Common message standards for electronic commerce in wholesale financial markets

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An important aspect of electronic commerce is the potential for market participants to automate transaction processing fully, from the point of trade to final settlement. Such 'straight-through processing' could make wholesale financial markets more efficient, and lower the costs and risks that participants face. But it requires participants to use common message standards to exchange transaction data electronically. Several market-led initiatives to develop common standards have made substantial progress. But many trade messages are still sent by fax or using incompatible electronic networks, which means that different participants may have to re-input the same data manually at various points during the trade process. This article describes some of the initiatives to establish common standards. It then looks to economic theory to explain why market participants may find it difficult to co-ordinate to introduce a single standard, in spite of the wider benefits. It discusses how such technological changes may affect market structure. Finally, it considers whether some recent technologies, in particular eXtensible Markup Language (XML), may make it easier for market participants to adopt common standards.

Introduction

New technology is bringing significant changes to wholesale financial markets. But the benefits seen so far probably represent only a fraction of the potential gains. The automation of business-to-business (B2B) transactions in wholesale financial markets is likely to have a greater impact than in most other industry sectors, for two reasons. First, virtually all the products of financial firms (both wholesale and retail) can, at least in principle, be delivered entirely in digital form. And second, compared with other industries, wholesale financial markets have an unusually high proportion of transactions between competing participants.

Financial firms are increasingly using automated electronic networks to select, execute and process transactions. The benefits of such automation can be considerable—wherever data are input manually, human errors increase the number of failed trades, and transaction costs rise. Technological progress also makes possible changes in market structure that can pave the way for further efficiency gains. The Bank of England has an interest in these issues because of their implications for the efficiency and effectiveness of UK financial services.

Automation also has potential benefits for the stability of the financial system as a whole.[2] Greater automation is probably a pre-requisite for any further shortening of the settlement cycle for securities transactions. Shorter settlement cycles reduce the risk to firms that their counterparty will default between the initial transaction and final settlement. In the event of a default, a firm would have to enter into a replacement transaction, which may be on less favourable terms if market prices have moved in the meantime.

This 'replacement cost risk' increases when market prices are more volatile. This is often also when concerns about counterparty credit quality are greatest. Shorter settlement cycles could make markets more resilient in such stressed conditions by reducing concerns about counterparty credit risk, which can deter trading and prevent markets from clearing. Automation will enable shorter settlement cycles to be achieved without an increase in settlement failures.

In the past, all financial trades took place on the telephone or face-to-face on the floor of an exchange. Firms processed trades on paper, and manually re-input the details several times into different proprietary IT systems, both within and outside the firm. More recently, firms have begun to automate their internal processes, and to use electronic networks to trade, match and settle transactions with counterparties. But, by and large, these pockets of automation are isolated. Contact between firms is still often

(1) The author would like to thank David Rule, Roger Dean, Eric Dubois, Wolfgang Emmerich, Anthony Finkelstein, Anthony Kirby, Alan Line, Geoff Prior, Nigel Solkhon, Tim Wildenberg and Alastair Wilson for helpful comments.

(2) The Bank has responsibility for 'the overall stability of the financial system as a whole', as well as for promoting 'the efficiency and effectiveness of the financial sector, with particular regard to international competitiveness', as set out in paragraph 2 of the Memorandum of Understanding between HM Treasury, the Bank of England and the Financial Services Authority.

via fax, or by electronic communication using incompatible systems. The full benefits of automation will be seen only where there is 'straight-through processing' within and between firms, with little or no manual intervention between trade execution and settlement.

Straight-through processing requires the automated electronic transmission of trade details between devices or applications. Such automation can be achieved only if the two applications are connected via an electronic network and, in effect, speak the same language. In other words, it requires common message standards for the electronic exchange of transaction data.

A message standard is defined as any standardised means of communicating between participants the data relevant to the processing of a trade. A standard has two components: syntax (the technical basis of the standard); and business content (the data necessary to process the transaction). 'Syntax' is roughly analogous to the grammar of a spoken language. An example might be HyperText Markup Language (HTML), the current syntax that underpins the World Wide Web (WWW), or eXtensible Markup Language (XML—see below). 'Business content' (for example the standard template for the data relevant to a cash equity trade, for instance as defined by the Financial Information eXchange protocol (FIX)), roughly corresponds to the vocabulary of a spoken language.

Where a common standard is used by a number of participants in a market, the trade details can be passed between participants without having to be re-input to conform to a different standard. Even if the message standards are not identical, a similar effect can be achieved where the messages contain data that can be automatically reformatted or translated into another system. In this case, the standards are known as 'compatible', or 'inter-operable'.

A standard may be either open or proprietary. An open standard is not owned or controlled by any particular supplier or group of suppliers. Indeed, it is usually created and developed by co-operative industry groups. The creation and amendment of a proprietary standard, on the other hand, is controlled by a particular supplier. The supplier typically restricts use of the standard to its own network, and charges for the use of the network and other associated services. Nevertheless, use of a standard is not always limited to a particular network. Open standards may typically be transmitted over a wide range of closed and incompatible networks.

The next section of this article examines in greater detail the potential benefits of common message standards, including increased efficiency and lower risk. It then looks at several market-led initiatives to establish common standards for messages related to payments and securities and derivatives transactions. These include those promoted by industry bodies such as FIX, FpML, GSTPA, ISITC and SWIFT (see the box on page 276).

