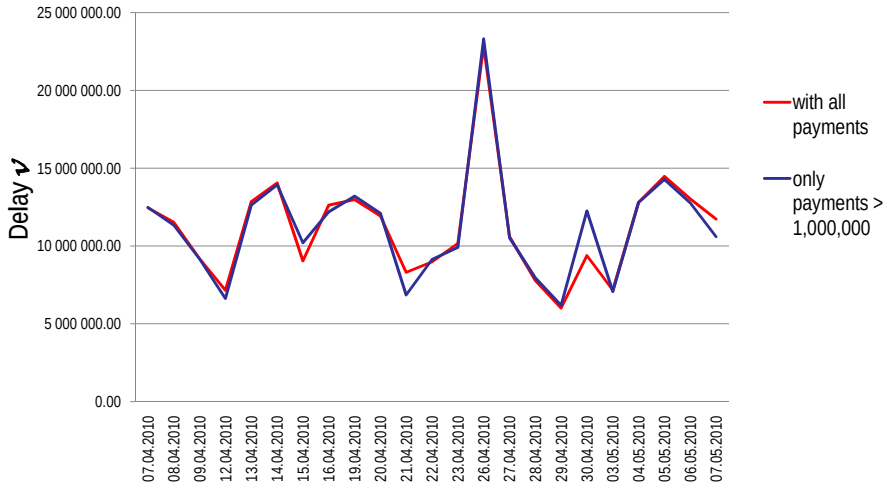
Low Level Liquidity Consumption

Delay of Payments > 100,000



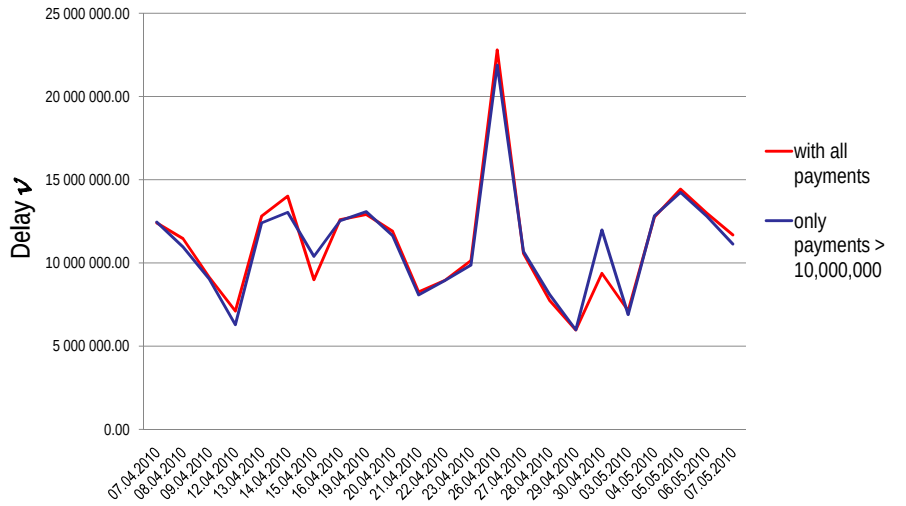
Low Level Liquidity Consumption

Delay of Payments > 1,000,000



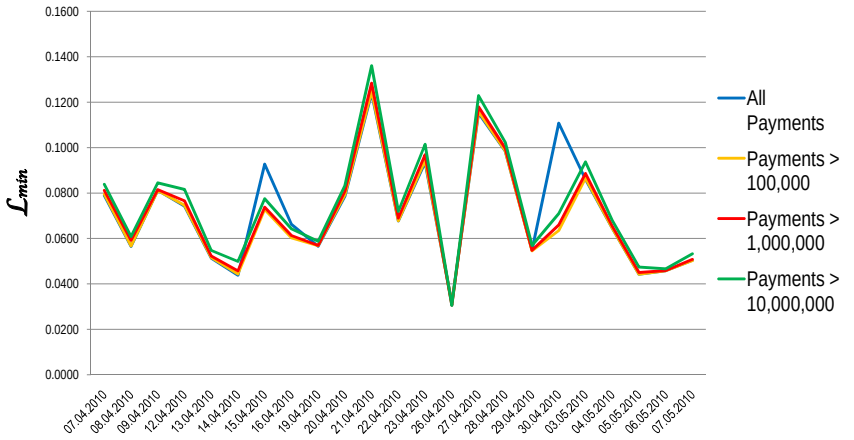
Low Level Liquidity Consumption

Delay of Payments > 10,000,000



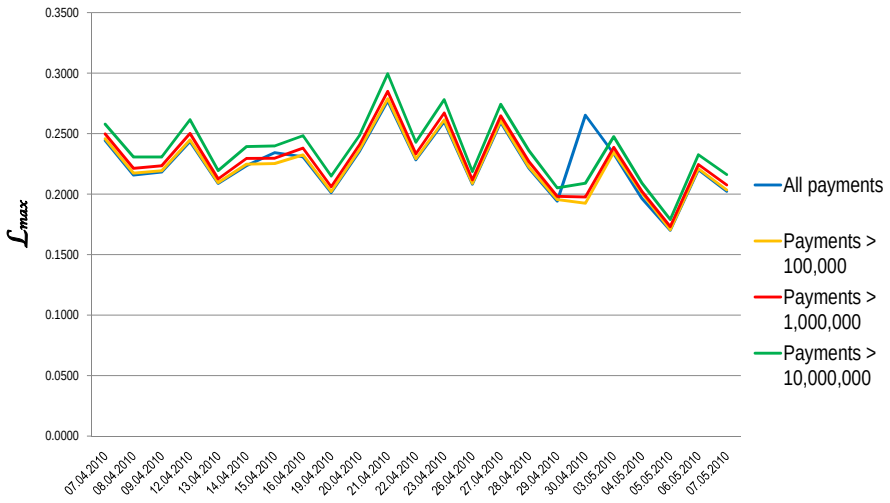
Low level of liquidity consumption

$\mathcal{L}_{min}$



High level of liquidity consumption

$\mathcal{L}_{max}$, $\mathcal{V}$=0



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Final Remarks

- This study has allowed us to evaluate the speed of settlement, measured through delay $\mathcal{V}$ and the liquidity consumption, measured through $\mathcal{L}$ in two cases:
  - Low liquidity consumption,
  - High liquidity consumption without delay.
- According to our results, low value payments do not have a negative impact over the speed and liquidity consumption;
- One possible extension to the present work is to find the conditions and the operational rules under which a smaller delay ($\mathcal{V}$) is obtained given a specific balance