



**Free-Riding, Under-investment and  
Competition: The Economic Case for  
Canada to Move to T+1**

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**Prepared for the Canadian Capital Markets  
Association**

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# Executive Summary

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## 1. EXECUTIVE SUMMARY

Charles River Associates (CRA) has been retained by the Canadian Capital Markets Association (CCMA) to provide an economic analysis of the potential effects on Canadian equities markets of a non-synchronous change in settlement period between Canada and the US. Specifically, CRA has been asked to address the following questions:

*Would there be a flight of capital markets activity from Canada to the United States if the US securities market used a settlement period of trade date plus one day (T+1) while Canada remained at a settlement period of trade date plus three days (T+3)? What mechanisms would cause this loss?*

*Would Canada have a competitive advantage over the United States if it were to move to T+1 before the US were ready to make the move?*

This study examines these two questions using a combination of economic theory, empirical analysis of historical data, and interviews with various Canadian market participants who would be significantly affected by the move to T+1. These participants included custodians, brokers, traders, the Ontario Securities Commission (OSC) and the Canadian Depository for Securities Limited (CDS).<sup>1</sup>

It is important to bear in mind the context within which the change in settlement date is being considered; namely, that the costs of settlement are only one component of the total transaction costs of undertaking an investment. If compared to the value of the investment, settlement is a very small component of the overall cost and would not be expected to be a determining factor of particular significance. At the same time, settlement can be undertaken in a manner that is more efficient than is currently the case today. By improving the efficiency of settlement, we should expect to see lower risk and lower transaction costs of undertaking investments. Within the competitive investment community, these effects should ultimately feed through to final investors in terms of improved prices for trades.

Firms involved in the settlement process must decide on how to minimize costs through a combination of investments, systems developments and day-to-day operational process improvements. Investments can be made, for instance, to automate manual tasks or to minimize the number of errors generated within the firm. The decision to invest in the settlement process is like any other investment decision in that the firm should only proceed with the investment if

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<sup>1</sup> A listing of the institutions that we interviewed is included in Appendix A.



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its net present value is positive. However unlike many standard investment decisions, the benefits of investing in respect of reduced settlement error do not fully accrue to the investing firm. This results in under-investment relative to optimal levels.

Another way of stating this is that the investment of one firm imparts some benefit to other firms since it reduces the likelihood of delay and errors, and, hence, cost for other participants since any error or delay in the settlement process potentially imposes costs on other members involved in the settlement. For example, an error is often caught not by the firm making the error but by another participant. The participant that detects the error immediately faces the costs of having to correct the error if possible, notify the erring participant, and re-process the transaction. Much, if not all, of this added operational cost is eventually passed on to the final consumer – the investor. The benefit of an investment in improving the settlement process for one member also depends on the quality of the settlement process for other members. While any single participant can improve the rate at which it makes errors, trades may be not affirmed due to the actions of others. In light of this, a single firm faces a reduced incentive to invest in improving its settlement processes, since it will incur the full costs but not the full benefits. This results in under-investment. In addition, there is a coordination problem. While there are proportionally higher benefits the more organizations are involved in improvements in settlement, it is not easy to get organizations to coordinate unless there is a regulatory requirement or some overall coordinating effort.<sup>2</sup>

The issue of error or delay in settlement is not strictly theoretical. The current settlement process is often reiterative, involving repeated interactions among participants in order to fully communicate all details of the trade for the purpose of settlement. In addition the process is reactive, in that typically it is when information is missing or potentially in error that further clarification is sought. Discussions then ensue to correct the error. Often the various participants' systems do not directly interconnect and hence there can be multiple manual entry.

In such a system, several participants report that the probability of error with manual data entry is approximately 10% for a straight, single entry situation such as keying the details of a trade from an in-house trading system into CDS' system. With institutional trades, there are typically three players involved – a custodian, broker and investment manager – on each side of the trade. In the cases where there are three parties involved in settlement, multiple manual entries and communication between various participants, one participant reports that the error rate for the entire process can be as high as 40-50%.

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<sup>2</sup> In the US the coordinating body is the Securities Industry Association. In Canada, in 1995 coordination occurred through the Group of Thirty Working Committee in Canada.



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Given the current information and manual systems in place, a move to T+1 without significant investments in improved settlement architecture will result in very substantial numbers of not affirmed trades at the close of T+1. With current systems, only 40% of Canadian trades are confirmed on T+1. Thus, the move to T+1 provides the catalyst to make the required investments to considerably improve the settlement process, in respect of timeliness and effectiveness. It is also the case that such investments will greatly lower the operational cost of settlement on a per trade basis. Our interviews indicated there are potentially very large operational savings available in Canada at current transaction levels. Market participants agree that, following the investments required in technology, the current staff levels involved in settlement will be able to handle much larger trading volumes, which are expected over the next several years. As an example of the possible operational savings available, in its T+1 Project, CDS estimates that it can settle more than double the current volumes at the same or lower cost, following its investments in new technology and processes and assuming cross-industry co-operation. While the cost of settlement is a small component of the overall transactions cost of undertaking a trade, in a competitive market we would expect that cost savings derived from improved settlement processes will eventually be passed on to investors.

At the same time that operational costs are reduced, a move to T+1 also reduces credit risk. This is perhaps more important today than in previous years given the increase in volatility in markets. A longer settlement period may have a particularly adverse effect in times of a steep market decline. Indeed, the earlier shortening of the settlement period from T+5 to T+3 was in part a response to the 1987 market decline.

If Canada were to remain at T+3 while the US moves to T+1, Canada would most certainly have higher settlement costs and higher risk. In turn, we would expect higher risk to be reflected in higher bid-ask spreads in Canada relative to the US given Canada would be the less efficient market. Differential settlement periods would also open up potential arbitrage opportunities to buy in Canada and sell in the US. The arbitrage opportunity arises from the differences in the timing of cash flows between a Canadian T+3 and US T+1 world which would drive a wedge between US and Canadian prices: prices in the US will be lower than Canadian prices by an amount equivalent to two days interest that can be earned by the seller in the US. Arbitrage opportunities will exist only if prices do not move to this new equilibrium. However, once prices shift to reflect the differences in the timing of cash flows, arbitrage opportunities should disappear.

With North American markets highly integrated, differential settlement periods between Canada and the US would be expected to result in some movement of trading activity south. The magnitude of such an effect and its exact relationship with the settlement period is unknown.



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However, the direction of the effect is clear. In the case of interlisted securities, there is a natural tendency for convergence to the marketplace with narrower bid-ask spreads. Given the importance of the interlisted securities to the overall trading activity of the largest Canadian exchange, the Toronto Stock Exchange (TSE), any further moves of trading activity south would have a much larger impact on overall liquidity on the TSE than on US exchanges. In turn, the cycle feeds upon itself, with corporate managers seeking interlisting and brokers seeking trading on the more liquid marketplace.

Taking past experience as a guide, a move to a settlement period of T+1 by Canada coincident with the move in the US is expected to have no impact on trading activity. Were Canada to attempt to achieve T+1 ahead of the US, it is unclear how much, if any, gain it might expect to realize. Market participants are well aware that the US is discussing a move to a settlement period of T+1 by June 2004. If Canada's early adoption of decimalization ahead of the US is any indication, it is not likely that Canada will gain significant trading volume from the US by moving to T+1 in advance of the US. Given the benefits of having a coordinated move, it may be more useful to move coincident with the US as was the case when moving from T+5 to T+3.



# Background

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## 2. BACKGROUND

This report is organized as follows. Section 2 provides background information on the current debate over T+1, the mechanics of the settlement process, the extent of settlement activity and the operational costs of settlement. Section 3 sets out the economics of settlement with attention paid to the incentives to invest in settlement systems and the costs of delayed settlement. Section 4 discusses differences between settlement versus trade location with particular emphasis placed on the extent to which Canadian and US securities markets are integrated. Section 5 presents empirical evidence on the effect of settlement period length on trading volume and market liquidity. Section 6 discusses issues relating to the possibility of a non-synchronous move by Canada and the US to a T+1 system. Section 7 concludes.

### 2.1. The Current Debate on T+1

Currently, both US and Canadian securities markets operate under a trade date plus three days (T+3) settlement period for equities and debt instruments with a term of more than one year.<sup>3</sup> This settlement period was implemented in 1995, having been shortened from the previous length of trade date plus five days (T+5).<sup>4</sup> The move from a settlement period of T+5 to T+3 did not require a fundamental change in the manner in which settlement occurs.<sup>5</sup> Little new investment was required in technology and there was no need to change the various interactions of the players involved in settlement. The same tasks were undertaken but in two fewer days. The move was coordinated in Canada in an informal fashion by Canada's Group of Thirty (G30) Working Committee. In the US, coordination was through the US Securities and Exchange Commission (SEC). Within the existing T+3 environment today whether in Canada or the US, many of the interactions between market participants to settle a trade involve multiple systems, inefficient data links, and manual paper procedures.<sup>6</sup>

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<sup>3</sup> Money market transactions as well as transactions for debt instruments with a term of less than one year are settled on the trade date.

<sup>4</sup> The move to T+3 from T+5 was made on June 7, 1995.

<sup>5</sup> See Toronto Stock Exchange (2000) "Canada to Shorten Time Period to Settle Securities Trades", TSE News Releases, October 11, 2000 and the accompanying Background, "Shortening the Securities Trade-To-Settlement Cycle from T+3 to T+1", October 11, 2000. In the case of the US, see Securities Industry Association (1999), *Institutional Transaction Processing Committee White Paper Version 1.5*, December 1, 1999.

<sup>6</sup> Toronto Stock Exchange (2000) "Canada to Shorten Time Period to Settle Securities Trades".





## Background

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The SEC is now advancing a further shortening of the settlement period from T+3 to T+1.<sup>7</sup> A recent study by the US Securities Industry Association (SIA) suggests that the move to T+1 could be completed by June 2004 assuming a start in the fourth quarter of 2000. The SIA study estimates that US market participants will receive annual benefits of approximately USD\$2.7 billion through improvements in efficiency from the move from T+3 to T+1. Specifically, the move to T+1 is expected to:

- Dramatically reduce settlement risk exposure.
- Enable US securities markets to maintain their global competitiveness by enhancing current trade processing.
- Synchronize clearance and settlement processes across asset classes.
- Improve current trade processing, thereby enabling the US securities market to support increased trading volumes.

At the same time, the cost of achieving such efficiencies is not inconsequential. SIA estimates that US market participants will spend USD\$8 billion to prepare for T+1. The costs are also expected to be large in Canada, with a move to T+1 settlement requiring investments by the industry possibly in excess of those expended to prepare for Y2K.<sup>8</sup>

Unlike the earlier move from T+5 to T+3, a move to T+1 will require substantial investments in new electronic infrastructure, agreement on electronic standards, resolution of legal issues and implementation of regulatory changes – in essence, a fundamental change in the behaviour of market participants.<sup>9</sup> For these reasons, the implementation timetable is lengthy. The SIA has recommended a four-year timetable for the US given the complexity of the changes that must be undertaken.

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<sup>7</sup> Securities Industry Association (2000) *T+1 Business Case: Final Report*, July 2000.

<sup>8</sup> Toronto Stock Exchange (2000) “Canada to Shorten Time Period to Settle Securities Trades”.

<sup>9</sup> See Toronto Stock Exchange (2000) “Shortening the Securities Trade-To-Settlement Cycle from T+3 to T+1”. Also, see Securities Industry Association (1999) *Institutional Transaction Processing Committee White Paper Version 1.5*.



## Background

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### 2.2. The Current Settlement Process in Selected Countries

#### 2.2.1. Settlement in Canada

Most investors in Canada hold securities through a multi-tiered system of intermediaries. At the lower tier, the intermediaries are brokers, banks or trust companies holding securities on behalf of their customers. At the upper tier, there are depositories and clearing agencies. In Canada, the central depository is the Canadian Depository for Securities Limited (CDS). CDS is the centralized debt and equity securities clearing house for the clearing and settlement of all Canadian stock exchange trades, as well as money market transactions and government bonds. In addition, CDS provides custodial safekeeping services to its participants. CDS is owned by its major users, including the major Canadian chartered banks, the members of the Toronto Stock Exchange (TSE) and the Investment Dealers Association of Canada.

CDS receives securities from its participants and holds them in fungible bulks. Deposited securities are delivered by book entry through the system either as a result of a trade through an exchange, such as the TSE, or through two institutions trading directly with each other (referred to as an institutional trade). However the security is traded, CDS registers the securities in the name of a CDS nominee and maintains accounts showing the holdings of each participant. Securities market transactions are reported to CDS, which then performs two separate functions: clearance and settlement.<sup>10</sup> Since most transactions occur between CDS participants, settlement of the security-transfer obligations can be done merely by book entries in the records of CDS, debiting the account of the seller and crediting the account of the purchaser, without any need for movement of certificates. This process is called “book-entry” settlement. Book-entry settlement only operates with securities positions held by intermediaries that are participants in the depository/clearing agency. This practice of holding securities through intermediaries is called the “indirect holding” system.<sup>11</sup>

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<sup>10</sup> Throughout this report, clearance is referred to as the calculation of each participant's net obligations. Settlement is the actual transfer of money and securities to satisfy those net obligations. An institution established separately from the stock exchanges that ensures the payment and delivery of stocks between investment dealers in a timely, cost-efficient manner is referred to as a clearing house. For example, an investment dealer may execute ten trades (any combination of purchases and sales) in the same security on the same day. Through a clearing house, the investment dealer only settles the net amount of the number of shares and the money owed or received.

<sup>11</sup> For most depositories, the indirect holding system contrasts with the “direct holding” system, where the beneficial owner is also registered as such on the issuer's records or in actual possession of negotiable certificates. In the indirect holding system, the beneficial owner is not shown on the issuer's records in the case of registered securities, nor does the beneficial owner have actual possession of a negotiable certificate. Instead, the securities are registered with or in the actual possession of CDS. The records of CDS show the securities held on behalf of its various



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Under the current T+3 process in Canada, in the initial contact, an investment manager instructs a broker to buy a security. The broker goes to the marketplace and completes the trade. Since the institutional orders are usually quite large, these orders may be filled in several tranches with each tranche having a different price. Once the order is filled, the broker will calculate an average price for the entire block. The broker will send a confirmation, often a facsimile, of the order back to the investment manager once it is completely filled. If the order was for a stock, the exchange on which the order was executed would feed the details of the trade directly to CDS. If the order was for a non-exchange traded security (e.g., a bond or money market security), the broker would input details of the trade directly to CDS. In either case, the broker would input a second transaction to CDS to facilitate the delivery of the purchased securities to the custodian of the client for whom the investment manager was acting.

