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## **1 - Introduction**

Information technology (IT) has been through a constant and fast development since the invention of the first computers, nearly 60 years ago. From the very specialized computers found only in huge organizations in the early 1950s and 1960s, to the personal computer (PC) that today is found in any house and can be used even by children, fundamental changes have taken place. From the first machines designed for numerical applications in science or engineering, to the electronic cash register integrated with computers to automatically update inventories in retail stores, to the Internet and biotechnology, IT has impacted our lives in almost everyway, from education and medicine to business and commerce.

One particular area where the impact of IT has been profound is the financial system. In recent years, financial institutions (FIs) have spent billions of dollars per annum in technologically related expenditures to lower costs by combining labor and capital in a more efficient mix and to increase revenue by allowing a broader array of financial services to be produced or innovated and sold to customers. Risk management is another area where technology has been especially important to financial institutions. Abundant real-time and value added information can help reduce uncertainties and lower the variances employed to guide portfolio decisions.

However all this development also brings also some concerns. As huge sums are transferred electronically each day, and the increase of networks facilitate transfers to relatively unregulated fiscal paradises, white-collar crimes and money laundry are becoming big concerns to financial institutions and, of course, to central banks and other public institutions. Government institutions, especially the ones in charge of regulating and supervising the financial system, have to keep up-to-date with new technologies and trends so they can define rules to protect consumers and financial systems health without breaking the

increasing development caused by technological advances. This awareness is vital to the government's role in guaranteeing the stability and, consequently, the credibility of the financial system. New and modern information systems are required to take real quality data from the inputs of financial institutions, to provide analysts with well-structured and value-adding information. Hence, the old-fashioned idea that some balance sheets in static, pragmatic and isolated information systems can adequately illustrate an institution's financial condition is long since gone. Financial institutions and government agencies need integrated and value added systems, matching data from diverse sources and providing analysis, projections and indicators that will help to identify possible problems, such as risks and/or crimes.

The main purpose of this paper is to explore this subject more deeply, trying to identify the main changes we are facing due to technological innovation and discuss where and how it can add substantial value to the information available in the aim of building a stronger basis for the financial system of a country. The first section will set the scene, by pointing out the main advances and trends that are impacting, or will impact, the way banks and other institutions operate. In the second section, the discussion will be focused on specific responses and consequences of technological evolution in financial systems. Then section 3 will focus on the role of government institutions; the trends in regulation and supervision in the era of the Internet and the increasing importance on information technology as a powerful management tool.

**2 - Technologic framework (fast development of Information Technology)**

The increasing technological development, especially in the field of information technology, has caused what some call the electronic revolution. This revolution can be better visualized if we take a closer look at what has been happening in recent years with hardware (computerized devices), software (sets of programmed instructions that are “run” by the hardware) and one specific area that combines the two previous ones - telecommunications. The amazing developments in these areas, and especially the Internet, have been responsible for an information revolution, bringing the computer to the firms, universities, schools and also to our houses, enabling access to any kind of information at any time for anyone.

This section will talk a little bit about these developments and also about the trends for the future in these areas, to establish a foundation for the following sections that will discuss how it has been affecting specific aspects of the economy and the society, especially the financial system, and the concerns for the government institutions involved in the regulation and supervision.

**Hardware**

Three of the most important IT trends are found in processing power, storage and form factors for IT devices. As you will see, the development in all of them have been amazing, and the continuing increase in their capacities tells us that we are still going to be surprised for a long time.

**Processors:** Every year new PCs can be bought for the same price - or even cheaper - than their predecessors, although they are much faster and more powerful. In the beginning of the 1990's, one processor (or chip) had about one million transistors and in 2000 they reached the mark of thirty million. This exponential growth in the processors' capacity was captured in

Moore's law, that asserts computing power doubles every eighteen months. But how long can Moore's law persist? Although the laws of physics impose some limits, Intel asserts that it can sustain Moore's law through 2017 with current knowledge; this projection implies that an enormous quantity of transistors per processor are still to come, increasing processing speed to amazing levels.

**Storage:** The ability to store and retrieve data has also been developing at a similar fast pace. Storage devices are becoming smaller, cheaper and with enormous storage capacity. This has created the ability to store and recall massive volumes of data, including not only text, but also video, static images and sound, handled in digital form.

**Form factors:** Handheld and wearable IT devices are trends for the future, such as heads-up displays, mobile phones and personal digital assistants (PDAs). Miniaturization will lead to devices that combine all this technology in wearable and embedded computing power that enables anytime/anywhere web connectivity with anyplace in the world. The idea is that no one will need to go to a physical location to turn on a computer and connect to the Internet, as they will be "wearing" their computers and connected through their mobile phones. Although it may look like science fiction, this kinds of portable devices are already being developed in high-tech laboratories, and the forecasts are that they will probably be commercially produced in five or seven years.

