# Some implications from technological developments affecting the commercial banking business: what happens when "blockers to business" are overcome.

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Abstract

This paper examines some of the implications that technological innovations have had on the retail side of the commercial banking industry in the recent decade. These innovations enabled financial institutions to overcome previous constraining "blockages" to growth and costs savings, such as geographic distances and volume processing obstacles but at the same time also removed many of the previous "blockages" that prevented competitors from invading their turf. The nature of such constraints (or "blockages") has changed as technology changed, and the financial intermediation delivery has changed with it. Although this paper focuses on the innovations relevant to retail banking, many of the implications can be of interest to other aspects of the financial services industry outside the scope here.

While enabling a greater variety of services and improved productivity, technology poses challenges to society since non-banks are often less regulated, compared to depository institutions. As noted in recent studies, despite the free spill-over of information, technology has the potential to increase monopolistic powers of institutions that develop advantages in the use of propriety information and technology. This paper reviews some recent innovations in the financial services industry that have a further potential role in the continuation of the transformation process. One needs to become familiar with them before one can proceed with further contemplation of the challenges that they pose to the banking and non-banking industries. This paper also addresses significant gaps in existing knowledge about the Internet banking landscape. Using information drawn from a survey of national bank examiners, it finds that as early as 5 years ago, while only 20 percent of national banks offered Internet banking in Q3 1999, these transactional Internet banks accounted for 84 percent of the total number of small deposit accounts. Today both numbers are already much higher. An estimated 45 percent of all national banks were offering Internet banking by the beginning of 2001, and today most already do. While most of the growth in new Internet banking was be due to small banks coming online, almost half of all national banks in 2001 had no plans to offer Internet services, while today the majority do. However, Internet was just a step and other products and service are emerging, and Banking institutions are becoming more challenged by those new competitors. The paper's main contribution is its conceptualizing a theory of banking innovations in which technology sensitive assets can enhance and/or substitute non-technology sensitive assets (relationship sensitive assets for example) in way which recognizes the "blocking (constraining) hurdles" which the bank tries to overcomes when applying technology innovations.

## Introduction

While one can conjecture many reasons why banks (and many other institutions) would need to stay current with technological innovations, the following reasons provide a significant (though not the only plausible one) explanation

1) Need to overcome Blockers/Barriers to profitability and growth.
2) Search for a competitive advantage over competitors
3) Need to comply with changing regulatory and social aspects that affect the bank
4) Search for Survival under adversity.
5) Other factors.

Let us examine these reasons:
Blockers/Barriers: For many years the depository institutions have enjoyed a certain level of protection from potential new competitors, in the form of Barriers to Entry such as the requirement for depository institutions to get a Charter. This expensive and complicated process limited the ability of new competitors to easily enter the market of existing institutions. Another Barrier which blocked new competition was the heavy regulatory requirements that were imposed over the years on the depository institution, in response to repeated banking panics and losses to depositors and in the last 60 years, also to government sponsored deposit insurance entities (which ultimately lead to the downfall of FSLIC in 1999 and the 2001 FDIC Improvement Act.)
While finance companies were mostly exempt from such Chartering and regulatory barriers, they mostly lacked the extensive physical presence in the many communities that the depository institutions developed over the years.
Another important blocker is geographic distance between the lender and the borrower. Peterson and Rajan (1995) find , in a study focused on the USA, that banks closer to the borrowing firms have more market power and can price their loans higher, compared to more distant banks. Degryse and Ongena (2005) find in a study of European banks and borrowers (in Belgium) that loan rates decrease with the distance between the borrowing firm and the lending bank and increase with the distance between the borrowing firm and the competing bank. They attribute the price discrimination to transportation costs.
There were distinct differences in the nature and scope of the business of the various depository institutions among themselves. Those differences often were driven by geography, which in turn implied customer loyalty and convenience of service to a “captive audience”. Another barrier/blocker that protected the “old ways of doing business” was the fact that technology was fairly expensive even

before that advent of computers (the process of physical transfer of funds and documents was slower and more expensive) and also the productivity of labor was much lower, thereby making the process and transaction cost much more expensive.
Even after the introduction of computers, the diffusion process of computers usage and programming and applications was fairly slow at first, thereby limiting the new technologies to mostly large institutions. Akhavein, Frame and White (2001) find that larger banking organizations introduce innovations earlier, compared to smaller banks. In many cases, small institutions could not afford the large overhead costs of maintaining an advanced technology and had to pay for them in the form of more extensive Correspondent Banking relationship with larger institutions, since many of the check clearing transactions could have been done through the Federal Reserve or private clearing houses, with less deposits requirements than those which the smaller institutions had to maintain with their larger brethren in return for the technology assistance through the "Correspondent Banking relationship".

2) Discovery costs of new opportunities and identifying where your competitor is 2) Discovery costs of new opportunities and identifying where your competitor is vulnerable and where your relative strength provides strategic advantages which can be exploited and magnified, can be quite high. Although such strategies were possible long before computers and new processing and communications technologies were discovered, their implementation and speed of discovery and implementation were dramatically accelerated as new technologies were developed and made feasible and accessible.

The current study aims to fill that gap. The remainder of this paper proceeds as follows: Section II compares the use of ATM machines and Credit and Debit cards in various countries in the European Union and the USA and Canada. Section III examines innovations such as e banking, and section IV examines other innovations that affect the banking industry. A perspective on the impact of technology related gains on financial services versus various other industries is provided in Section V. The implications of technology for regulators and banks are discussed in Section VI. Section VII presents some conclusions. An appendix follows at the end of the paper, presenting a mathematical model that shows a theoretical basis The empirical data was collected from numerous sources, and in many cases such sources had specific observations taken at some point in time without repetition at other times, so the available information is presented here as best as was possible to obtain from the sources. It nevertheless provides a very informative insight into the evolving trends.

## II A theory insight into how the process of technology supplements and/or substitutes the banking firm's assets

### The Model.

This section presents a model which attempts to synthesize a theory which explains some of the findings presented in the main text of this paper. It provides a theory framework for a bank (or for that matter, it could be extended to non banks as well) to invest in "technology intensive" assets which are defined here as L1, versus "non technology intensive" assets (defined here as L2), and non- risky assets (defined here as G). The model describes a bank investor (used here in singular, but in reality representing in the aggregate, with an underlying assumption of homogeneous expectations) whose income comes from three sources: L1, L2 and G..

These assets L1 and L2 carry risks, which may or may not be interrelated. The risks of the two assets concern the bank, because of their relative contribution to its overall risk exposure. If the bank can not meet its obligation, depositors and other creditors and regulators will step in and cause the bank to reposition the portfolio. Similarly, if profits fall below some required rate of return by the bank, they will close (fold) the portfolio. The bank therefore perceives the relevant risk in this model as the probability of asset ruin that leads to liquidation.

The rate of return required by the investor is externally determined (e.g. by alternative investment opportunities elsewhere), for the bank' perceived risk level.

. The bank's risky assets $L_1$ and L2 are expected to produce yields $l_1$ and $l_2$, respectively. It gets its funds from shareholders who provide equity capital K and from deposits and borrowings, D, and its cost, d, which has to be competitive externally. This is done for simplicity, which somewhat restricts the model, but does not alter its' conclusions. But, funding the borrowing does entail uncertainty, and the shareholders who provide equity K, expect uncertain return, r. This simplification is necessary in order to keep the model focused on the two risky assets, technology intense and technology non-intense assets

The bank also has risk-less investments G yielding a rate, $g$, and owes liabilities (deposits and borrowings), $D$, with a cost rate of $d$. Investors provide capital, $K$, and expect that their wealth will be maximized by their investment strategy. The balance sheet constraint is:

a) $$L_1 + L_2 + G = D + K.$$

If we lump all risky assets together, the profit function is defined as:

b) $$\tilde{\pi} = L\ell\tilde{x} + gG - dD,$$ and

The bank is defined in this model as bankrupt when $\tilde{\pi} \leq 0.$ The bank is assumed to have access to domestic and global sources of capital *D* in its preferred currency, and is assumed to not distinguish between their origins. Now, let us define also $\hat{\pi} = 0,$ as the bankruptcy threshold, where:

c) $$\hat{\pi} = L\ell\hat{x} - dD + gG = 0.$$

Thus the critical *x* for the bankruptcy threshold is defined as:

d) $$\hat{x} = \left(dD - g\left(D + K - L\right)\right) / L\ell$$

$= \left(d - g\right)D + \left(L - K\right)g / L\ell$, or

e) $$\hat{x} = \frac{g}{\ell} + \frac{D\left(d - g\right) - gK}{\ell L},$$

where

$G = D + k - L$

from the budget constraint has been substituted into equation (3). In this model, the investor stays in the game as long as $\tilde{x} \geq \hat{x}.$ The probability for this condition is

$$0 \leq \int_{\hat{x}}^{1} \phi\left(x\right)dx \leq 1,$$

and the probability for bankruptcy is

$$\int_{0}^{\hat{x}} \phi\left(x\right)dx = 1 - \int_{\hat{x}}^{1} \phi\left(x\right)dx.$$

Bankruptcy here occurs when

$\tilde{\pi} < 0,$

namely when total current receipts on risky and risk-less assets are insufficient to pay total current interest on liabilities.

The expected value of $\tilde{x},$ is

$$\int_{0}^{1} \left(x\right)dx,$$

and has to be greater than $\hat{x}$ for positive profits to exist. Therefore, the bank has to push $\hat{x}$ down.

The bank maximizes shareholders' wealth in the following constrained, single-period model, where shareholders (providers of *K*) get a positive return only over the range of non-bankruptcy (namely, the bankruptcy procedures are assumed to reduce shareholder returns to zero):

Equation 1:

$\max \hat{\tilde{\pi}} = \max E(\tilde{\pi} | \tilde{x} \geq \hat{x})$ , s.t.

Equation 2;

$L_1 + L_2 + G = D + K$ (balance sheet constraint).

We can define the following function incorporating the balance sheet constraint via substitution for *G*, as follows:

Equation 3:

$$\hat{\tilde{\pi}} = \left( \ell L \int_{\hat{x}}^{1} \phi(x)dx + g(D + K - L) - dD \right),$$

Taking first order conditions we get:

Equation 4:

$$\frac{\partial \hat{\tilde{\pi}}}{\partial L_1} = \ell \int_{\hat{x}}^{1} \phi(x)dx \cdot \frac{\partial L}{\partial L_1} - g \cdot \frac{\partial L}{\partial L_1} + \ell L \cdot \frac{\partial}{\partial L_1} \int_{\hat{x}}^{1} \phi(x)dx = 0$$ , and

Equation 5:

$$\frac{\partial \hat{\tilde{\pi}}}{L_2} = \ell \int_{\hat{x}}^{1} \phi(x)dx \cdot \frac{\partial L}{\partial L_2} - g \frac{\partial L}{\partial L_2} + \ell L \frac{\partial}{\partial L_2} \int_{\hat{x}}^{1} \phi(x)dx = 0.$$

Subtracting equation (4) from equation (5) and eliminating *g*, we get:

Equation 6:

$$0 = 0 + \frac{\ell L}{\frac{\partial L}{\partial L_1}} \cdot \frac{\partial}{\partial L_1} \int_{\hat{x}}^{1} \phi(x)dx - \frac{\ell L}{\frac{\partial L}{\partial L_2}} \cdot \frac{\partial}{\partial L_2} \int_{\hat{x}}^{1} \phi(x)dx.$$

After canceling out *L* and rearranging, we get:

Equation 7:

$$\frac{\partial L}{\partial L_1} / \frac{\partial L}{\partial L_2} = \frac{\partial}{\partial L_1} \int_{\hat{x}}^{1} \phi(x)dx / \frac{\partial}{\partial L_2} \int_{\hat{x}}^{1} \phi(x)dx.$$

In order to evaluate this equation, let us examine some of the model's implicit construction assumptions. Note that the bank in this model is allowed to consume only after satisfying the required return[3] $r_i K_i$ in each period i. Thus, the bank's survival is conditional upon satisfying that requirement. The P probability of that is:

$$0 \le \int_{\hat{y}}^{1} \theta(y)\, dy \le 1 \quad , \qquad (7a)$$

in period 1. After that the bank moves to period 2, where the probability of satisfying the shareholders and creditors in that period is:

$$0 \le \int_{\hat{x}}^{1} \phi(x)\, dx \le 1 \qquad (7b)$$

The bank reinvests at the end of period 1 and for simplicity let us assume that all the net earnings are reinvested (dividend payout will complicate the math but not change the implications) so that their capital in period 2 is:

$$K_2 = K_1(1+r). \qquad (8)$$

If the portfolio survived period 1 (namely if $K_2 = K_1(1+r) \quad where\ \pi_1 \ge r_1 K_1$). The conditional linkage between the two periods provides a dynamic structure with interesting properties that are discussed later.

Footnote (3): The investor can undertake in period 1 less risk than that what is needed to build up the investment endowment. In this case the expected income is expected to be too small and this will make it more difficult for him/her to deliver the required $r_1$. Doing so reduces $C_1$ and failure to deliver $r_1$ gets the agent to die from starvation before entering period 2 or to be too poor to make it through that period. Alternatively, the investor can undertake more risk, thereby increasing the portfolio's expected profitability as well. In that case we require a greater $r_1$ on one hand; whereas, the greater risk (and effort involved) will imply that the investor should increase his/her personal discount rate $r_a$ which he/she applies to future periods. These factors reduce the agent's motivation to increase risk.

Note that survival in this single-period model is assumed to require positive earnings $\tilde{\pi} > \hat{\pi}.$ Otherwise, the bank is assumed to be bankrupt and dissolved; admittedly, these are rather strong assumptions.

Furthermore, the bank views the overall global risky investments as generating the following revenues overall:

Definition e.:

$$L\ell\tilde{x} = L_1\ell_1\tilde{x}_i + L_2\ell_2\tilde{x}_2,$$

Thus, the distribution of $\tilde{x}$ is assumed to depend on the weights $L_1\ell_1 / L\ell$ and $L_2\ell_2 / L\ell$ and on the distributions of $\tilde{x}_1$ and $\tilde{x}_2$. The bank is considering the effects that investments $L_1$ and $L_2$ have on their overall profitability and survival.