At this point, CDS informs the custodian of the transaction as entered by the broker. The investment manager would separately deliver “settlement instructions” to the custodian, often through a facsimile. The custodian will match the details on the trade that was submitted by the broker with the details on the settlement instructions received from the investment manager. If the details match, the custodian “confirms” the trade within CDS’ system. If the details do not match, a labour-intensive process of discussion occurs. Finally, the custodian verifies that its client has the funds necessary to complete the purchase and then authorizes the transaction for settlement within CDS. CDS completes the settlement by moving securities and funds between the accounts of the broker and custodian.

In the case of institutional trades, the above process is often reiterative, involving repeated interactions among participants in order to fully communicate all details of the trade for the purpose of settlement.<sup>12</sup> In addition the process is reactive, in that typically it is when information is missing or potentially in error that further clarification is sought. As noted above, this occurs through discussion rather than electronic links. Often the various participants’ systems do not directly interconnect and hence there can be multiple manual entry. Figure 1 below provides an illustration of the typical interactions between a custodian, investment manager and broker/dealer for an institutional trade.

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participant brokers, banks and trust companies. The records of each such participant show the securities held on behalf of their individual customers (typically, the beneficial owners). Book-entry settlement, combined with improved clearance techniques, provides an extremely efficient system for processing securities transactions. Indeed, it would be impossible to settle the current daily volume of transactions in T+3 by actual delivery of certificates.

<sup>12</sup> The Securities Industry Association (1999) *Institutional Transaction Processing Committee White Paper Version 1.5* provides a useful description of these processes in the US. CRA’s interviews with Canadian market participants indicate that the same process applies in Canada.



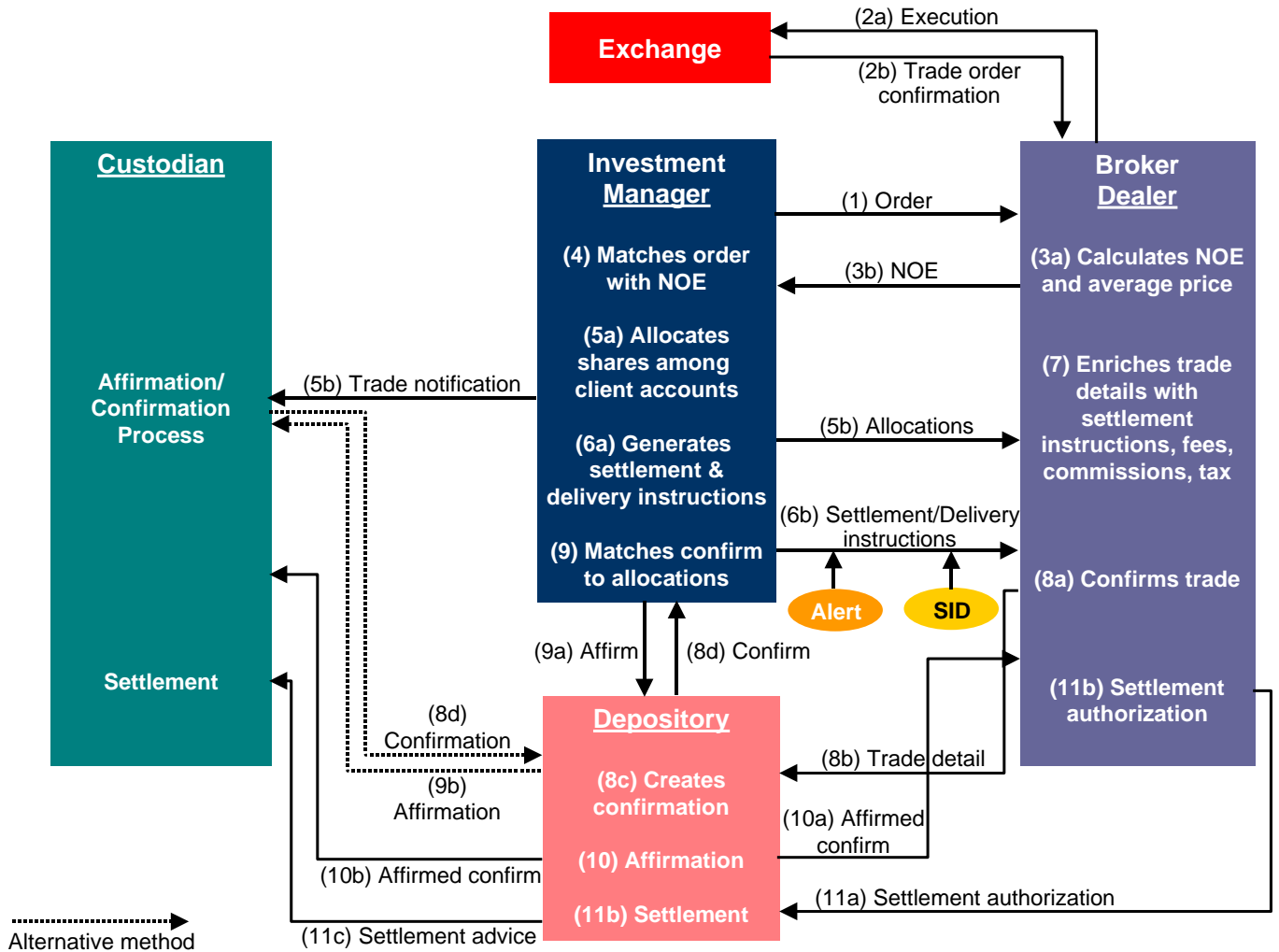
## Background

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# Background

Figure 1. Typical Institutional Trade Settlement Process



Source: Securities Industry Association, *Institutional Transaction Processing Committee, White Paper Version 1.5*.

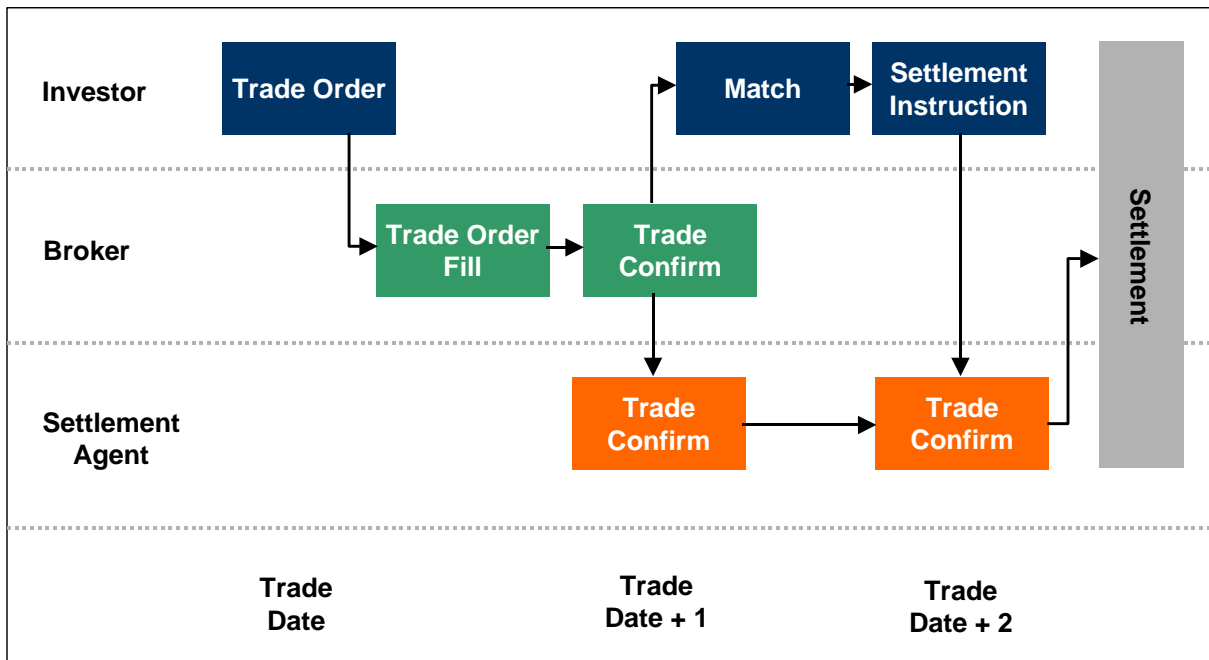
From a timing perspective, the above activities are to be completed by T+3. At the moment, the custodian must await reports from the brokers before trades are confirmed. With many participants using overnight batch systems, the process is normally completed over multiple days. Ideally, it would proceed as follows. On the evening of the trade date (T), the broker sends a file of trades to CDS which then forwards the trades to the custodians. On the evening of T+1, the custodians send confirmations for trades received from CDS on T. Finally, late on the



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evening of T+2, CDS runs a settlement process for trades settling on T+3. Figure 2 below illustrates the timing of the current T+3 settlement cycle.

**Figure 2. T+3 Trade Settlement Cycle**



Source: Securities Industry Association, *T+1 Business Case Final Report*

There are, however, trades for which settlement is not confirmed within this time period. Typically, settlement is not confirmed because the instructions from one side of the transaction do not fully match the other side.<sup>13</sup> Such occurrences do not normally result in default. Rather, a custodian bank or investment dealer agrees to settle the transaction, often without an additional fee to the client after which that institution pursues the other side of the transaction to finalize the trade. Table 1 below provides CDS' estimates of the following percentages of trades reported and confirmed on the respective days:

<sup>13</sup> Part of the move to a T+1 settlement system will require investments in technology for a trade matching arrangement where both sides of a trade input the details of the trade and a system compares the two versions and matches the ones that are the same. The Securities Industry Association (1999) *Institutional Transaction Processing Committee White Paper Version 1.5* provides initial design recommendations for such a matching utility and process model.

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**Table 1. Percentage of Canadian Trades Reported and Confirmed on Respective Days**

Day	Trades Reported	Trades Confirmed
T	50%	0%
T + 1	35%	40%
T + 2	10%	35%
T + 3 and greater	5%	25%

Source: CDS

### 2.2.2. Settlement in the US

The US equivalent to CDS is the Depository Trust & Clearing Corporation (DTCC), which is the holding company for the Depository Trust Company (DTC) and the National Securities Clearing Corporation (NSCC). DTC and NSCC provide the primary infrastructure for the clearance, settlement and custody of the vast majority of equity, corporate debt and municipal bond transactions in the US. Like CDS, DTCC is owned by its major users including major banks, brokers/dealers and other companies in the financial services industry as well as the National Association of Securities Dealers and the New York Stock Exchange (NYSE). DTC and NSCC serve 11,000 companies in the global financial services industry.<sup>14</sup>

DTC is the world's largest central depository for participants' securities. DTC also processes institutional trades, providing both affirmation and confirmation. NSCC handles the clearance and settlement for equity, corporate and municipal bonds, mutual funds and annuity transactions. NSCC guarantees trades entered into its system and through netting reduces the total financial obligations. NSCC has a separate affiliate, Government Securities Clearing Corporation which clears and settles US government securities. Mortgage-backed securities are settled through a separate organization which is partly owned by NSCC, known as the MBS Clearing Corporation.

DTC's mandate is more limited than that of CDS in that while it settles broker-to-broker and broker-custodian trades, the majority of its settlement is for institutional trades. In addition, DTC will attempt to transfer money and securities between brokers' and custodians' accounts; however, settlement is not guaranteed. DTC provides institutional customers the resources required to agree on the terms of a trade, notify the firms involved in the trade and move securities and funds among brokers and custodians. Institutional investors can be mutual funds,

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<sup>14</sup> The Depository Trust & Clearing Corporation.



## Background

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pension funds, insurance companies, banks and other organizations that place orders to buy and sell large blocks of securities, while assigning the safeguarding of the assets in trust to custodians. DTC's service also supports broker custody and prime broker trading. With broker custody, no settlement occurs since the executing broker acts as custodian. In a prime broker arrangement, a broker – other than the executing broker – settles on behalf of the customer through NSCC's comparable system.

The process by which settlement occurs, between investment managers, brokers and custodians is the same as that described above for Canada. Also the same is the extent of sequential and repetitive steps and interactions between participants, illustrated in Figure 1 above. As in Canada, there are typically several manual processes and many potential break points along the settlement cycle where information is not fully or accurately communicated, leading to the potential for delay.<sup>15</sup>

The rate of confirmed trades within the T+3 settlement period in the US is comparable to that reported in Canada, given similar overnight batch systems. The SIA Institutional Transaction Processing Committee reports that, in the first half of 1999, 11.7% of the DTC eligible trades on NASDAQ, AMEX and NYSE combined were not affirmed prior to settlement.<sup>16</sup> Moreover, only 12% of trades on these exchanges were affirmed on trade date. From this information, the SIA Institutional Transaction Processing Committee estimates that if a move to T+1 is made without substantial reform of the current settlement mechanisms, the not affirmed rate prior to a settlement of T+1 would be 40% at best.<sup>17</sup>

### 2.2.3. Settlement in Europe

On a pan-European basis, there are over 30 local clearance and settlement systems across Western Europe.<sup>18</sup> Recently, there has been some consolidation occurring between clearing and depository agencies in Europe. For example, Euroclear and the French clearing and settlement

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<sup>15</sup> Securities Industry Association (1999) *Institutional Transaction Processing Committee White Paper Version 1.5*, at 6.

<sup>16</sup> Securities Industry Association (1999) *Institutional Transaction Processing Committee White Paper Version 1.5*, at 4.

<sup>17</sup> Securities Industry Association (1999) *Institutional Transaction Processing Committee White Paper Version 1.5*, at 5.

<sup>18</sup> See European Market Monitor (2000) "Consolidation Fever Grips Europe's Clearing Entities", Volume 9, Number 13.





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agency, Sicovam have merged and together settled 99.5 million pre-netted transactions.<sup>19</sup> Clearstream International has been formed from the merger of Cedel International and Deutsche Börse Clearing, which together settled 82 million pre-netted transactions.<sup>20</sup> Crestco, in the UK, is also a major depository that has developed direct bilateral links to major European depositories.