## **Software**

Developments in software have also an important task in IT's future, and the focus is in interoperability and portability on one side and in distributed objects and standards on the other. The general trend is that from now on software needs to be portable, because of the speed in which new and different

form factors are invented, and it also needs to be standardized, because it has to facilitate the exchange of information between different form factors and different locations and companies.

**Interoperability and portability:** As the form factors for IT diverge into many new types of devices, interoperability and portability become more and more an economic necessity for the future, as companies cannot develop new software for each new device created. Also, they cannot afford losing all the existing code and developing new ones every time they change to another platform or device. In this context, companies need portable languages and standard sets of programming instructions that can be executed in servers, PCs, mobile phones, PDAs and other handheld devices without modification. They also need software that can interact with other software and data for unplanned exchanges. That is why firms are converging to the trend of writing new systems in portable languages as Java, and even rewriting old ones if they are critical to their business.

**Distributed objects and standards:** Distributed objects and communication standards will enable unplanned exchanges among different software. Objects are a means of representing data (properties) and instructions (methods) with powerful concepts of abstraction and inheritance. Object-oriented programming languages can be distributed in different machines and can exchange information via networks. Standards as “common object request broker architecture” (CORBA) and “common object model” (COM), enable objects to make requests of one another. Network standards, such as “hypertext markup language” (HTML) and “extensible markup language” (XML), are powerful tools to enable easy information exchange among companies, even if they use different hardware devices and different software.

## **Telecommunications**

Most of the trends related to hardware and software that were mentioned depend on the development of telecommunications. The growth of digital and optical networks, satellite communications, mobile cellular phones and the Internet, give us the ability to communicate with anyone and access information from anywhere at any time. All types of data - video, static image, voice, text - can be handled in digital form and transmitted via networks to anyplace in the world in seconds. "Wireless access protocol" (WAP) provides a standardized way for a mobile phone to talk to a server in a mobile network. Wireless technologies are necessary for a real wearable and handheld computing and connectivity. Bandwidth expansion to increase data-carrying capacity and speed, is necessary to achieve real-time applications and services in business, education, medicine, commerce and banking, among other areas.

## **Implications**

These technological advances have created a new concept of computing, making it easy for anyone with a personal computer and a telephone line to be constantly linked to this new powerful media: the internet, which has turned into a massive information dissemination channel. And the consequence is the increase of web-based applications, especially in commerce, business, education and services, with banks and other financial institutions playing an important role in the areas of e-commerce, e-banking, e-business and, more recently, e-bonds. All these e-something terminology (that sometimes make us get tired of them and willing to say that's e-nough) are just to indicate the use of electronic data interchange in each subject, and of course a marketing planned strategy to associate them with the idea of the modern and new. Anyway, what matters is not the terminology but rather the concepts and the changes involved in the way the information technology is revolutionizing these areas. In a world of increasing technological development, being up-to-date and recognizing the perfect time to

explore the profit chain of an innovation can determine a company's success. On the other hand, being current is also important to public institutions because, although the goal here is not profit, information technology can provide regulators and supervisors with value-added information systems that will enable analysts to perform their activities more efficiently and with a lower cost. Hence, information technology may allow supervisors to obtain better data and ask new questions about risk that could not be handled some years ago. If it is achieved, the consequence will be a better and more reliable system, and there will be benefits for the society as a whole.

### **3 - Impact on the Financial System**

The impacts of technological innovation in financial institutions are immense. Increase in profitability due to better administration tools or to economies of scale advantages are incentives to invest in IT, as new and better services, that give customers more efficiency and flexibility in their financial transactions and management, can be the key to increase market share and leverage the profit chain.

#### **Technology and profitability**

For financial institutions, technological innovation is crucial to the efficient management and combination of the two most important inputs, capital and labor, resulting in financial outputs at the lowest possible cost. That's why, in recent years, financial institutions have invested billions of dollars in technology, including computers, information systems, telecommunication and other information technology (IT).

With an efficient technological base, financial institutions can lower costs by combining labor and capital in a more efficient mix and increase revenues by allowing a broader array of financial services to be produced or innovated and sold to customers. Well-chosen technological investments have the potential for increasing net interest margin, improving profitability. Fee income can increase as the FI sells a broader array of financial services due to technological developments, such as cross selling of financial products by having the computer match customers and products directly and over the Internet. Interest expense can be reduced as information systems link the domestic and international interbank lending markets, giving the FI access to a lower-cost funding market.

**The impact of technology on banking services**

Wholesale or corporate customer services largely used technology to provide cash management or working capital services. A lot of technology based services were provided to help corporate clients to improve the efficiency in managing their financial positions, by reducing excess cash balances (that result in significant opportunity cost due to loss of interest) and fulfilling their need of having real-time position of cash or working capital. Controlled disbursement accounts, account reconciliation, funds concentration , electronic funds transfer and electronic data interchange are good examples of these services.

As retail customers also demanded efficiency and flexibility in their financing of transactions, banks invested a lot of money in retail-oriented electronic payments technology and web-based applications. Automated teller machines (ATMs) and home banking Internet portals give customers 24-hour access to their checking accounts, including payment of bills, withdrawals of cash and direct transfer of funds, nationwide and internationally. Other examples of IT based services are point-of-sale debit cards, preauthorized debits/credits, call centers, integrated voice response systems and smart-cards (details in Table 1).

