Gross or Net Settlement? What Type of Securities Settlement System Works Best?

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Abstract. *The securities markets are going through material structural changes. Some best practices have been identified in order to deliver safety and efficient securities settlement systems. The paper investigates when gross settlement works better than the net solution. We highlight that, due to the new trends in securities markets characteristics, the safetyness criteria might deliver indifference between using gross or net settlement. The efficiency criterion is the one that makes the difference. We build a model and develop some scenarios in order to assess what type of settlement (gross or net) works best.*

Key words: securities; settlement; risk; efficiency; banks.

JEL Codes: C15; G21; G29.
REL Codes: 7J, 11B.

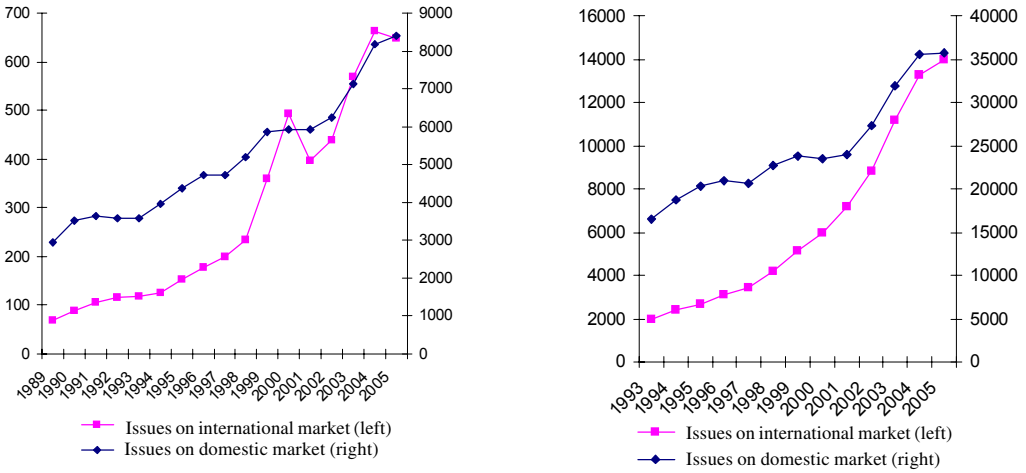
1. Introduction

Safetyness and efficiency are the most important features to be achieved within a security settlement system (SSS). Best practices (BIS, 2001) recommend that settlement of securities transactions should take place on a delivery versus payment (DVP) basis in order to eliminate principal risk (securities are delivered, but payment is not received, or vice versa). Finality may be in real time, intraday, or at the end of the day. DVP models differ according to whether the securities or/and funds transfers are settled on a gross or net basis, and in terms of the timing of the finality of the transfers.

The most important SSSs use DVP1 (see Annex). If such DVP is in place, the finality always takes place intraday. We find no evidence that certain SSS characteristics (type of settled securities, number or value of transactions, number of participants) trigger a path towards gross or net use in the settlement process. We question if this is the most safety and efficient way to build an SSS, or we may find some room of improvement.

The securities operations, especially in the new segments, develop very fast. The infrastructure might not keep the pace. Secondly, the risk of liquidity springs considerably. In such conditions, it is feasible, in terms of efficiency and safetyness, to embark the settlement into the same approach as in the plain vanilla operations?

Securities markets delivered important structural changes during the last decades. The most material are the following three, to our view. Firstly, the securities delivered higher trends than the banking assets, both in volumes and paces, but the focus in settlement remained especially on the payment (cash leg) systems. Secondly, the international securities transactions are more dynamic than the domestic ones (figure 1). The share of cross-border transfer with bonds and equities increased tens of times during the last decades. Thirdly, new instruments, very complex and with not-straightforward pay-offs, emerged and extended rapidly (OTC derivatives are the best example). These structural changes are so fast, that the infrastructure (legislation, netting procedures, settlement systems, etc.) is not able to keep the same pace. In the most situations, the same in-place infrastructure is used.



Source: BIS.