It is not always easy for market participants to agree and use a common standard. The second part of the article discusses how widely electronic messages based on common standards are currently used in financial markets, compared with messages sent using fax or separate proprietary networks. The article goes on to consider some of the reasons why market participants may have difficulties in co-ordinating the introduction of a single standard. It then looks at the potential for new technologies, such as XML, to facilitate the adoption of common standards, and discusses the effect that these technological changes may have on market structure. Finally, the article considers whether there is any role for central banks and regulators in the standard-setting process.

Benefits of common message standards

The academic literature on standardisation starts from a general premise that common standards will increase social welfare if there are direct 'network externalities'. A good or service is said to exhibit network externalities if the benefit to each existing user increases as more market participants adopt it (as long as it meets its users' basic needs). The most socially efficient outcome in this case is for all market participants to use the same standard. This can also be achieved by the use of messages that are fully inter-operable.

Common standards provide direct benefits. There are economies of scale where participants can band together to share the fixed costs of technical development. And participants can transfer data and exchange messages with lower transaction costs: firms need to purchase only a single IT system to exchange information with clients and counterparties using the same standard.(1) Eliminating the manual re-input of data by different firms at each stage of the transaction process is likely to bring increased efficiency, as well as a reduction in costs and risks. So common standards can play a significant role in the straight-through processing of trades.

Preliminary indications are that the cost savings from such straight-through processing would be substantial. Research from GSCS Benchmarks suggests that 11% of cross-border equity trades fail to settle on time. IBM estimates that around two thirds of all securities trades need to be amended, repaired or cancelled for some reason. SWIFT estimates that more than half of a custodian's settlement costs are caused by trade failure resolution (41%) and non-automation (18%).(2)

There are further implications for financial stability. Common standards, where they facilitate automation, may

(1) This may also enhance competition by reducing barriers to market entry—particularly for smaller intermediaries, who may be reluctant to purchase multiple proprietary systems. Nevertheless, there are operational risks associated with the use by all market participants of the same software. For instance, a deficiency in the software could affect all market participants simultaneously.
(2) Sources: GSCS Benchmarks survey; IBM Straight-through Processing for E-business Research; SWIFT.

Organisations and industry bodies involved in message standardisation and automation

- **DTC** (the Depository Trust Company), part of the Depository Trust and Clearing Corporation (DTCC), is the central securities depository for US equities. DTC's TradeSuite service is a leading provider of electronic trade confirmation (ETC) in the United States. *www.dtcc.com*

- **ebXML** (electronic business eXtensible Markup Language) is a joint initiative between UN/CEFACT and OASIS (the Organisation for the Advancement of Structured Information Standards), an international consortium of major software suppliers. ebXML plans to provide an open technical framework to allow XML to be used in a consistent manner for the exchange of all electronic business data. *www.ebxml.org*

- **EEMA** (the European Forum for Electronic Business) is a professional association for participants in electronic business. One of its projects is to develop EDIFACT messages that are compatible with XML. *www.eema.org*

- **FIX** (the Financial Information eXchange protocol) is an open message standard designed to support pre-trade and post-trade messages between broker-dealers and fund managers on trade date. It is currently used up to the point of allocation. *www.fixprotocol.org*

- **FpML** (Financial products Markup Language) is a planned initiative to create an XML-based market standard for electronic messaging relating to OTC derivative transactions. It plans to cover a range of services including electronic trading, confirmation and portfolio specification for risk analysis. *www.fpml.org*

- **GSTPA** (Global Straight-Through Processing Association) is an industry association. It is preparing to set up a 'transactions flow monitor' (TFM), to act as a central data store for the post-trade, pre-settlement flow of information between fund managers, broker-dealers and custodians. The TFM is designed around open industry standards based on XML. *www.gstpa.org*

- **ISITC** (International Securities Association for Institutional Trade Communication) is an industry body that agrees standards principally for trade communications between fund managers and custodians. *www.isitc.org*

- **ISO** (the International Organization for Standardization) has developed the ISO15022 standard for securities-related messages. It provides for a single definition of each data field (held in a 'data field dictionary') from which new messages can be created. The data field dictionary should thus facilitate the translation of one standard into another, where the two are otherwise incompatible. *www.iso15022.org*

- **SwapsWire** is an initiative announced in April by six major swaps dealers to automate the process of negotiation and trading of OTC derivatives. *www.swapswire.com*

- **SWIFT** is both a network-independent standard-setting body (based on the work of market participants on its committees) and a network provider (which can support non-standard as well as standard messages). SWIFT is also the designated registration authority for ISO15022. *www.swift.com*

- **Thomson Financial ESG** is a private sector supplier, which provides electronic trade confirmation (ETC) of trades, between fund managers and broker-dealers. Among Thomson's proprietary services are OASYS Global (its ETC system), an 'intelligent trade matching' (ITM) system, and Alert, a database of settlement details. *www.thomsonesg.com*

- **UN/CEFACT** (the United Nations Centre for Trade Facilitation and Electronic Business), jointly with ISO, developed in 1986 an international standard for structured electronic data interchange (EDI). This is known as UN/EDIFACT (United Nations Electronic Data Interchange for Administration, Commerce and Transport). In financial markets, it is used mostly for communication between banks and corporates. *www.unece.org/trade/untdid/welcome.htm*

- **W3C** (the World Wide Web Consortium) is a non-profit, vendor-neutral consortium developing common protocols for the Web. Among its responsibilities is the development of XML. *www.w3.org*

help markets to cope with higher volumes of transactions and settlements, without an increase in the number of fails. The experience of the 1960s, when the paper-based system in the United States was unable to cope with a significant increase in volumes, warns of the danger of insufficient capacity. The volume of trades has been increasing appreciably in recent years, and there is every reason to suppose that this trend will continue. For example, between 1997 and 1999, volumes traded on the New York Stock Exchange increased by 54% and on the London Stock Exchange by 20%; volumes settled in CREST increased by 59% and in the Depository Trust Company by 142%; and volumes of securities messages sent through SWIFT increased by 107%.(1)