More recently, investment banks have responded to the information technology revolution with a huge variety of initiatives in an attempt to gain an early advantage on the competition. In this case the focus of the new services are Internet based applications, from 24-hour access to stock markets all over the world to equity trading and futures and options. Although this kind of services are still beginning to be developed and offered to customers, in the future, banks may use their capital to underwrite deals, but may not be too much involved in the distribution. In fact some specialists say that it probably will not take long till bond, loan and equity syndication become largely automatic, with issuers mostly doing it for themselves. We will see that after the downturn of e-commerce this point of view has changed a little.

Table 1 - Banks technology- based products and services.

Wholesale banks	Retail banks
<p><b>Controlled disbursement accounts:</b> checking accounts debited in real-time so that corporations have exact net cash positions.</p> <p><b>Account reconciliation:</b> records of each firm’s checks that have been paid by the bank.</p> <p><b>Funds concentration:</b> redirects funds from accounts in a large number of different banks or branches to a few centralized accounts at one bank.</p> <p><b>Electronic funds transfer:</b> overnight payments , automated payment of payrolls or dividends via automated clearinghouses (ACHs) and automated transmission of payments messages by SWIFT.</p> <p><b>Electronic data interchange (EDI):</b> specialized application of electronic mail to transfer and transact invoices and purchase orders, using banks as clearinghouses.</p>	<p><b>Automated teller machines (ATMs):</b> 24-hour access to checking accounts to payment of bills, deposits, transferences and withdrawals of cash, nationwide and internationally.</p> <p><b>Point-of-sale debit cards:</b> transfers funds from customer’s account to the merchant’s account at the time of the purchase using the debit card.</p> <p><b>Home banking:</b> access via Internet to the checking account, including payment of bills, balances and transferences.</p> <p><b>Preauthorized debits/credits:</b> direct payment into bank accounts of payroll checks and direct debits of utility bills.</p> <p><b>Smart-cards:</b> cards with chip storage devices; can be used to store money for transactions or even to increase security in credit or bank cards.</p>

**Incremental and radical innovations in bank services**

The innovations in the wholesale and retail banking services are matter of adapting to new technologies, with positive effects on revenues and costs. In the economic sense, they can be considered “incremental innovation” or “competence enhancing”, which means that the new technology improves the existing capacity of the institution, lowering costs and allowing it to offer better products and services, without rendering existing knowledge obsolete. In other words, this kind of innovation is called incremental because banks had to invest in new equipments, like new computer networks, automated teller machines, new software, and websites among others, but they didn’t have to face a change in the way they do business in a basic sense. Their knowledge of markets and banking operations was not destroyed and, on the other hand, they were able to explore an economy of scale advantage, reducing costs and enhancing revenues.

But the changes investment banks are facing, when investing in web-based solutions to achieve and/or maintain a competitive advantage in this market, are more challenging. Some traditional banks are already talking about a radical change in the traditional model of investment banks and brokerage, as portals offering information and transactions are threatening their traditional role as intermediaries. In this case investment banks are facing a “radical innovation” or “competence destroying”, because as the Internet enables any investor to have access to accurate and abundant financial information and also to buy or sell stocks and bonds without needing the help of consultants or brokers, part of the knowledge and the advantage of these institutions are being dissipated, or “destroyed“. So, different from what happened with wholesale and retail banks, there is a challenge here for the investment management community. As cost per trade collapses thanks to online brokers, more individuals may be tempted to do it themselves, reducing the capacity of these banks to profit from intermediating the transactions, as they have been doing for decades.

*Obs.: The classification of innovation used above is based in one of the static models that focus on the economic sense of innovation and defines two kinds of impact on a firm: incremental versus radical. More details about this and other models of innovation can be found in the book “Innovation Management - Strategies, Implementations, and profits”, Allan Afuah, Oxford University Press.*

## **Risk management**

As we have seen, acceleration in technology that has produced such an extraordinary effect upon economies in general has had a particularly profound impact in expanding the scope and utility of financial products over the last years. Information technology has made possible not only the creation, valuation, and exchange of complex financial products in a global basis (derivatives are one the many products it has inspired) but, also new ways to unbundle risk. This process of acceleration in financial technology has given no sign of approaching an end. Actually, it has been moving at an exceptionally rapid pace, fueled not only by the enhanced mathematical applications produced by our ever-rising computing capabilities, but also by our expanding telecommunications capabilities and the associated substantial broadening of our markets. Finance has a significant share in a country business output, enhancing the process of wealth creation, and also for the role of central banks, as financial institution's risk is always a big concern for these government boards. The words of Alan Greenspan, chairman of the US Federal Reserve Board, give us an idea of the importance of this issue:

*“All the new financial products that have been created in recent years contribute economic value by unbundling risks and reallocating them in a highly calibrated manner. The rising share of finance in the business output of the United States and other countries is a measure of the economic value added by the ability of these new instruments and techniques to enhance the process of wealth creation. The reason, of course, is that information is crucial to the evaluation of risk. The less*

*that is known about the current state of a market or a venture, the less the ability to project future outcomes and, hence, the more those potential outcomes will be discounted.”*

The relation between information technology and risk reducing becomes clear as we can see again in Greenspan’s words:

*“By itself, more abundant real-time information should both reduce the uncertainties and lower the variances employed to guide portfolio decisions. At least part of the observed fall in equity premiums in our economy and others over the past five years may have resulted from a permanent technology-driven increase in information availability, which by definition reduces uncertainty and therefore risk premiums. And because knowledge once gained is irreversible, so too are the lowered risk premiums.”*

But , although information technology can reduce risk by providing a great source of integrated and value-added information and diversifying investments, risk management and uncertainties still depend upon human evaluation process; and perceptions of risk and uncertainty vary widely. Basically the problem is that probability distributions are estimated largely, or exclusively, over cycles, that do not include periods of panic. So, as they fail to capture a secondary peak associated with extreme negative outcomes, they will probably underestimate the likelihood of extreme price movements, and may also underestimate the outcome of these adverse events. Consequently, the benefits of portfolio diversification will tend to be overestimated when the rare panic periods are not taken into account, as in these periods fear and hence disengagement on the part of the investors often lead to simultaneous declines in the values of private obligations, and increases in the values of riskless government securities. This makes clear the importance of risk managers at banks and other financial intermediaries, and their role in considering portfolio dynamics under a variety of

alternative scenarios in their models.

Another question is about the necessity, or recommendation, that financial institutions should set aside somewhat higher contingency reserves or capital to cover losses that will inevitably emerge from time to time when investors suffer a loss of confidence. And the problem is that almost all the time these reserves will appear to be a sub-optimal use of capital. But the question is that it has to be considered as an insurance, and insurance premiums also seem like sub-optimal use of capital, until there is a fire.

So it seems that these reserves are important to prevent losses in panic periods and the matter is the evaluation of the amount necessary to face future uncertainties without reducing too much the rates of return on capital and leverage. This subject will be focused on again in the next section, when we will be discussing the role of government institutions and some examples of models that have been developed and implemented with the help of information technology systems.

The fact is that the emphasis in risk models by itself is not sufficient to guarantee an efficient risk management. It has to be balanced with the experience, skills and judgment of the senior managers and supervisory authorities who have to apply those models. It means that the advent of sophisticated risk models has not made skilled and experienced managers obsolete, just the opposite, their expertise is even more important now in taking advantage of the abundant and value-added real-time information available.

### **Facing the challenges of innovation**

Again we are going to use Mr. Greenspan's words to emphasize how technology is affecting financial services, reducing cost of capital, and consequently increasing profits, but on the other hand, reducing the role of

financial institutions as intermediaries, as information becomes easily and abundantly available:

*“ More fundamentally, technology may be affecting the underlying economics of financial intermediation. One of the profound effects of technology on financial services is that the increasing availability of accurate and relevant real-time information, by reducing uncertainty, reduces the cost of capital. That is to say, the cost of capital is lower for both lenders and borrowers and for banks in their role as both. It is important to a bank as borrower because funding costs are critically tied to the perceived level of uncertainty surrounding the institution’s condition. It is important in the role of lender because a decline in uncertainty resulting from a substantial increase in real-time information implies a reduction in what might be called “knowledge float” - the ability to maintain proprietary information and earn a rate of return from that information with no cost. As you know, financial intermediaries historically have been successful not only because they diversified to manage risk but also because they possessed information that others did not have. This asymmetry of information was capitalized at a fairly significant rate. But that advantage now is rapidly dissipating. We are going to real-time systems, not only with transactions but with knowledge as well.”*

So the challenge financial institutions are facing is that from one side technology is an important tool to help reduce risk and costs and consequently improve profits in the case of wholesale and retail banking, while on the other hand, the same technology improvements are also threatening the traditional bank’s role as intermediaries when talking about investment banks. As Internet portals offer an entry point to applications from FX trading, futures and options, that will enable medium-sized clients to see the heart beat of the markets on their desktops, it is possible that they will not need the help of brokers anymore.

In other words, it is characteristic of the Internet that it can bring people together in new ways, but this is not necessarily a good point for an institution that profits from intermediation. This is especially true of the banks that have claimed advantage from a superior distribution network thanks to large scales teams. On the other hand, for firms that lack such a network of retail brokers , the Internet offers the chance to break out into the broader retail investor base. It means that as a radical innovation, the impact is greater to the incumbents than to the new entrants in the marketing, because while the former have a lot to lose as they need to adjust their structure and teams to the new model, the latter can take advantage of the situation to gain market shares.

Some financial institutions would feel tempted to respond to this disappearing advantage by keeping information, specially adverse information, away from their clients. But that, some specialists say, would be a foolish policy that maybe would bring some short-term gain but almost certainly substantial long-term cost, because whenever it becomes clear that information coming out of an institution is somehow questionable, that institution will pay an uncertainty premium.