Figure 1. *Debt securities issued on domestic and international markets (bll. USD)*

The second part of the paper assesses that, from the safety ness point of view, it is broadly indifferent if you settle net or gross. In the third part, we demonstrate that, if the efficient principle should be observed, the type of settlement should be tailored according to the SSS characteristics. The last part concludes the main ideas from the paper.

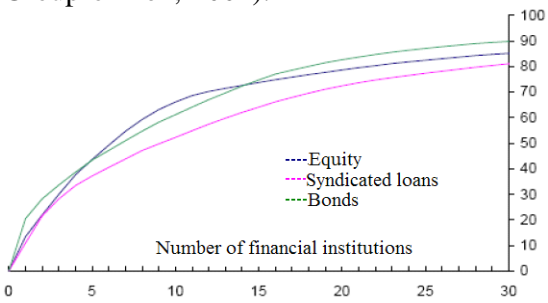
2. Safetyness

The employed type of settlement might not matter too much when the safetyness is assessed. This conclusion is based both on the change in the quality of the participants, and in the risk profile of securities operations.

The role of systemically important participants in the SSSs is up trending. Banks largely involved in securities operations are the bulk of such kind of participants. These banks are more prone to deliver systemic risks, because: (i) usually these entities are the biggest banks in the world and (ii) they develop multiple connections through the securities operations. Marsh and Stevens (2003) or Wredenburg (2006) also underpin that banks involved in securities markets (brokerage, settlement etc.) have higher ability to trigger systemic implications.

For the most dynamic securities markets, we should add the characteristic of high level of concentration, which also add to the systemic risk. The top 8-10 dealers from credit derivatives markets count for 70% of the overall international total gross positions, and this market share was pretty constant in the previous years (Figure 2).

The top 10 dealers for the securities traded on international markets are responsible of around 75% of the operations, with some sub-categories touching the limit (eg 96.6% for international US equities, 81.2% international European equities etc, Group of Ten, 2001).



Source: Gieve, 2006.

Figure 2. *Financial markets concentration*

Change in the risk profile is another characteristic that has surged in the securities operations. Most opinions refer to an atomization of risk (Knight, 2007, Borio, 2007). The innovation in the financial markets (delivered especially through complex securities channels) allows the unbundling and re-bundling of the payoffs. It is also true that the lack of transparency of these transactions is not an effective support of the idea of atomization and dissemination of risks along multiple participants. It might be possible to have atomization of risk, but there are no statistics to support clear evidence. In fact, as the recent financial turmoil are unfolding, other opinions (Trichet, 2007) highlight that, despite the fact that over the recent years credit risk transfer facilitated the risk sharing, credit risk ultimately resides in the financial system. In a large number of cases, the credit risk stood in the banking sector, through the commitment they still had to activate back up lines of conduits or structured investment vehicles. In other words, who is at the beginning of the chain of building up complex securities (and the banks are the

originators, in most cases), might not be so shielded against risks, even if the exposure is gone from the balance sheet.

Concluding, the banks largely involved in the securities operations are especially the systemically important ones, therefore choosing net or brut settlement in order to reach the criterion of safetyness does not matter too much.

3. Efficiency

We measure the efficiency of a settlement system in terms of (i) liquidity burden per transaction, and (ii) the value of average loss per transaction in case of a default.

Gross settlement systems call for a critical mass of securities and adequate liquidity in order to reach an efficient functioning. The systemic risk in such SSS is lower because a transaction is not settled if the participants' accounts are not fueled with cash or securities. The problem that might rise is the lack of liquidity in cash or in financial instruments. The recent financial turmoil highlighted that liquidity risk is an issue that should be better tailored in the future.

Net settlement systems edge out the need for important intra-day liquidity needs, but the netting process might increase the systemic risk because each participant exposure is revealed at the end of the clearing process. The intra-day exposure is hidden, and the lack of liquidity in cash or securities is unveiled only at the end of the day. Some solutions promote for several settlements during the same day.