Let us examine definition e. By construction of the model, we can define a threshold $\hat{x}$ such that at that level of x the profit is zero, namely, at $\hat{x}$ $\hat{\pi} = L\ell\hat{x} - dD + gG = 0.$ From equation, d we have, by construction,

Equation e.:

$$\hat{x} = \frac{g}{\ell} + \frac{D(d-g) - gK}{\ell L}.$$

The value $D(d-g) - gk$ in definition (e) (equation 8) can be either negative or positive. Let us examine these alternative scenarios: a) The value is negative (namely, by re-arranging, we get $Dd - g(D+K) < 0)$ which implies that the total costs of borrowed funds are less than the "hypothetical" risk-free return on all the capital equity funds available to the bank; Consequently, in the R.H.S. of equation (e), $L$ (which is positive) in the denominator implies that a bounded solution for $\hat{x}$ exists in $L$ (thus $\left[D(d-g) - gk\right] / \ell L$ is negative and increasing $L$ will increase $\hat{x}$, namely increase risk. The negative value scenario further implies that, because of the increase in $\hat{x}$ that an increase in L triggers, the probability of ruin increases and the probability of survival decreases, as shown in the following equation 9a:

Equation 9a: $$\frac{\partial}{\partial L}\int_{\hat{x}}^{1}\phi(x)dx < 0.$$

A bounded solution exists since L would not have to increase indefinitely.

b) The other alternative scenario is that the value is positive (namely

$Dd - g(D + K) < 0)$. This implies that $L$ goes up and $\hat{x}$ gets smaller, as long as the denominator in equation 8 is positive (namely, as long as the bank pays depositors more then what it could earn risk free rate, g, by investing all their capital (K) and funds obtained from depositors (D). This implies an unbounded solution, as increasing risky investments will, in this scenario, will reduce the investor's risk of ruin. If this scenario holds, the value of the probability of survival which is

$\int_{\hat{x}}^{1} \phi(x)dx$ becomes larger as its lower limit of integration is decreased. Consequently,

Equation 9b:

$$\frac{\partial}{\partial L}\int_{\hat{x}}^{1} \phi(x)dx < 0.$$

The above condition is an unlikely scenario and, thus can be ignored. This brings us back to the first scenario, where;

Equation 9a: $$\frac{\partial}{\partial L}\int_{\hat{x}}^{1} \phi(x)dx < 0.$$

Consequently, in the R.H.S. of equation (d), $L$ (positive) in the denominator implies that a bounded solution for $\hat{x}$ exists in $L$ (thus $\left[D(d-g) - gk\right] / \ell L$ is negative and increasing $L$ will increase $\hat{x}$, namely increase risk).

The yield on risky assets $_1$ and $_2$ are assumed to be risk-adjusted and market-determined (a specific CAPM or multi-factor market model can be implied but is not necessary for the solution of this model). Finally, the investor regards $g$ as given exogenously, and adjusts their $D$ and $L$. Furthermore, it is assumed that the investor has access to global sources of funds at a universal rate $d$, and can borrow any amount $D$, after the firm determines its optimal $L_1$ and $L_2$. Although these may seem strong assumptions, they may be realistic for investors in current global capital markets.

At optimal equilibrium (Equation 7), the investor equates the ratio of the marginal changes in total assets from L1 and L2 to the ratio of marginal changes in the probability of survival. We can now return to the resolution of equation 7, from which we get, based on assumption of scenario (a) and validity of equation 9a, the following result:

Equation 10:

$\frac{\partial}{\partial L_1}\int_{\hat{x}}^{1} \phi(x)dx < 0$, and also

Equation 11:

$$\frac{\partial}{\partial L_2}\int_{\hat{x}}^{1}\phi(x)dx < 0.$$

In equation (7) the right hand side has a positive sign (two negative numbers divided produce a positive number). Consequently, also on the left side both the numerator and the denominator must be of identical sign. Hence on the left-hand side of equation 7 we must have,

Equation 12:

$$\frac{\partial L}{\partial L_2} > 0 \text{ and } \frac{\partial L}{\partial L_1} > 0$$ , or

Equation 13

$$\frac{\partial L}{\partial L_1} < 0 \text{ and } \frac{\partial L}{\partial L_2} < 0.$$

Now examine the expression $\frac{\partial L}{\partial L_1}$ since,

Equation 14:

$$L = L_1 + L_2.$$

Therefore, we have:

Equation 15:

$$\frac{\partial L}{\partial L_1} = 1 + \frac{\partial L_2}{\partial L_1}$$ , and

Equation 16

$$\frac{\partial L}{\partial L_2} = 1 + \frac{\partial L_1}{\partial L_2}.$$

Substituting into equation (9) we get,

Equation 17:

$$\frac{1 + \frac{\partial L_2}{\partial L_1}}{1 + \frac{\partial L_1}{\partial L_2}} = \frac{\frac{\partial}{\partial L_2}\cdot\int_{\hat{x}}^{1}\phi(x)dx}{\frac{\partial}{\partial L_1}\cdot\int_{\hat{x}}^{1}\phi(x)dx}.$$

Consequently,

Equation 18:

$$\Rightarrow \frac{\partial}{\partial L_1}\int_{\hat{x}}^{1}\phi(x)dx + \frac{\partial L_2}{\partial L_1}\cdot\frac{\partial}{\partial L_1}\int_{\hat{x}}^{1}\phi(x)dx = \frac{\partial}{\partial L_2}\int_{\hat{x}}^{1}\phi(x)dx + \frac{\partial L_1}{\partial L_2}\cdot\frac{\partial}{\partial L_2}\int_{\hat{x}}^{1}\phi(x)dx$$ , and

Equation 19:

$$\Rightarrow \left[\frac{\partial L_2}{\partial L_1}\cdot\frac{\partial}{\partial L_1}\int_{\hat{x}}^{1}\phi(x)dx - \frac{\partial L_1}{\partial L_2}\cdot\frac{\partial}{\partial L_2}\int_{\hat{x}}^{1}\phi(x)dx\right] + \left[\frac{\partial}{\partial L_1}\int_{\hat{x}}^{1}\phi(x)dx - \frac{\partial}{\partial L_2}\int_{\hat{x}}^{1}\phi(x)dx\right] = 0.$$

The marginal change in overall risk (in the left-hand brackets), therefore is equal to zero or is positive or negative, depending on the following condition:

Equation 20:

$$\frac{\partial L_2}{\partial L_1}\cdot\frac{\partial}{\partial L_1}\int_{\hat{x}}^{1}\phi(x)dx - \frac{\partial L_1}{\partial L_2}\cdot\frac{\partial}{\partial L_2}\int_{\hat{x}}^{1}\phi(x)dx = 0$$

iff:

Equation 21a$_1$

$$\frac{\partial}{\partial L_1}\int_{\hat{x}}^{1}\phi(x)dx - \frac{\partial}{\partial L_2}\int_{\hat{x}}^{1}\phi(x)dx = 0, \text{ or}$$

iff:

Equation 21a$_{2:}$

$$\frac{\partial L_2}{\partial L_1} = \frac{\partial L_1}{\partial L_2}, \text{ or}$$

iff:

Equation 21a$_{3:}$

$$\frac{\partial L_2}{\partial L_1} / \frac{\partial L_1}{\partial L_2} = \frac{\partial}{\partial L_2}\int_{\hat{x}}^{1}\phi(x)dx / \frac{\partial}{\partial L}\int_{\hat{x}}^{1}\phi(x)dx.$$

The left-hand side of equation 19 is positive if the following condition exists:

Equation 21b:

$$> 0 \text{ iff } \frac{\partial}{\partial L_1}\int_{\hat{x}}^{1}\phi(x)dx - \frac{\partial}{\partial L_2}\int_{\hat{x}}^{1}\phi(x)dx < 0,$$

or it is negative if the following condition exists:

Equation 21c

$$< 0 \text{ iff } \frac{\partial}{\partial L_1}\int_{\hat{x}}^{1}\phi(x)dx - \frac{\partial}{\partial L_2}\int_{\hat{x}}^{1}\phi(x)dx > 0.$$

Relaxing the assumption that $\ell_1 = \ell_2$:

Taking the first derivatives of equation (3),

$$\hat{\hat{\pi}} = (\ell_1 L_1 + \ell_2 L_2)\int_{\hat{x}}^{1}\phi(x)dx + g(D + K - L) - dD$$

(recall that $L = L_1 + L_2$), we get the following first order conditions:

Equation 22:

$$\frac{\partial\hat{\hat{\pi}}}{\partial L_1} = \ell_1\int_{\hat{x}}^{1}\phi(x)dx - g + (\ell_1 L_1 + \ell_2 L_2)\frac{\partial}{\partial L_1}\int_{\hat{x}}^{1}\phi(x)dx = 0$$

And,

Equation 23:

$$\frac{\partial\hat{\hat{\pi}}}{\partial L_2} = \ell_2\int_{\hat{x}}^{1}\phi(x)dx - g + (\ell_1 L_1 + \ell_2 L_2)\frac{\partial}{\partial L_2}\int_{\hat{x}}^{1}\phi(x)dx = 0$$

Subtracting equation 24 from equation 23 and rearranging, we get:

Equation 24:

$$0 = \int_{\hat{x}}^{1}\phi(x)dx(\ell_1 - \ell_2) + (\ell_1 L_1 + \ell_2 L_2)\left(\frac{\partial}{\partial L_1}\int_{\hat{x}}^{1}\phi(x)dx - \frac{\partial}{\partial L_2}\int_{\hat{s}}^{1}\phi(x)dx\right);$$

Therefore,

Equation 25:

$$\frac{\frac{\partial}{\partial L_1}\int_{\hat{x}}^{1}\phi(x)dx - \frac{\partial}{\partial L_2}\int_{\hat{x}}^{1}\phi(x)dx}{\int_{\hat{x}}^{1}\phi(x)dx} = \frac{\ell_1 - \ell_2}{\ell_1 L_1 + \ell_2 L_2}.$$

The above condition states that the investor will equate at the margin the weighted marginal risk contribution from Technology-intense-assets L1 and the non-technology-intense assets L2 (left-hand side of equation 25) to their marginal yield contribution (right-hand side of equation 25). This would be consistent with risk-neutral behavior.

## II. B. Outcome and implications of the Model

We obtain in equations (20)-(21c) a set of special cases. If equations (21a), ($21a_2$) or ($21a_3$) are true, the impacts cancel each other out and no change in overall risk occurs. If equation (21b) is true, then it requires that:

Equation $21b_{1:}$

$$\frac{\partial L_2}{\partial L_1} > \frac{\partial L_1}{\partial L_2} > 0.$$

Similarly, if equation (21c) is true, then it requires that:

Equation $21c_{1:}$

$$\frac{\partial L_2}{\partial L_1} < \frac{\partial L_1}{\partial L_2} < 0.$$

This implies that the technology-intense-assets and the assets which are non-technology intense supplement each other.

We can therefore conclude that we have **Supplementation:** $L_1$ and $L_2$ are supplementing each other. In equation (21b) we have supplementation when: Equation $21b_{2:}$

$$\frac{\partial L_2}{\partial L_1} > \frac{\partial L_1}{\partial L_2} > 0 \text{ (as shown in Figure 1)}$$

.

But this also implies for known properties of supplementation, that:

Equation $21b_{3:}$

$$\frac{\partial L_2}{\partial \ell_1} < \frac{\partial L_1}{\partial \ell_2} < 0 \forall \frac{\partial L_2}{\partial \ell_1} < 0 \text{ and } \frac{\partial L_1}{\partial \ell_2} < 0$$

,

or, restating in absolute terms, we get:

Equation $21b_{4:}$

$$\left|\frac{\partial L_2}{\partial \ell_1}\right| > \left|\frac{\partial L_1}{\partial \ell_2}\right|$$

And,

Equation $21b_{5:}$

$$\left|\frac{\partial L_2^d}{\partial \ell_2}\right| > \left|\frac{\partial L_1^a}{\partial \ell_1}\right| \forall \frac{\partial L_2^d}{\partial \ell_2} < 0 \text{ and } \frac{\partial L_1^a}{\partial \ell_1} < 0.$$

Consequently,

Equation $21b_{6:}$

$$\frac{\partial L_2^d}{\partial \ell_2} < \frac{\partial L_1^a}{\partial \ell_1} < 0.$$

Note that $L_1^a$ and $L_2^d$ define investment opportunity functions abroad and at home, respectively, and $\frac{\partial L_2^d}{\partial \ell_2}$ $\frac{\partial L_1^a}{\partial \ell_1}$ describe marginal investment opportunities in the L1 and L2 markets (presumably, some market opportunities supports L1 and some market opportunities support L2). Furthermore, while this model is focusing on the assets side, in reality the technology implications affect also deposits (and borrowings as well) to a very significant extent. While the extension of the math also to the deposits sensitivity to technology is deferred to a later paper, the implications that follow this model here can be extended also to implications concerning deposits and their influence by technology. The model so far demonstrates that banks (in aggregate) invest in L1 (technology intense assets) when they supplement and enhance the non-technology-intense assets L2 (under the supplementation case) under the above stated conditions, if asset growth there enhances asset growth at the L2. as shown in equation ($21b_2$). For this enhancement, $L_2^{d'}$ would have to be less steep than $L_1^a$ . This supports the synergism effect implied earlier

**The results of the model also suggest that the two types of assets may substitute for each other, namely, the bank moves from assets which are relatively non-sensitive to technology (for example, assets which depend on neighborhood location, labor intensive relationships etc.) to asset which are less dependent on those factors and more dependent on technological innovations, mass marketing and quick delivery and low spreads due to customers ability to compare prices immediately and shop elsewhere. This is the case of the Substitution:**

Substitution: $L_1$ and $L_2$ substituting for each other: In equation ($21c_1$) we have substitution when:

Equation $21c_1$

$$\frac{\partial L_2}{\partial L_1} < \frac{\partial L_1}{\partial L_2} < 0 ,$$

Therefore when:

Equation $21c_2$

$$\left|\frac{\partial L_2}{\partial L_1}\right| > \left|\frac{\partial L_1}{\partial L_2}\right|.$$

This substitution condition implies that:

Equation 21c$_3$:

$$\frac{\partial L_2}{\partial \ell_1} > \frac{\partial L_1}{\partial \ell_2} > 0.$$

Since investment opportunity functions are assumed to be negatively sloping, namely $\frac{\partial L_1}{\partial \ell_1} < 0,$ and $\frac{\partial L_2}{\partial \ell_2} < 0,$ it follows that:

Equation 21c$_4$:

$$\left|\frac{\partial L_2^d}{\partial \ell_2}\right| < \left|\frac{\partial L_1^d}{\partial \ell_1}\right|;$$

Or,

Equation 21c$_5$:

$$0 > \frac{\partial L_2^d}{\partial \ell_2} > \frac{\partial L_1^a}{\partial \ell_1}.$$

When yields on assets are declining (relative to the cost of D) the investor will go to L1 because of the greater return growth potential there, substituting it for L2 investments. No synergy is apparent here. The opposite occurs when yields rise, for a given shift in supply of resources.

We can summarize these results into the following propositions:

When equation (21b$_5$) is true, capital flow to the L1 technology intense assets and those in turn enhance the other, non technology intense assets L2.

When equation (21c$_5$) is true, Capital which flow to the L1 does in fact substitute capital flow to the L2 (more traditional, non technology intense assets).