Outside of North America, the settlement period may be longer. Settlement is mostly on a T+5 system, but can be up to one month from trading date.<sup>21</sup> In the case of the UK, the current settlement period is T+5 having been shortened from its previous T+10 on June 26, 1995. The UK is expected to move to a T+3 settlement period in February 2001. In the case of France, the most actively traded French and foreign shares listed on the Premier Marché are traded currently on a monthly account basis. All other issues are traded on a T+3 or what is referred to as a cash basis.<sup>22</sup> Table 2 below provides a summary of the various western European countries' settlement periods.

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<sup>19</sup> European Market Monitor (2000) "Consolidation Fever Grips Europe's Clearing Entities" .

<sup>20</sup> European Market Monitor (2000) "Consolidation Fever Grips Europe's Clearing Entities" .

<sup>21</sup> See Securities Industry News (2000) "Straight-Through Processing: Paris Mulls Letting Some Equities Still Settle Monthly", March 6, 2000, and Accountancy (1995) "City Regulation", Volume 116, Number 1223.

<sup>22</sup> The Paris Bourse: *Organization and Procedures*.



## Background

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**Table 2. Settlement Periods in Western Europe**

Country	Settlement Period
Austria	T+3
Belgium	Fortnightly settlement period
Denmark	T+3
Finland	T+3
France	T+3 and monthly settlement basis
Germany	T+2
Greece	T+3
Ireland	T+5
Italy	T+5
Luxembourg	T+3
Netherlands	T+3
Norway	T+3
Portugal	T+3
Spain	T+3
Sweden	T+3
Switzerland	T+3
United Kingdom	T+5

Source: International Federation of Stock Exchanges.

### 2.3. North American Settlement Activity

As of October 2000, CDS held close to \$2 trillion worth of securities on deposit, and the majority of publicly-traded Canadian securities by value.<sup>23</sup> The gross value of trades reported to CDS can vary considerably but is approximately \$100 billion daily, which netting distills down to about \$5 billion in settlement obligations.<sup>24</sup> Less than 1% of the trades reported to CDS result in withdrawals of certificates from the depository; the rest are settled by book-entry.<sup>25</sup>

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<sup>23</sup> The Canadian Depository for Securities.

<sup>24</sup> The Canadian Depository for Securities.

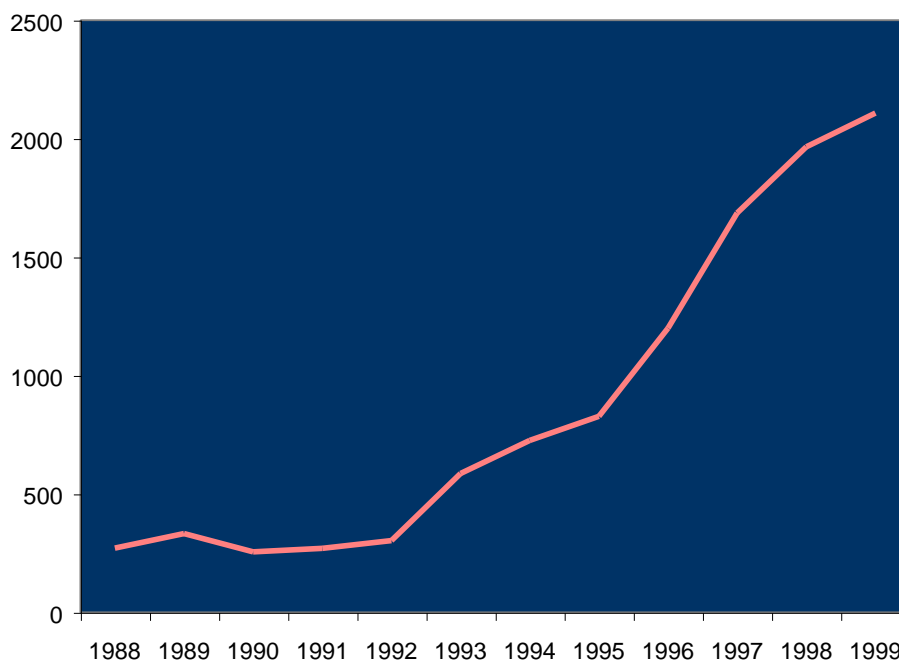
<sup>25</sup> The Canadian Depository for Securities.



## Background

Figure 3 below illustrates the significant increase in settlement activity with which CDS has had to deal over recent years based only on TSE securities. In addition to the trading activity of TSE securities, CDS also settles transactions on the CDNX, institutional trades and money market transactions.

**Figure 3. Average Daily Trading Value of all TSE Securities (in millions of \$)**



Source: TSE Review, August 1998 and August 2000. Note that the numbers are based on 251 trading days per year.

DTCC held USD\$23.4 trillion of securities in custody in July 2000, and as of 1999 DTCC processes more than 212 million institutional trade confirmations annually.<sup>26</sup> As in Canada, volumes have increased dramatically. In 1998, the one day peak on September 1, 1998 saw DTCC process 6.4 million transactions. By 1999, the one day peak on December 17, 1999 had climbed to 9.3 million transactions. In 2000, on April 4, 2000, DTCC processed 18.1 million transactions.<sup>27</sup> Similarly, the value of transactions has increased dramatically, from a one day peak in 1998 of USD\$282 billion to the April 4, 2000 peak of \$722 billion. Figure 4 below

<sup>26</sup> Depository Trust and Clearing Corporation.

<sup>27</sup> Depository Trust and Clearing Corporation.

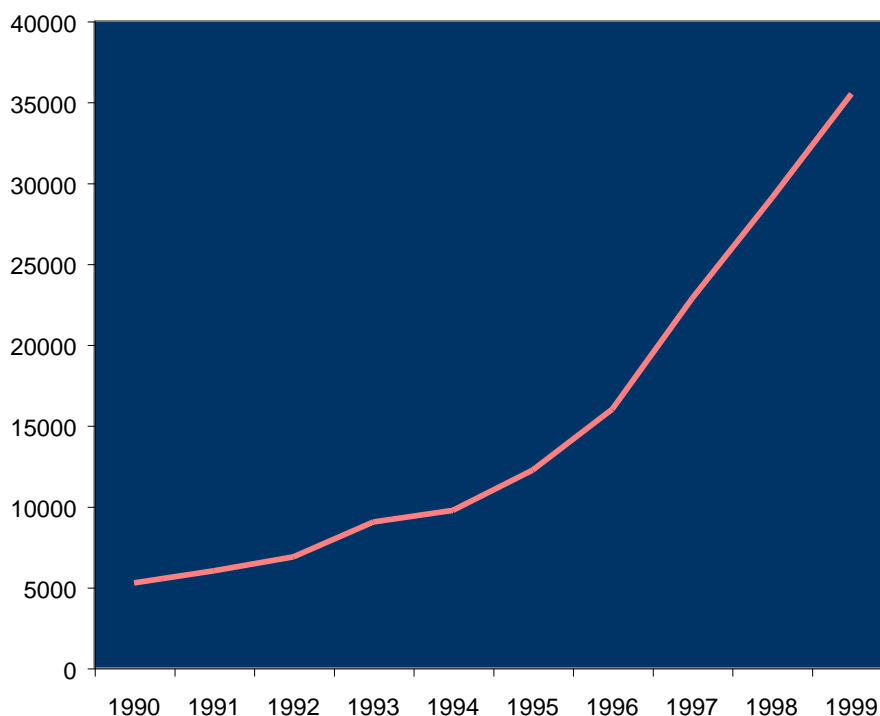


## Background

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presents comparable trading value for NYSE securities over the same period as provided in Figure 3 above.

**Figure 4. Average Daily Trading Value of all NYSE Securities (in millions of USD\$)**



Source: New York Stock Exchange.

### **2.4. North American Settlement Systems Integration**

In light of the integration of Canadian and US markets (described in more detail below), CDS has several transborder links with its US counterparts. CDS and DTC are linked to support cross-border inventory management of securities by participants. For example, there is a link with DTC for stock and bond delivery orders and institutional trades. In addition, CDS also links Canadian and US brokers through its ACCESS service via DTCC: settlements take place within the country where the trade has taken place, but inventory can be moved seamlessly in order to balance portfolio positions. Outside of CDS, large brokers in Canada will also have direct dealings in New York.



## Background

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To illustrate the respective links between the Canadian and US settlement systems, consider the following possible trade: a Canadian investor wishes to purchase a security interlisted in Canada and the US. If the security is to be held in the US and earn US dividends, it will typically be purchased in the US with settlement through NSCC. If the Canadian broker making the purchase has an office in New York, the transaction will be completed through the US with settlement in the US. There would be no involvement on the part of CDS in settling such a transaction. Nonetheless, it is possible that CDS might assist the Canadian broker with offices in New York and Toronto to manage its overall inventory position through a book-based move of inventory. Thus, for example, if the Canadian broker is routing trades of Nortel stock to NYSE rather than the TSE and finds itself at the end of the day with a 10 million Nortel stock shortfall in New York, it can move some of its Canadian Nortel stock inventory through CDS to DTC. Note that while assisting in the broker's inventory management, CDS has not settled any portion of such a trade, which continues to be fully settled in the US by DTCC.

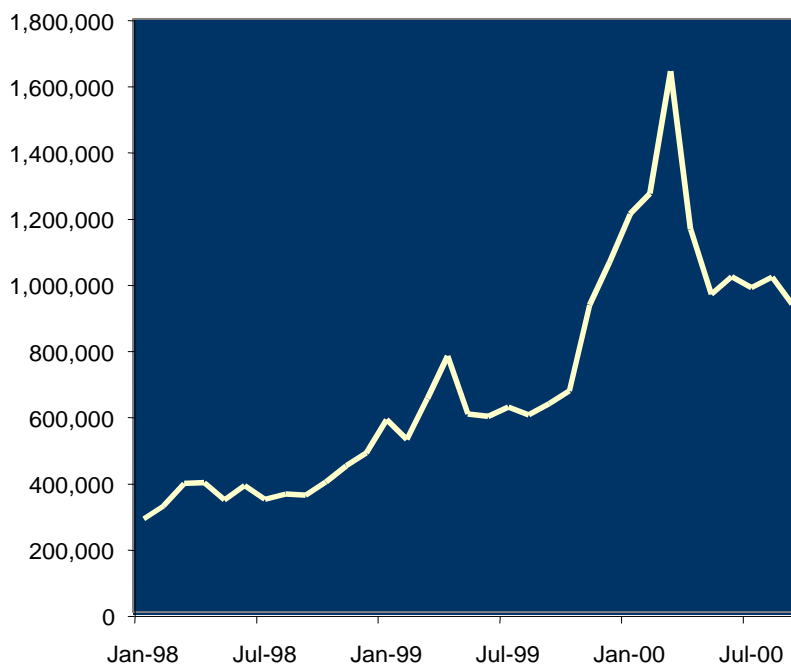
Even if the Canadian broker does not have an office in the US, it may still make US stock purchases through the ACCESS service link between DTCC and CDS. In such a case, CDS is settling one side of the transaction. For example, suppose a Canadian broker without a New York office is purchasing Microsoft securities. The Canadian broker will route its request to a US broker who reports the trade to DTCC with the Canadian broker's identification number attached. Since the Canadian broker is not a participant in DTCC, this identification number is replaced by CDS' identification number. Similarly, in Canada, the Canadian broker sends its record to CDS with the US broker's identification number. CDS replaces the US broker's identification number with that of DTCC. CDS and DTCC then settle up with each other, while each broker settles up with its respective depository. The transaction is completed in US currency, and from the Canadian broker's perspective appears no different than a Canadian transaction through CDS.

There has been a steady increase in the volume of trading activity that occurs across these links as Figure 5 below demonstrates. From a settlement perspective, CDS reports that the significant majority of the trading activity noted below is settled in the US.



## Background

Figure 5. Cross Border Trades by CDS Participants



Source: CDS.

### 2.5. Operational Costs of Settlement

While exact cost comparisons are difficult to make given the range of services available, CDS suggests that Canadian settlement through CDS is more expensive than that of DTCC but is considerably less expensive than in Europe. This is not surprising, given settlement is essentially a fixed cost business. With dramatically larger volumes being processed in the US, its cost of settling would be expected to be less than Canada. In the case of Europe, the fragmentation and number of exchanges has meant smaller volumes still and hence higher costs of settling compared to the US.<sup>28</sup> In addition to the costs of settling at the depository and clearing agency, a typical broker would also have costs associated with its own staff, internal systems and premises and service bureau (which handles back-office accounting and processing systems).

<sup>28</sup> Pen Kent, Executive Chair of the European Securities Forum (2000) *Address to the International Bar Association*, September 19, 2000. Pen quotes settlement processing costs of USD\$580 million in the US compared to USD\$960 million in the UK. When divided by transaction units, this figures translate into unit costs of USD\$0.50 and USD\$4.60 for settlement in the US and UK respectively.

## Background

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The labour and capital costs required for the settlement system to work include telecommunications infrastructure, computer systems, account maintenance, and clerical tasks (data entry, data verification, data correction). Some costs can be thought of as investments in that they are paid in large blocks and the flow of services they generate occur over an extended period of time. Developing a system of electronic messaging, exception handling and information storage would typically appear as a long-term investment cost. In the long-run, all of these costs, to the extent that the industry is competitive, are expected to be passed on to buyers and sellers of securities as part of transaction costs.



# Economics of Settlement

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## 3. ECONOMICS OF SETTLEMENT

It is important to bear in mind the context within which the change in settlement date is being considered; namely, that the costs of settlement are only one component of the total transaction costs of undertaking an investment. Framed in a more practical way, settlement is described by one market participant interviewed for this study as the “plumbing” of a house – fundamental, but not of much interest to homeowners until there is a problem, and certainly not the basis upon which a purchase decision is made. If compared to the value of the investment, settlement is a very small component of the overall cost and would not be expected to be a determining factor of particular significance.

At the same time, settlement can be undertaken in a manner that is more efficient than is currently the case today. By improving the efficiency of settlement, we should expect to see lower risk and lower transaction costs of undertaking investments. Within the competitive investment community, these effects should ultimately feed through to final investors in terms of improved prices for trades.

### 3.1. The Investment Decision in Settlement Systems

Firms involved in the settlement process must decide on how to minimize costs through a combination of investments, systems developments and day-to-day operational process improvements. Investments can be made, for instance, to automate manual tasks or to minimize the number of errors generated within the firm. The decision to invest in the settlement process is like any other investment decision in that the firm should only proceed with the investment if its net present value is positive. However unlike many standard investment decisions, the benefits of investing in respect of reduced settlement error do not fully accrue to the investing firm. This results in under-investment relative to optimal levels.