In tranquil times, liquidity is just a matter of cost. In financial distresses, the evaporation of market liquidity (cash or securities) is very likely to occur. In such conditions, a SSS architecture that embarks in gross settlement might deliver material imbalances in the finality of the process, affecting efficiency. Borio (2007) singularizes that the new financial environment is more reliant on the availability of funding liquidity, and it might become scarce at time of distress. This is even problematic in the field of securities lending.

Therefore, there are situations where gross settlement costs might outpace the benefits, and we may not rule out the possibility of using net instead of gross settlement. In order to find out which typology of operations fits better the efficiency criterion, we use Guadamillas and Keppler (2000) methodology, adjusted for our specific needs.

Let us assume a market where act k banks as brokers/dealers. The matrixes below illustrate the characteristics for each type of settlement, i.e. gross (G), bilateral net (N) and multilateral net (M) system. The t_{ij} element represents the value of securities bought by bank i from bank j. Let also assume that t_{ij} is one operation (not the net of transactions between these two banks).

Matrix G	Matrix N	Matrix M
$\begin{matrix} 0 & t_{12} & t_{13} & \dots & t_{1k} \\ t_{21} & 0 & t_{23} & \dots & t_{2k} \\ t_{31} & t_{32} & 0 & \dots & t_{3k} \\ \dots & \dots & \dots & \dots & \dots \\ t_{k1} & t_{k2} & t_{k3} & \dots & 0 \end{matrix}$	$\begin{matrix} 0 & n_{12} & n_{13} & \dots & n_{1k} \\ n_{21} & 0 & n_{23} & \dots & n_{2k} \\ n_{31} & n_{32} & 0 & \dots & n_{3k} \\ \dots & \dots & \dots & \dots & \dots \\ n_{k1} & n_{k2} & n_{k3} & \dots & 0 \end{matrix}$	$\begin{matrix} m_1 \\ m_2 \\ m_3 \\ \dots \\ m_k \end{matrix}$
	$n_{ij} = \max\{0, t_{ij} - t_{ji}\}$	$m_h = \sum_{j=1}^{k} t_{hj} - \sum_{i=1}^{k} t_{ih}$

Each matrix shows the number and the value of settlement operations. In matrix N, n_{ij} is the net position of bank i against bank j. In matrix M, m_i is the net multilateral position of bank i against other credit institutions.

Table 1 reflects the number and the value of each type of settlement process. It is easy to prove that gross settlement systems come with the most complex pattern of transaction in terms of number and liquidity needs. But we do not penalize these type of settlement in terms of liquidity burden (affecting also efficiency), because what matters more is the average liquidity needs per settling each transaction. In order to rank this burden, we compute the probability a certain type of settlement to deliver higher liquidity requirements than the other two, according to specific market characteristics.

Number of settled operations and the liquidity needs

Table 1

Type of settlement	Number of affected settled operations	Value of affected settled operations
Gross	1	t_{ij}
Bilateral net	2	$t_{ij} + t_{ji}$
Multilateral net	2k-3	$\sum_{j=1}^{k} t_{ij} + \sum_{i=1}^{k} t_{ij} - t_{ij}$

Secondly, in order to assess the impact of one default, let us consider that bank i would not be able to deliver the cash or security leg to bank j at the settlement day. As a consequence, the transaction t_{ij} will stay unfold. Table 2 summarizes the number and the value of affected transactions, according to the type of settlement.

Number and value of settled operations affected by one default

Table 2

Type of settlement	Number of settled operations	Value of settled operations
Gross	k(k-1)	$\sum_{i=1}^{k} \sum_{j=1}^{k} t_{ij}$
Bilateral net	k(k-1)/2	$\sum_{i=1}^{k} \sum_{j=1}^{k} n_{ij} = \left(\sum_{i=1}^{k} \sum_{j=1}^{k} \left| t_{ij} - t_{ji} \right| \right) / 2$
Multilateral net	k	$\sum_{h=1}^{k} \left| m_h \right| = \sum_{h=1}^{k} \left(\left| \sum_{j=1}^{k} t_{hj} - \sum_{i=1}^{k} t_{ih} \right| \right)$

In order to find which solution embarks better in the efficiency criterion, we tailor 11 scenarios tested on 100,000 hypothetical cases each. To capture the variety within the SSS characteristics (type of settled securities, number of participants etc.), we test the influence of small and large banks, considering the value dispersion of the settled securities, the share of small and medium banks in the SSS, the number of

participants. The results of liquidity constraints for each type of operation are presented in Table 3.