**C. Risk Treatment in the Model**

Equation (21b) implies for supplementing $L_1$ and $L_2$, the following condition:

Equation 21b$_6$:

$$\frac{\partial}{\partial L_1}\int_{\hat{x}}^{1}\phi(x)dx < \frac{\partial}{\partial L_2}\int_{\hat{x}}^{1}\phi(x)dx < 0,$$

That is:

Equation 21b$_{7:}$

$$\left|\frac{\partial}{\partial L_1}\int_{\hat{x}}^{1}\phi(x)dx\right| > \left|\frac{\partial}{\partial L_2}\int_{\hat{x}}^{1}\phi(x)dx\right|,$$

Assets, $L_1$, have a larger (negative) effect on marginal safety than assets $L_2$. This would imply that L1 assets are riskier than L2 assets. If we could separate the density functions we would get:

Equation 21b$_{8:}$

$$\int_{0}^{\hat{x}}\phi_1(x)dx > \int_{0}^{\hat{x}}\phi_2(x)dx$$

where $\phi_1(x)$ is the density function of $x$ abroad and $\phi_2(x)$ is the density function of $x$ at home. Thus, the above proposition (I) should be modified as follows:

Proposition I : When $L_1$ and $L_2$ are supplementing assets, the growth in the L1 supplements growth at the L2; but marginal risk in the former is greater than marginal risk at the L2 (thus ensuring a bounded optimal solution for $L_1$ and $L_2$).

As for substituting assets, from equation (21c) we have:

Equation 21c$_{6:}$

$$0 > \frac{\partial}{\partial L_1}\int_{\hat{x}}^{1}\phi(x)dx > \frac{\partial}{\partial L_2}\int_{\hat{x}}^{1}\phi(x)dx,$$

That is:

Equation 21c$_{7:}$

$$\left|\frac{\partial}{\partial L_1}\int_{\hat{x}}^{1}\phi(x)dx\right| < \left|\frac{\partial}{\partial L_2}\int_{\hat{x}}^{1}\phi(x)dx\right|.$$

Thus, if the density function could be separated, then we would get:

Equation 21c$_{8:}$

$$\int_0^{\hat{x}} \phi_1(x)dx < \int_0^{\hat{x}} \phi_2(x)dx.$$

In this case banks perceive risk per unit of return in the L1 to be is smaller than at the L2. Proposition II should therefore be modified as follows:

Proposition II: When $L_1$ and $L_2$ are substituting assets, (L2 asset growth substitutes for L1 asset growth), marginal risk of investing in the L2 index is smaller than marginal risk of investing in the L1.

In this case a bounded solution for $L_1$ and $L_2$ (except for "corner solutions") requires that $\ell_1 < \ell_2$. Otherwise, we get corner solutions (either $L_1$ or $L_2 = 0$). Whenever $\ell_1 \geq \ell_2$, the bank will move out of $L_2$ into $L_1$. Complete substitution or supplementation, however, is rare in real life. Rather, it is likely that some segments of L2 and L1 in the bank's aggregate portfolio enhance each other, while others exhibit substitution. Thus, an in-depth analysis of each case is necessary if an appropriate decision is desired.

Proposition II can therefore be redefined as follows:

**Proposition II**: When $L_1$ and $L_2$ are substituting assets, the L1 (Technology sensitive) asset growth substitutes L2 (low technology assets) growth, and marginal risk in L1 is perceived by the bank to be smaller than marginal risk in the l2. In this case a bounded solution for $L_1$ and $L_2$ (except for "corner solutions") requires that $_1 < _2$. Otherwise we get corner solutions (either $L_1$ or $L_2$). Thus partial substitution of $L_2$ for $L_1$ takes place even when $_1 < _2$. When $_1 \geq _2$ the bank will move out of $L_2$ and into $L_1$. Complete substitution when the investor moves completely out of L2 into L1, but that is unlikely, since as we have already seen, a supplementation effect exists simultaneously.

Another reason can also be that as the L1 may be riskier than originally estimated by the bank, price too high, (risk was under-estimate), a correction would eventually follow, and if it persists it can alter the bank's previous perceptions. Earlier studies discussed above show that investors are slow to fully adjust their beliefs systems due to habit persistence, which is the basis for momentum trends, both whenever stock prices rise and whenever they decline. Thus, at any given time, we may have both, the substitution effect and the supplementation effect, co-existing side by side, with one effect possibly dominating the other for a period of time.

The rest of the paper would present examples of technological innovations in the banking industry and examines their implications, in the context of this model. To a large extent, the examples demonstrate that the innovations enabled the banks to expand their scope of products and services and their sources of funding, in a mix of **substitution and supplementation** of technology intensive and technology non intensive assets liabilities.

**III . Technology impact on information processing and access to funding and product and service delivery and market expansion in banking**:

Recent studies have found that better technology can improve information processing in banking institutions and credit screening and productivity, thus benefiting bank profits. However, it also might lead to free or low cost information spill-over and to low cost delivery of competing services from other banks and non-banks, which in turn can depress bank profits. Thus, as Hauswald and Marquez (2002) and Petersen and Rajan (2002) and Rajan (1996) point out, the net effects of technology on the banking industry pose challenges that are yet to be resolved. Indeed, a study by the Federal Reserve of Philadelphia (Banking Brief, 2001) finds that in 2000, small community banks in the USA have increased deposits and loans twice as much as did large banks (10% and 13% versus 5.8% and 6.42%, respectively). Petersen and Rajan (2002) likewise suggest that technology has improved the ability of a wide cross section of borrowers to obtain funding from lenders, irrespective of distance or of the organizational structure of the lender. Ip (2002) reports that in 2002, banks and thrifts have provided only 19% of the total credit in the economy, compared to 26% in 1990 and 40% in 1980. The increase in the nonblank credit is directly attributable to technological innovations. While enabling a greater variety of services and improved productivity, technology poses challenges to society since non-banks are often less regulated, compared to depository institutions. As those and other studies have found, despite the free spillovers of information, technology has the potential to increase monopolistic powers of institutions that develop advantages in the use of propriety information and technology, as suggested recently by Hausman and Marquez (2002). The latter suggest that predictions about the ultimate effect of technology on interest rate and bank profits hinges on the overall effect ascribed to technological progress. They find that advances in information technology improve the ability to process information of those institutions who invest resources in gathering information, enabling them to obtain higher rents,, compared to competitors who are less advanced technologically. This supports the arguments of Petersen and Rajan (2002), that technology enables competitive advantages that once were the domain of large, metropolitan banks, to different size financial institutions, banks and nonbanks, even in long distance from the borrower.

While significant work on the impact of technology on the American banking industry has begun to appear recently in academic journals, there is still a void in the literature with respect to a descriptive review of technological innovations in several countries that have the potential to further impact the banking industry. The technology factor could for example add further insights into the otherwise comprehensive and important study on determinant factors in bank growth (Cyree, Wansley and Boem, 2000) that looks at bank structure, regulatory environment, performance and balance sheet characteristics.

for technology sensitive assets to supplement and in some cases substitute the bank's other, less technology intense assets.

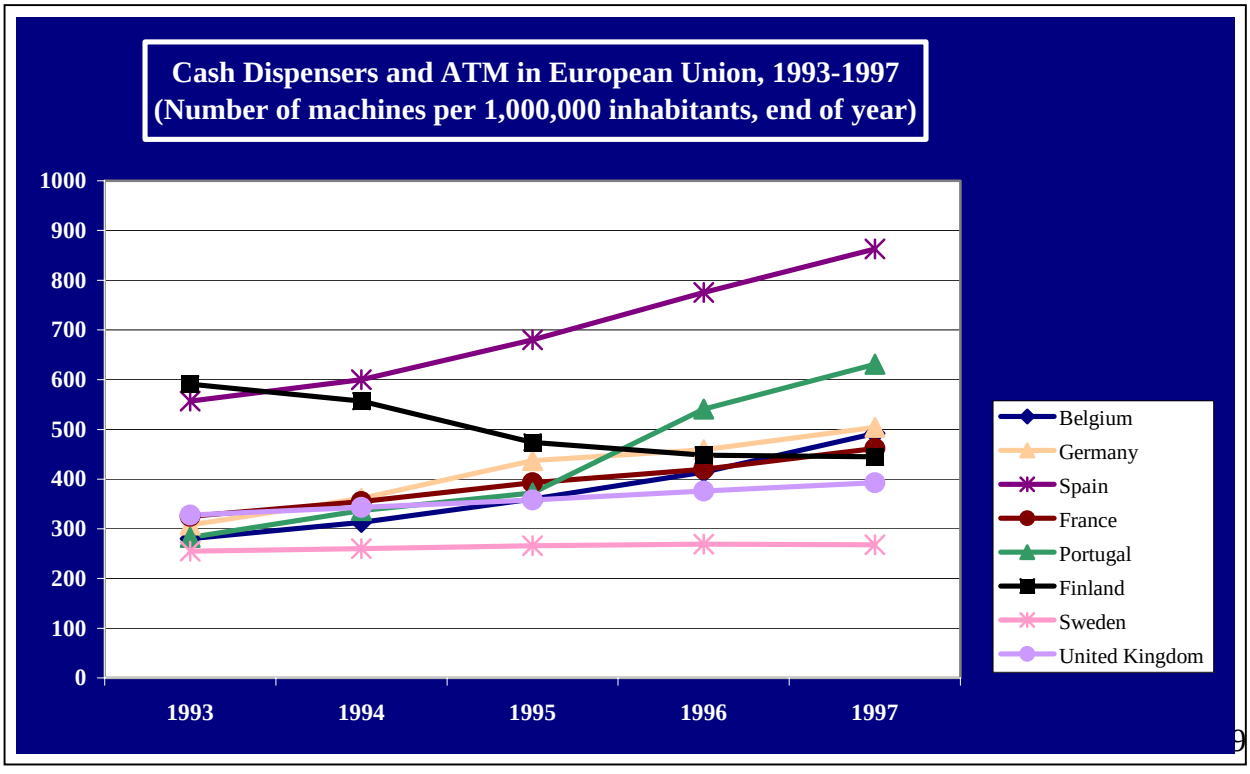
**The growing role of "none traditional "brick and mortar" bank services.**

The banking industry underwent major transformation in the last two decades. The number of banks has been steadily decreasing while bank assets have increased, along with an increase banking assets per bank employee, as FDIC and Federal Reserve data consistently demonstrate. This increase has been accompanied by many technology driven innovations, some of which will be examined in this paper. The increased productivity has enabled the banking industry to provide an ever expanded range of services to customers, despite fierce competition from nonblank financial intermediaries who likewise were driven by similar technology innovations.

For many years banking institutions developed and researched new techniques to improve their services. Electronic transfers, credit or debit cards are some example of how banking institutions have contributed to technological improvements. These original technologic tools were dedicated to better develop the relationship between a bank and its customers, to offer services at anytime, even when the branches were closed. The automatic teller machines (ATM) were developed to allow customers to rapidly access their accounts at any time of the day. The number of Cash Dispensers has increased constantly so people do not have to go to their banking branch to withdraw cash or make deposits.

Insert Figure 1 here.

**Figure 1. Cash dispensers and ATMs in the European Union**



*Source:* Blue Book 2001 from European Central Bank, Payments and Securities Settlement System in the European Union, June 2001, *p548 to p712*

However, the growth is not homogeneous all over the world, as illustrated by the European Community, where there is a major difference between countries such as Sweden and Finland compared to Spain or Portugal. This increase of the number of ATMs for Spain and Portugal could be explained by the specific habits to a country: Spain and Portugal are used to cash in their history because of economic considerations (part of the hidden market for Spain for example, tax issues; Blue Book 1996 from European Central Bank, Payments and Securities Settlement System in the European Union, p184). Even if cash is the main mean of payments in Sweden and Finland, we notice a decrease in the number of ATM for two distinct reasons: in Sweden, the networks are unified among the banks providing cash; in Finland, the value of the transactions paid by cash is weak even the volume of transactions is bigger (Blue Book 2001 from European Central Bank, Payments and Securities Settlement System in the European Union, p531 and p582).
Consequently, the impact of technology and its use throughout different countries with their habits was not identical because it takes into account some cultural background. Definitely, the ATM uses are not exactly the same in Spain or in Sweden, even if it brings more or less the same kind of services.

insert Figure 2 here

**Figure 2. Cash dispensers and ATMs, in the USA, in numbers.**

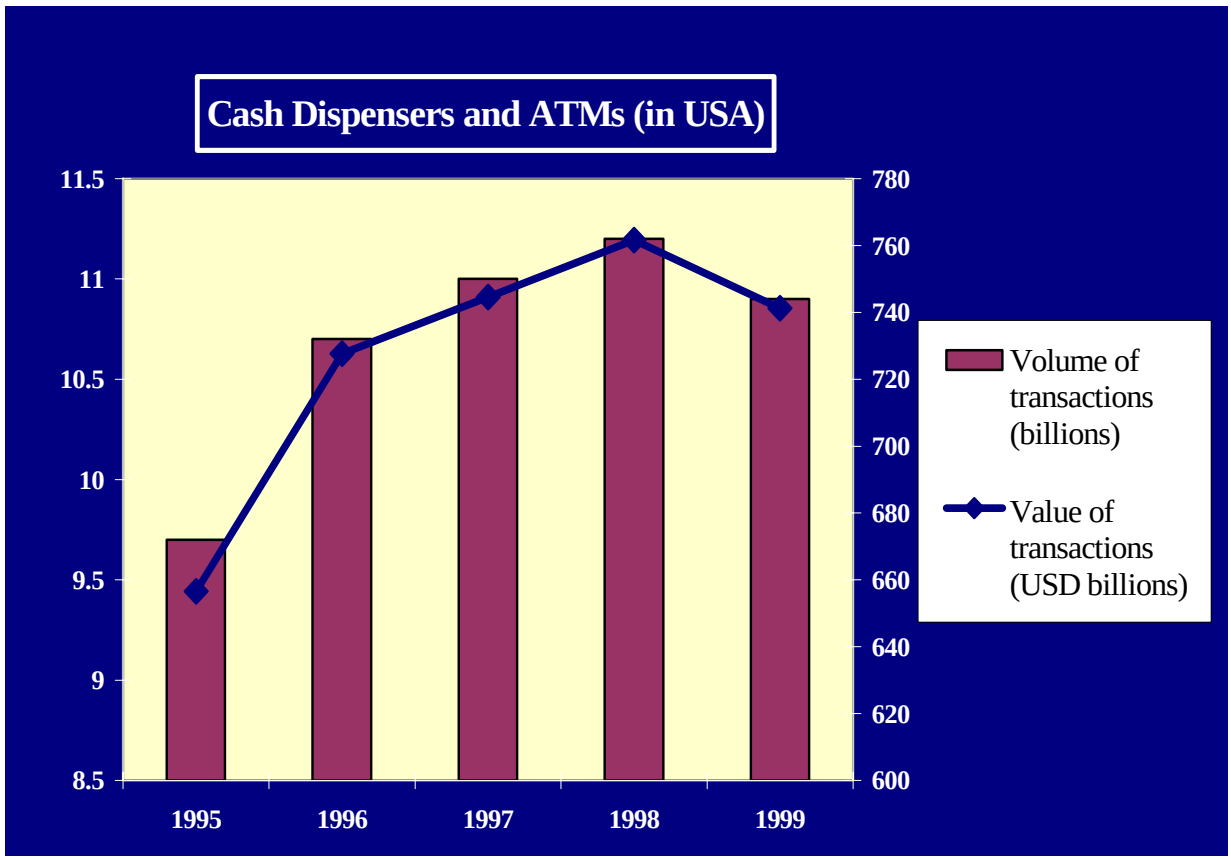
| Cash dispensers and ATMs (in USA) | 1995 | 1996 | 1997 | 1998 | 1999 |
|---|---|---|---|---|---|
| Number of networks[1,2] | 50 | 52 | 49 | 45 | 44 |
| Number of machines[2,3] | 122,706 | 139,134 | 165,000 | 187,000 | 227,000 |
| Volume of transactions (billions) | 9.7 | 10.7 | 11 | 11.2 | 10.9 |
| Value of transactions (USD billions) | 656.6 | 727.6 | 744.6 | 761.6 | 741.2 |

1 The number of networks in 1999 includes eight national ATM networks and 36 regional networks. 2 Year-end figure.
3 Does not include card-activated terminals which do not dispense cash. 4 Transactions include withdrawals and other transactions. Withdrawals are estimated to be at least 70% of transactions.