Other institutions prefer to bet on their trust and reputation with its clients, that cannot be put on a web site. As Thorkild Juncker, head of JP Morgan's e-commerce strategy unit, says, "as price of generic information goes to zero, the price of expertise goes to the moon". It means that with the dissolution of the integrated banking model, the outsourcing of non-core competences and the automation of much trading and syndication, perhaps the most important asset of any investment bank will be its brand, and the expertise of its team.

This latter point of view is in accordance to what we've said before, that although technology innovation has provided financial institutions and people in general with accurate and abundant information, and sophisticated risk models, the skills and experience of talented managers are also a very valuable input for

financial institutions. Thus, this human capital may be the key point in differentiating one institution from another, as the information will be available for everyone.

Some people also think that perhaps capital markets professionals will one day bill for advice like lawyers or consultants, rather than through day-by-day transactions; others bet that most clients are not willing to work that hard to handle their investments, as they have their own business to worry about, and so they will still need the skills and experience of their consultants and brokers.

Another point of view is that the Internet will force firms to a vertical integration, with each firm concentrating on what it does best, and buying in other elements from specialized outsiders. Rather than perform the traditional series of services, and just get paid for the execution, a bank could charge for those individual elements along the line, where it can really claim a competitive advantage. “Where we do something very well, there is the potential to develop it into a stand-alone business in which we take an equity stake,” said Juncker. To his way of thinking, banks will move from the old competition on all fronts to selective co-operation in many areas. This point of view is in accordance to the theories around radical innovations that say that when the innovation destroys some capabilities of an incumbent firm, this firm is more likely to try to cooperate than to compete. Collaboration among potential competitors can be a strategy in the case of a radical innovation, to create a larger network and therefore make the product more attractive for customers, to split the high up-front costs of development, and also if a standard is important. In the case of incumbents, collaboration can also give the firm time to unlearn the old knowledge and absorb the new one, as new entrants can benefit from not having to develop the capabilities from scratch.

More recently, after the e-commerce bubble burst, banks are beginning to change their minds about the extension of the impact of IT in the brokerage area.

If first they thought that electronic web-based brokers would replace the traditional structure of investment banks, now they bet that the huge floors with hundreds of operators and analysts, with their various computer screens and telephone lines, will continue to be seen in the day-by-day of the stocks and bonds market. It means that although IT plays an important role in the development and modernization of this area, again the point is that human expertise and interaction are still considered very important for customers when they are investing their money. The Internet is an important tool for investment banks, from advertising to distribution but, balancing technology and human skills in an efficient way is the key to gain competitive advantage.

### **Consolidation and convergence**

According to recent reports by the G-10 central banks, IT has encouraged consolidation in the financial systems because institutions tend to merge in order to spread high fixed costs across a large consumer base. As products like credit cards, custody and cash management have low profit margins, consolidation can help financial institutions achieve the high volumes required to take advantage of economies of scale. Mark Sievwright, President and CEO of TowerGroup expressed this view as he said that *"consolidation is not only necessary but inevitable...only a big bank has the money to buy state-of-the-art technology and develop and maintain multichannel delivery systems"*. Some people claim that this process of consolidation is reducing competition in financial services but, on the other hand, bigger and stronger institutions are also less risky. However, being bigger can also mean that in case of a failure the effects in the whole financial system can be much more drastic, what causes some concerns to central banks too.

The G-10 also points out convergence as a trend, as retail banks are adding brokerage to their portfolio of services, pushing investment banks and brokerage firms to offer traditional banking services like bill payment and cash

management. New distribution channels, such as the Internet, are leading to a new era of delivering improved service and convenience to customers, and that is the greatest incentive to convergence. Information technology tools like customer relationship management (CRM) are the keys to convergence's success, as they allow customers to view, access and interact with the set of services that the organization offers.

Account aggregation, an online interface that integrates products, services and tools, is another technology contributing to convergence. Institutions, specially retail brokerages, are using aggregation as a CRM tool

Together, CRM and account aggregation have been the main channel to split the manufacturing and distribution of products and services. This means that institutions are using their online web-based tools to offer not only their own products and services, but also products and services manufactured in other institutions.

### **Implications**

The effects of technology in the financial sector have been very profound, and the outcome seems to have been positive, not only for the financial institutions, but also for countries as a whole. Banks were able to benefit from taking advantage of lower costs and economies of scale and also from the use of information systems to more efficiently manage their businesses. In addition, customers were provided with better services and information, and central banks have better input into the supervision process.

Some concerns arose around the tendency towards consolidation, because it can reduce competition in financial services. Nevertheless, bigger and stronger banks offer less risk to financial system's stability and therefore benefit the society. But being bigger doesn't mean necessarily being stronger, as

increased size will only bring benefits if it allows bankers to reduce costs, improve profits and reduce risk by diversification. On the other hand, as mentioned before, being bigger can mean “too big to fail”, or in other words, can mean big trouble for central banks in the case of a failure.