Many major markets are moving toward shorter settlement cycles, causing further pressure on markets' processing capacities. The US Securities and Exchange Commission (SEC) has announced its intention for the US equity market to move from settlement three days after trade date (T+3) to T+1 in 2002. The United Kingdom plans to move from T+5 to T+3 in February 2001, with a possible view to moving subsequently to T+1.(2)

None of this is likely to be possible without a significant increase in the automation of the trading process. So the adoption of common standards for the processing of information is likely to play a key role. There is general agreement that, while the US move from T+5 to T+3 in 1995 was achieved simply by increased efficiency, a further reduction will require re-engineering of the trading process. If successfully implemented, however, shorter settlement cycles will provide firms with cost savings, and, as discussed above, may enhance the stability and resilience of the financial system in times of crisis.(3)

Further benefits of common standards derive from indirect network externalities. Suppliers are likely to develop and make available a wider range of complementary products (eg software if operating systems are made compatible). The cost of repairs is typically lower, since the pool of technical expertise is larger. And the 'learning-by-using' mechanism can take effect across as wide a group of users as possible. This is the process by which users' specific experience and knowledge of the standard contributes to the development by the supplier of the standard's technical capabilities.

Use of common message standards

The main recent initiatives to establish common message standards for the exchange of data in financial markets are described in the box opposite. Some of these standards have existed for a number of years and are used fairly widely in particular markets. But many trade details are still passed via fax or incompatible proprietary networks, particularly between fund managers and custodians, and by smaller brokers and fund managers. The box on pages 280–81 describes the different stages of a typical client-side cash equity trade.

Cash equities—pre-trade

The Financial Information eXchange protocol (FIX) is now used by most of the largest fund managers and brokers as an open message standard for pre-trade flows of information. FIX was originally developed by Salomon Brothers and Fidelity Management and Research Company to automate their bilateral messages, but has subsequently become used more widely. It is geared towards cash equities, though in principle it could be extended to any market.

FIX is independent of any specific network. But FIX functionality may be adopted by network suppliers as part of their proprietary systems. So proprietary systems that use FIX are not necessarily inter-operable. As a result, there are many 'flavours' of FIX; and in addition, there are many optional fields. Both of these factors militate against precision. To combat this, the FIX steering committee is establishing an ongoing certification and testing process, which is intended to ensure that FIX systems developed by different suppliers are compatible.

The FIX standard is defined at two levels: session and application. The session level concerns the delivery of data, and the application level defines business-related data content. FIX launched its latest version (4.2) in late March 2000, and plans to move soon to the XML-based FIXML. FIX and SWIFT are also in the process of mapping the FIX fields into ISO15022, an initiative to provide a common definition for each data field used in securities markets (see the box opposite).

Despite the popularity of FIX, market participants say that many smaller brokers in particular have not yet adopted the standard. Nevertheless, they have a strong incentive to do so: proprietary systems have acted as a barrier to entry to the smaller brokers, who are more reluctant to invest in multiple systems (or translation software where available). And their clients—the fund managers—are increasingly adopting FIX-compliant order management systems, which is likely to be an additional incentive. The large brokers currently have the capacity to accept most standards over most networks, but most of them strongly favour FIX.

(1) Sources of data: *New York Stock Exchange Annual Report 1999*; *London Stock Exchange Secondary Market Fact Sheet*, various issues; *CRESTCo Ltd Annual Report & Accounts 1999*; *Depository Trust and Clearing Corporation 1999 Annual Report*; *SWIFT 1999 Annual Report*.
(2) For further information on the US plans, see the speech by SEC chairman Arthur Levitt (1996) in which he first set out the goal of T+1 settlement. For further information on UK plans to shorten the settlement cycle for equities, see the joint Bank of England/CRESTCo/London Stock Exchange press release, 23 November 1999: 'UK equities: proposal for a shorter settlement cycle'.
(3) Hills and Rule (1999) discuss replacement cost risk in more detail, in the context of counterparty credit risks faced more generally by participants in payment and settlement systems.

And software suppliers are increasingly building FIX functionality into their new systems.

Cash equities—confirmation

FIX messages are used for the trade process up to the point of allocation. But FIX is not widely used for allocation and confirmation, for which Thomson Financial ESG's proprietary OASYS Global network and standards still dominate in the UK market.(1) Following the 1987 stock market crash, a group of market participants produced a specification for an automated version of the confirmation process, which had previously been conducted by fax or telex. Three suppliers—SEQUAL, ISMA and Thomson Financial ESG—built (interlinked) systems. But within a couple of years, Thomson's OASYS Global had acquired virtually 100% of the market, which it has retained since.

Thomson is currently implementing an 'intelligent trade matching' (ITM) system, which will provide central matching of trades. The ITM will calculate fees, tax and commission based on static data from participants, which it will store. ITM will use Alert, Thomson's proprietary database of settlement details. Although OASYS Global is a proprietary system, it can also take feeds from an open standard such as FIX. Thomson also operates MarketMatch, an electronic matching service for broker-to-broker trades.