Source: Bank for International Settlements, Statistics on Payment Systems in the Group of Ten Countries – Figures for 1999, Committee on Payment and Settlement Systems, March 2001

The recent concentration in US banking institutions leads to decrease the number of networks. However, contrary to Sweden and in the same way of Spain, the number of machines increases to provide a high service quality. It could be explained by the fact that the existence of several networks makes the needs of more ATMs relevant: 2 networks in Sweden, one network in France, 44 networks in United States in 1999. When you have one network only, like in France, you can withdraw money from any ATM, whether it is in a supermarket or belongs to a competitor, without having to pay any fee. That is why you rarely see several ATMs closed to each others. On the other hand, several networks will increase the number of ATM for a competitive point of view.

**Figure 3. Graphic illustration of the trend in Cash dispensers and ATMs in the USA**




Source: Bank for International Settlements, Statistics on Payment Systems in the Group of Ten Countries – Figures for 1999, Committee on Payment and Settlement Systems, March 2001

The volume and the value of the cash transactions in the United States, like in Europe, tend to decrease even if update data would be required to be sure of this statement.

Today, however, the relationship between banks and Technology seems to be inversed; banks are now led by technology. Banks used to influence the development of technology; now technology influences the way banks conduct business. The reason resides in the development of alternatives channels to fit the customers' needs through the technology.

The Internet has increased customer's expectation, creating a need for "anytime and anywhere banking" (The Banker, November 1st, 2001). Financial institutions are constantly racing to improve their e-banking system. Nevertheless all the new services have dramatically changed the banking field and reduced the need for bank agencies. Therefore, the future of banking seems to be linked to applications developed to run throughout a personal computer, mobile phones, televisions or Personal Digital Assistants (PDA). These devices were not created to cater to the needs of banking institutions but are increasingly used for such purpose. We can wonder then if technology improvement will result in the elimination of the need for banking institutions.

The payment systems, such as credit or debit cards, have considerably influenced banks. A study conduced by the Federal Reserve in 2000 revealed an explosion in electronic payments. Check payments have fallen from 85% in 1979 to 60% in 2000. Since the last study dates from 1979, it is hard to really evaluate the proportional change. However, Fed Vice Chairman Roger Ferguson said, "We believe the results clearly paint a picture of a payments system in migration" from paper to electronics (Albert B.Crenshaw, The Washington Post, November 18th, 2001,).

Insert Figure 4 here.

**Figure 4. Credit cards in Canada**

| Credit Cards in Canada | | | |
|---|---|---|---|
| **Year** | **Number of Cards in circulation(1) (millions)** | **Average Sales** | **Merchant Outlets(2)** |
| ***1977*** | 8,2 | $30,46 | 271 150 |
| ***1978*** | 9 | $32,50 | 290 692 |
| ***1979*** | 9,9 | $35,72 | 322 115 |
| ***1980*** | 10,8 | $39,47 | 347 831 |
| ***1981*** | 12 | $42,43 | 371 831 |
| ***1982*** | 11,6 | $50,30 | 382 206 |
| ***1983*** | 12,1 | $49,88 | 419 610 |
| ***1984*** | 13,1 | $52,05 | 442 928 |
| ***1985*** | 14 | $51,90 | 527 042 |
| ***1986*** | 15,5 | $55,15 | 571 771 |
| ***1987*** | 17,6 | $58,52 | 642 429 |
| ***1988*** | 19,4 | $61,90 | 646 844 |
| ***1989*** | 20,4 | $66,00 | 709 674 |
| ***1990*** | 23,2 | $67,22 | 786 288 |
| ***1991*** | 24,3 | $67,40 | 857 159 |
| ***1992*** | 24,4 | $69,30 | 896 365 |
| ***1993*** | 25 | $70,50 | 904 689 |
| ***1994*** | 27,5 | $72,40 | 955 993 |
| ***1995*** | 28,8 | $74,51 | 981 851 |
| ***1996*** | 30,2 | $77,80 | 1 076 694 |
| ***1997*** | 31,9 | $82,50 | 1 106 141 |
| ***1998*** | 35,3 | $89,96 | 1 143 110 |
| ***1999*** | 37,7 | $90,35 | 1 139 228 |
| ***2000*** | 40,1 | $95,57 | 1 187 745 |
| ***2001*** | 44,1 | $99,16 | 1 206 779 |

*Source : Canadian Bankers Association, Table includes data from all VISA & MASTERCARD issuers.*

(1) As at last day of fiscal year end, include non-interest bearing

(2) Merchants accepting VISA and/or MASTERCARD. Note that merchants accepted both have been reported by each plan. To estimate # of merchant accepting VISA or MASTERCARD, divide Outlets by 2 and multiply by 1.1.

In the last 25 years, the number of credit cards issued by VISA or MASTERCARD in Canada has been multiplied by more than 8. In 2001, 44 million cards were in circulation for a population of 31,592,805

inhabitants. On average, a Canadian has 1,4 Credit Cards. In the same time, the number of Outlets accepting payments by credit card has increased by 350%. Henceforth, Credit Cards are part of the landscape. This statement is even more accurate in Western Europe, in 1999, for example 47% of payments in Portugal were made by credit card and 37% in Finland (Blue Book 2001 from European Central Bank, Payments and Securities Settlement System in the European Union, June 2001). Credit cards are a real success all over the world. Moreover, in France, the number of transactions by cards (4.8 billion operations: withdrawals and payments) was superior to the number of transactions by checks (4.5 billion operations) for the first time in 2001 (Federation Bancaire Francaise, Newsletter "Actualite Bancaire", April 2002).

Credit Cards are not the only method of payment technology brought. In a recent survey, the Canadian Bankers Association estimated that over 85% of all banking transactions are done electronically. The survey also revealed that over 60% of bank customers do the majority of their banking electronically. Since 1994, telephone banking has grown by 50%, PC and Internet banking by 10% and debit cards by 91% annually (Source: McKinsey & Company Report, The Changing Landscape, 1998). Checks are subject to a wide competition and are less often used for payments. However, checks remain the preferred payment system for consumer-to-consumer payments.

insert figure 5 here

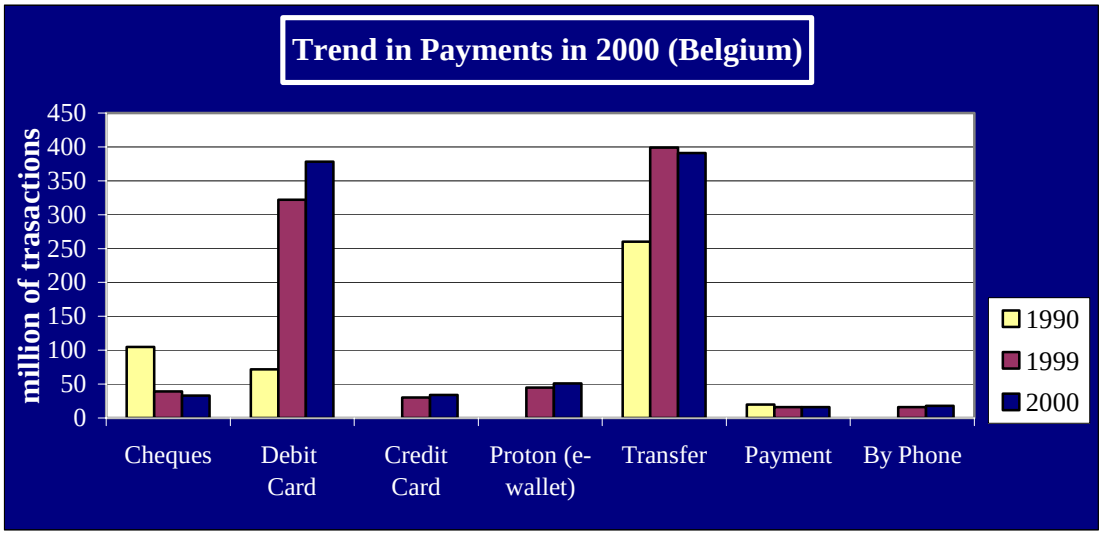
**Figure 5. Trend in payment choices , in Belgium**

| Trend in payments in 2000 (Belgium) | | | | | |
|---|---|---|---|---|---|
| **Number of transaction** | **2000** | **1999** | **1990** | **Variation 1999-2000** | **Variation 1990-2000** |
| **Cheques** | 32,684,694 | 39,568,462 | 105,479,685 | *-17,4%* | *-69%* |
| **Debit Card** | 378,888,616 | 322,517,536 | 72,069,536 | *17,5%* | *425,7%* |
| **Credit Card** | 34,056,010 | 30,104,000 | - | *13,1%* | - |
| **Proton (e-wallet)** | 51,267,114 | 45,470,181 | - | *12,7%* | - |
| **Transfer** | | | | | |
| Free paper | 88,986,671 | 93,750,901 | 101,216,541 | *-5,1%* | *-12,1%* |
| Structured paper | 100,036,695 | 105,904,052 | 63,857,733 | *-5,5%* | *56,7%* |
| Free electronic | 155,607,301 | 154,741,554 | 75,197,556 | *0,6%* | *106,9%* |
| Structured electronic | 19,235,156 | 16,762,559 | 517,120 | *14,8%* | *3619,7%* |
| Permanent Orders | 27,420,740 | 28,255,868 | 19,151,034 | *-3,0%* | *43,2%* |
| **Payment** | 16,476,406 | 16,207,116 | 20,212,529 | *1,7%* | *-18,5%* |
| **By Phone** | 18,788,458 | 16,153,488 | - | *16,3%* | - |

Source: ABB, (Belgian Bankers Association), 2001.

insert figure 6 here

**Figure 6. Graphic illustration of the trend in payment choices in Belguim**

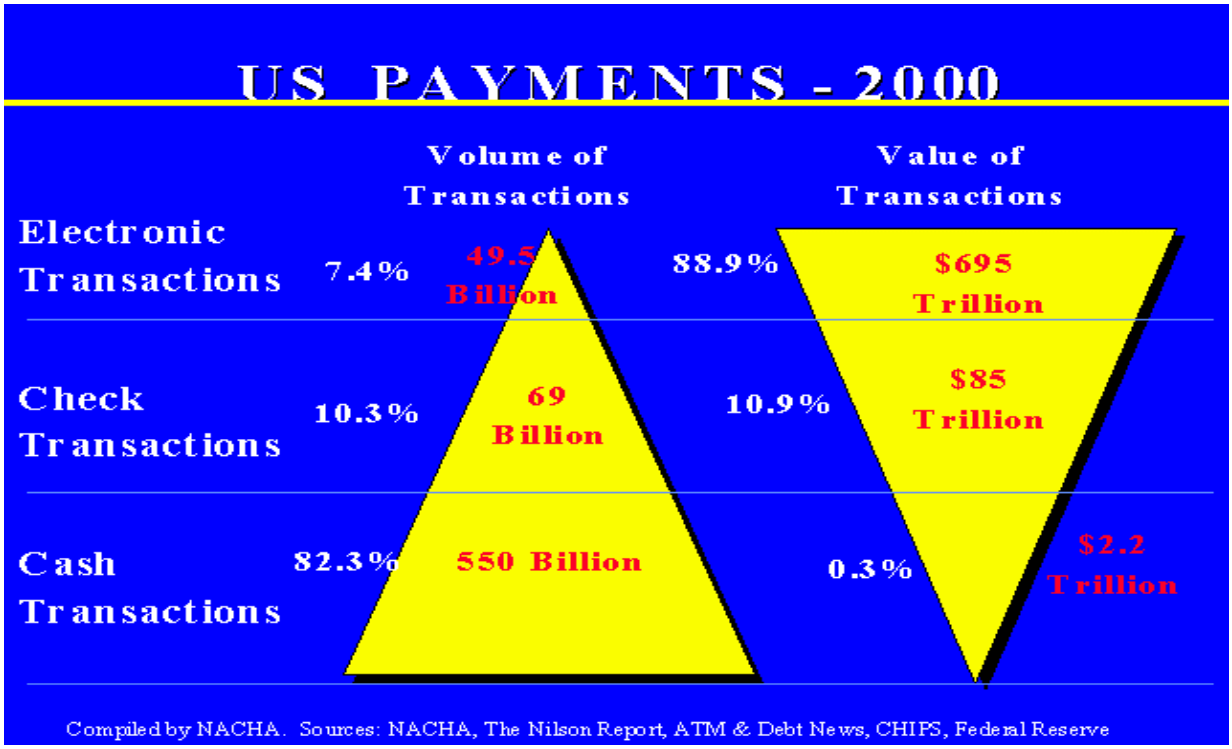



Source: ABB, (Belgian Bankers Association), 2001.

In comparison, the payments in the United States are still done in cash before any other mean of payments. However, the amount of the electronic payments is much bigger than the one of cash payments in the year 2000.

insert figure 7 here

**Figure 7 . Graphic illustration of the volume and value of recent payment choices in the USA**




Source: National Automated Clearing House Association, The Nilson report, ATM & Debit News, CHPIS and Federal Reserve.