Another way of stating this is that the investment of one firm imparts some benefit to other firms since it reduces the likelihood of delay and errors, and, hence, cost for other participants since any error or delay in the settlement process potentially imposes costs on other members involved in the settlement. For example, an error is often caught not by the firm making the error but by another participant. The participant that detects the error immediately faces the costs of having to correct the error if possible, notify the erring participant, and re-process the transaction. Much, if not all, of this added operational cost is eventually passed on to the final consumer – the investor. The benefit of an investment in improving the settlement process for one member also depends on the quality of the settlement process for other members. For instance, if no other





## Economics of Settlement

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member has straight through processing capabilities then the benefit for one member in investing in straight through processing is very low.<sup>29</sup> However, if all but one member have straight through processing capabilities, then the benefit of the one member investing is very large. In such a situation, we might expect the market to move towards one of two possible situations – one where all participants have straight through processing capabilities or one where no participant has such capabilities.

The following simple example illustrates the problems of both under-investment and coordination effects that affect settlement investment decisions. Suppose for the moment that there are just two firms involved in the settlement process (e.g., a broker and a custodian), and that these firms need to send messages to each other to settle a trade. If the messages match, both firms affirm the trade. If the messages do not match, the firms have to pay a cost to reconcile the differences.

For simplicity, suppose that initially each firm's system is such that an error is made with probability one half and errors at one firm are independent of errors at the other. Thus, there is a 75% probability that there is at least one or two errors and only a 25% probability that no firm makes an error. The two firms then expect to pay the cost to reconcile the errors 75% of the time. Suppose one of the firms has an investment opportunity that would allow it to avoid making any errors. If the firm makes the investment, the probability that there is no error improves to 50%. Thus, there is a reduction of 25 percentage points in the probability that both firms have to pay the error reconciliation cost. However, the investing firm bears all the cost of reducing the occurrence of errors. If the investment is sufficiently costly, the firm may not make the investment even if the total net benefit for both firms of avoided costs exceeds the investment cost. The investment of one firm imposes a positive externality on the other firm (i.e. the second firm benefits from the first firm's investment but does not contribute to the cost of the investment).

Now suppose there are three firms involved in the settlement process (e.g., an investment manager, a broker and a custodian), each making independent errors, each 50% of the time. The probability of all firms being without error is now only 12.5%. If one firm invests, the probability of no errors occurring increases from 12.5% to 25%. The benefit for one firm is now only a 12.5 percentage point improvement in avoided reconciliation cost rather than a 25 percentage point improvement that was realized in the two firm example. Thus, the private

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<sup>29</sup> "STP: What is STP": Reuters InterTradeDirect defines straight through processing as the end to end automation of the trading process within and between both buy and sell side institutions, from the first capture of an order through to final settlement. It involves the seamless, electronic transfer of information to all parties involved in the trading cycle utilizing standardized information flows, technologies and infrastructures.

## Economics of Settlement

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return on investment is lower. As the number of firms involved in the settlement of a trade continues to rise, the return on investment by any one firm will become smaller.

The coordination problem can be illustrated with the same example. Continuing with three firms, if the first firm makes an investment, the gain to the firm is only a 12.5 percentage point reduction in errors. However, if two firms coordinate their investments, then the reduction in errors is 50 percentage points, four times as large as an individual investment. Thus while neither firm may find it in its own interest to unilaterally invest, two firms may find it in their collective interest if they both invest. Note that the non-investing firm still free-rides on the investment of the other two firms since it benefits from the investments of the first two firms without having to pay the cost. However, this problem is distinct from the coordination issue. To see the distinction one need imagine a case where error reduction only occurs if all firms invest. In such a case there can be no free-riding, since no firm can benefit unless it invests, but a coordination issue still exists.

While the above examples use hypothetical error rates, several participants report that the probability of error with manual data entry is approximately 10% for a straight, single entry situation such as keying the details of a trade from an in-house trading system into CDS' system. With institutional trades, there are typically three players involved – a custodian, broker and investment manager – on each side of the trade. In the cases where there are three parties involved in settlement, multiple manual entries and communication between various participants, one participant reports the error rate for the entire process can be as high as 40-50%.

Theoretically, to correct the under-investment problem, participants responsible for the error could be identified and charged the full cost of the error, including the costs this imposes on other firms as higher correction costs and lower trading volumes. This would move firms toward making optimal investments and structure employee monitoring and incentive programs optimally to equate the marginal cost of reducing errors with the marginal benefit of reduced errors. While theoretically appealing, practically identifying which participant is responsible for an error is costly and, moreover, no individual firm has a strong incentive to monitor other firms or enforce the penalty. That said, CRA's interviews did reveal that some firms do keep records of the error rates of other firms and would consider imposing sanctions (such as barring service for a period of time) on those committing a large number of errors. Such sanctions would likely benefit all other participants that deal with the sanctioned firm if they result in the firm improving its electronic capabilities or its organizational structure, i.e. reducing its contribution to errors to the system. In particular, this might be helpful in encouraging participants to make the required investments to improve their systems. Because benefits accruing to other firms are not captured by the firm imposing the sanctions, and monitoring other firms and imposing



## Economics of Settlement

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sanctions is costly, the actual level of sanctions and monitoring is expected to fall below the optimal level.

A further complicating feature of imposing penalties successfully is found in the nature of the relationships between the various participants. As expanded upon below, the indirect nature of some of the relationships often means that the party committing an error is not charged for the time and effort involved in correcting it. For example, imagine a large pension fund in a client relationship with a custodian but being advised by an investment manager. There is no contractual relationship between the investment manager and the custodian of the pension fund. The investment manager advises the pension fund on a trade and reports the trade to the custodian. If there are errors in the investment manager's report, the custodian may or may not inform or charge the pension fund for its costs in resolving the situation. Thus, the pension fund may be unaware of the error and the investment manager faces little incentive to improve the error-rate with which it submits reports to the custodian.

### 3.2. Costs of Delayed Settlement

In the current system, a seller of an equity must be willing to wait three days, and sometimes even longer, to receive payment for the sale of the stock. Thus, one cost of settlement for the seller is the time-cost of money. The length of time to settlement may also be uncertain and, in the case that the counterparty becomes insolvent, settlement may never occur. In such a case, the seller is exposed to market risk. Various intermediate agents (brokers/dealers, custodians, or depositories) may be willing to guarantee settlement by a given date at some point in the settlement process, such as with theoretical settlement, but then the agents offering the guarantee must bear the cost of an uncertain settlement date and counterparty default, which would be presumably passed on in fees to final buyers and sellers of securities. In practice, default is extremely rare. Rather, the cost is more one of delayed settlement rather than no settlement.

On the other side of the transaction, a buyer of a stock has the good fortune of being able to avoid payment for a purchased stock for three days under the current T+3 system. The corresponding float can be invested by the buyer. And since a percentage of trades take longer than three days to settle, the buyer may have more than three days before payment is required. In either event, the loss for the seller in terms of the time cost of money is a gain for the buyer.

The delay in settlement (or the possibility of a buyer becoming insolvent) effectively forces sellers to make a loan to buyers. *A priori*, it is unclear that this is the optimal manner in which to proceed. The net result of delayed settlement and uncertainty in the settlement date is that, from



## Economics of Settlement

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a theoretical point of view, we would expect the equilibrium price of a security to be worth less and the number of trades between buyers and sellers to be lower relative to optimal levels.



## Settlement Versus Trade Location

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### 4. SETTLEMENT VERSUS TRADE LOCATION

In 1998, Canadian equity markets represented approximately 2% of total world capitalization and 1.6% of total world trade in equities.<sup>30</sup> In 1998, US equity markets represented approximately 49% of total world capitalization and 58% of total world trade in equities. In general, while the Canadian share of global trade volume has been decreasing in recent years, the US share of global trade volume has been steadily increasing.<sup>31</sup>

Statistics reported by the TSE indicate that there has been an increase over time in the number of Canadian firms choosing to interlist on US exchanges.<sup>32</sup> In 1990 there were 143 Canadian-based firms listed on the TSE interlisted on US exchanges. By August 2000, there were 211 such firms. In terms of a percentage of the total number of firms listed on the TSE this represents 12% in 1990 and 14.8% in August 2000. The number of foreign-based firms listed on the TSE and also interlisted on US exchanges has been steadily falling. In 1990 there were 59 foreign-based firms on the TSE also interlisted on US exchanges which by August 2000 was 22 firms.

To understand the importance of these firms for total trade on the TSE, Figure 6 below depicts the percentage of trade value (\$) and trade volume (number of securities traded) for the Canadian-based US interlisted stocks as a share of total TSE trade value and volume. As Figure 6 indicates, the interlisted stocks are far more important in terms of trading value and volume than their percentage of companies traded on the TSE would imply. While representing less than 15% of total TSE listings, these Canadian-based stocks represent almost 40% of trade volume activity and almost 60% of the value traded on the TSE. Furthermore, their importance with respect to volume and value has been gradually increasing over time.

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<sup>30</sup> See Security Industry Association (1999) "Global Markets" chapter in *1999 Securities Industry Fact Book*.

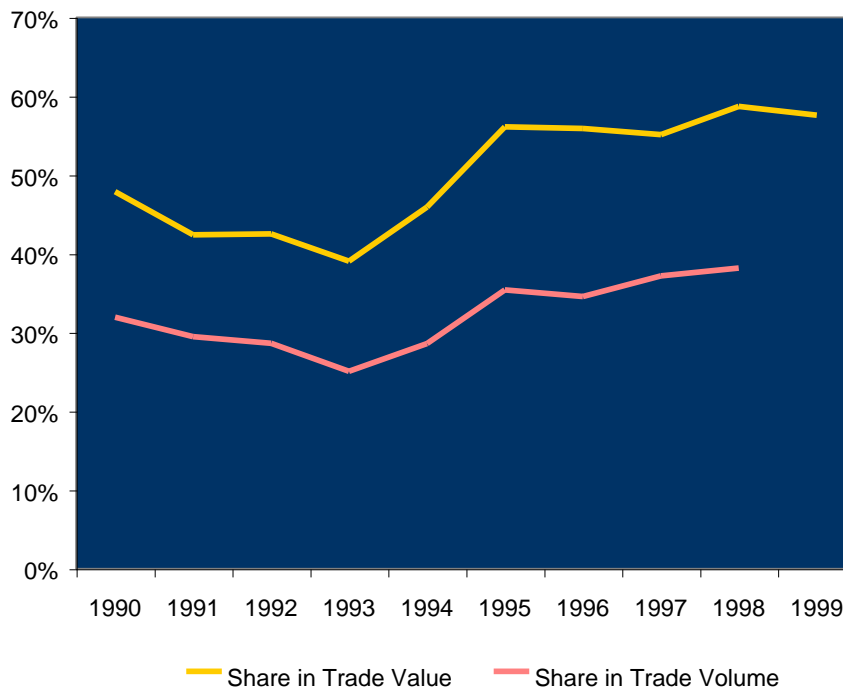
<sup>31</sup> Security Industry Association (1999) *1999 Securities Industry Fact Book*.

<sup>32</sup> Managers will pursue interlisting when it improves the liquidity of markets within which their firm's securities trade, thereby decreasing their cost of capital (see Foerster, Steven R. and G. Andrew Karolyi (1998) "Multimarket Trading and Liquidity: A Transaction Data Analysis of Canada-U.S. Interlistings" *Journal of International Financial Markets, Institutions and Money*, Volume 8, Numbers 3 & 4).



## Settlement Versus Trade Location

Figure 6. Canadian-Based US Interlisted Stocks as a Share of Total TSE Trade

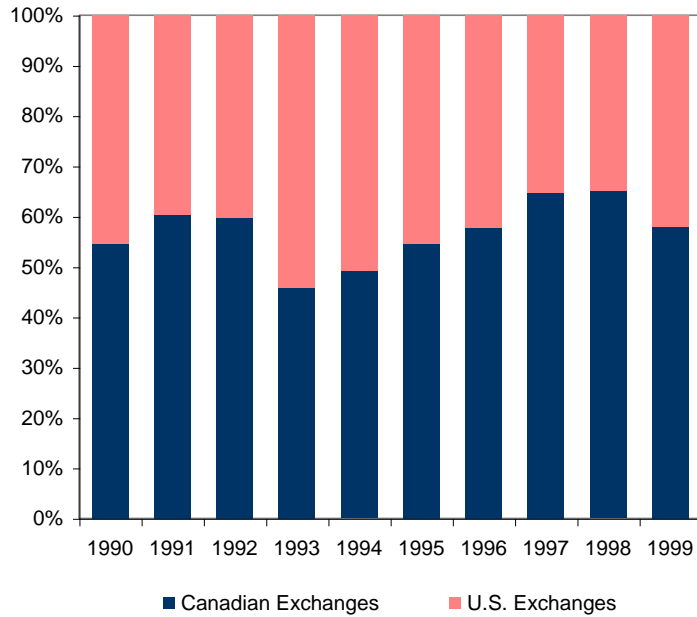


Source: TSE.

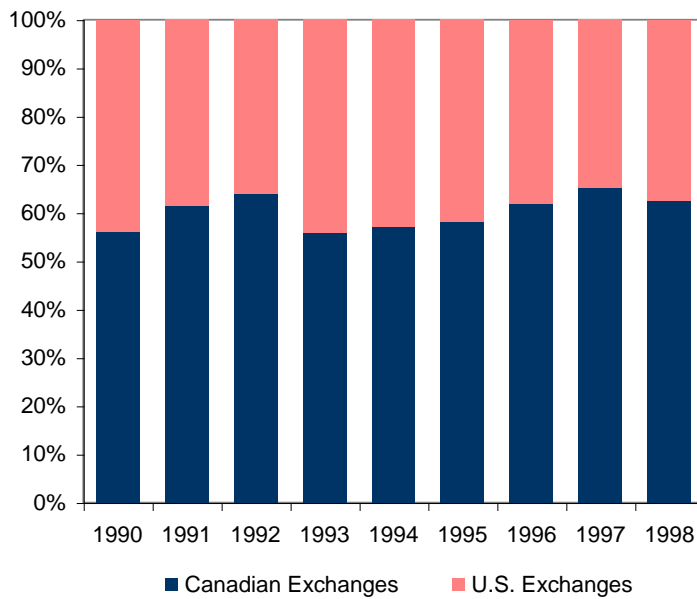
It is also noteworthy that within the group of Canadian-based US interlisted stocks, a significant portion of their overall trade takes place on US exchanges. As Figures 7 and 8 indicate below, if split between US and Canadian exchanges only over the past decade, about 39% of these stocks' volume and 41% of their value were traded on US exchanges. In recent years there has been a slight decrease in the volume and value that these stocks represent in terms of trades on Canadian exchanges, as US exchanges have increased. In 1997, Canadian exchanges represented 65% of the Canadian-based US interlisted trade value. By 1999, this had dropped to 58%, with US exchanges rising from 35% to 42% over the same three years.