Another approach is that of the Global Straight-Through Processing Association (GSTPA). GSTPA's activities focus on the post-trade, pre-settlement flow of information between fund managers, broker-dealers and custodians for cross-border trades. GSTPA was originally set up simply to agree a single operating model for cross-border trades. But it has since extended its scope by proposing a utility, known as a 'transactions flow monitor' (TFM). The TFM will act as a central data store, allowing data to be input only once. It will match cross-border trades multilaterally prior to sending information to the local market place. This is intended to reduce the extent to which trade details need to be repaired and hence the proportion of trades that fail to settle on due date, to involve custodians at an earlier stage in the process, and so to facilitate straight-through processing. Initial operation is scheduled for summer 2001. The TFM will be built by a consortium known as Axion4.gstp, which comprises SWIFT, the Swiss central securities depository (CSD) SegaInterSettle, and software suppliers TKS-Teknosoft (with IBM as a 'strategic technology partner').

On 1 May, Thomson and the Depository Trust and Clearing Corporation (DTCC) announced a joint venture to provide centralised trade processing, with a focus on the US market. Together, Thomson and DTCC process virtually 100% of automated electronic trade confirmation (ETC) messages in the United States. It remains unclear by how much the new venture will overlap with GSTPA, given that the TFM has been designed with cross-border trades in mind, and is intended to be neutral as regards the settlement practices in local CSDs.

Cash equities—settlement

Custodians receive settlement instructions either by the SWIFT network, their own proprietary system or fax. The SWIFT messages used for this purpose are typically those mandated by the industry body International Securities Association for Institutional Trade Communication (ISITC). ISITC was originally set up in the United States in 1989, but now has steering committees for Europe and Asia/Pacific. In 1991, ISITC agreed to adopt SWIFT message formats (though not necessarily the network) as the template for standardised trade communication between fund managers and custodian banks. ISITC agreed the business needs and the attributes of a message, and then approached SWIFT for implementation. These messages (SWIFT MT520/530) are now used widely in the market. ISITC is merged with the International Operations Association, and is formally known as ISITC-IOA.

Market participants say that the trend is towards the use of the SWIFT network. For instance, custodians receive an estimated 80%–90% of messages via SWIFT or the custodian's proprietary system. Despite the fact that custodians tend to demand indemnities for fax communications, which are less secure, some fund managers still use fax messages—even though some of them use SWIFT for their payment messages. In domestic markets, matched trade instructions are typically processed electronically through to the CSD. In the United Kingdom, for instance, custodians use SWIFT or BT Syntegra to communicate with CREST. Global custodians use SWIFT to communicate with sub-custodians in local markets.

But trade messaging is only one part of the custodian's role. Most of the information services that they provide relate to the timely presentation of information (eg corporate actions) to clients. There is less desire or scope to standardise this information; indeed, it is often a bespoke service as clients often want to manipulate the data themselves. So it tends to be sent by fax or e-mail.

Payments

SWIFT messages are used more widely for payments-related than for securities-related messages—they are the *de facto* standard for international cross-border messages between correspondent banks, and are increasingly used within payments systems (eg CHAPS € and TARGET). Securities broker-dealers and investment managers have been allowed full membership of SWIFT since June 2000. Along with a wide range of other

(1) Research from the Tower Group released in September 1998 showed that in 1998 only 0.2% of FIX messages were for allocations. 82% were for indications of interest. UBS Warburg—a fairly representative large broker-dealer—currently uses FIX 66% for indications of interest, 10% for orders, 24% for executions, and not at all for allocations (as reported by a representative of the firm speaking at the Buy-Side/Sell-Side Trading Conference in April 2000).

non-bank financial institutions, they were already permitted to use the network for securities-related business.

OTC derivatives

There is no standard messaging as yet for swaps and other over the counter (OTC) derivative transactions. But the development of Financial products Markup Language (FpML) and SwapsWire may change this. The project to develop FpML was initiated in summer 1999 by JP Morgan and PricewaterhouseCoopers. A steering committee has since been formed, comprising the heads of most of the largest interest rate swap trading houses.

The OTC derivatives market differs in key respects from the cash equity market. Although legal documentation is standardised, there is no standard definition of the data relating to instruments; a swap message typically contains ten times as much information as an equity trade message, and back-office processing is still largely paper-based. The FpML steering committee intends to provide standard definitions for the data fields relevant to OTC derivative transactions. A specification for FpML Version 1.0 was made available in July 2000.

SwapsWire is an initiative of ten leading OTC derivative dealers to automate the message flows for, in the first instance, US$ and € vanilla interest rate swaps. It is not a trading system, and will not replace the current form of private, bilateral negotiations between dealers in the OTC market. The system will be used for the exchange of prices, indications of interest and information relating to completed deals. A common, open standard will be chosen for exchanging messages. In the future there may be a formal link to a central counterparty clearing house. The dealers envisage that some form of system will be operational by the end of the year.

Corporate-to-bank communication

A significant proportion of communication between banks and their corporate customers is paper-based or takes place via proprietary networks. The principal common standard used for bank-to-corporate messaging is EDIFACT. EDIFACT standards can be transmitted over a wide range of networks, including SWIFT. In addition, EEMA (the European Forum for Electronic Business) is leading a project to develop EDIFACT messages compatible with the XML syntax. In practice, however, this standard appears to be used almost exclusively by larger corporates, given the relatively high cost of integration with in-house systems, and it is not used widely outside the European Union.

Potential barriers to the widespread adoption of common standards

Despite the theoretical benefits of common message standards, it is not always easy in practice for market participants to agree to use a particular standard. Given certain types of market structure, one or several suppliers in a market might have an incentive to establish or maintain different, incompatible proprietary standards. For instance, market participants often face different levels of costs from moving from one standard to another ('switching costs'). This would mean that some firms would benefit less than others from adopting a common standard. So market co-ordination may be difficult.