## V. E-banking, a new service, more than a mere competitor.

The biggest change is probably coming from e-banking. Before the Internet, banks already started offering new services through telephone and television. In 1989, First Direct was launched by Midland Bank, the first bank without any agencies. All transactions and operations were done by phone. Most of Midland's competitors initially did not believe in that new way of conducting business. However, after considering First Direct success, they all started offering additional services that customers could access from their homes.

insert figure 8 here

**Figure 8 . The number of**

| Statistics at the end of the year | New clients per year | Total Number of clients | Total number of accounts | Call per day |
|---|---|---|---|---|
| **Jan-Apr. 1996** | 70 000 | 641 000 | 1 100 000 | 32 000 |
| **1995** | 110 000 | 586 000 | 800 000 | 26 000 |
| **1994** | 115 000 | 476 000 | 700 000 | 21 000 |
| **1993** | 120 000 | 361 000 | 500 000 | 16 000 |
| **1992** | 105 000 | 241 000 | 350 000 | 11 000 |
| **1991** | 70 000 | 136 000 | 200 000 | 7 000 |
| **1990** | 55 000 | 66 000 | 105 000 | 3 000 |
| **1989** | 11 000 | 11 000 | - | - |

**customers at the USA first e-bank (First Direct), 1989-1996.**

Source: First Bank, 1996

These statistics from First Bank underline an unsatisfied need of customers using financial services: First Bank had more than 1 million accounts in 1996, seven years after its launch. Moreover, it is interesting to notice that the number of accounts grew faster than the number of clients. It could mean that First Bank succeeded in earning the trust of its customers throughout time; customers then opened more than one account.

**British banking and the technological revolution**:

In the nineties, phone services increased all over the British Banking landscape, and the few services already offered were upgraded. The following figure shows the increase in banking by phone in Great Britain since 1985:

Insert figure 9 here.

**Figure 9: The increase in banking by phone in Great Britain since 1985:**

| Service | Launched in | Description |
|---|---|---|
| *CardCall* | Oct. 1993 | Interactive vocal phone service |
| *HOBS* | 1985 | Interactive TV service |
| *Phoneline* | 1985 | Banking operations from home with a telephone |
| *Direct Line* | 1985 | Direct Telephone Insurance service |
| *Direct Banking* | Apr. 1994 | 24 Hours banking telephone service |
| *Speedlink* | 1987 | Telephone transfer with vocal recognition |
| *Phonebank* | Oct. 1994 | Telephone Banking |
| *Actionline* | Sept. 1988 | Information telephone service |
| *Primeline* | Sept. 1991 | High quality phone banking |
| *Touch* | 1995 | Banking operations and Travel services with interactive born |
| *Homelink* | 1983 | Telephone Banking |
| *Customer Service Center* | May-93 | Information telephone service |
| *Armchair Banking* | 1992 | Telephone Banking |
| *Barclaycall* | Jul-93 | Telephone Banking |
| | 1995 | Transfer from computer-to-computer |
| *Telecare* | 1995 | Telephone Banking |
| *Swiftcheck* | | Information telephone service |
| *Home Banking* | 1995 | Banking operations from home with a Personal Computer |
| *Telebank* | 1995 | Banking operations from home with a Personal Computer |
| *Lloydsline* | 1994 | High quality phone banking |
| *Virgin Direct* | Mar. 1995 | Telephone Financial Services |

Source: British Bankers Association

Those services affected the British Banking institutions. Between 1989, the beginning of non-branch banks, and 1995, the number of bank agencies (branches) decreased in Great Britain whereas their assets and their profitability increased.

Insert figure 10 here

**Figure 10. Bank agencies and bank assets and employees in Britain, 1989-1995**

| Retail Banks | Assets (million £) | | Profit (%Net Sales) | | Number of agencies | | Number of employees | |
|---|---|---|---|---|---|---|---|---|
| | *1989* | *1995* | *1989* | *1995* | *1989* | *1995* | *1989* | *1995* |
| **National Westminster Bank** | 116,189 | 166,347 | 0.3 | 1.1 | 2,997 | 2,215 | 86,600 | 61,000 |
| **Barclays Bank** | 127,616 | 164,184 | 0.5 | 1.3 | 2,645 | 2,050 | 85,900 | 61,200 |
| **Lloyds Bank TSB** | 83,023 | 131,750 | -0.7 | 1.3 | 3,722 | 2,858 | 87,500 | 66,400 |
| **Abbey National** | 37,201 | 97,614 | 1.3 | 1.1 | 678 | 678 | 13,600 | 16,300 |
| **Midland Bank** | 62,619 | 92,093 | -0.4 | 1.1 | 2,042 | 1,701 | 47,500 | 43,400 |
| **Royal Bank of Scotland** | 27,436 | 50,497 | 0.8 | 1.2 | 842 | 687 | 20,500 | 19,500 |
| **Bank of Scotland** | 14,073 | 34,104 | 1.3 | 1.3 | 527 | 411 | 12,100 | 11,300 |

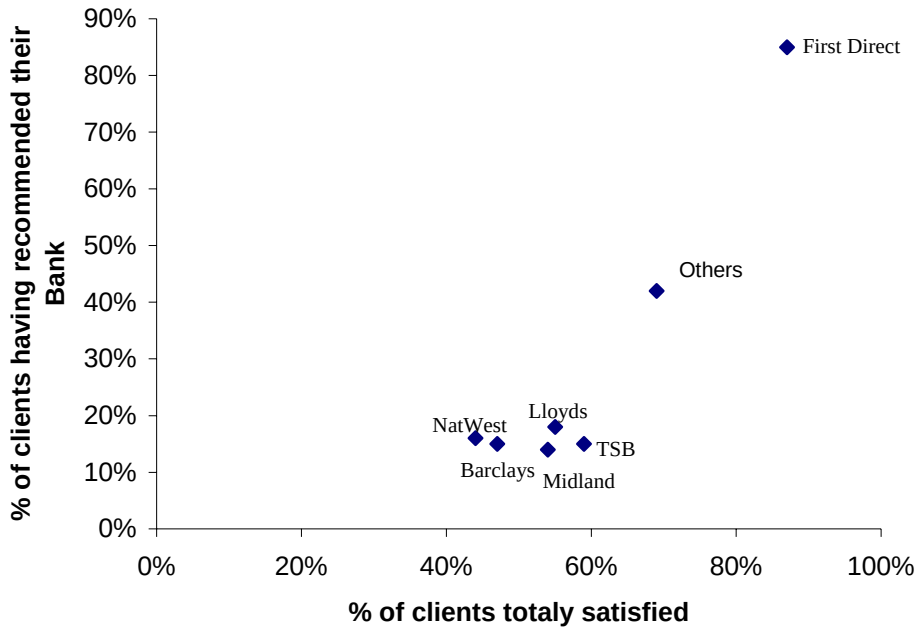
Source: British Bankers Association

However, the decrease in the agencies number cannot be associated to telephone banking only. A large wave of merger also contributed to this phenomenon. In October 1995, Lloyds Bank and TSB merged and bought Cheltenham & Gloucester the same year. In 1995 again, Abbey National bought National & Provincial. Finally, Midland bought HSBC in July 1992.

A possible explanation of First Direct success is its satisfaction rate. Absence of branch does not mean fewer services. On the contrary, according to a survey directed by First Direct between November 1995 and January 1996, First Direct clients are more satisfied with their banks than any other banking customers (see figure 11). Still in 2002, according to the First Direct website, the bank remains the most recommended in the United Kingdom.

Insert Figure 11 here

**Figure 11. Banking clients' satisfaction**




Source: First Direct, 1996.

Such satisfaction rates can be explained several ways. Telephone Banking is operating 24 hours a day, 7 days a week, consequently, operating costs are lower and lower rates are offered to the customers.

Insert Figure 12 here

**Figure 12 .First Direct versus some British banks: Comparison of cards, Annual interest rate (APR) and**
**fees:**

| | *Natwest* | *Lloyds* | *Royal Bank of Scotland* | *Barclays* | First Direct |
|---|---|---|---|---|---|
| ***Card*** | Access/Visa | Access | Visa | Barclaycard | **Visa** |
| ***APR*** | 22,90% | 22% | 21,70% | 21,60% | **19,50%** |
| ***Annual Fee*** | £12 | £12 | £10 | £10 | **None** |

*Source : First Direct, February 1996*

| | *Natwest* | *Alliance & Leicester* | *Halifax* | *Abbey National* | *Barclays* | *First Direct* |
|---|---|---|---|---|---|---|
| ***Interest rate*** | 6,99% | 6,99% | 6,99% | 7,04% | 6,99% | **6,69%** |
| ***APR*** | 7,20% | 7,20% | 7,20% | 7,30% | 7,20% | **6,90%** |

*Source : First Direct, February 1996*

In most of western countries similar banks emerged. In France, Paribas created Banque Directe in March 1994, the first branchless French Bank. In Germany, Citibank launched CitiDirect in September 1995. The same year, in April, Banco Santander installed the first autonomous phone bank with Open Bank. Earlier, in 1988 in the United States Wells Fargo launched Person-to-Person. Chase Manhattan launched Chase Direct, First Chicago Bank had its own First Direct and Huntington Bancshares floated Huntington Direct. Even some developing countries such as Brazil and Kuwait had their direct bank too. Banco 1 launched Unibanco for Brazilian managers; and in August 1990, National Bank of Kuwait introduced Watani National Phone Bank.

The increasing demand for such services was not the only motivation for banking institutions to launch direct phone service. In fact, the main reason is the profile of customers looking for those services. First Direct's customers were not only younger than the customers of more traditional banks; they also belonged to higher social classes and had therefore more revenues.

insert Figure 13 here

**Figure 13. First Direct' customers, by age and gender and professional status**

| | | | |
|---|---|---|---|
| **Age** | ***15-19*** | 2% | 8% |
| | ***20-24*** | 3% | 7% |
| | ***25-34*** | 37% | 20% |
| | ***35-44*** | 34% | 17% |
| | ***45-54*** | 14% | 16% |
| | ***55-64*** | 7% | 12% |
| | ***65+*** | 3% | 20% |
| **Sex** | ***male*** | 56% | 48% |
| | ***female*** | 44% | 52% |
| **Professional Status** (1) | ***AB*** | 45% | 22% |
| | ***C1*** | 35% | 27% |
| | ***C2*** | 14% | 23% |
| | ***DE*** | 6% | 28% |

(1)

| | |
|---|---|
| *A* | *Medium-Higher Class* |
| *B* | *Medium class* |
| *C1* | *Lower Medium Class* |
| *C2* | *Qualified Workers* |
| *D* | *Working Class* |
| *E* | *Minimum wage* |

***Source*** ***: First Direct, 1996***

The “target market” of a First Direct is a man between 25 and 44 years old, who belongs to the medium-higher class. Meanwhile, the traditional British bank customer is more difficult to define since it is a mix of the whole British population.

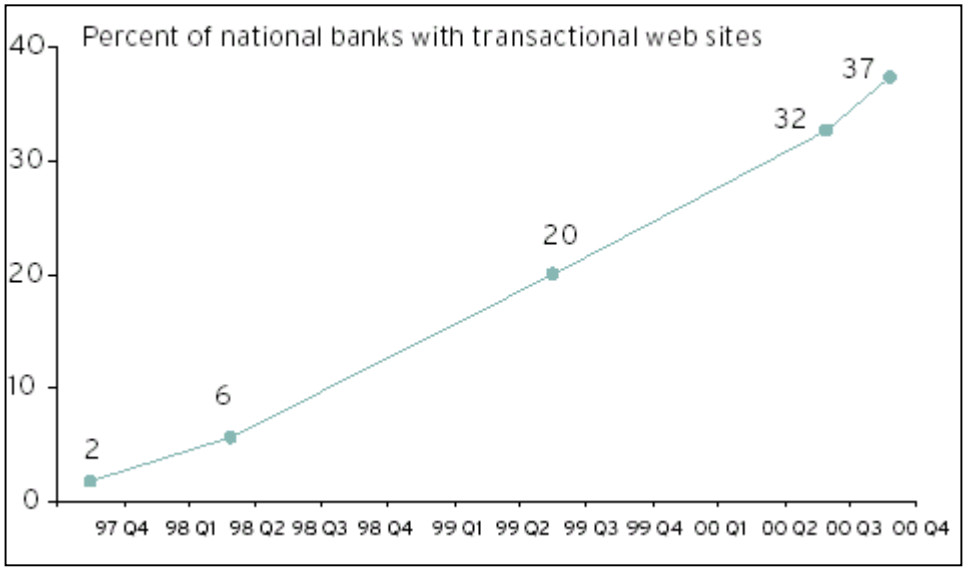
The same results are found with Internet Banking. Now an individual does not need to go to a bank to open an account he can directly do that from his home. His contact with his bank is limited to his personal computer. He can transfer money from one account to another, make payment, give brokerage orders 24 hours a day, 7 days a week without actually going to his bank. The main advantage for the bank is the decrease of operating expenses generated by owning or leasing different buildings. The main difficulty consists in reaching enough clients to make the business model profitable without increasing too much the marketing expenditure. Banking over the Internet has attracted increasing attention from bankers and other financial services industry participants. The reason for this attention is the notion that electronic banking and payments will grow rapidly, more and less in tandem with proliferating e-commerce. Internet Banking refers to the use of the Internet as a remote delivery channel for banking services. Such services include traditional ones, as opening a deposit account or transferring funds among different accounts, and new banking services, as electronic bill presentments and payments. There are two ways banks can offer Internet Banking – a Website established by a “Brick and Mortar” Bank, in addition to its traditional delivery channel or a second alternative is to establish a virtual “branchless” and Internet only bank. Virtual banks however remain rare. In an interview accorded to *Management Magazine* in October 2000, Dung Ramon, Director of Credit Lyonnais Interactif, the second largest Internet banking in France and the subsidiary of Credit Lyonnais,

a traditional bank, revealed that only 5% of the French population is willing to open an account in a 100% virtual bank.