## Settlement Versus Trade Location

**Figure 7. Share of the Total Trade Volume of the Canadian-Based US Interlisted Stocks Traded on Canadian and US Exchanges**



**Figure 8. Share of the Total Trade Value of the Canadian-Based US Interlisted Stocks Traded on Canadian and US Exchanges**



## Volume and Liquidity Effects of Settlement Period Length

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### 5. VOLUME AND LIQUIDITY EFFECTS OF SETTLEMENT PERIOD LENGTH

In the interviews for this study, market participants indicated that their decision about where to purchase or sell a particular security is not made on the basis of the settlement period or cost. Rather, brokers will make a trade where they expect to earn the best price: where buyers hope to pay the lowest price and sellers hope to gain the highest price. Typically, we would expect to find markets with higher volume (i.e. liquidity) to have lower bid-ask spreads than those with lower volumes. Given this, there is a natural tendency for convergence to the marketplace with the higher volume.<sup>33</sup> Nonetheless, we would expect to find that as transactions costs for a trade increase above minimum levels, this would at the margin result in lower trade volumes. To the extent that settlement cost is only a fraction of transactions costs, the overall effect of settlement on trading volumes is expected to be small. Ultimately, the effect of settlement on trading volume is an empirical question, and one which we examine later in this section.

#### 5.1. Settlement Risks

Generally, the longer the settlement period, the greater the risk of entering into any transaction. Settlement risk can be thought of as being comprised of two components: (i) counterparty or credit risk; that is, the risk that a trader will default on his/her obligations; and (ii) operational risk; that is, the risk that there may be a breakdown in communications, either human or technological, such that carrying costs will need to be incurred until a trade is settled. The amount of counterparty risk to which traders are exposed is dependent on fluctuations in security prices. If a trader does not meet his/her obligations, the trade is voided and the counterparty is forced to go back to the marketplace, exposing that person to the possibility of facing adverse security price movements. Increasing volatility in securities markets in recent years has dramatically altered the potential market risk exposure. In the case of operational risk, moving from a T+3 to a T+1 settlement period changes both who bears operational risk and the extent to which it is a technological risk.

In the US, the NSCC guarantees the settlement of reported trades following their comparison on the evening of T+1, thereby becoming a counterparty to the buying and selling participants in all trades. As a result, the clearing organization incurs all counterparty risk. In Canada, CDS

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<sup>33</sup> This phenomenon is well-articulated in a recent speech by Alan Greenspan, Chairman of the US Federal Reserve Board. See Greenspan, Alan (2000) *Remarks at the Financial Markets Conference* sponsored by the Federal Reserve Board of Atlanta, Sea Island, Georgia, October 16, 2000.





## Volume and Liquidity Effects of Settlement Period Length

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guarantees exchange trades once they are netted on the evening of T+2. In the case of institutional trades, CDS guarantees the settlement once they have been novated on settlement date.

Generally, the longer the settlement period, the greater is the chance that a party to a particular trade will default and the larger is the potential open position of that party for a given set of transactions. Therefore, a shorter settlement period should be associated with lower counterparty risk, but it is not necessarily the case that a shorter settlement period will result in lower operational risk.<sup>34</sup> However, to the extent that a move to a shorter settlement period entails a technological upgrade to clearance and settlement systems, operational risk is expected to be reduced. While a shorter settlement period could reduce the ability to detect and correct human error, at the same time, it is expected that the improved technology needed for a shorter settlement period will compensate for the current number of errors that occur with manual systems.

Ultimately, the effect of settlement period length on trading risk is an empirical question. In the following empirical analysis, we make the assumption that the competitive nature of the securities industry is such that a reduction in trading risk, if any, brought about by a shorter settlement period will be passed through to investors in terms of more efficient security pricing. Our proxy for efficiency is the bid-ask spread. Bid and ask quotes are the prices at which market makers commit to buy and sell a particular security. The difference between these two numbers (i.e., the spread) can be thought of as a commission that market makers receive for executing a trade. Much academic research has linked the bid-ask spread to how much risk investors face by trading in a particular market or security. Typically, riskier trading environments are associated with higher bid-ask spreads.

All else equal, traders prefer lower bid-ask spreads since they generally mean being able to buy at lower prices and sell at higher prices. Therefore, if a shorter settlement period results in lower bid-ask spreads because of reduced trading risk, demand to trade in the less risky environment should increase.

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<sup>34</sup> The evidence on the effect of shorter settlement date and failure is mixed. Ireland, J. and T. Ryan (1993) "Equity Settlement in London – Its Importance to London as a Financial Centre", London Business School, The City Research Project, Subject Report V, provide evidence of a negative relationship between settlement date and failure (i.e., shorter settlement date results in a higher probability of failure). However, other studies, including the Securities Industry Association *T+1 Business Case Final Report* July 2000 suggest the opposite.



## Volume and Liquidity Effects of Settlement Period Length

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### 5.2. Empirical Analysis

#### 5.2.1. Summary of Toronto Stock Exchange Findings

This section of the report describes the results of an empirical analysis that utilizes a sample of companies that made up the TSE 300 Composite Index at the time of Canada's switch from a T+5 to a T+3 settlement period.<sup>35</sup> The analysis is designed to test whether this switch had any impact on trading volume or market liquidity. Examining this earlier change in settlement period length will hopefully provide useful insights into the current debate over moving to a T+1 settlement period.

Canada's switch from a T+5 to a T+3 settlement period took place on June 7, 1995. Individual trades in companies comprising the TSE 300 Composite Index are obtained for 100 trading days around this date from a database maintained by the TSE. This database contains information on trade size as well as bid and ask prices. With this information, measures of trading volume and liquidity can be computed.

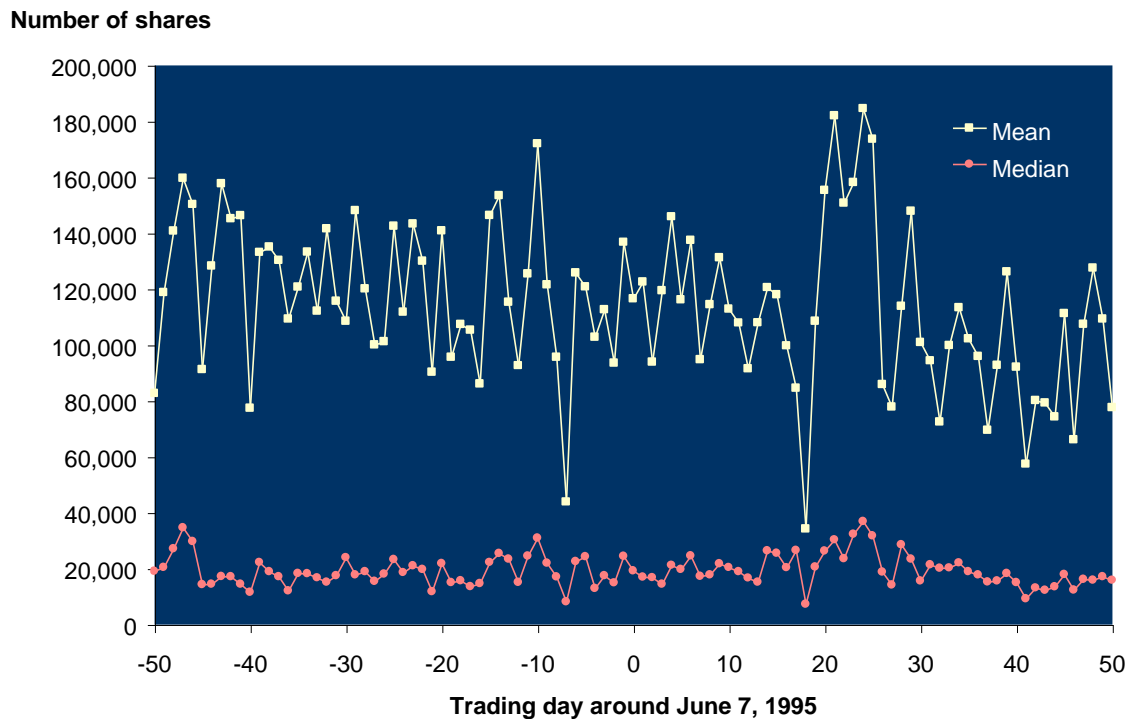
Figure 9 below describes mean and median daily trading volume for the companies in the TSE 300 Composite Index around June 7, 1995. Mean daily trading volume for the sample companies typically fluctuates between 75,000 and 150,000 shares but displays no discernable trends, which suggests that Canada's switch from a T+5 to a T+3 settlement period had an insignificant impact on trading activity in Canadian equities markets.

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<sup>35</sup> This work was performed jointly by CRA and Professor Aditya Kaul, Associate Professor of Finance, Faculty of Business, at the University of Alberta. Professor Kaul kindly provided access to the TSE trading database for this analysis.

## Volume and Liquidity Effects of Settlement Period Length

Figure 9. Daily Trading Volume of Stocks in TSE 300 Composite Index



This result is not terribly surprising. Most of the trading in Canadian equities outside of Canada occurs in the US, and the US switched from a T+5 to a T+3 settlement period on the same date as Canada. Even if a shorter settlement period increases a market's appeal for traders, this opportunity could not be exploited between the two countries. Confirming the mean results, median daily trading volume also displays no apparent trend around June 7, 1995.

While Figure 9 provides graphical intuition for how trading activity in Canadian equities was affected by Canada's switch from a T+5 to a T+3 settlement period, regression analysis is used to assess the statistical significance of changes in trading volume for the sample companies around June 7, 1995. Specifically, the regression model tests whether mean or median daily trading volume for the sample companies changes around Canada's switch to a shorter settlement period after controlling for other factors likely to influence trading activity.<sup>36</sup> These additional factors include a seasonal-effect variable as well as a time-trend variable. It is essential to incorporate these additional variables into the regression model to guard against

<sup>36</sup>A detailed description of this regression model is contained in Appendix B.

## Volume and Liquidity Effects of Settlement Period Length

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mistakenly attributing general shifts in trading activity over this time period to Canada's switch from a T+5 to a T+3 settlement period.

The results of the regression analysis reinforce the graphical intuition from Figure 9. Using either mean or median daily trading volume for the sample companies, the coefficient in the regression model designed to capture any shift in trading activity around June 7, 1995 is not statistically different from zero after controlling for other determinants of trading activity. This lack of statistical significance suggests that if Canada were to switch to a T+1 settlement period at the same time as the US, Canadian equities markets would not experience any noticeable change in trading activity. It is not clear, however, what would happen if Canada delayed or accelerated implementation of a T+1 settlement period in the face of a US change.

As a further refinement to the above analysis, the sample companies were divided into three sub-groups based on total trading volume over the 100-trading-day window around June 7, 1995. This refinement is designed to test whether very actively traded stocks had a differential volume reaction to Canada's switch from a T+5 to a T+3 settlement period than less actively traded stocks. Figures 10 and 11 below contain data on the mean and median daily trading volume for the sample companies around June 7, 1995, broken down by sub-group. These figures reveal that all three sub-groups displayed daily trading volume patterns similar to those in Figure 9 above. Regression analysis was also used to analyze each of these groups separately, which is not reported here. No significant differences emerged in the sub-group versus the full-sample regressions.



# Volume and Liquidity Effects of Settlement Period Length

Figure 10. Mean Daily Trading Volume of Stocks in TSE 300 Composite Index  
Number of shares

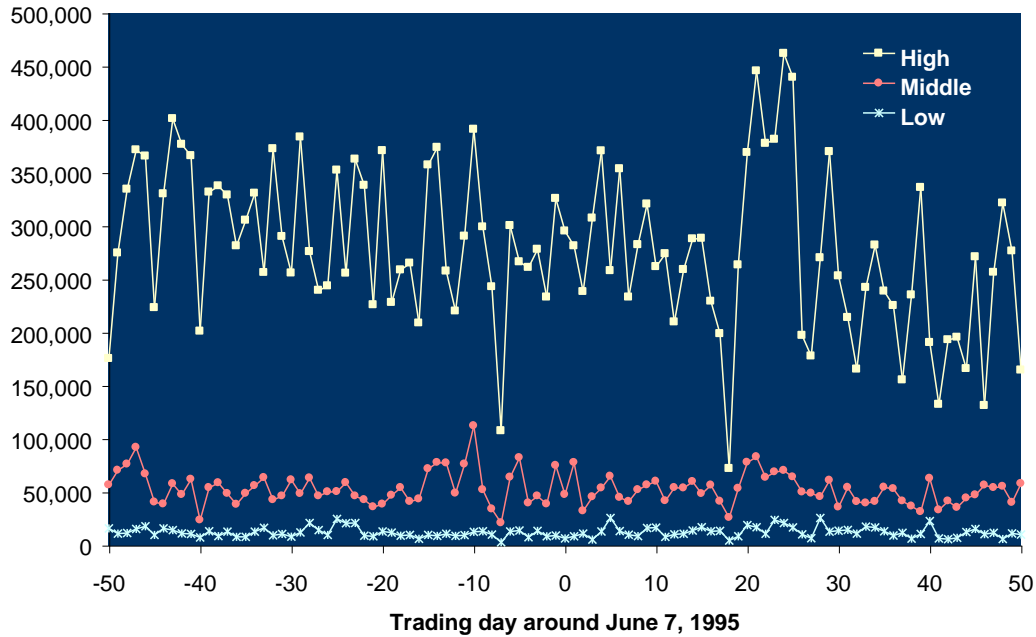
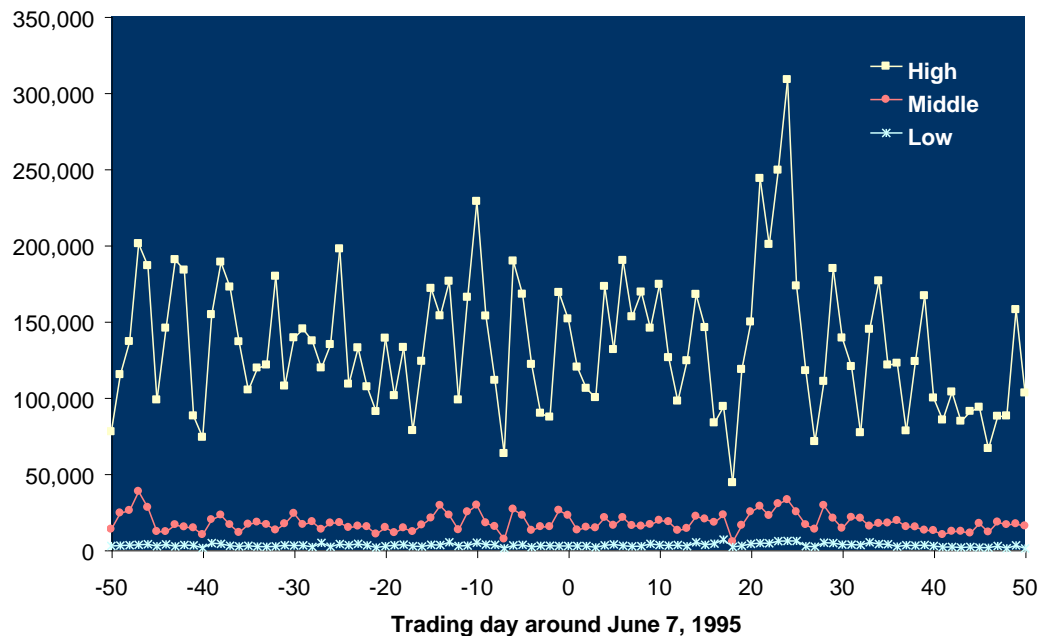