If the SSSs settle many types of securities (bonds, CD, government securities, equities, other), then gross settlement should be implemented (e.g. scenario 7 or 8).

If new and complex securities (we include here the OTC derivatives, too) should be settled, then the bilateral net procedures might be the best solution (e.g. scenario 1). Therefore, it is more probable to face a situation like (B)<(G)<(M), due to the material level of concentration, and the important values traded by the largest banks.

If the government bonds market is characterized by high dispersion in values, then gross settlement should be used (scenario 9, 10 or 11). On the other hand, if the market is very homogeneous, then bilateral net settlement is the most efficient solution (e.g. scenario 6). The same outcome we reach when the number of participants is low, or the weight of operations settled by small and medium banks in the total settlement is humble.

Where there is a high dispersion in the value of the settled securities, in most cases the value per transaction is the lowest for bilateral net settlement. In the opposite corner is the multilateral net settlement. This high dispersion appears when there are a few banks that trade large value securities (comparing to the average), or the value of securities lies on a large array (e.g. the system allows several types of securities in the settlement process).

The scenarios (values of default per transaction)

Table 3

No. scenario	A	B		C		D		E
1	10	0	10	10	20	1	2	(B)<(G)<(M), in 96% of situations (B)<(M)<(G), in 4% of situations
2	10	0	10	85	90	5	10	(G)<(B)<(M), in 93% of situations (B)<(G)<(M), in 7% of situations
3	10	0	1000	85	90	5	10	(G)<(B)<(M), in 91% of situations (B)<(G)<(M), in 9% of situations
4	10	0	1000	85	90	3	4	(B)<(G)<(M), in 99% of situations (G)<(B)<(M), in 1% of situations
5	10	0	1000	50	60	1	100	(G)<(B)<(M), in 99% of situations (B)<(G)<(M), in 1% of situations
6	100	0	10	85	90	3	4	(B)<(G)<(M), in 100% of situations
7	100	0	100	85	90	5	10	(G)<(B)<(M), in 100% of situations
8	100	0	100	85	90	1	100	(G)<(B)<(M), in 100% of situations
9	100	0	1000	85	90	5	6	(B)<(G)<(M), in 51% of situations (G)<(B)<(M), in 49% of situations
10	100	0	100	50	60	5	10	(B)<(G)<(M), in 61% of situations (G)<(B)<(M), in 39% of situations
11	100	0	100	85	90	5	10	(G)<(B)<(M), in 100% of situations

Legend:

A = number of participants in SSS

B = interval of variation for the value of securities settled by small and medium banks

C = interval of variation of the share of small and medium banks in the overall banks participating in the SSS

D = interval of variation for the value of securities settled by large banks (calculated multiplying the average value of the securities settled by small and medium banks with the coefficients presented in the columns)

E = the hierarchy of the average value of default per transaction. In such way, we computed the value of settlement

per transaction for (G) gross, (B) bilateral net and, (M) multilateral net settlement, where:

$$(G) = \frac{\sum_{i=1}^{k}\sum_{j=1}^{k} t_{ij}}{k(k-1)} \quad (B) = \frac{\left(\sum_{i=1}^{k}\sum_{j=1}^{k}\left|t_{ij} - t_{ji}\right|\right)/2}{k(k-1)/2}$$

$$(M) = \frac{\sum_{h=1}^{k}\left(\left|\sum_{j=1}^{k} t_{hj} - \sum_{i=1}^{k} t_{ih}\right|\right)}{k}$$

The next step is to find out which type of settlement (gross or net) delivers the highest value of losses per transaction when a default occurs. We compare the results obtained for reducing the liquidity burden with the outcome delivered when we focus on abating the level of risk. In Table 4 we identify, for each of the 11 scenarios, the average probability of default and the Sharpe ratio (mean/variance) for each type of settlement to deliver higher losses than the other.