More and more banking institutions are now offering Internet Banking services. Most are just traditional banks using Internet as a new channel of delivery.

insert Figure 14 here

**Figure 14. Percentage of national banks in the USA with web sites**

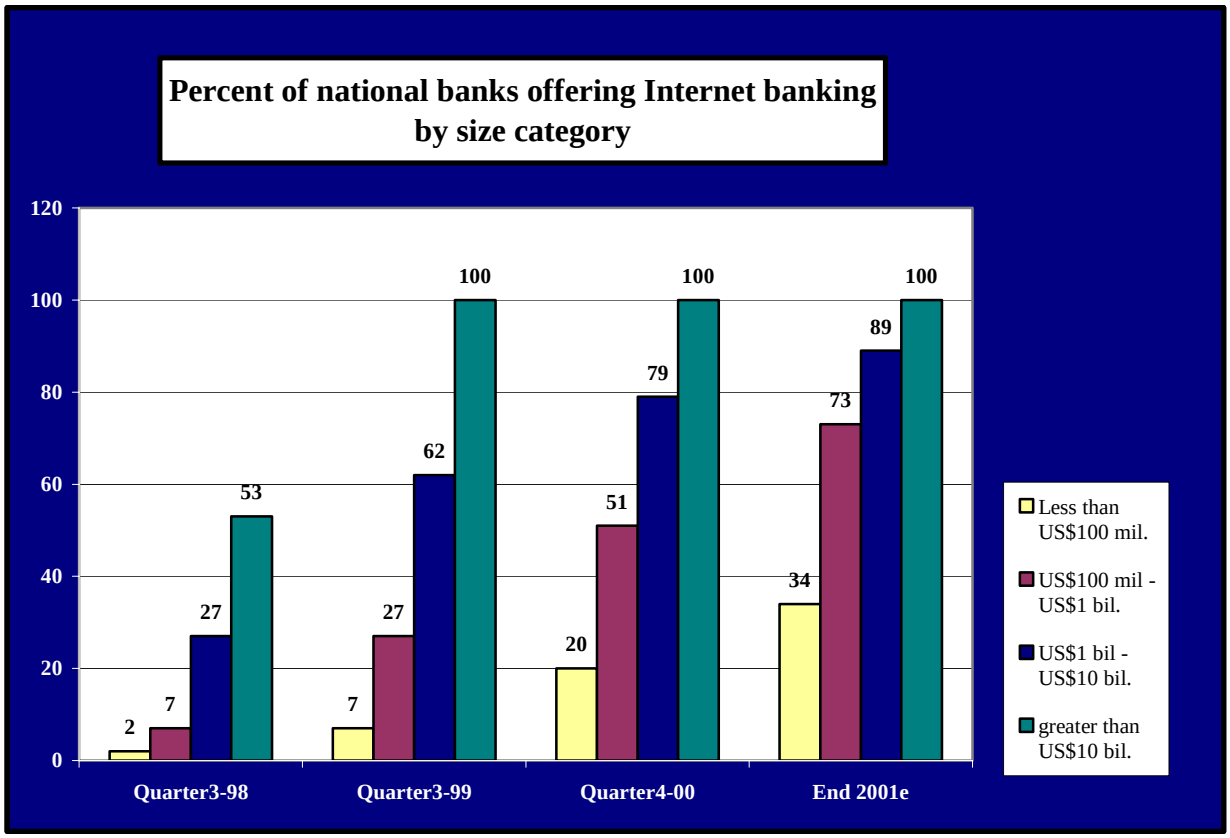



Source: Office of the Comptroller of the Currency.2001

In September 2000, Karen Furst, William W. Lang and Daniel E. Nolle wrote a report on Internet Banking for the Office of the Comptroller of the Currency. They found that only 20% of US national banks offered Internet Banking in Q3 1999. However these Internet banks accounted for almost 90% of national banking system assets and 84% of the total number of small deposit accounts. All of the largest banks offered Internet banking but only 7% of the smallest banks offered it. These numbers are increasing but smaller banks are still a step behind. insert Figure 15 here

**Figure 15. Chart of Percent of National banks in the USA offering internet banking, by Size, as of**

**2001.**




Source: Office of the Comptroller of the Currency, Internet banking in the U.S.: Landscape, Prospects, Industry Implication, 09/2001)

This chart illustrates the gap between the bigger banks and the smaller ones; it takes time for a smaller organization to build an Internet banking channel. According to this estimation, only one third of the smaller banks (less than US$100 million in assets) offered Internet banking in 2001. In contrast, the bigger US banks got into this line of service since the 3rd quarter of 1998.
As a group, transactional Internet banks have, on average, 33 times more assets, 24 times more employees, and 12 times more offices than non-internet banks. Strangely, Internet banks have more employees and offices than non-Internet banks. This suggests that Internet banks are not virtual banks. Internet is more a new service for a "brick and Mortar" bank than the only channel for a branchless bank.

We saw that direct banking through telephone reduced significantly the number of bank agencies (figure 10); however this tendency does not seem to repeat itself with Internet Banking.

The number of Bank branches in Canada between 1987 and 2000 has increased. The year 2000 was the only year the number of agencies decreased for the past 15 years. It seems that if Internet Banking has not induced the same reduction in bank branches than direct phone banking, the effects are still observable. Between 1987 and 1995, the number of branches increased by more than 15%, while between 1995 and 2000, that increased was around 3%.

Insert Figure 16 here

**Figure 16 . Banking branches in Canada, 1987-2000.**

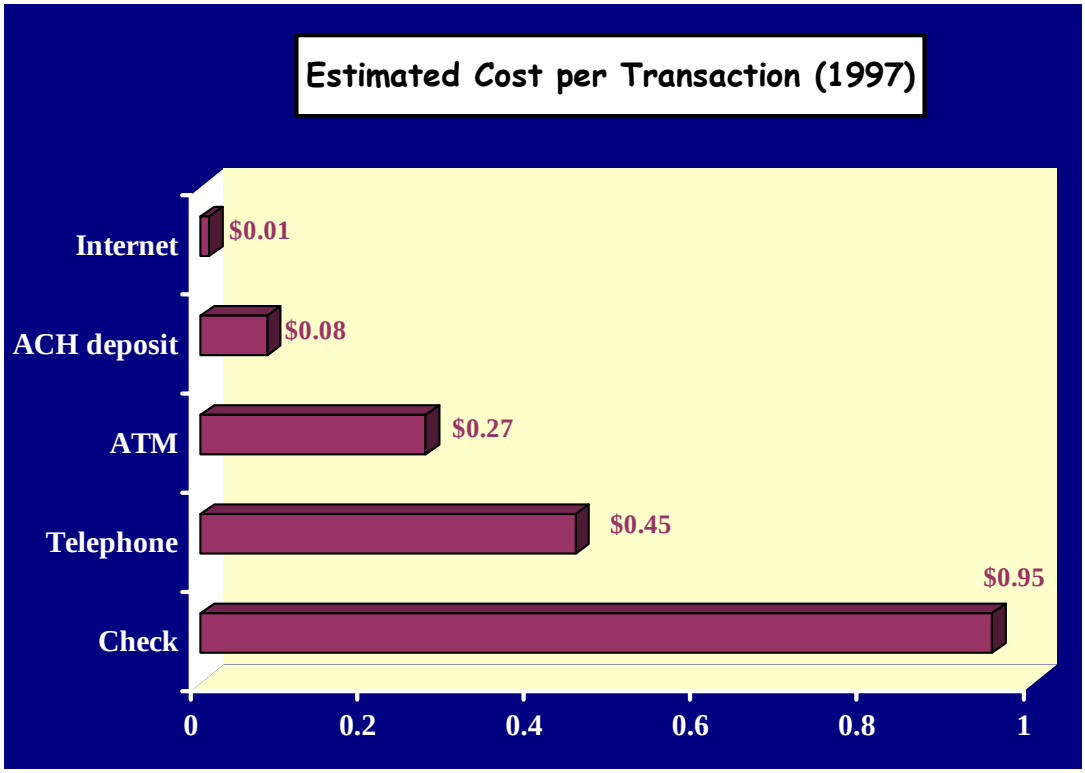
| Bank Branches in Canada | | |
|---|---|---|
| **Year** | **Branches** | **Evolution** |
| ***2000*** | 8,329 | -1,12% |
| ***1999*** | 8,423 | 2,58% |
| ***1998*** | 8,211 | 1,30% |
| ***1997*** | 8,106 | 0,48% |
| ***1996*** | 8,067 | 0,36% |
| ***1995*** | 8,038 | 0,00% |
| ***1994*** | 8,038 | 3,80% |
| ***1993*** | 7,744 | 1,59% |
| ***1992*** | 7,623 | 0,53% |
| ***1991*** | 7,583 | 2,51% |
| ***1990*** | 7,397 | 1,33% |
| ***1989*** | 7,300 | 1,73% |
| ***1988*** | 7,176 | 3,00% |
| ***1987*** | 6,967 | - |

Source: Canadian Bankers Association

Like direct banking, Internet banking could enable banks to reduce costs of operations. In particular, greater reliance on Internet banking might allow banks to reduce expenditures on “brick and mortar”.

insert Figure 17 here

**Figure 17. Estimated Costs per Transaction, for various banking products**

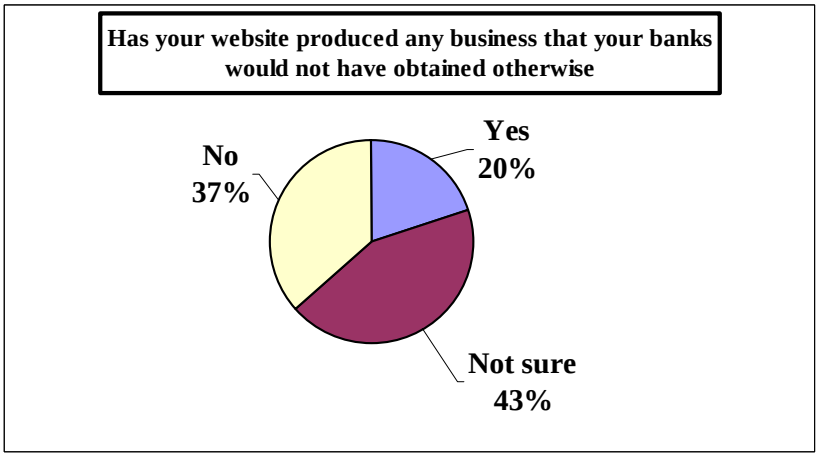



Note: Estimated cost per transaction. For checks, figures are for deposit by check using a bank teller.
Source: Office of the Comptroller of the Currency, using data from Faulkner & Gray (1997) and from the National Automated Clearing House Association (NACHA).
In: Karen Furst, William W. Lang, and Daniel E. Nolle, Technological Innovation in Banking and Payments: Industry Trends and Implications for Banks, Quarterly Journal, Vol. 17, No. 3, September 1998

This chart highlights the competitive advantage from the electronic transactions considering the cost per transaction. Consequently, banks push their clients to increase their electronic transactions so that banks would improve their performance.

insert Figure 18 here

**Figure 18. Chart: banker's estimate of the value of their Web Site for new business, as of 1999.**

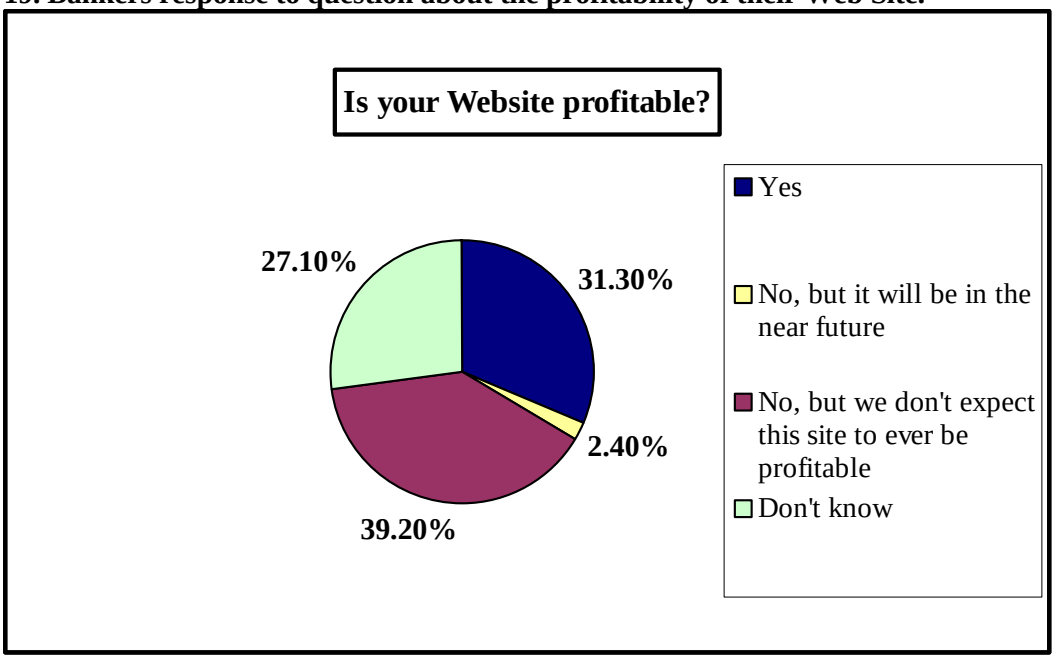



Source: Office of the Comptroller of the Currency, 1999

Few Banks agreed that Internet banking helped them acquire new businesses, which they would not have obtained otherwise. Internet Banking brought younger and wealthier customers but also new businesses.

insert Figure 19 here

**Figure 19. Bankers response to question about the profitability of their Web Site.**



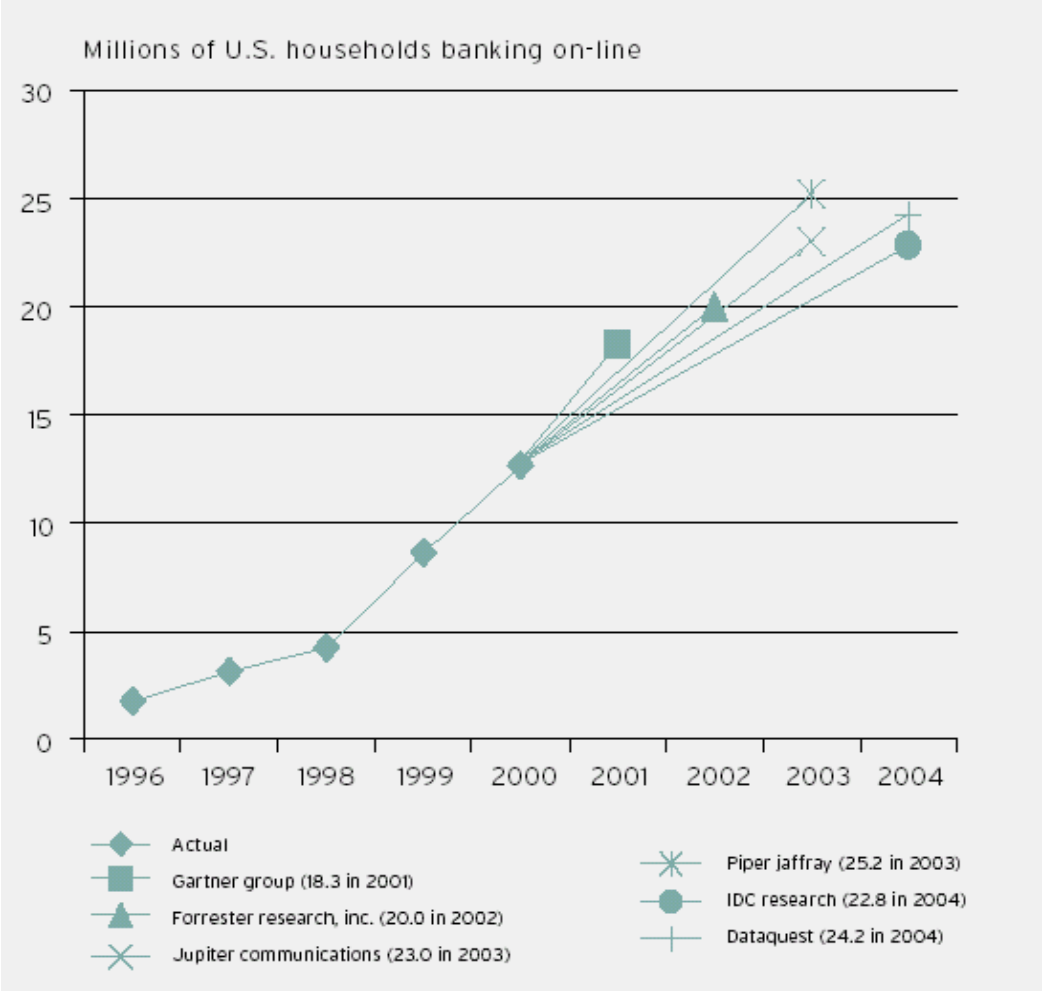

Source: Office of the Comptroller of the Currency, 1999

The conclusion of Furst, Lang and Nolle study (Internet Banking: Development and Prospects, September 2000) was that Institutions with Internet banking outperformed non-Internet banks in terms of profitability. On the other hand, the Community Bank Competitiveness Survey revealed in 1998 that

less than a third of the websites was profitable. Nevertheless the main reason for banks to implement those websites is future growth. Internet banking users are already numerous but everybody expect them to increase considerably.