Figure 11. Median Daily Trading Volume of Stocks in TSE 300 Composite Index  
Number of shares

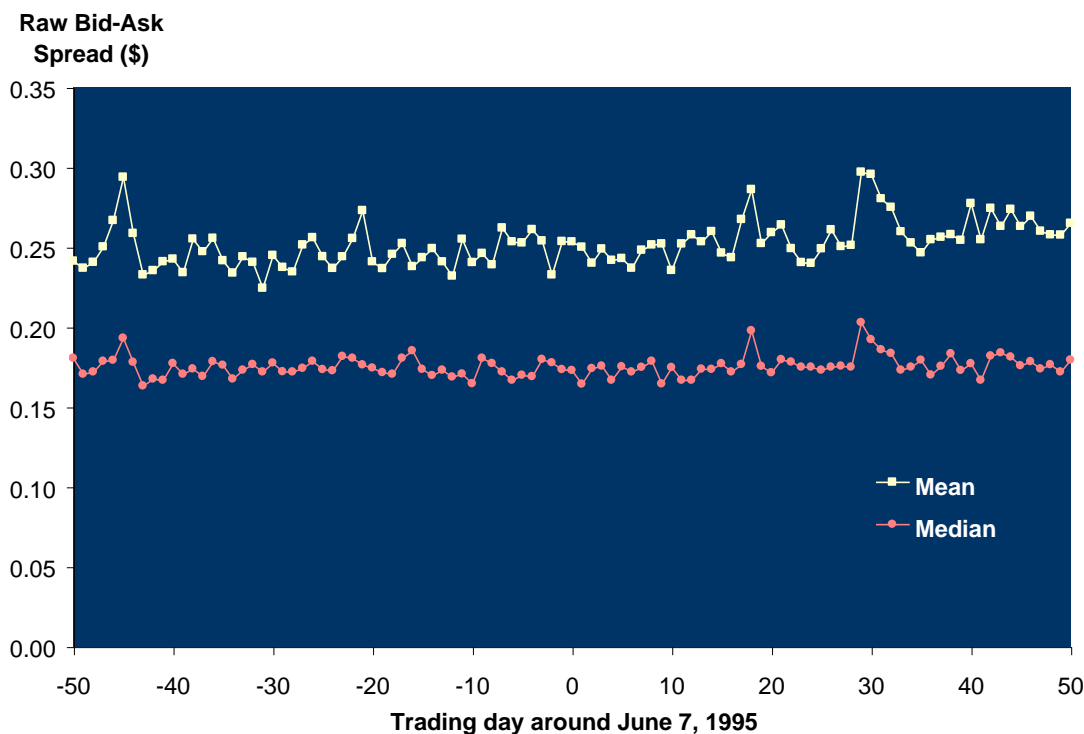


## Volume and Liquidity Effects of Settlement Period Length

In addition to the preceding analysis of trading volume, changes in liquidity for the sample companies are examined around June 7, 1995. Liquidity provides a sense for how much risk investors face when executing a trade in a particular market or security. A portion of this risk could be associated with the possibility of trades being defaulted upon due to longer settlement periods.

The bid-ask spread is used in this analysis to proxy for liquidity. Figure 12 describes the mean and median daily raw bid-ask spread for the sample companies around June 7, 1995. A raw bid-ask spread is simply the difference between the bid and ask quotes for a particular stock. The daily numbers in Figure 12 are calculated by first averaging the bid-ask spreads from different quotes for a particular stock on a particular day. Next, the daily means and medians of these averages are calculated across all of the sample companies. Much like the trading volume results, mean and median daily raw bid-ask spreads for the sample companies show no discernible trends around June 7, 1995. Mean daily raw bid-ask spreads are always close to \$0.25 while the daily median values fluctuate between \$0.15 and \$0.20 over the period.

**Figure 12. Raw Bid-Ask Spread of Stocks in TSE 300 Composite Index**



## Volume and Liquidity Effects of Settlement Period Length

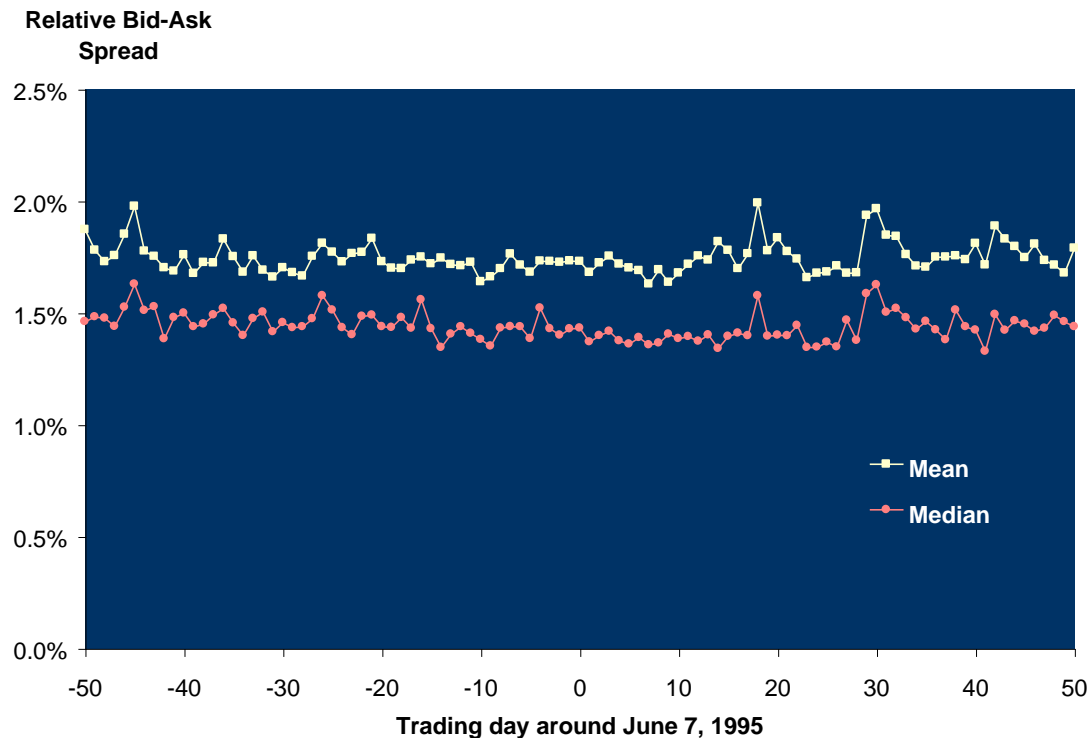
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Raw bid-ask spreads, however, provide a potentially misleading measure of liquidity because they do not take into account the price of the security being traded. For example, the bid-ask spread on a per share basis is lower for a \$100 stock with a raw bid-ask spread of \$0.25 than a \$10 stock with the same raw spread. To control for the effect of varying stock prices on the above liquidity results, the preceding bid-ask spread analysis is repeated using relative bid-ask spreads. A relative bid-ask spread is calculated by simply dividing the raw spread by the average of the bid and ask quotes. Figure 13 below describes mean and median daily relative bid-ask spreads for the sample companies around June 7, 1995. Mean daily relative bid-ask spreads are approximately 1.75% of stock price while the median relative spreads are roughly 1.5%, but neither data series displays any apparent trends over the time period being examined.



## Volume and Liquidity Effects of Settlement Period Length

Figure 13. Relative Bid-Ask Spread of Stocks in TSE 300 Composite Index



Regression analysis is used to confirm that Canada's switch from a T+5 to a T+3 settlement period did not significantly affect relative bid-ask spreads of Canadian equities. Specifically, the regression model tests whether mean or median daily relative bid-ask spreads for the sample companies change around Canada's switch to a shorter settlement period after controlling for other factors likely to influence relative spreads.<sup>37</sup> The control variables in this regression are analogous to those included in the trading volume regression.

The results of the regression analysis reinforce the graphical intuition from Figure 13 above. Using either mean or median daily relative bid-ask spreads for the sample companies, the coefficient in the regression model designed to capture any shift in relative spreads around June 7, 1995 is not statistically different from zero after controlling for other determinants of spreads.

<sup>37</sup>A detailed description of this regression model is contained in Appendix C.



## Volume and Liquidity Effects of Settlement Period Length

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Figures 14 and 15 below contain data on the mean and median daily trading volume for the sample companies around June 7, 1995, broken down into three sub-groups based on trading activity over the 100-trading-day window around this date. Like the trading volume analysis, this refinement reveals that very actively traded stocks had a similar spread reaction to Canada's switch from a T+5 to a T+3 settlement period than less actively traded stocks. Regression analysis was also used to analyze each of these groups separately, which is not reported here. No significant differences emerged in the sub-group versus the full-sample regressions.



# Volume and Liquidity Effects of Settlement Period Length

Figure 14. Mean Relative Bid-Ask Spread of Stocks in TSE 300 Composite Index

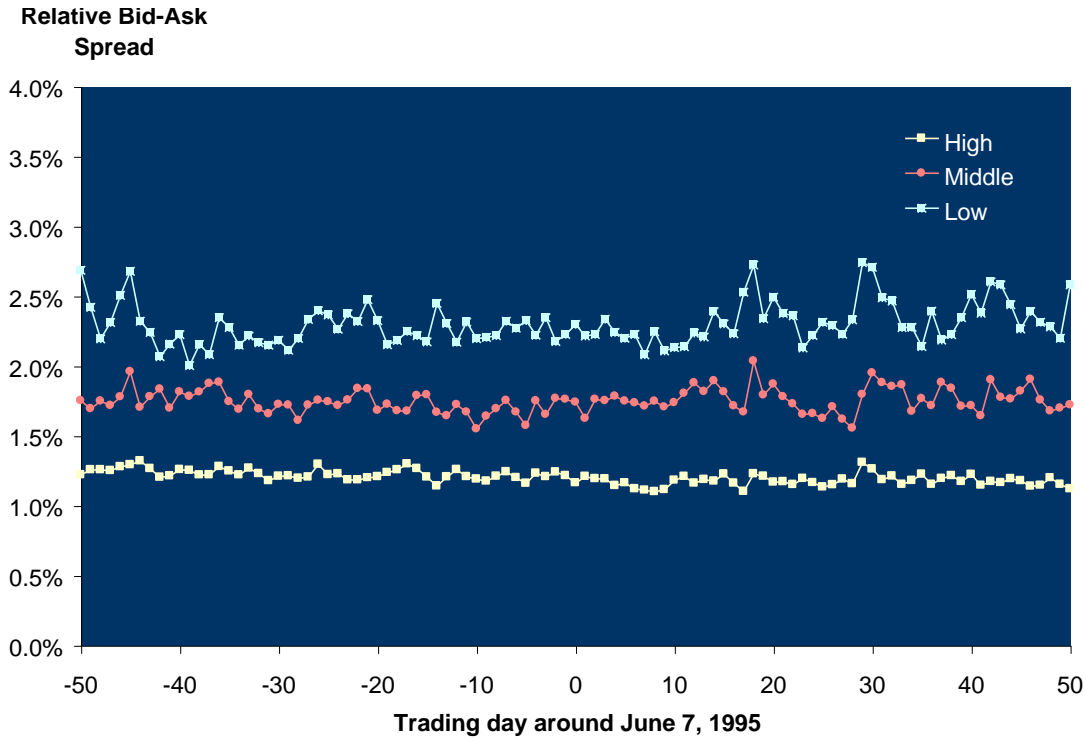
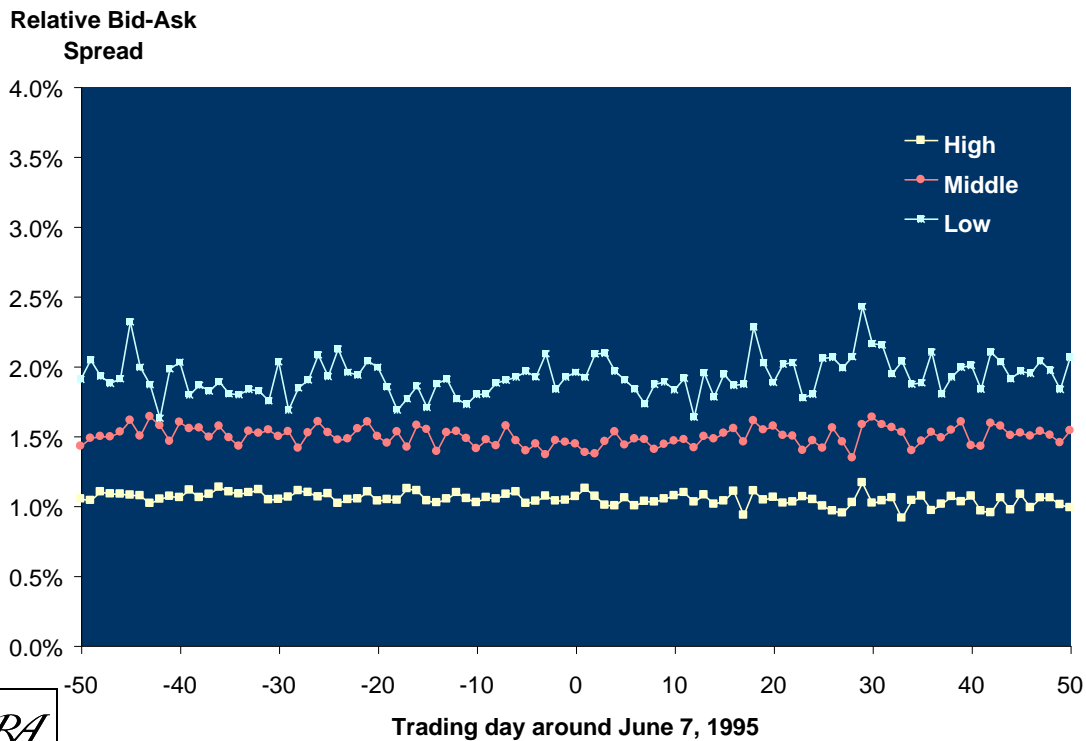


Figure 15. Median Relative Bid-Ask Spread of Stocks in TSE 300 Composite Index



## Volume and Liquidity Effects of Settlement Period Length

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The lack of statistical significance suggests that settlement period length is not a principal factor in determining market liquidity.<sup>38</sup> An important caveat to this, however, is that it relies upon relative bid-ask spreads as an appropriate measure of market liquidity. Although such reliance is reasonable based upon prior academic research, it is possible that a shorter settlement period could lower transactions costs at some other point in the trading process, which would not be reflected in this variable.