In this context, risk management systems are also important to the stability and credibility of the financial system, and technology has played an important roll in this area, improving models and risk management systems.

Implications in regulation and supervision of financial institutions or even in its structure are likely to take place. Payment systems are being restructured to catch up with the new technological reality and better adjust to new volumes and complexities of transactions. Real-time is the key word, from answering requests to updating transactions.

In the next section, aspects related to the role of government institutions involved in the regulation and supervision of financial systems will be discussed with more detail. Concerns about crime and fraud risk will also be addressed, especially white-collar crimes and money laundry.

#### **4 - The role of Government Institutions**

Why do all that technological innovations and their effects in the financial systems impact government institutions? Which government sectors are affected by these changes? Do they need to invest in information technology in order to catch up with the development of the financial institutions? What would be the focus of the investment in IT in the government institutions? Would these investments produce value, or in other words, will there be a return from them? These are the main questions being addressed, and hopefully answered, in this section. Of course, the main focus will be on regulation and supervision and, consequently, on central banks.

#### **Impact of the financial system's innovations**

As discussed in section 2, technological innovation has been changing structures of finance and giving financial institutions the incentive to create and introduce new products and services. As a consequence, it is also dramatically increasing the number of financial transactions per day, which means a huge amount of data to be stored and controlled. Not only the volume, but also the complexity of these transactions has increased, as new products and services are created and offered to customers.

Hence, as mentioned before, the old-fashioned idea that some balance sheets in static, pragmatic and isolated information systems can adequately illustrate an institution's financial condition is long since gone. If we want the supervisory system to remain effective in fostering the safety and soundness of the country's financial system, it must adjust to the changing structure of that system.

### Impact on risk management

When talking about supervision, risk management is a core issue. Nowadays, the huge volume and complexity of the information entering risk management systems do not allow a simple analysis of raw data. Risk models need better inputs from the financial institutions and have to provide analysts with qualitative and value added output, projections and indicators that will help to identify problems. This concern can be identified in the following conscious and accurate remarks of Federal Reserve Board Chairman, Allan Greenspan:

*“Inevitably, therefore, we as supervisors are recognizing this reality and have been placing greater emphasis on how well internal risk models are functioning and whether the risk thus measured is being appropriately managed and offset with reasonable hedges. We are also scrutinizing how well an institution is able to tie risk exposures to internal capital needs. We have a long way to go, but this is where competitive pressures and the underlying economic forces are pushing both financial intermediaries and the supervisory system.”*

Hence, another problem for central banks regarding risk management is determining how much of the underlying risk in a financial system should be shouldered by banks, setting aside contingency reserves or capital to cover losses that will inevitably emerge from time to time when investors suffer a loss of confidence. The problem is that these reserves would decrease rates of return on capital and, therefore, the degree of leverage. The losses in return on capital will appear to be a sub-optimal use of capital and, actually, they are, but the issue is that they have to be considered as an insurance, and insurance premiums also seem like sub-optimal use of capital, until there is a fire. As mentioned before, the matter is the evaluation of the amount necessary to face future uncertainties without drastically reducing the rates of return on capital and leverage. Of course, when customers invest their money they want some level of

return on this investment, but, it is a common knowledge that rates of return are directly related to risk rates. In other words, if you want more return on your investment you will have to be willing to undertake more risk ventures, as generally high returns are related to high levels of leverage on capital. Again the words of Mr. Greenspan convey this assumption in a very didactic way:

*“ By its actions in the marketplace and its chosen governmental structure, society reveals its preference for trading off leverage with its underlying risks and economic growth. Few, I presume, would agree that zero leverage is optimum. Fewer would argue that zero leverage is consistent with maximum growth. Yet the dangers of too much leverage are all too evident. (...) The degree of leverage in financial systems is obviously tied to the degree of risk at the margin of lending.”*

#### Impact on payment systems

Besides risk management, technology advances also have a huge impact on a country's payment system. With the increase in the use of electronic methods of payment (automated clearing houses, credit cards, debit cards and electronic transfer of funds) by financial institutions and customers, daylight overdrafts, or negative intraday balances, are other potential sources of instability. Banks must maintain cash reserves on deposit at central banks at specific determined levels. But in traditional payment systems, while banks and their customers send payment messages and borrow funds during the day, settlement occurs by the end of the banking day, when central banks adjust each member bank's reserve account to reflect its net debit/credit position with other banks. This end-of-day reserve position cannot be negative. However, during the day, banks can run into negative reserve balances, depending on the sequence in which its borrow and payment operations occur. So, temporary negative positions can occur, as payment outflow messages exceed payment inflow messages.