insert Figure 20 here

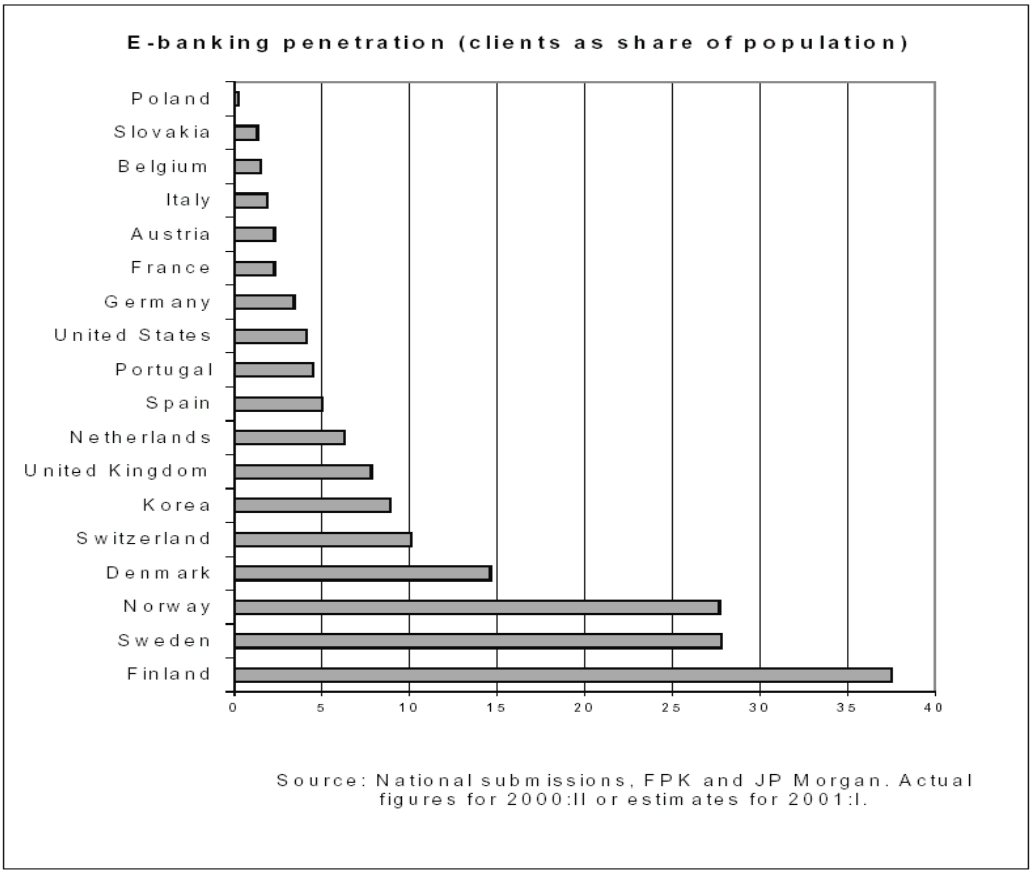
**Figure 20. US households banking on-line**.




*Source:* *Office of the Comptroller of the Currency*

Insert figure 21 here:

**Figure 21 : Penetration of E-banking in various countries** *:*




Source: FPK, JP Morgan,2000

Looking ay the key services offered by Internet national banks (figure 22), the conclusion of Furst, Lang and Nolle study was that Internet banks rely more on non-interest income and less on deposits for funding than do non-Internet banks.

Insert Figure 22 here

**Figure 22; Key services offered by transactional Internet national banks**

| **Type of service** | **Percent of transactional Internet banks offering selected services** | | | | |
|---|---|---|---|---|---|
| | **All banks** | **Less than $100 million** | **$100 million to less than $1 billion** | **$1 billion to less than $10 billion** | **$10 billion and over** |
| Balance inquiry and funds transfer | 88.8 | 74.1 | 90.2 | 94.5 | 100.0 |
| Bill payment | 78.2 | 60.0 | 77.4 | 90.4 | 100.0 |
| Credit applications | 60.0 | 51.8 | 51.7 | 75.3 | 80.5 |
| New account set-up | 36.6 | 29.8 | 43.9 | 45.2 | 43.9 |
| Brokerage | 21.6 | 10.6 | 14.7 | 41.1 | 53.7 |
| Cash management | 15.7 | 14.1 | 16.2 | 15.1 | 17.1 |
| Fiduciary | 11.9 | 3.5 | 9.8 | 12.3 | 14.5 |
| Bill presentment | 10.6 | 7.1 | 7.9 | 16.4 | 24.4 |
| Insurance | 5.4 | 2.4 | 2.3 | 6.8 | 29.3 |
| | | | | | |
| Basic [1] | 77.6 | 56.5 | 77.4 | 90.4 | 100.0 |
| Premium [2] | 23.9 | 14.1 | 17.0 | 41.1 | 58.5 |

Source: Office of the Comptroller of the Currency. (Q3, 1999)

[1]Basic includes balance inquiry, funds transfer, and bill payments

[2]Premium includes Basic and at least three other services.

For all but the smaller, Internet banks have better accounting efficiency ratios and higher returns on equity than non-Internet banks. So far, however, bank customers have not been yet persuaded that Internet banking products and services warrant a substantial change in their banking habits (Furst, Lang and Nolle, Internet Banking: Development and Prospects, September 2000). There is no doubt that the revolutionary developments in information and communication technology will continue to transform

the banking and financial industry. The American Banking Association's Community Bank Competitiveness Survey conducted in April 2001by Steve Cocheo also led to the same conclusion.

For example, the new tendency for financial institutions is to re-evaluate and improve their most trusted consumer-oriented technology: the ATM networks with this new concept of web ATM. Web ATM are offering a wide variety of services including online banking services and Internet access.

All these services have been generated or integrated by banks and do not represent a real threat to their existence. Specific site branches, which do not generate enough revenues, might be in danger to be eliminated. However, it is undeniable that technology has changed the approach people have to banking institutions, and above all, technology has changed the concept of money. Money is dematerialised and people are not shocked or afraid anymore to use e-payment or e-currency. The danger may come from this new payment system. According to Peter Thiel, PayPal co-founder, "money is the ultimate viral product, you can pass it on to other people" (Leslie Walker, The Washington Post, May10th, 2000). If PayPal's Thiel has his way, you will never go to the bank again. For him, we are just one small step from the total elimination of banks. So what are those new payment systems frightening banking institutions?

## VI. Other new technologies challenging the baking institutions

In Europe, several cities are testing a new kind of debit card, the "Smart Cards" as they call them. Each card is equipped with a computer chip instead of a black magnetic strip. Basic designs, equipped with memory chips, function as stored value cards that are loaded with credit by phone or at a cash machine (Keegen and Greene, Global Marketing). The cards can then be used to make purchases or pay for telephone calls. The card is used to pay everything, from bus tickets to clothes; there are no minimum amounts. In fact it is accepted in everywhere, even small grocery stores. How is it different from a debit card? It works like a prepaid phone card, you go to an ATM or make a phone call to credit your card and then you use it to make payments and purchases. The major difference is that the card may be credited by phone; the amount is therefore charged to the phone bill instead of being taken from a bank account. More sophisticated cards can also contain personal information, such as medical records, social security numbers, etc. Doctor's prescription are registered in the chip and sent simultaneously to social services, insurance carrier, and the pharmacists, which in turn reads the card and provides the medication. During this whole process, you never have to pay. The card's owner is debited for the cost of the doctor's consultation and the medications but is also instantly credited by the governmental social security and the complementary personal insurance. The aim of those cards is to reduce the use and transfer of cash. Those Smart Cards are also supposed to be safer than usual cards and are especially dedicated to e-commerce (www.gemplus.com). Security remains the main boundary for the total elimination of cash. A lot of consumer are still worried about those cards and do not feel confident because they cannot physically see the money. But those are small reticence that can be overcome. The adaptation should not take long as people are more and more familiar with "plastic money" (Anne Ashworth, The Times, December 22nd, 2001).

It seems that telecommunication companies (Telcos) are developing many new payment systems that can reduce the need for a banking institution. A unique innovation has been conduced by France Telecom. The French still feel unsecured to make payments through the Internet and enter their credit card number on the web. In order to better develop the E-commerce, several web sites and companies have asked France Telecom to work on a safe Internet payment system. A new system has been introduced to allow people to buy online without having to enter their credit card number or their bank account number. When a purchase is made, such as subscription to a magazine or a newspaper, the buyer just gives his phone number, and after a quick verification – the number entered must be the same than the one dialled from – the purchase is accepted. The amount is then added to the phone bill and France Telecom then transfers the money to the seller (www.francetelecom.fr). In April 2002, the Credit Card association (Groupement Carte Bleue) in France launched a new service to meet also this security issue. This new service, named e-carte bleue is dedicated to fight cyber fraud. Before the end

of the year, every French Banks would offer this new service (www.carte-bleue.com). The originality is that you don't give your credit card number but just a virtual number given by your banks. This number can only be used once. Basically, you have to download a software from your bank website, and this software will give you every time you open it a new number for your next purchase on the net. The association thinks that this service can increase the number of Interne sales. The association reveals that 47% of web users in France are not using their credit card for security measure for purchases on the Internet. Some banks already announced their fee for this service. Societe Generale, which will be the first to offer this service in June 2002, indicates that the fee would be 6 euros for the registration to the service and then 0.5 euro per transaction. The Bank explains that this is the price as if you had to buy to stamp to send a check (www.carte-bleue.com).

The biggest revolution generated by telecommunication companies (Telcos) is the third generation of mobile phone, which allows what some already call m-commerce, or mobile-commerce. Through these telephones, anyone can access the web and make payments. Once again those payments increase the phone bills, but eliminate the need of a bank. One can go as far to say that if phone companies could accept deposits on accounts, banking institutions would become obsolete. However, those companies do not have the technology needed and the experience required to act like banks. Therefore, both phone companies and banks are working together to develop these new systems. Security and privacy of information remain the main concern of the general population. Many consumers do not yet trust mobile payments. However, such issues do not decrease the possibility for dramatic changes. A mobile phone could serve as highly effective virtual wallet by functioning as cash, checks, debit and credit cards all in one. Both banks and credit card associations could be disintermediated in the mobile payment process if Telcos build their own payments network. Telcos however, is still disadvantaged comparing to banks since it does not yet have access existing payments infrastructures, credit-management skills, and a trusted brand name or reputation. The telecom companies do not seem to be strong enough to go alone in this market and they are therefore teaming with banks, Telcos provide skills and innovation and banks offer experience.
The biggest threat for banking institutions comes from the e-currency and the creation of new companies such as PayPal, which are not yet considered as banks but act like one.
PayPal defines itself as "a quick and easy way for businesses and entrepreneurs to accept credit card payments online, and a popular way for people to send money to each other on the Internet. PayPal enables any businesses or consumers, with an e-mail address to securely, conveniently, and cost-effectively send and receive these payments. Thanks to PayPal and its competitors anyone can send money to anybody who possesses an e-mail address. You just need to open an account at PayPal and then you are free to transfer your money via e-mail. PayPal resembles in some ways to an electronic

wallet since it stores personal data and allows buying things without revealing private information (Michelle Slatalla, The New York Times, March 2nd, 2000). The best advantage is that PayPal deals with real money and not credited accounts reserved for specific websites. Created in December 1998 but operational since October 1999, PayPal has already became the first method of payment on E-Bay (www.paypal.com). As is, customers have two opportunities, keep their money for making other e-payments with their PayPal account or withdraw it and the company will send a check.

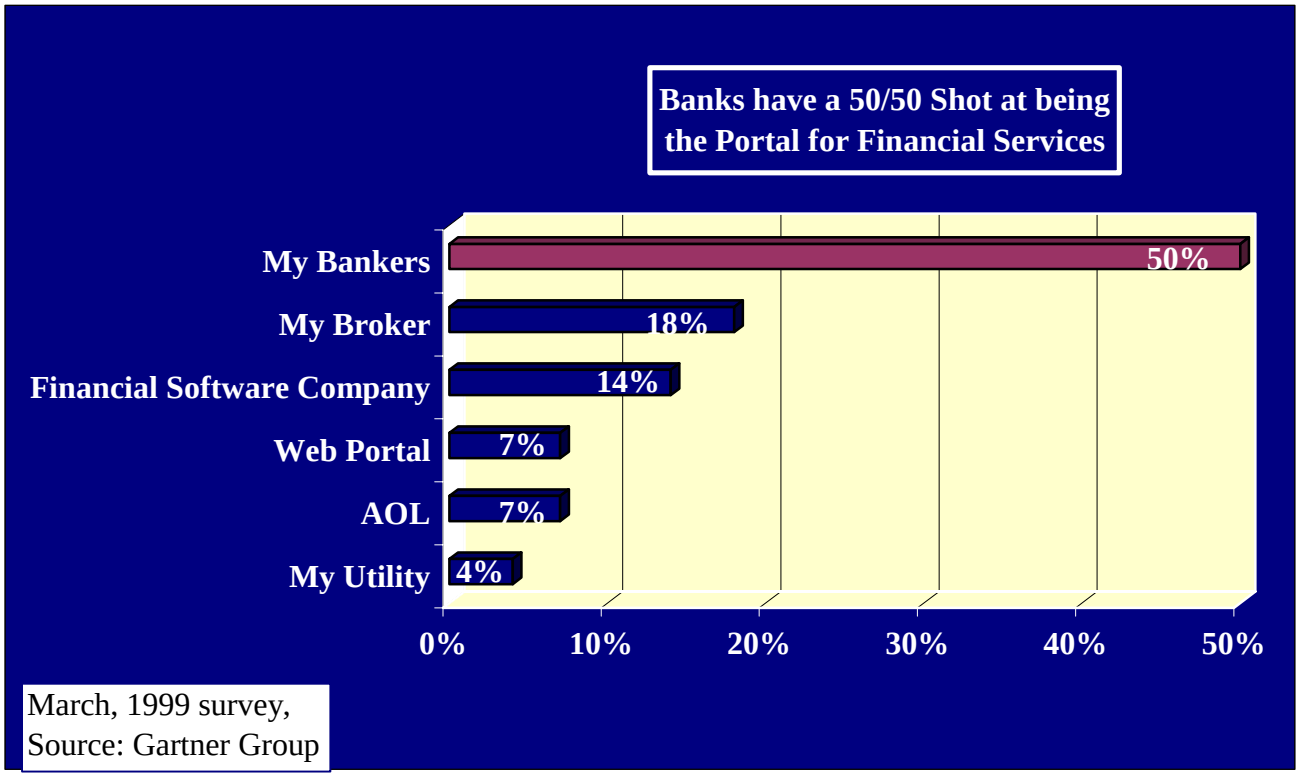
Still, all those advantages notwithstanding, PayPal has agreed to be acquired by E-Bay in July 2002, since it found it hard to survive independently.

