Intraday Liquidity Demand of Banks in Real-Time Gross Settlement System

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Abstract

In this study a simulation analysis is applied to address the change in banks liquidity demand due to a shift in settlement method brought about by adopting Real Time Gross Settlement System. At the first stage of this research, we use a data generator model along with some information on the time distribution of coded cheques over a working day in order to produce intraday flow of payments. Then the output is fed to the Bank of Finland Payment Settlement Simulator (BoF-PSS) to estimate banks intraday liquidity needs in Satna. The results indicate the movement towards a real time gross-settlement system increases the liquidity demand of Iranian banks in payment system by about 66 percent.

Key words: *RTGS, liquidity, model, interbank*

JEL classification: *C15, C70, E58, G21, G35*

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Introduction

There are a bulk of researches on banks' behavior and their liquidity demand under various settlement systems. Some of these studies are concerned with the theoretical examination of banks' behavior while the others deal with some policy-oriented problems. A number of theoretical papers (Angelini 1998, Bech and Garratt, 2003) have used a game-theoretic perspective to understand the differences in incentives for the banks created by different credit and settlement arrangements in interbank payments. These papers are insightful and give qualitative suggestions on design issues. However, they cannot address the banks liquidity demand in the quantitative fashion that is needed for a realistic comparison of different 'real-life' interbank payment systems. Further, these authors typically make a number of simplifying assumptions that are not always true. For instance, most assume that banks are of equal size and know in advance what payments are coming in to them over the course of the day.

Most applied works are heavily relied on simulation analysis. In fact the complexity of payment economics explains well the appeal of simulation analysis in applied researches.

There are two main approaches in this regards. First the one that has been adopted by the Bank of Finland (BoF-PSS) wherein the volume, number and timing of payment orders are deterministic and derived from a sample of real data. For example Leinonen and Soramäki (1999) used a simulation analysis to examine different hybrid systems that combine the advantages of netting in multilateral or bilateral form with real time settlement processing. Koponen and Soramäki (1998) and Bech and Soramäki (2002) take the experiments with the BoF PSS a step further. They allow the banks to post varying amounts of liquidity at opening and take the recorded time that payments are submitted to the central processor as being identical to the time of arrival of requests at the bank. The simulator first determines at each minute the settlement balances of each bank and then operates an automatic system of settlement which follows a first in first out rule. The delays in payment settlement are evaluated at different levels of opening liquidity.

Second, used by the Bank of England where data are stochastic and vary in a range theoretically imposed (Alentorn, A., S. Markose, S. Millar, J. Yang, 2005). This simulator is built by a team of experts at Essex University for interbank payments and is capable of handling real time payment records along with autonomous bank behavior and show that it can be used to evaluate different payment system designs.

This study takes the Bank of Finland approach for the sake of simplicity. It is worth mentioning the BOE simulator is more appropriate for analysis of banks' strategic behavior. However, as the data on actually submitted payments was not available at the time of conducting this research and considering the main objective of this study, we adopted the Bank of Finland approach.

This study uses the information on coded cheques on the time distribution of payments in the net settlement system to make a gesture about the possible flow of payments in a gross settlement system. So to fill the gap in required data another simulator tool was developed. In this simulator payments are generated by a random process and then were submitted to the central processor. Then the second version of BoF-PSS is applied to estimate the banks liquidity demand in the payment system.

The rest of the paper is organized as follows: In Section 2 computational modeling framework is set out and the features of the Simulator are discussed. Section 3 deals with the data generating process. In Section 5 the results of simulation analysis are reported. Section 6 concludes.

Basic Model

To model the payment system let first denote P_i^I as the payment received by and denote P_i^O as the payment ordered by bank i. Now if we consider the whole time span of our analysis as T and t is denoted as a specific period during T, the Lower Bound (LB) of liquidity demand of bank I can be calculated by:

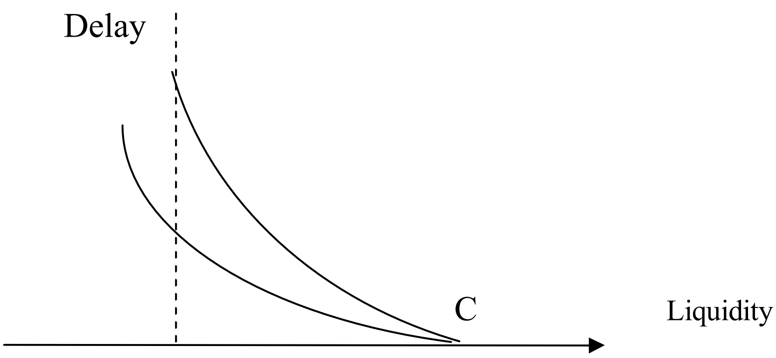
$$LB_i = \min\{0, (\sum_t P_i^{It} - P_i^{Ot})\} \quad (1)$$