Two important aspects arise in this process. First, central banks are implicitly lending banks within-day funds to cover their temporary negative positions, and sometimes they are not even charging these banks interest rates or fees for these daylight overdrafts. Some people could say that this is not a big problem as it is only a cash flow problem that does not cause any damage to the financial system as long as the position by the end of the day is in accordance to the regulations. However, the problem is that if no interest or fees are charged, there is no incentive for banks to economize in these transactions, and as a result, central banks overdrafts loans can be oversupplied. But even if central banks impose controls on this process and charge banks interest and fees, daylight overdrafts would still be possible, and could create some risks. Second, and more critical, is that central banks, while responsible for the soundness and stability of the financial system, guarantee payment finality for every transfer message in the system, in order to prevent an insolvency crisis from spreading throughout financial institutions in case one bank does not honor a payment. This eliminates any risk that a payment message to a receiving bank or its customers would be left short of funds at the end of the day. This means that if one bank were to fail during the day, for example at 3 pm, the central bank would be liable for all the transactions made by that bank until this hour. Of course this is a great risk for central banks and therefore to tax-payers.

A restructuring in payment systems is required to avoid these risks and adapt financial transactions to the real-time imposed by safe and credible financial systems. Borrow and payment messages have to be registered in the moment they occur, updating automatically the banks' position. So, there will be no daylight overdrafts and, consequently, central banks will not face the risk of being liable for transactions made by a bank that fails during the day.

Other impacts and concerns

Cash and checks payments are increasingly being replaced by electronic

methods of payment or exchange and, as a consequence, new problems regarding theft, data snooping, white-collar crime and money laundry have become sources of increasing concern not only for financial institutions, but also for central banks.

As huge sums are transferred across the networks each day and some bank employees have specialized knowledge of personal identification numbers and other entry codes, the incentive for white-collar crime appear to have increased. Some analysts say that “greater bank and regulatory resources will have to be spent on surveillance and employee monitoring as well as on developing fail-safe and unbreakable entry codes to wire transfer accounts, especially as a number of countries have passed data privacy laws” (Anthony Saunders, Financial Institutions Management). However, statistics show that only a very small percentage of white-collar crimes could be attributed to employee sabotage or internal fraudulent attacks.

The development of networks and telecommunications and the facility of transferring money in an almost anonymous way to relatively unregulated fiscal paradises are turning money laundry into a large concern for central banks and other public institutions. And again data privacy laws are obstacles to the efficient control of these obscure activities. Efforts in this area are still a new issue for central banks, which lack specific information systems to control and analyze the information received from financial institutions with more efficacy. Government institutions need new information systems that use networks and information exchanging facilities to match data from different sources, such as central banks, the IRS and federal police, in order to provide analysts with valuable information to trace these illegal transactions.

Consolidation is also a source of some concern about competition in financial services. As the number of banks has fallen as a result of failures and especially mergers, central banks, which must approve mergers, fear that this

process could lead to an overly concentrated financial system where very large institutions could exert some monopoly power. On the other hand, stronger institutions can be much more efficient in delivering financial services, and also less risky. Nevertheless, as mentioned before, being big can also mean being a greater concern in case of failure, as the effects on the whole system could be catastrophic. Hence, the task is to assess how concentrated the financial market can be without hurting customers' interests.

### **Government investment in information technology**

It is clear by now that all the technological innovation in the financial institutions have had significant effects on the role of the government, or more specifically, on central banks, as they are facing new challenges imposed by the ongoing restructuring of the bank industry. *"(...) although information technology by its very nature has lowered risk, it has also engendered a far more complex international financial system that will doubtless bedevil central bankers and other financial regulators for decades to come"*. With these concerned words, Mr. Greenspan points out that besides the clear benefits that information technology brought to reduce risk in financial institutions, it also turned the role of regulators and supervisors into a much more complex activity.

So, investments in technology have to be done by central banks in order to catch up with the development in the private sector. Keeping current with new technologies and trends, and the effects that can be undertaken by financial institutions, is crucial to help central banks in the hard task of defining rules to protect consumers by fostering the safety and soundness of the financial system, without breaking the increasing development caused by technological advances. As the volume and complexity of transactions among financial institutions and customers increases, new and modern information systems are required to take real quality data from the inputs of the financial institutions and to provide analysts with well-structured and value-adding information.

Investments in information technology, such as computers, telecommunication frames, software and training, are essential to provide analysts and policy makers with accurate and value-added information that will enable a better quality analysis of the financial system. The payment system and credit risk are examples of areas where this necessity of new and better information systems is urgent. Money laundry chasing is also a new area that IT can help to improve significantly.

### **Return on investments in information technology**

Assessing the value of investments in information technology, or in other words, if there is a return from these investments is not a very easy question when we are talking about government institutions. As we've discussed previously, financial institutions have been investing huge sums in technology in the last years and the tendency is that these investments will continue for a long time. But in the case of private institutions it is easier to assess the return on these investments, as it helps to increase revenues, reduce costs, improves efficiency in management and therefore is an important instrument to achieve competitive advantage.

There are skeptics who think that corporations are wasting vast sums on IT, but the common sense is that technology have made financial institutions more profitable by enabling more efficient use of capital and labor and the creation of new financial products and services (such as derivatives), and another good result is the reduction of risk. The growth of the economy throughout the technological boom is absolutely astonishing, remaining no doubt about the power of information technology in the leverage of productivity and, consequently, economic growth.