For the first time, banks are challenged in their second activity. They resisted the fact that they no longer had the monopoly of making loans, and now they also have to face companies that are accepting deposits. To be recognized as a bank, an institution must be able to accept deposits and issue loans. In July 2001, after a little more than a year and half of activity, PayPal was already treating more than 180,000 transactions a day. That is more than 65 million transactions a year. In comparison, it took the Society for Worldwide Interbank Financial Telecommunications (SWIFT) nine years to reach more than 60 millions transactions a year (www.swift.com). The Success of this payment system is undeniable and that is why several banks are now developing similar services. Yahoo launched PayDirect in partnership with a Canadian Bank, American Online teamed with Citigroup whereas Bank of America joined with CheckFree Corp., an Internet bill-payer. E-Bay also proposed its own service BillPoint with Wells Fargo but recently bought back the 35% Wells Fargo detained in BillPoint.

The new payment method participates in the decline of checks. As we previously discussed, check payments have fallen from 85% in 1979 to 60% in 2000. However, personal payments or “consumer-to-consumer” checks represent 20% of all written checks (Federal Reserve, 2000). That is a significant loss for banking institutions. Individual like to pay by checks in order to benefit from the float. However, even this benefit is not enough to counter balance the attractiveness of this new payment system. For individuals, the choice of a payment system is likely to remain a matter of convenience and cost. PayPal is very easy to use, and the cost is low.

Insert Figure 23 here

**Figure 23: Survey of consumers response regarding who will provide their financial portal**




Therefore, the elimination of banking institutions, if it ever happens, will take a lot of time. Banks have some real advantages those companies cannot offer. The experience and the confidence they have built during all those years. Who else than a bank can you trust for taking your deposits? PayPal faces this problem. A majority of its consumers ask for PayPal to give them a check and transfer the money from their PayPal account into their bank account. The concerns linked to web security are also responsible for the slow move to the e-money game. It is undeniable however, than in a few years, cash and checks will be less and less used. The danger for customers is the same as it was at the beginning of the debit card. People like new technology, find it easy to use and generally spend more money than they usually would have or want. As the money is not physically touchable, it takes time to adapt and to become familiar with the process, to be conscious of the amount already spent.

## VII. Productivity and technology:

A 2001 study by Stiroh, from the Federal Reserve Bank of New York, investigates how productivity growth in different industries has varied over time and how the observed variation relates to IT capital accumulation. Two empirical questions are at issue: First, are U.S. productivity gains confined to a few industries or shared by many? Second, are industry productivity gains linked to the use of IT? Analysis of the industry-level data reveals that a broad productivity resurgence took place after 1995, with all

principal sectors and a majority of industries posting productivity gains. The analysis also shows that the industries experiencing the largest productivity acceleration in the late 1990s were the producers and most intensive users of IT.

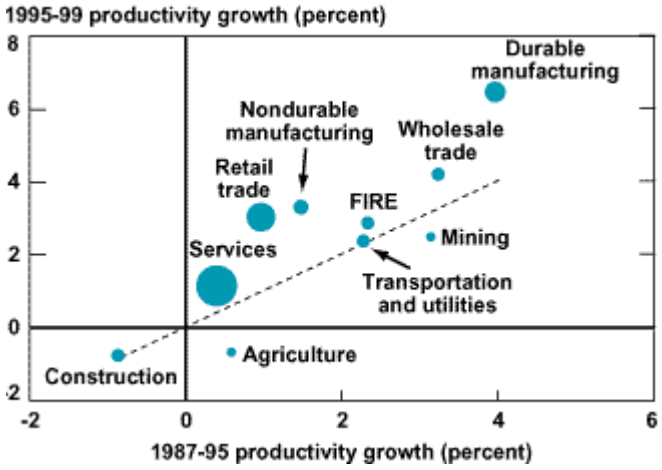


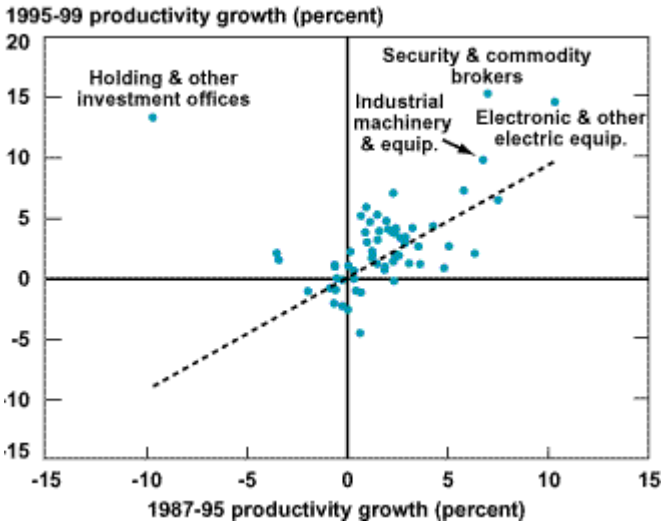

Figure 24:

Sources: Bureau of Economic Analysis; author's* calculations.

Notes: All estimates represent average annual growth rates of real gross output per full-time-equivalent worker. The diagonal line indicates no change in productivity growth. Sectors above the line show productivity growth acceleration; those below it show productivity growth deceleration. Sectors are weighted by their 1995 share of private employment.*in :Stiroh, Kevin,J. "Investing in Information Technology: Productivity Payoffs for U.S. Industries" ***Current Issues in Economics and Finance June 2001 Volume 7, Number 6***

Figure 25;

Productivity Accelerated in a Majority of Industries




Sources: Bureau of Economic Analysis; author's* calculations.

Notes: All estimates represent average annual growth rates of real gross output per full-time-equivalent worker. The diagonal line indicates no change in productivity growth. Industries above the line show productivity growth acceleration; those below it show productivity growth deceleration.

.*in :Stiroh, Kevin,J. "Investing in Information Technology: Productivity Payoffs for U.S. Industries" ***Current Issues in Economics and Finance June 2001 Volume 7, Number 6***

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Stiroh argues that the substantial training and support costs that often accompany IT investment may limit output gains. Indeed, if all of these forces are large enough, one might not see any link between IT investment and productivity gains.

Since actual productivity has in fact accelerated in recent years, the view that IT use has brought no real gains is buttressed by the fact that productivity is procyclical. That is, productivity tends to move with overall economic activity because of changes in resource utilization, productivity shocks, increasing returns, or reallocation effects. Consequently, part of the U.S. productivity resurgence likely reflects

particularly strong output growth during the late 1990s. Disagreement exists, however, about how much of the recent productivity surge reflects improvements in the underlying trend and how much is attributable to cyclical forces. Stiroh examines the productivity performance of the sectors and industries that make up the U.S. private economy. Using 1987-99 data on real gross output and full-time-equivalent workers from the Bureau of Economic Analysis (BEA), one can construct a measure of labor productivity-real gross output per full-time-equivalent worker-for ten broad sectors and their sixty-one constituent industries. The breakdown by sectors and industries follows the BEA classifications, with the exception that manufacturing is decomposed into a durable and a nondurable component.

Examinatining the aggregate productivity growth series Stiroh suggests that a breakpoint occurred in 1995, so productivity growth for the earlier period (1987-95) can be compared with productivity growth for the later period (1995-99). Figure 24 plots average annual productivity growth in the 1995-99 period against that in 1987-95 for the ten broad sectors that compose the private economy. Any sectors above the diagonal line show an acceleration of productivity growth, while sectors below the line show a deceleration of productivity growth. Since these sectors vary considerably in terms of size, the chart represents each with a plot point proportional to its 1995 share of private employment.

The chart shows a broad productivity revival across virtually all of the private U.S. economy. Eight of the ten major sectors experienced accelerating productivity growth after 1995. As one would expect, the durable manufacturing sector, which produces IT hardware and equipment, achieved especially impressive productivity gains after 1995, but many did not. Neither was the gain in productivity in the Financial services industry big relative to the other industries, despite its significant “stand alone” growth.

## VIII. Implications for regulation and emergence of new competitors.

The first step in banking substitution was the deregulation of banking laws, which allowed non-banking firms to provide financial services through their existing networks. Companies that enjoyed a good reputation and the trust of their customers could develop their financial services. Car dealers, real estate agencies and even retailers (such as Wal-Mart) started to offer services traditionally provided by bank institutions. Such corporations developed divisions with missions similar to banks: auto credits, consumption credits, refinancing, and even financial investments. The main advantage, comparing with banking institutions, resides in the particular relationship established between the user of the service (the customer) and the provider (the company). These corporations are able to create additional benefits to their users, such as special checkout lines in stores, additional rebates when payments are made with the company’s credit card. In France for example, car dealers are losing their exclusive right to sell cars to the benefit of supermarket chains. Soon, consumers will be able to find everything they

need in any retailer store. They would buy their car, finance it, and insure it in the same location, in addition to buy groceries and clothing, and plan their next vacation. That could increase the reducing need for banking institutions. Banks do not have monopoly over the financial market anymore and competitors can come from a diversified horizon. They could become serious competitors to banks because they benefit from a large cash flow generated from diverse activities. However those competitors do not represent a real danger for banks. When a private company offers financing, the customer has to use it to purchase company's products. The consumer is not free to spend the money somewhere else. Both systems can be coexisting.

## IX. Conclusions

It is doubtful that technology can eliminate in the near future the need for banking institutions, although their share in credit lending is likely to continue to be challenged by other alternatives that technology has fostered. Banks have competitors in both their activities: making loans and accepting deposits. They are not offering any services any one else can't offer. However, those new competitors face challenges of their own. The recent example of PayPal being acquired by E*Trade rather than staying independent demonstrates this point. PayPal is already considered by some US States as a bank in itself because it accepts deposits. When an institution takes deposits, it has to register with the Federal Deposit Insurance Corporation (FDIC). PayPal registered and that is why for many think that should be considered as a bank. Many institutions are now offering similar services with different partners. Therefore technologies redefine the traditional bank agency. From a consumer's point of view, the elimination or transformation of banking institutions would not be a drastic change. In fact, they will be offered the same services at a lower price. We can also imagine that one day we will find on the Internet some market places working like an inversed auction. People will ask for a loan and wait for the lower interest rate. Competition is usually promoting better services and lower prices. Those kinds of services already exist for automobile insurance or real estate loans.

These innovations enabled financial institutions to overcome previous constraining "blockages" to growth and costs savings, such as geographic distances and volume processing obstacles but at the same time also removed many of the previous "blockages" that prevented competitors from invading their turf. The nature of such constraints (or "blockages") has changed as technology changed, and the financial intermediation delivery has changed with it. Although this paper focuses on the innovations relevant to retail banking, many of the implications can be of interest to other aspects of the financial services industry outside the scope here. For example: Twenty years ago, in the mid 1980's, there were about 15,000 commercial banks and about 5000 Savings and Loans Associations. By the second half of 2004 there were 45% fewer banks and 80% fewer Savings and Loans, yet the volume and scope of assets and services has become much bigger.

Even with the emergence of new competitors, it seems that banks still have a future. They have integrated the majority of those new technologies and they benefit from their notoriety and their experience. The findings are consistent with a recent survey published by the FDIC in 2001, which suggests that banks have a 50/50 shot at being the portal for financial services. That study reported that already 50% of the American population claimed to be able to use other Portal for Financial services. The findings here are also supporting arguments by Hauswald and Marquez (2002) and Petersen and Rajan (2002) and Rajan (1996), that the net effects of technology on the banking industry pose challenges that are yet to be resolved. The innovations reviewed in this study enable smaller banks as well as large and small nonbanks to challenge the roll of the large banks in providing credit to the economy. This provides an explanation for the findings of the Federal Reserve of Philadelphia (Banking Brief, 2001) that in 2000, small community banks in the USA have increased deposits and loans twice as much as did large banks (10% and 13% versus 5.8% and 6.42%, respectively), and of Ip (2002) who reports that in 2002, banks and thrifts have provided only 19% of the economy's credit, compared to 26% in 1990 and 40% in 1980. The increase in the nonblank credit is directly attributable to technological innovations. While enabling a greater variety of services and improved productivity, technology poses challenges to society since nonbanks are often less regulated, compared to depository institutions.

Suggestions for future research: Mergers, voluntary and involuntary consolidations and liquidations, new consequences due to rules changing and new laws, the collapse of the High Tech Stock Bubble during 2000-2002 and the partial recovery in 2003-2004, had all affected many aspects of the banking industry. Some banks which responded to the 1999 new banking act which allowed them to get back into Investment banking or into insurance business, got themselves into trouble when they again began to use business loans as a sweetener to lure underwriting business (as they did in the 1920's). Others expanded into new lines of business which may yet change again the nature of commercial banking in the future. Such issues go beyond the scope of this paper and would have to be addressed by future research. Likewise, the impact of technology on Non-Banking competitors has implications for the banking industry itself. It would be useful if future research would further investigate how these impacts play out currently and in years to come. The paper's main contribution is its conceptualizing a theory of banking innovations in which technology sensitive assets can enhance and/or substitute non-technology sensitive assets (relationship sensitive assets for example) in way which recognizes the "blocking (constraining) hurdles" which the bank tries to overcomes when applying technology innovations. The paper shows that as the technological innovations get more widely accepted, they act not only to substitute traditional banking business but to a large extent also enhance it, by enabling the bank to overcome distance hurdles and by enabling the bank to develop banking relationships with customers who otherwise would have not found it convenient to deal with that bank. This improves the

bank's overall business, provides it with economies of scale and with synergistic benefits where the technology sensitive assets (L1) and the more traditional assets (L2) supplement each other rather than just being substitutes for each other. One implication for example is that relationship sensitive banking is not about to disappear anytime soon due to technology, if the bank learns to apply innovations to improve the scope of the business and its services and respond promptly to competitors' challenges.

As this paper shows, some innovations that already became widespread in other countries (such as the European countries) may pose additional challenges to the American banking industry. An interesting avenue for future studies is the potential impact of such innovations as the American babnking industry post the Grahm-Leach-Blilie Act of 1999 moves closer to the European model of Universal Banking. Another area of research interest could be a specific in-depth study of the impact of technology on productivity in the banking industry, and a comparison of such impact relative to other industries. Indeed, the current study raises a lot of new questions and directions for future research. Further understanding of the conditions for each effect remains to be determined by future studies.

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