Average probability of default according to the type of settlement

Table 4

No. scenario	Comparison between the following lines of Table 2								
	Solutions for settlement between (G) and (B)			Solutions for settlement between (G) and (M)			Solutions for settlement between (B) and (M)		
	Mean	Variance	Mean/ Variance	Mean	Variance	Mean/ Variance	Mean	Variance	Mean/ Variance
1	0.4945	0.0440	11.237	0.4543	0.0279	16.3050	0.4589	0.0349	13.1371
2	0.4811	0.0744	6.4620	0.3168	0.0682	4.6446	0.2763	0.0846	3.2681
3	0.4506	0.0710	6.3434	0.2940	0.0713	4.1242	0.2599	0.0879	2.9583
4	0.4506	0.0710	6.3453	0.4090	0.0600	6.8196	0.3673	0.0695	5.2818
5	0.4504	0.1269	3.5488	0.2757	0.0985	2.7993	0.3779	0.1123	3.3662
6	0.5406	0.0523	10.3289	0.4939	0.0351	14.0730	0.4307	0.0434	9.9265
7	0.5091	0.0523	9.7280	0.3684	0.0523	7.0481	0.2845	0.0702	4.0515
8	0.5091	0.0518	9.8288	0.0884	0.0504	1.7540	0.1611	0.0912	1.7654
9	0.5057	0.0524	9.6600	0.4197	0.0449	9.3446	0.3283	0.0593	5.5402
10	0.5072	0.1173	4.3228	0.3666	0.1555	2.3575	0.4407	0.2105	2.0935
11	0.5091	0.0523	9.7314	0.3684	0.0522	7.0520	0.2846	0.0702	4.0539

Legend:

The scenario number is the same as in the Table 3.

The values for settlement in the cases (G), (B) or (M) represent the losses per unit that might occur in the case of a default in the context of using (G) gross, (B) bilateral net or (M) multilateral net procedures. The net values per unit in each of these 3 situations are computed dividing the column 3 to column 2 from Table 2, for each line. In the computation process, we reach a matrix of values (apart from Table 3 where the outcomes are values). For each matrix, we compute the mean and standard deviation of the elements.

The mean represents the average probability that the first solution for settlement scratched in the table to be the lower than the second (i.e. (G)<(B), or (G)<(M), or (B)<(M)). A small value for the mean reflects that the average probability of the first solution of the settlement process is lower than the average probability ascribed to the second solution.

The variance and the Sharpe indicator have been computed for each of the 3 matrixes.

Table 4 highlights that, if a default occurs, the probability to loose participating in a multilateral net system is higher than in other situations. The extreme case is accounted when there are many participants in the SSS, a large fan of securities to be settled, and a large palette of the securities values. For this described situation, the multilateral net system should be strongly avoided. The

loss encountered in the gross settlement system is quite the same as in the bilateral net system. The results maintain the decisions formulated when considering the minimization of the liquidity burden.

4. Conclusions

Although securities markets face important structural changes, the infrastructure used to settle these operations might have not kept the pace. Banks largely involved in security business are usually of systemically importance. That is way, from a financial stability point of view, the criterion of safety ness in choosing gross or net settlement do not matters too much. The efficiency criterion is the key. We assess it from both the liquidity burden point of view, and the level of loss encountered when a default occurs. We conclude that, for the most dynamic segments of the securities markets (i.e. new and complex financial instruments, and cross-border large value transactions), it should be implemented a DVP3 procedure (or a DVP4 – gross settlement for cash leg and net settlement for securities leg). The same idea goes when the number of participants in SSS is low. When the type of securities settled is eclectic, gross settlement should be in place.