Path dependency and installed base

The adoption of a common standard need not be related to its technical quality, particularly where a number of incompatible proprietary standards are available. It could be related more closely to market participants' expectations of the ultimate size of the network of other users of a standard. In many circumstances, these expectations could be self-fulfilling. So the standard that participants expect to dominate may dominate. Nevertheless, the standard must fit its users' basic business needs, such that a message based on the standard contains all the information necessary to process the transaction.

Such a market may have a tendency towards 'path dependency'. This means that the path taken by a market depends on the nature and the number of users that a particular standard can claim at the beginning of the period of competition—its 'installed base'. So first movers may have an advantage, because their choice of standard may have a disproportionate effect on the choices of the other market participants.

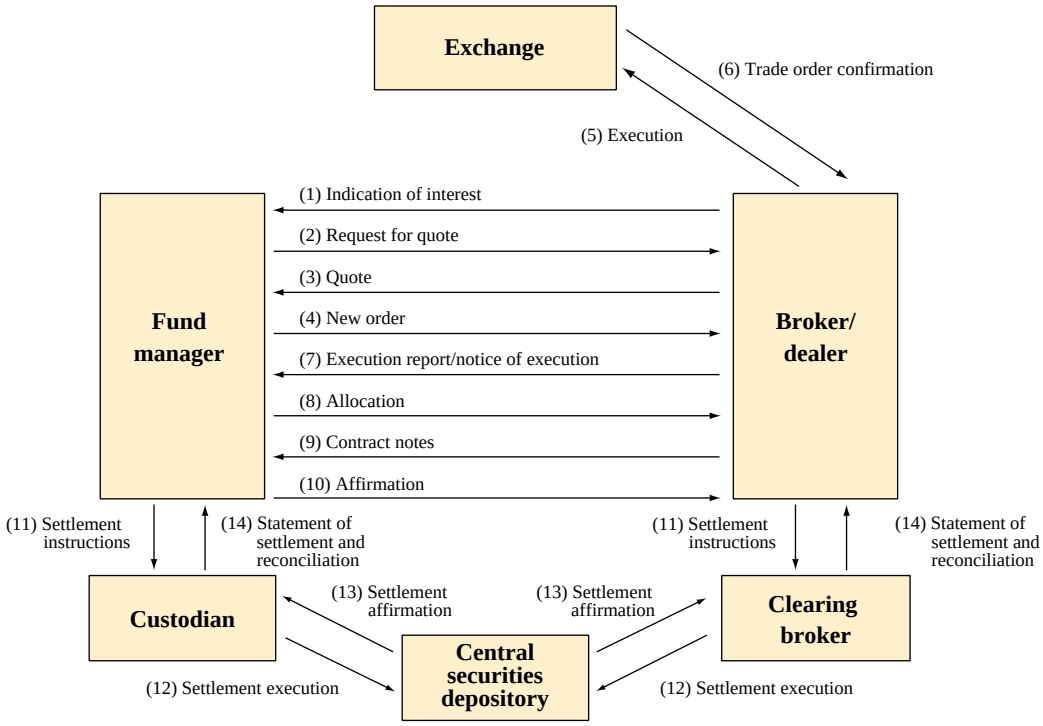
Incentives to adopt multiple or proprietary standards

The academic literature on standard-setting sets out some circumstances in which an industry might fail to adopt a common standard, even where it is socially optimal. A supplier's key strategic question when considering whether to support a common standard is whether competition for the market (ie between two proprietary standards to become the unique standard) will be more profitable than competition within the market (ie both using the same standard). This in turn depends largely on how likely it is that an equilibrium will be reached in which one firm dominates the market. In markets that exhibit strong network externalities, the co-existence of incompatible products may be unstable, since the benefits to each user increase with every additional user (economists call this a 'corner solution').

Besen and Farrell (1994) discuss three simple two-firm network market structures, in which agreement on a common standard may prove difficult. In each case, the two suppliers offer network services to customers on the basis of message standards that are either common or incompatible.

- **'Tweedledum and Tweedledee'.** Where the two suppliers have networks with similar costs and market shares, both may prefer incompatible standards. If each firm has a comparative advantage in the use of its preferred standard, each knows that it will lose market share by adopting the other standard. Equilibrium is therefore likely to be reached only where the two use incompatible standards. The suppliers might then use

Message flows for a cash equity trade



This box describes the typical flow of information between a fund manager (FM), broker-dealer (BD) and global custodian (GC) during the course of a typical client-side, on-exchange cash equity trade. This transaction is likely to be mirrored by a market-side trade between the BD and a market-maker, unless the BD is trading on its own behalf.

Independent of the trade

- Many data fields do not change from trade to trade, and so can be separated from the message flow. An interpretation of such 'static settlement data' might include trade date; settlement date; security description; time of trade; traded currency; settlement currency; commission details; indication of agency/principal/agency cross; local fee; local taxes; net consideration; fund allocation information; broker settlement details; and institutional settlement details.(1)

Pre-trade

- *Indication of interest* (IOI)—(BD to FM). IOIs market securities that the BD is buying or selling either in a proprietary or agency capacity. BDs send many more IOIs to FMs than they expect to be taken up, as an advertisement of the liquidity that they can offer. They are distributed to multiple FMs.

- *Request for quote*—(FM to BD). A FM may request a quote from the BD prior to placing an order.

- *Quote*—(BD to FM). This can be used either in response to a request for quote, or to publish unsolicited quotes.

- *New order*—(FM to BD). An FM submits an order to a BD for execution. It will typically contain special handling and execution instructions.