### 5.2.2. Summary of London Stock Exchange Findings

This section of the report analyses trading volume data for a sample of 15 Canadian companies that were interlisted on the London Stock Exchange (LSE) when Canada switched from a T+5 to a T+3 settlement period.<sup>39</sup> At the time of Canada's switch from a T+5 to a T+3 settlement period, the UK typically settled trades on a T+10 timetable, although small, individual trades could be settled on a T+20 timetable. On June 25, 1995, the UK switched from a T+10 to a T+5 settlement period. Because the UK did not change its settlement period at the same time as Canada, examining Canadian equities that traded in London around June 7, 1995 may yield some additional insights into what effect, if any, settlement period length has on the decision of where to trade. Unfortunately, lack of intra-day trading data for the UK traded securities meant that the analysis was confined to daily volume effects.

Figure 16 below describes mean and median daily trading volume around June 7, 1995 for the 15 Canadian companies interlisted in London. Daily London trading volume for these companies is obtained directly from the LSE.

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<sup>38</sup>An additional econometric analysis was performed in which the effect of Canada's switch from a T+5 to a T+3 settlement period on trading volume and bid-ask spreads are estimated simultaneously. Such an estimation allows for changes in volume to affect spreads and vice-versa. The results of this estimation displayed no meaningful differences from those reported.

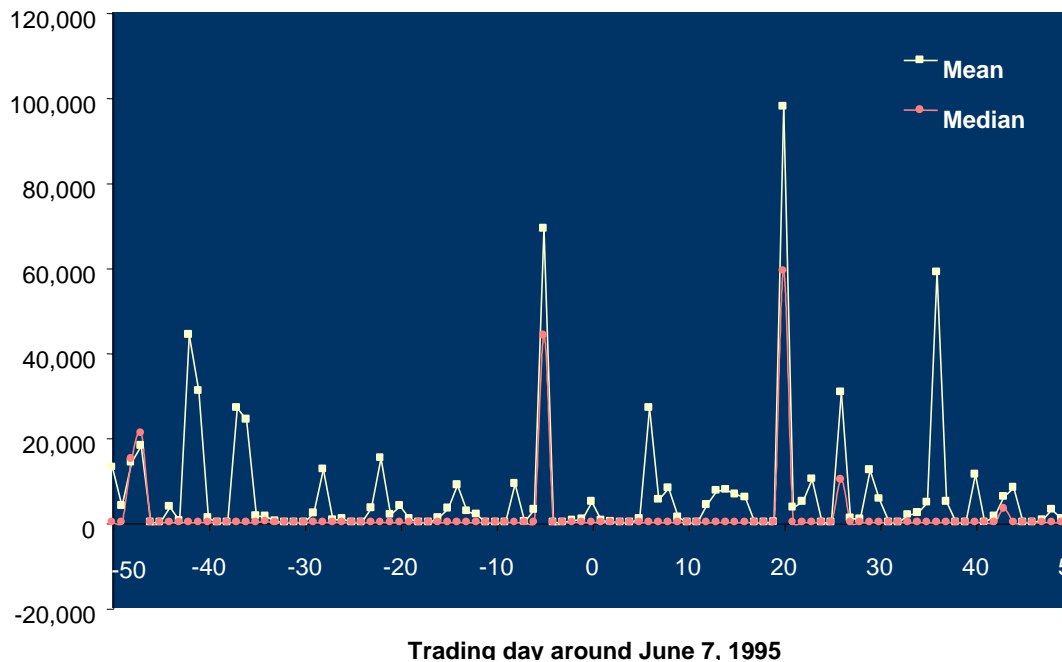
<sup>39</sup>Appendix D contains a list of these companies.



## Volume and Liquidity Effects of Settlement Period Length

Figure 16. Daily London Trading Volume of 15 Canadian Stocks

Number of shares



As Figure 16 shows, mean daily trading volume is highly variable, fluctuating between zero and 150,000 shares. Conversely, median daily trading volume is virtually constant at zero. Taken together, these results suggest that daily trading activity over the time period being examined could best be characterized as consisting of large, intermittent trades with no regular pattern. In the end, the small sample of firms involved in the comparison of differential settlement periods between Canada and the UK does not allow us to comment on how differential settlement periods between Canada and the US might affect daily trading volume of Canadian stocks interlisted in New York.

## Non-Synchronous Change in Settlement Period Between Canada and US

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### 6. NON-SYNCHRONOUS CHANGE IN SETTLEMENT PERIOD BETWEEN CANADA AND US

Interestingly, almost all of the survey participants thought that it would be inconceivable that Canada would not move to a T+1 settlement period at the same time as the US. This sentiment alone is a clear reflection of the importance of integration between Canadian and US financial markets. The effects of a non-synchronous change in settlement period can be divided into operational, risk management and price effects. This section examines these effects within the context of two hypothetical scenarios. First, Canada remains at T+3 or delays moving to T+3 while the US moves to T+1. As part of this first scenario, we will discuss available arbitrage opportunities that different settlement periods in Canada and the US may encourage. In the second hypothetical scenario, Canada is assumed to move to T+1 ahead of the US.

#### 6.1. Canada Remains at T+3

##### 6.1.1. Operational Effects

As noted earlier, it will be impossible to implement T+1 with any level of effectiveness without substantial investments in new settlement systems by all market participants. Thus, the move to T+1 is a catalyst for the industry to move in a coordinated fashion to improved common open networks that will allow seamless electronic connectivity. Thus, the many incompatible proprietary information systems and manual processes will be all but eliminated. These information system investments are expected to result in large operational cost savings. SIA has estimated that half of the annual savings of USD\$2.7 billion result from improved back-end clearing and settlement activities. Assuming that USD\$1.35 billion is possible in operational costs, and taking the trading volume on the peak day of April 4, 2000 as an example of future trading volumes (also assuming 251 trading days per year) yields operational cost savings of USD\$0.30 per transaction. Clearly there are a number of assumptions involved in this calculation, but the overall magnitude is potentially very sizeable relative to the current settlement processing costs.

While comparable total operational cost calculations have not been undertaken for Canadian participants, our interviews indicated there are also potentially very large operational savings available in Canada. For example, some custodians estimate they may be able to settle the same number of transactions as currently with one-quarter of their current staff. Other participants



## Non-Synchronous Change in Settlement Period Between Canada and US

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with more efficient current systems will not experience as dramatic savings, although these are still expected to be significant, possibly in the order of staff reductions of 50%. With higher expected volumes, it is more likely that staff currently employed in settlement will be redeployed rather than dismissed. In this, market participants agree that, following the investments required in technology, the current staff levels can handle much larger trading volumes, which are expected over the next several years. Essentially, they will move from processing a set number of trades to processing only those trades that by exception do not match. As an example of the possible operational savings available, in its T+1 Project, CDS estimates that it can settle more than double the current volumes at the same or lower cost. CDS' estimates are that it can achieve a 61% reduction in the per trade settlement cost assuming significant volume increases and following its investments in new technology and processes. Should similar savings be available to other participants in settlement, there are very large savings available.

If Canada chose to remain at T+3, it is highly unlikely that the above-noted investments in new infrastructure on a coordinated industry basis will be made, for the reasons outlined above in the Economics of Settlement section of this report. As a result, the cost of Canadian settlement from an operational perspective would be higher than that in the US. Canada already has higher operational settlement costs than the US, given the considerable economies of scale in settlement and the substantially larger trading activity in the US compared to Canada. To expand this differential in settlement costs further may result in large institutional trades moving to the more efficient systems in the US for the interlisted securities. Given the importance of the interlisted securities to overall liquidity on the TSE, shifts to the US (which in the US might be considered small) have a much larger impact in Canada. In turn, decreasing liquidity on the TSE increases bid-ask spreads which in turn drives investors to the more efficient markets in the US.

### 6.1.2. Risk Management Effects

A reduction in credit risk is expected to be one of the major benefits of reducing the settlement period. The move to T+1 will reduce the credit risk associated with unsettled trades by two thirds. Until settlement, investors face the risk that the counterparty to the trade may default. The longer the settlement period, the longer the investor faces this risk and for investors with credit limits, the longer they must provide collateral. For investment banks and other financial institutions, a three-day settlement period means that they must tie-up counterparty credit lines for a minimum of three-days.<sup>40</sup> A reduction in the settlement period means trade turnover can

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<sup>40</sup> The settlement risk is longer if a weekend or public holiday occurs before the three business days.



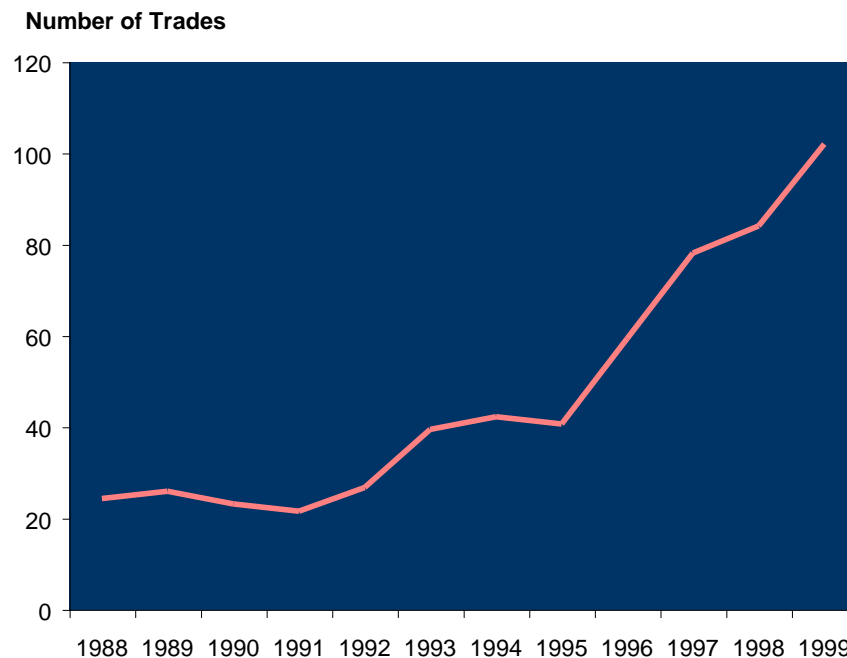
## Non-Synchronous Change in Settlement Period Between Canada and US

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increase three-fold. The reduction in credit risk and improvements in liquidity are considered to be a major component of the SIA's USD\$2.7 billion estimate of annual benefits to the US from moving to T+1.<sup>41</sup> The risk-management benefits associated with a move to T+1 could cause a movement in trade and settlement volume to the US should Canada fail to implement T+1.

Figure 17 below provides statistics on the average daily settlement volume in Canada for domestic exchange and non-exchange trades. All else equal, the dramatic increase in trading volumes will have led to increased risk associated with unsettled trades.

**Figure 17. Average Daily Canadian Settlement Volume (in thousands of trades)**



Source: CDS. Note the numbers are based on 251 trading days a year.

Longer settlement may also have particularly adverse consequences in times of a highly volatile market. For instance, if an investor believes the market is in a steep decline, that investor may sell more than he/she otherwise would to compensate for the possibility that the counterparty may default and the investor is left with a worthless stock. If many investors act in this fashion,

<sup>41</sup> See Securities Industry Association (2000) *T+1 Business Case: Final Report*.

## Non-Synchronous Change in Settlement Period Between Canada and US

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the market falls more than it would have otherwise due to greater selling pressure. As a result, the probability that defaults occur is increased. Thus, the investor's beliefs of high counterparty risk are confirmed, but are also reinforced by the investor's and others' actions. This is not dissimilar to the developments accompanying a standard bank-run, and also the events surrounding the impetus for the move from a settlement period of T+5 to T+3.<sup>42</sup>

There is little doubt that today's trading environment is one of higher volatility than previous periods. As Figure 18 below indicates, the magnitude of the volatility today is considerable compared to just a few years ago, with little expectation that it will decrease in the future.

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<sup>42</sup> In a standard bank-run story, a customer fearing that her bank might become insolvent decides to withdraw greater funds than may otherwise have been needed in order to secure her deposits. If many of the bank's customers act in this fashion, the bank's reserves will not be sufficient to cover all withdrawals no matter how high is the reserve ratio. As a result, the bank may become insolvent. Thus, the more customers believe that their bank may become insolvent and act in this fashion, the more likely is bank failure.