In other words, the lower bound of a bank in SATNA is the net received payments of that bank in the payment system at the end of the day. But if the regulator or the Central Bank is willing to avoid any delay, it can provide all the liquidity needed for the on time settlements. This is indeed the Upper Bound (UB) of the liquidity demand

$$(UB_i = \min\{0, (\sum_t (P_i^{It} - P_i^{Ot}) \forall t \in [0,T])\}) \quad (2)$$

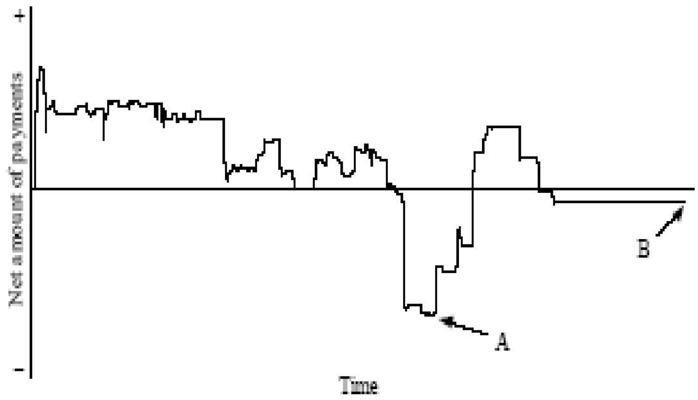
The relationship between liquidity needs and settlement delay in different payment settlement systems is analyzed in this study within the framework depicted in Figure 1.

Figue 1



The upper bound for liquidity need is relevant if all payments are settled without queuing. An accountholder's minimum liquidity position during the day then represents the theoretical upper bound for its liquidity need (UBt). This was calculated as the minimum of the cumulative net positions of incoming and outgoing payments at all points of time during the day. This amount is represented by point A in Figure 2.

Figure 2



The amount of liquidity available for any account holder i is calculated as shown in equation 3. Liquidity available for each bank at a particular liquidity level is the sum of the lower bound and the corresponding liquidity level multiplied by the difference between the bounds. The lower bound for liquidity need is the 0 per cent liquidity level and the upper bound is 100 per cent.

$$LL_i = LB_i + s_i (UB_i - LB_i) \qquad (3)$$

In calculating system liquidity need, the system upper bound, and system lower bound; the corresponding values for each account holder are simply added up. It should be noted that the liquidity must be optimally distributed in order the system bounds to hold.

Generating Data of Payment Flows

In conducting this research we exploited the available information from the Tehran Interbank Clearing House (TICH) on total daily gross payments. A sample of three days coded cheques data was used to calibrate the model based on the time distribution of payments for all banks in the payment system. If one is to extend the results of this study to the whole country an adjustment is needed to be done. As the TICH is dealing only with the payments originated from banks working in the Capital city at the time of this research, the results are required to be proportionally increased in order to capture the whole country payments.

The simulator used in this study benefits a gridlock resolution algorithm with a time interval parameter that can be adjusted manually. We use half an hour value for the parameter. Also the feeding system is based in FIFO (First in, First out) method. Though the system is capable of prioritizing and queue management algorithm, it has not been used to make the results comparable across different scenarios. For the sake of simplicity, we assume after the full operation of the new payment system all the payments are channeled to SATNA.

Table 1: Average daily value and volume of payments in TICH in 2005

(Values in billion Rials)

No	Bank	Average Value of Transactions	Average Daily Volume	Share of each Bank in Total Transaction
1	Melli	215129188	10179	24.3
2	Saderat	142575200	6825	10.8
3	Tejarat	100658930	10168	13.5
4	Mellat	303578299	5198	17.5
5	Sepah	185033778	5773	11.9
6	Refah	163281171	1981	3.6
7	Post Bank	188323529	170	1.1
8	Maskan	62528561	2626	1.8
9	Keshavarzi	150549662	2074	3.5
10	BIM*	789297297	74	0.6
11	Toseh Saderat	337169173	266	1.0
12	Karafarin	327381974	466	1.7
13	Saman	308904899	347	1.2
14	EN**	456528926	363	1.8
15	Parsian	194360731	2628	5.7