- *Execution report*—(BD to FM). The BD may send a number of execution reports, which describe the current state of the order and execution. This information can also be conveyed in fill messages via telephone. The message might confirm receipt of an order; confirm changes to an existing order; relay order status information; relay fill information on working orders; reject orders; or reject post-trade fee calculations associated with a trade.

(1) 'Variable trade data', the data essential to the life cycle of each trade, may include information such as the nominal amount of shares traded; the price; security code; buy or sell information; and account identification. 'Optional data' might include corporate actions; management reporting; currency conversion; lost and stolen securities; and compliance reporting.

Confirmation (post-trade, pre-settlement)

- *Execution*—(BD to exchange) and trade order confirmation (exchange to BD).
- *Notice of execution*—(BD to FM). The BD informs the FM that the transaction has been executed.
- *Allocation*—(FM to BD). Having matched the notice of execution with the original order, the FM informs the BD how it wishes the trade to be split across its sub-accounts (for different investment funds). It can also use this message to communicate fees and other details which can be computed only once the trade has been broken down across the sub-accounts.
- *Contract notes*—(BD to FM). The BD sends a contract note for each sub-account that has received a share of the executed trade. The BD may also deal with commissions, fees and taxes at this stage.
- *Affirmation*—(FM to BD). The FM agrees that the new data are correct.

Settlement

- *Settlement instructions*—(BD to clearing agent; FM to GC). The FM instructs the GC either to deliver or receive specified securities, either against or free of payment. In the case of transactions in overseas securities, the GC may pass these instructions on to a local sub-custodian. The BD sends similar information to its own clearing agent.
- *Settlement execution*—(GC, or local sub-custodian and BD's clearing agent to central securities depository (CSD)). The GC or local sub-custodian, and BD's clearing agent submit settlement instructions to the CSD for matching and settlement.
- *Settlement affirmation*—(CSD to GC, or local sub-custodian and BD's clearing agent). The CSD confirms that settlement has taken place.
- *Statement of settled transactions*—(GC to FM). The GC provides details of all transaction activity that has been received for a specified period and that has been settled. Similar messages can detail all pending transactions, or provide a statement of holdings.

Post-settlement

- Reconciliation. The GC ensures that the underlying securities accounts reflect the trade that has just been executed.
- GC may perform certain value-added post-settlement services to the FM, such as valuation, securities lending and management of corporate actions.

tactics to attract market share, such as giving customers introductory price offers (although this may lead to technical inertia once the initial intense competition has died down) and making a credible commitment to low future price levels.

- **'Battle of the Sexes'.** Both suppliers may agree that competition within a common standard is preferable to having incompatible standards. But if each has a comparative advantage in the use of their preferred standard, reaching agreement on which standard to choose may prove difficult. So the suppliers may adopt initial tactics such as making concessions in return for the use of favoured standards (eg low-cost licensing).
- **'Pesky Little Brother'.** Where the suppliers have different market shares, a consensus may be difficult. A supplier with a large installed base is likely to prefer incompatible standards, in the expectation that the market will tip (or remain) in its favour.(1) A smaller firm or new entrant, however, (as shown in Katz and Shapiro (1985)), is likely to prefer compatibility as this removes the larger firm's installed base advantage. So agreement is unlikely to be reached. Firms can actively prevent compatibility, either by asserting intellectual property rights or by frequently changing technologies.

Process of adoption

A further strand of research stresses cases in which a standard is not agreed because the process of adoption is not optimal. David and Greenstein (1990) set out the four main mechanisms by which standards are adopted in a network industry: (i) gradual adoption through a market mechanism, not sponsored by a firm with proprietary control over the standard; (ii) a market mechanism, where the standard is sponsored; (iii) through a voluntary committee of users; or (iv) through government intervention. In this section, we discuss the first three of these mechanisms. The role of governments in the standard-setting process is discussed in a later section.

- **Unsponsored.** Where no firm has a proprietary interest in the use of the standard, general adoption requires a certain threshold of early-adopter users. If the threshold is not reached, then others will not be persuaded.(2) So suppliers may have an incentive to

(1) The same might occur if the supplier is particularly confident of its technology.
(2) Other than the exceptional case in which every firm is better off under a new standard and there is full information.

give their technology to market participants free, or at a significant discount. In some cases, users that are early adopters may also find it beneficial to give their favoured technology to other market participants. Even if this does not mean that the number of users reaches the critical value, it could nevertheless increase the firm's own processing efficiency by ensuring that their counterparties use a single standard.

- **Sponsored.** Where a supplier has proprietary control over standards, it may seek to lock users into its technology, reducing their incentive to switch in the future. One method of achieving this is by aggressive pricing in early periods. Again, the supplier might consider giving the technology away at an early stage.

- **Voluntary user coalition.** No standard will actually be used in a market unless it fits the needs of users—which the users themselves are in the best position to determine. So in most cases it is better for the users of products (rather than software suppliers, official bodies or third parties) to drive the decision-making process. Most initiatives in financial markets are in practice developed by voluntary coalitions of users. Most of the costs of incompatibility are borne by the users of products. Where the optimal outcome for suppliers is incompatibility, users may have to purchase multiple sets of technology to communicate with a full range of counterparties or clients.

There are problems with standards being determined by such co-operative committees. For example their decisions tend to be less imaginative (in order to maintain consensus). They also tend to be more technically complicated (particularly where suppliers are involved). Committees are likely to recommend a market structure that preserves the interests of all of the coalition members, even where technological change means that other market structures may now be more efficient. Farrell and Saloner (1988) find that committees tend to move less quickly than the market, even if co-ordination may overall be of better quality. If the group's needs are not symmetric, then mechanisms need to be found to bind the minority to the consensus.