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Features of selected securities settlement systems

System	Type of securities*	Settlement of cash leg**	Securities settlement (delivery)***	Intraday finality****
Belgium				
NBB SSS	B, C, G, O	G	G	Yes
CIK (FMS)	E, O	N	G	Yes
CIK (EMSS)	B, E O	G	G	Yes
Euroclear Bank	B, C, G, E, O	G, RTGS	G, RTGS	Yes
Canada				
CDSX	B, G, E, O	N	G	Yes
France				
RGV2				
Irrevocable channel	B, C, G, E, O	RTGS	RTGS	Yes
Revocable channel	B, C, G, E, O	N	G	Yes
Germany				
Clearstream Banking Frankfurt	B, G, E, O	N, RTGS	G, RTGS	Yes
Hong Kong SAR				
CCASS	E, O	N, RTGS	G, RTGS	No
CMU	G, O	G, N	G, N	Yes
Italy				
LDT	B, G, E, O	N	N	No
Monte Titoli	B, G, E, O	nap	RTGS	Yes
EXPRESS II	B, G, E, O	N, RTGS	N, RTGS	Yes
Japan				
BOJ-NET JGB Services	G	RTGS	RTGS	Yes
JASDEC	O(1)	RTGS	RTGS	Yes
	E(2)	N	RTGS	No
	E(3)	N	N	No
Netherlands				
Euroclear Netherlands	B, G, E	RTGS	RTGS	Yes
Singapore				
DCSS	B	G	G	Yes
CDP	E, O	N	G	Yes
MEPS	G	RTGS	G	Yes
Sweden				
Stockholmsborsen	O	N	N	Yes
VPC	G, E, O	G, N	G	Yes
Switzerland				
SECOM	B, G, E, O	G	G	Yes
United Kingdom				
CREST	B, C, G, E, O	RTGS	RTGS	Yes
United States				
NBES	G, O	RTGS	RTGS	Yes
DTC	B, C, E, O	N	G	No

Legend:

* Bonds (B), certificates of deposit (C), government securities (G), equity (E) and/or other (O).

** Gross (G), net (N) or real-time gross settlement (RTGS).

*** Final transfer of a security or financial instrument: it can either be gross (G), net (N) or real-time gross settlement (RTGS).

(1) From January 2006, in addition to commercial paper, corporate and other debt securities are eligible for JASDEC;

(2) For equities traded outside the exchanges and cleared via the JASDEC DVP Clearing Corporation;

(3) For exchange-traded equities cleared via the Japan Securities Clearing Corporation.

Source: BIS, 2007

System	Number of transactions (million)	Value of transactions (USD billion)*	Average value per transactions (USD thousands)*	Total number of participants
Belgium				
NBB SSS	0.3	6390	24024	94
CIK	1.0	201	194	81
Euroclear Bank	27.0	191780	7113	1497
Canada				
CDSX	66.0	nav	nav	76
France				
Euroclear France	32.9	207330	6306	184
Germany				
Clearstream Banking Frankfurt	47.3	48623	1029	369
Hong Kong SAR				
CCASS	43.3	2052	47	480
CMU	0.0	852	21739	307
Italy				
LDT	nap	nap	nap	nap
Monte Titoli	1.2	nav	nav	2174
EXPRESS II	25.3	65234	2576	129
Japan				
BOJ-NET JGB Services	3.3	147008	44092	335/351**
JASDEC	61.4	nav	nav	277/65***
Netherlands				
Euroclear Netherlands	3.0	1183	394	57
Singapore				
DCSS	0.0	4	1138	44
CDP	203,881	123	0	1278
MEPS	0.0	340	7511	111
Sweden				
Stockholmsborsen	141.8	503	4	100
VPC	13.0	14514	1116	42
Switzerland				
SECOM	22.5	8571	381	437
United Kingdom				
CREST	68.8	162110	2356	43051
CMO	nap	nap	nap	nap
United States				
NBES	22.4	368897	16499	1319
DTC	263.0	148200	563	334

Legend:

* converted at yearly average exchange rates.

** book entry/registration system

*** equities/commercial paper

Source: BIS, 2007.