However, in government institutions these effects are not so clear, as central banks do not “grow” and do not profit as a consequence of investing in

technology. Some effects in reducing costs of labor and improving productivity can be measured and are surely positive, but they are tremendously small to face the huge sums in the budget of these institutions for technological expenditures. Nevertheless, the indirect benefits for central banks in improving efficiency in management and providing decision makers with value-added information, even if they can't be measured, they are certainly very important tools to help these institutions to maintain the strength and integrity of the financial system. Hence, the conclusion is that investments in information technology do produce value and that the return on these investments are huge, although most of the times they cannot be appropriately measured and expressed in figures.

## **5 - Conclusion**

The purpose of this paper is to analyze how information technology development has been impacting financial systems and as a consequence, government institutions responsible for maintaining its stability and credibility. This analysis showed that the increasing technological development, especially on information technology and telecommunications, has produced an extraordinary effect in financial institutions, such as wholesale, retail and investment banks, enabling the creation of new products, services, and delivery channels. Innovations have been positive for the financial institutions as they have been able to use them as powerful tools to improve profits and growth and to reduce risk in their operations by providing efficient management systems.

It has been also positive for customers, as new products, services and delivery channels, such as Internet banking, ATMs, preauthorized credit/debits and smart-cards, contribute to their convenience. Another positive effect of this electronic revolution is that it has dramatically expanded the access to abundant and accurate information, which increases the transparency of the financial system.

The analysis also showed a trend towards consolidation in financial services, with a growth in mergers aiming to take advantage of economies of scale by spreading costs across a large customer base. Large and strong institutions are developing as a consequence of this consolidation trend, and it can be positive to reduce the risk in the financial system. We have to be aware that larger banks will not be stronger just because they are large; they have to be able to lower costs, improve profits and reduce risk by diversification. Convergence is another trend, with retail banks offering services that were only provided before by investment banks, and vice-versa. Account aggregation and Customer Relationship Management (CRM), providing integrated interface to products and services, are the tools driving to this convergence.

But these technological changes have also caused some concerns. White-collar crimes and money laundry have become very important threats to financial systems as electronic methods of payment or exchange have enabled the transference of huge sums across networks with relative anonymity. Consolidation is also a source of concern as mergers can lead to an overly concentrated financial system with large institutions that can exert some kind of monopoly power. In addition, being bigger can mean “too big to fail”, or in other words, can mean big trouble for central banks in the case of a failure, as the effects in the whole financial system can be much more drastic.

Another concern for central banks is how to distribute the risk-bearing between financial institutions and the government. It is a common knowledge among policy makers that some capital reserves have to be set aside to reduce the risk of too much leverage on lending. The problem is defining the optimal level for these reserves in order to cover losses in an eventual crisis, without overly reducing the rates of return on capital and leverage. For Alan Greenspan, Federal Reserve Chairman, “to choose the distribution of risk-bearing between private finance and government is to choose the degree of moral hazard” .

Therefore, the impact on central banks has also been profound, as IT has led to a restructuring of the financial system. Huge volumes of transactions with highly complex information have been forcing the investment in IT in order to catch up with the increasing development of the financial institutions. Being current about technological changes and trends is highly important to succeed in fostering the soundness and safety of the financial system, as new information systems are required to provide analysts and policy makers with quality and value-added information that is crucial for their activities. The today’s complexity of the financial system requires a new standard of information systems. It means that, different from the old databases storing and retrieving raw data, new information systems need to incorporate some of the expertise of the technicians and analysts, in order to add significant value to the inputs received from

financial institutions, aggregating and crossing data from different sources into specialized analytical tools.

The key word is real-time, as information systems for financial management and/or supervision have to provide updated and consistent information at any time. As an example, payment systems have to be adapted to update reserve positions when transactions occur, as end-of-day settlements brings the risk of negative intraday balances that can end in losses for the taxpayers in the case of failure of one institution during the day.

The main conclusion is that IT has caused an electronic revolution in financial systems and, as a consequence, in central banks. The effects of this revolution have been positive for the society as a whole, although some concerns had also arisen as it became a much more complex system.

The fact is that IT can no longer be treated as only a cost reducing resource as it is becoming the primary tool for increasing the effectiveness of business and developing new products and services for serving the expanding markets for management information. IT is one of the strategic levers of the firm, and it shapes business strategy through creative combinations with other strategic levers. It means that any decision within a firm or government bureau has to take into account information technology aspects, and also any decision involving IT cannot be made without considering the institutional focus of the enterprise. That is why firms have created the Chief of Information Office (CIO) position, which is in charge of information technology in the firm on a high organizational level, with great influence and interaction with the Chief of Executive Office (CEO). Information technology management has to be directly linked to the higher strategic planning level of the organization, as investments are more likely to produce optimal return if decision criteria comes not only from technical aspects but also from corporate strategy.

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