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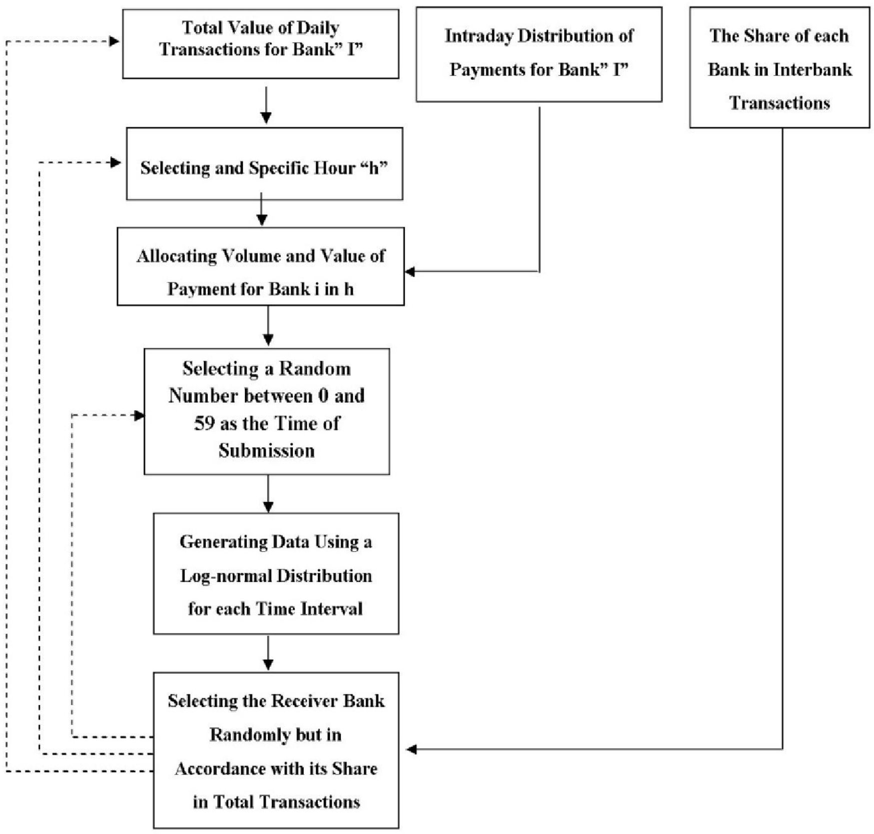
Figure 3 shows the way that payments flow is generated by the data generator simulation model. For each bank total value of daily transactions, intraday distribution of payments and its share in the total payments are inputs and the simulator converts the net data to an intraday flow of payments so as it was produced by a gross settlement systems.

Figure 3



The Results and Conclusion

Table 2 summarizes the results of interbank simulation model for costumer to costumer (C2C) transactions in its second column.

Table 2: Banks' projected liquidity needs in the payment system

(Values in billion Rials)

Bank	Liquidity Needed for C2C Transactions	Liquidity Needed for B2B Transactions	Lower Bound	Upper Bound
Saderat	2465	501	2222	2966
Parsian	2101	148	1463	2249
Tejarat	2055	454	1472	2509
Mellat	1654	372	1420	2026
Melli	1612	814	1351	2426
EN	1948	19	1180	1967
Sepah	1086	560	1038	1646
Toseh Saderat	310	724	607	1034
Refah	658	173	1055	831
Keshavarzi	445	236	503	681
Saman	595	102	412	697
Maskan	546	67	398	613
Other Banks	449	6	273	455
BIM	294	231	309	525
Karafarin	296	19	192	315
Total	16514	4426	13895	20940

The payments could come from banks as a bank to bank (B2B) payments, costumer to costumer(C2C) or costumer to bank(C2B) or vice versa. An example of B2B payments are payments for the Rial legs of bank's foreign exchange purchases. This type of payments is considered as payments coming from an ancillary system that enters as a bunch of payments that is added to the liquidity needs of banks.

As the results show, the movement towards a real time gross-settlement system increases the liquidity demand of the payment system by 66 percent. On the top of the list, there is Saderat bank with Rial 2966 billion liquidity needs, while the liquidity need of the largest bank, Bank Melli, is Rial 2426 billion. That is because the liquidity demand of the Bank Melli is partly provided by payments received from other banks as it receives more than what it pays in interbank transactions.

There are two other policy variables that can be used by the regulator that affects the liquidity needs of the system. First, the regulator may introduce a ceiling policy, so making the settlement of payments above some threshold in the large value payment system obligatory. The larger is the threshold; the lower would be the liquidity demand of banks in the payment system. Another policy variable is the amount of credit facilities expected to be provided by Central Bank through Intraday Loan Facilities. Further investigations are required to address the effects of these variables on liquidity demand in payment system.

References

1- Alentorn, A., Markose., S, Millar & Yang J., (2005). Designing large value payment systems: An agent-based approach, *Bank of England Working Papers.*

2- Angelini, P. (1998). An analysis of competitive externalities in gross settlement systems. *Journal of Banking and Finance*, 22, 1-18.

3- Bech, M. L., & Garratt R. (2003). The intraday liquidity management game. *Journal of Economic Theory*, 109, 198-219.

4- Koponen, R. & Soramäki K., (2005). Intraday liquidity needs in a modern interbank payment system – a simulation approach. *Bank of Finland Publication,* E.31.

5- Leinonen, H., & Soramäki, K., (1999). Optimizing liquidity usage and settlement speed in payment system. *Bank of Finland Discussion Paper,* 16.