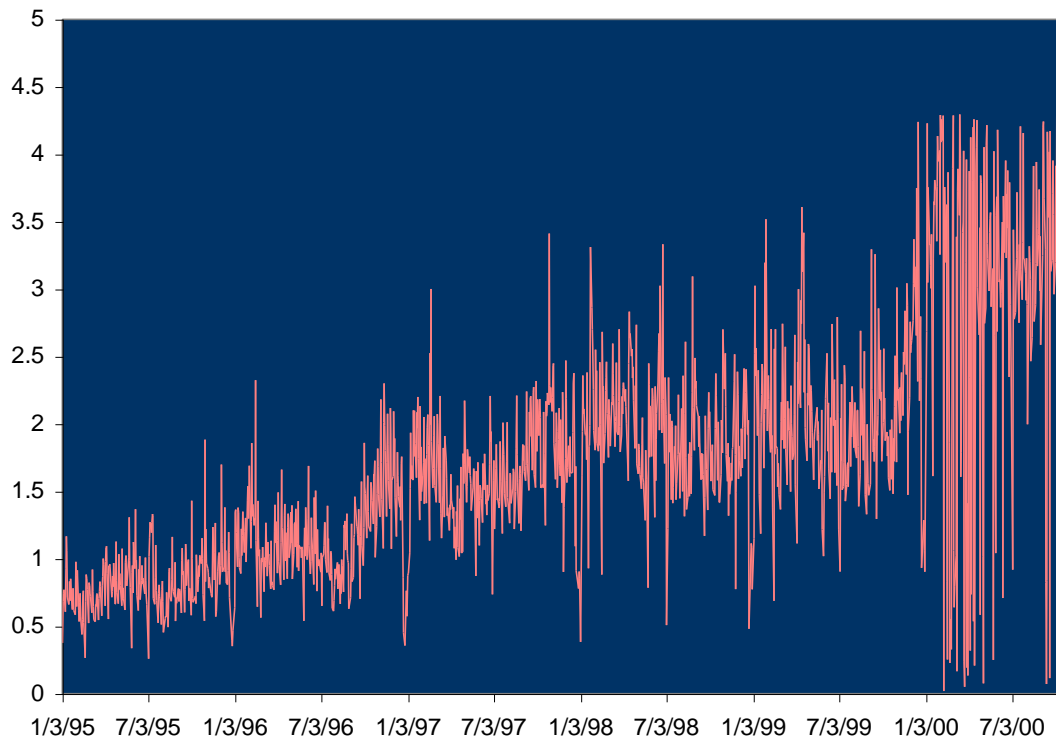




## Non-Synchronous Change in Settlement Period Between Canada and US

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Figure 18. Daily Trading Values on TSE (in billions of dollars)



Source: CDS. Note the numbers are based on 251 trading days a year.

Thus, if Canada were to fail to implement T+1 coincident with the US, it would expose Canadian market participants to possibly three times more counterparty risk.<sup>43</sup>

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<sup>43</sup> Calculating the actual cost of counterparty risk in settlement is complex. The following information is required: 1) an estimate of the probability of default; 2) the expected size of the open position of a defaulting member that is in excess of the collateral requirement; 3) the cost of the collateral requirement for all participants; and 4) the cost of risk associated with holding a returned security rather than the expected cash payment. Complicating this latter requirement further is that default may be more likely during a sudden market downturn so that the appropriate risk premium associated with holding a security due to settlement failure may be significantly higher than the usual risk premium required for equity investments.

## Non-Synchronous Change in Settlement Period Between Canada and US

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### 6.1.3. Price Effects

Differences in settlement period length could affect securities prices in two ways: First, differences in the timing of cash flows associated with buying and selling securities will affect the relative cost of any trade. For example, an investor who sells a security in the US where there is a T+1 settlement period will receive the proceeds from selling the security two days before an investor who sells a security in Canada where there is a T+3 settlement period. In this case, selling in the US would result in an additional two days of interest on cash received. The reverse holds for buying securities: Buyers would prefer to purchase securities in Canada, all else equal, as they are able to delay paying for the security by two days. Second, settlement risk associated with a longer settlement period may increase the overall risk of the trade, which is reflected by a wider bid-ask spread. However, given the empirical evidence that settlement risk has an insignificant effect of spreads, the following analysis will focus on potential price effects that could arise due to cash flow timing differences.

The results of CRA's analysis suggest that the differences in the timing of cash flows will drive a wedge between US and Canadian prices: prices in the US will be lower than Canadian prices by an amount equivalent to two days interest that can be earned by the seller in the US.<sup>44</sup> Arbitrage opportunities will exist only if prices do not move to this new equilibrium. However, once prices shift to reflect the differences in the timing of cash flows, these arbitrage opportunities should disappear.

Differences in settlement date will affect the relative *demand* and *supply* for Canadian equities in Canada and the US on interlisted securities. Consider a Japanese investor who is considering buying a Canadian issue that is interlisted in the US. The Japanese investor will prefer to purchase the security in Canada rather than the US because the longer settlement period means that the investor can earn an additional two days of interest on the money to be paid for the securities. The opposite effect should be observed for a Japanese investor who is trying to sell a Canadian issue. Investors will prefer to sell the security in the market with the shorter settlement period since they will receive the proceeds from the sale more quickly than if they had sold in Canada. In fact, regardless of where the investor resides, and assuming all other regulatory and institutional effects are equal, it is preferable to buy the security in Canada and sell the security in the US.

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<sup>44</sup> This has analogies to the money market where yields and prices are calculated based on settlement date rather than trade date.

## Non-Synchronous Change in Settlement Period Between Canada and US

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Arbitrage opportunities arise from differences in price when the same security is traded on two or more markets. Without the wedge in US and Canadian prices, there would be opportunities to arbitrage across the two markets. Suppose that an investor sells short shares in Placer Dome in the US market at the same time that he/she buys an identical number of shares in Canada.

Assume that:

- The shares are traded at the same price.
- The amount earned by lending shares is around 25-50 basis points.
- The amount paid to borrow shares depends on how a short position in stock is financed.
  - (i) If the arbitrageur already holds a position in the security, it is not necessary to borrow the security from a broker but there is a lost opportunity to lend the securities and the cost of the short position in the arbitrage position is 25-50 basis points.
  - (ii) If the arbitrageur must short-sell the security, then the arbitrageur will have to provide a margin equal to 50% of the position which has an opportunity cost equal to the risk-free rate of interest. In most cases, the short-seller earns a risk-free rate on the margin position but will have to pay around 25-50 basis points to the lender plus any fees associated with borrowing the security. The net cost to borrowing will be 25-50 basis points plus any transaction fees.

In either case, the cost of borrowing is 25-50 basis points plus any transaction fees.

The expected transfers are illustrated in Table 3 below.



## Non-Synchronous Change in Settlement Period Between Canada and US

**Table 3. Arbitrage Opportunity Summary - Buy in Canada, Sell in US**

	T+1	T+2	T+3	Net
<b>Shares</b>	-		+	Borrow shares. Cost is 25-50 basis points plus any transaction fees.
<b>Cash</b>	+		-	Lend Money: Receive money market interest rates
<b>Position</b>	Sell Shares Receive Cash		Buy Shares Pay Cash	Positive as long as money market rate of interest is greater than the cost of borrowing securities.

Note that the arbitrage strategy of buying in Canada and selling in the US will be profitable as long as the money market rate of interest is greater than the cost of borrowing securities – this is likely to be the case if the securities are generally available for short-selling.<sup>45</sup> However, this analysis ignores any fees relating to borrowing securities and/or foreign exchange transactions. If costs of borrowing securities or transaction costs are high enough, the arbitrage strategy may become unprofitable. Market participants had a mixed reaction to possible profitability of such a strategy. Some argued that such a strategy would not be profitable either because of limits on the amount of stocks that could be borrowed or because of high transaction costs. Others believe that such a strategy would be feasible.<sup>46</sup>

Regardless, this strategy ignores that changes in demand and supply across markets, potentially arising initially from the arbitrageurs' activities, will cause stock price of shares in the US to be lower than Canada by an amount equivalent to two days interest based on money market rates. If the difference in stock prices occurs, the arbitrage strategy of buying in Canada and selling in the US would no longer be profitable as the price received for selling in the US will be lower by the amount that exactly offsets the benefit of receiving cash two days before payment is due in Canada. The “wedge” or difference in stock prices in the US and Canada should eliminate any arbitrage opportunities associated with selling a security and receiving cash on T+1 and buying in Canada but being able to delay payment until T+3.

<sup>45</sup> A strategy of buying in the US and selling in Canada could only be profitable in the unlikely scenario where the return on lending securities is higher than the interest rate paid to borrow money.

<sup>46</sup> In fact, a major impetus to the discussion of arbitrage strategies in this report was the anecdotal evidence that market participants believed that a non-synchronous move to T+1 would result in arbitrage opportunities. It is not immediately obvious how any opportunities beyond the example in this report would arise. However, given that arbitrage opportunities only exist until markets correct themselves, it may be the case that survey participants have wisely chosen to keep these strategies to themselves.



## Non-Synchronous Change in Settlement Period Between Canada and US

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### 6.2. Canada Moves to T+1 Before US

In theory, the benefits to Canada from moving to T+1 before the US can be examined in a similar framework to the discussion above. However, where Canada may be expected to lose trade and settlement volume if it lagged the US, it is not necessarily the case that Canada can expect to win significant trade and settlement volume if it moves ahead of the US.

The main issue is that the US is arguably the largest, most liquid market in the world. The increase in the number of Canadian firms choosing to interlist in the US and the increasing share of order flow moving to the US suggests that the US is increasing its position in North American financial markets. Although it may be possible to reduce the movement of order flow from Canada to the US, the ability to attract order flow from the US is likely to be limited and any benefits will likely be restricted to the window during which the US remains at T+3.

The clearest evidence of Canada's limited ability to attract order from the US is the TSE's move from fractional to decimal trading in April, 1996. The move to decimalization reduced the relative tick size and was widely expected to attract order flow back to Canada by reducing spreads and improving liquidity in the Canadian market vis-à-vis the US exchanges. However, numerous studies have shown that despite a reduction in spreads, order flow did not migrate from the US markets to the TSE.<sup>47</sup> The fact that order flow has continued to shift to the US suggests that there are other reasons why investors prefer to trade on US exchanges rather than the TSE.

Indeed, as discussed earlier, theoretically, if more than one market for a security exists, one market is expected to emerge as the dominant market.<sup>48</sup> This results from the more liquid market having lower bid-ask spreads and hence being more attractive to corporate managers seeking to lower their cost of capital through interlisting. The relationship between improved bid-ask spreads and interlisting has been found empirically in a study of 52 stocks interlisted on the TSE and NYSE and AMEX.<sup>49</sup> The authors find that bid-ask spreads on the TSE decrease subsequent to interlisting on the US exchanges. The decline in bid-ask spreads is concentrated in those TSE stocks that have a significant shift of their total trading volume move to the US exchanges after interlisting reflecting the additional competition faced from US market makers.

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<sup>47</sup> See, for example, Ahn, H-J., Cao, C. and Choe, H. (1998) 'Decimalization and competition among stock markets: Evidence from the Toronto Stock Exchange interlisted securities', *Journal of Financial Markets*, Volume I.

<sup>48</sup> Chowdhry, B. and V. Nanda (1991) "Market shares and liquidity" *Review of Financial Studies*, Volume 4.

<sup>49</sup> Foerster and Karolyi (1998).



## **Non-Synchronous Change in Settlement Period Between Canada and US**

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## Conclusion

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### 7. CONCLUSION

To understand the difficulties in improving settlement, we have viewed the issue through an economic lens. From this perspective, settlement systems are not unlike other networks. In other words, the likelihood that settlement will be affirmed within the required time period and without expending resources on resolving errors or omissions is dependent upon the actions of all participants involved in the process. While any single participant can reduce the rate at which it incurs errors, trades may remain not affirmed due to the actions of others. In light of this, a single firm faces a reduced incentive to invest in improving its settlement processes, since it will incur the full costs but not the full benefits. This results in under-investment. In addition, there is a coordination problem.

Given the current information and manual systems in place, a move to T+1 without significant investments in improved settlement architecture will result in very substantial numbers of not affirmed trades at the close of T+1. Thus, the move to T+1 provides the catalyst to make the required investments to considerably lower the existing rate of error. It is also the case that such investments will greatly lower the operational cost of settlement on a per trade basis. While the cost of settlement is a small component of the overall transactions cost of undertaking a trade, in a competitive market we would expect that cost savings derived from improved settlement processes will eventually be passed on to investors.

At the same time that operational costs are reduced, a move to T+1 also reduces credit risk. This is perhaps more important today than in previous years given the increase in volatility in securities markets. A longer settlement period may have a particularly adverse effect in times of a steep market decline. Indeed, the earlier shortening of the settlement period from T+5 to T+3 was in part a response to the 1987 market decline.

If Canada were to remain at T+3 while the US moves to T+1, it would most certainly have higher settlement costs and higher risk. In turn, we would expect higher risk to be reflected in higher bid-ask spreads given the less efficient market. Differential settlement periods would also open up potential arbitrage opportunities between Canada and the US. With North American markets highly integrated, increasing already existent discrepancies between Canada and the US would be expected to result in some movement of trading activity south. The magnitude of such an effect and its exact relationship with settlement period is unknown. However, the direction of the effect is clear. In the case of interlisted securities, there is a natural tendency for convergence to the more liquid marketplace. Given the importance of the interlisted securities to the overall trading activity of the TSE, further moves south have a much larger impact on overall liquidity



## Conclusion

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on the TSE than on US exchanges. In turn, the cycle feeds upon itself, with corporate managers seeking interlisting and brokers seeking trading on the more liquid marketplace.

Taking past experience as a guide, a move to a settlement period of T+1 by Canada coincident with the move in the US is expected to have no impact on trading activity. Were Canada to attempt to achieve T+1 ahead of the US, it is unclear how much, if any, gain it might expect to realize. Market participants are well aware that the US is contemplating a move to a settlement period of T+1 by as early as June 2004. If Canada's early adoption of decimalization ahead of the US is any indication, it is not likely that Canada will gain significant trading volume from the US by moving to T+1 in advance of the US. Given the benefits of having a coordinated move, it may be more useful to move coincident with the US as was the case when moving from T+5 to T+3.





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