XML: the role of new technology

eXtensible Markup Language (XML) is a technological development with potentially profound implications for the standardisation of electronic messages. According to the definitions mentioned earlier, XML is a syntax. XML-based standards can then be created by defining data fields to relate to the particular business needs of a market. XML is being developed by the World Wide Web Consortium (W3C) in California, and is intended to overcome some of the limitations of HTML, the current WWW standard language.

XML is a significant advance on HTML because it describes the meaning of the data, in such a way that a computer can understand their significance. XML distinguishes the definition of content from the style of presentation (the latter is specified in a separate style-sheet written in XSL—eXtensible Style Language). Applications will be able, in effect, to talk to each other. XML is 'extensible'—it allows for the creation of new 'tags' to describe new and unforeseen message fields. This means that new customised XML tags can be created by anyone at any time. The meanings of the tags are described in a separate file known as a 'document type definition' (DTD). So data can be marked up in such a way that their style or format can be read on different platforms.(1)

XML has the potential to address two of the most common failings of standards—that they are either over-engineered and inflexible, or too flexible to constitute a standard. *Ex ante*, XML is highly flexible. Since it is extensible, participants in a particular market can define fields in any way that meets their needs. But *ex post*, XML is rigid. Once specifications have been agreed, messages can be sent only if formatted precisely. In this way, XML-based standards should significantly reduce the need for repairs to transaction details. But for this, users sacrifice the flexibility afforded by the optional fields available in other message standards.

XML's greatest asset may be its ubiquity. The fact that XML is embedded in the wider WWW technology should help it to establish critical mass. Even though most of XML's applications in financial markets will not take place over the public Internet, firms' investment in Internet software and expertise can be re-used for the XML-based closed networks used in financial markets. Virtually every current initiative to establish message standards for financial markets involves XML in some manner. FIX and GSTPA are both developing XML tags. Both new open market standards such as FpML and new proprietary standards are

(1) For instance, the trade details from a simple retail transaction may appear in HTML in the following form, where the tags <H3>, <I> or <B> indicate that the enclosed text should appear in headline type, italic or bold:
<H3>Sale price: £24.95</H3> <I>(Suggested retail: £39.95)</I> <B>Shipping cost: £4.00 UPS Ground</B>
So a computer may be able to interpret how the content should appear. But XML tags actually indicate what the content means. For instance, the same transaction details may appear in XML as:
<PRICE type="sale" unit="GB Pound">24.95</PRICE> <PRICE type="retail" unit="GB Pound">39.95</PRICE> <SHIPPING type="UPS Ground" unit="GB Pound">4.00</SHIPPING>
The meaning of the tags, such as <PRICE type="sale"unit="GB Pound"> are defined in a separate file—the document type definition. An XML-enabled search engine, for instance one looking for the lowest price on the Web for a particular item, can thus readily interpret this information, and recognise that £24.95 is indeed the price at which the good is being offered for sale. An excellent introduction to XML, from which this example derives, is Halfhill (1999).

based on XML. SWIFT's next generation network (swiftML) will also use XML.

However, these different XML standards will not necessarily be able to 'talk to one another' in their present form.(1) One initiative that might help to remedy this incompatibility is SWIFT's planned Standards Repository. The Repository will be an extension of the existing ISO15022 'data field dictionary', for which SWIFT currently acts as registration authority. Both are means of achieving inter-operability between different message standards, by ensuring that a single definition of each particular data field is used. Both will in principle facilitate the translation of messages between different standards. However, the Repository differs from ISO15022 because it maps standards at three levels: the business level (focusing on the understanding of the business processes); the logical level (focusing on the business information that needs to be exchanged); and the physical level (focusing on the messages and their syntax).

SWIFT intends that the Repository will include message types from all wholesale financial markets, and that it will be placed in the public domain. To ensure that it is a success, the Repository will have to be genuinely inclusive of a wide variety of standards and industry bodies. The governance arrangements for the new Repository will pose a particular challenge.

A further initiative to ensure *ex post* inter-operability between standards based on XML is ebXML (electronic business eXtensible Markup Language). This is a joint initiative between UN/CEFACT and OASIS (the Organisation for the Advancement of Structured Information Standards), an international consortium of major software suppliers. ebXML will provide an open technical framework to allow XML to be used in a consistent manner for the exchange of all electronic business data. The partners are seeking to involve a wide range of standard-setting bodies. ebXML faces issues similar to those faced by SWIFT's Standards Repository in its efforts to reach a critical mass of market participants.

Possible effects on market structure

Technology affects market structure by changing the relative costs of conducting a transaction in different ways—within a firm, using intermediaries or in an open market. Coase (1937) provided the classic analysis of the effects of changes in transaction costs on market structure. He argued that 'a firm will tend to expand until the costs of organising an extra transaction within a firm becomes equal to the costs of carrying out the same transaction by means of an exchange on the open market or the costs of organising in another firm'.

Although the current structure of intermediated financial markets will undoubtedly be affected by technological advances, it is not clear which institutions will be affected, and in what ways. For instance, if common message standards used over electronic networks reduce the cost of transactions in the market, there may be more transactions in the market and a lesser role for intermediaries. Indeed, exchanges are developing the technology to admit institutional investors directly. And common message standards such as FIX are increasingly allowing investors direct access to multiple pools of liquidity. Will this lead to broker-dealers becoming increasingly disintermediated from markets?

According to another argument, however, the efficiency savings from straight-through processing in financial markets may be more readily implemented within individual firms, given the difficulties and slowness of co-ordinating a large number of market participants. In other words, the marginal cost of organising a transaction within a firm would fall relative to the marginal cost of an open market transaction. If intermediaries are more efficient at adopting new technology than end-users, or if intermediaries are simply cutting costs faster than the cost of trading in the open market, then end-users will continue to use their services. It is difficult to predict the future structure of financial markets with any certainty, but the role of technology in determining it will be key.

The impact of XML on this process will be of some interest. The principal economic effect of XML may be to reduce switching costs, because it facilitates backward compatibility. In other words, more advanced versions of systems, standards or software will be readily compatible with older systems, standards and software. The costs of moving to a technically superior but still XML-based standard are thus reduced. This means that an industry will be less likely to experience technical inertia. It also means that market participants will be more likely to agree on a common standard because the differentials between firms' switching costs are likely to narrow.

The public sector perspective

The primary justification for public involvement in the standard-setting process is set out in Kindleberger (1983). Kindleberger argues that standards exhibit many of the characteristics of public goods. In other words, there may be a 'free rider' problem, such that no market player is willing to put resources into developing a common standard, even where there would be a social benefit to its adoption. Indeed, as discussed above, there are many situations in which market forces alone do not produce a solution that maximises social welfare.

In theory, central banks and regulators could remedy these market failures by mandating the standards to be used in a

(1) This problem is being addressed by the development of eXtensible Style Language Transformations (XSLT), which is a language for transforming XML documents into documents that use other XML-based standards. XSLT has been designed for use as part of XSL, the stylesheet language for XML, which has two components: transformation and formatting.

market. But public authorities need to exercise this power, if at all, with great discretion. Central banks and regulators may have less technical knowledge than suppliers and less knowledge of user needs than user groups. Moreover, where market participants face asymmetric switching costs, public sector mandate of a particular standard will have a redistributive effect, which should be taken into account.

A less prescriptive approach is for the public sector to set objectives, or criteria that a standard should meet. Market participants are then left to determine how to attain them. For instance, one possible approach to standards could be for central banks and regulators to stipulate that all new standards should be inter-operable. But a danger in adopting this approach alone is that it provides no new incentive for market participants to standardise.(1)

Another possible role for the public sector is co-ordination of market participants. In practice, financial market participants appear to be co-ordinating reasonably well in most cases, notwithstanding the fact that many of the standard-setting initiatives are still at a relatively early stage. Most of the new standards are open and user-driven. And most have the support of the major market players (although this means that progress is rarely fast). Where the different standards consortia overlap in scope, efforts have been made to co-operate. For example, FIX, GSTPA, FpML and SWIFT are working together. So the role for the public authorities seems, at this stage at least, to be limited. But if market participants do experience problems in agreeing common standards, central banks may be in a good position to act as catalysts for collective action.

Conclusions

The development of common message standards is central to the move towards automated processing of trade data and the wider adoption of electronic commerce in wholesale financial markets. This automation is expected to bring significant efficiency gains, as well as a reduction in costs and risk. Initiatives led by market participants to establish common standards have made considerable progress.

But it remains the case that too many trades in today's financial markets are still processed using fax or incompatible electronic networks. Standard-setting bodies continue to face difficulties in their efforts to gain widespread adoption of common and compatible message standards over the life of a trade.

Competitive pressures may force common standards to be adopted more widely if they are associated with new technologies that give market participants new ways to reduce costs or improve services.

The impact of XML, in particular, could be considerable. It has the potential to address some of the traditional failings of standards—that they are either too rigid, and do not reflect the needs of a particular market, or else that they are so flexible that they barely constitute a standard. It may also facilitate technological progress, by reducing firms' switching costs and so lowering barriers to entry and barriers to change. But this is likely to happen only if market participants work together to ensure that the XML-based standards that they create are inter-operable.

The precise ways in which electronic commerce and the development of common message standards will affect market structure in the medium term are difficult to predict. But it is clear that changing technology has the potential to bring about significant changes: to the ways in which markets operate and to the roles of market participants.

(1) Lelieveldt (2000) argues this point in greater detail.

References

Besen, S M and Farrell, J (1994), 'Choosing how to compete: strategies and tactics in standardisation', *Journal of Economic Perspectives*, Vol 8, pages 117–31.

Coase, R H (1937), 'The nature of the firm', *Economica*, Vol 4, November.

David, P A and Greenstein, S (1990), 'The economics of compatibility standards: an introduction to recent research', *Economics of Innovation and New Technology*, Vol 1, pages 3–41.

Farrell, J and Saloner, G (1988), 'Co-ordination through committees and markets', *Rand Journal of Economics*, Vol 19, pages 235–52.

Halfhill, T R (1999), 'XML: the next big thing', *IBM Research Magazine*, No 1.

Hills, B and Rule, D (1999), 'Counterparty credit risk in wholesale payment and settlement systems', *Financial Stability Review*, No 7, pages 98–114.

Katz, M L and Shapiro, C (1985), 'Technology adoption in the presence of network externalities', *American Economic Review*, Vol 75, pages 424–40.

Kindleberger, C P (1983), 'Standards as public, collective and private goods', *Kyklos*, Vol 36, pages 377–96.

Lelieveldt, S (2000), 'Standardising retail payments instruments', in Jakobs, K (ed), *Information technology standards and standardisation: a global perspective*, Hershey Press.

Levitt, A (1996), 'Speeding up settlement: the next frontier', remarks at the US SEC Symposium on risk reduction in payments, clearance and settlement systems, 26 January.