# An Empirical Investigation into the Impact of Electric Connectivity on the Adoption of Internet Banking

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#### Abstract

In recent years, Internet banking has made dramatic progress across the world. In this paper, the nature and business rationale of Internet banking are briefly reviewed and analysed. Then a multiple regression model is proposed to study the relationship between electric connectivity (PC, Internet and Mobile) and customers' adoption of Internet banking. Empirical results are obtained and analysed. The results show that the electric connectivity has important impact on the adoption rate of Internet banking. Moreover the impact of each connectivity factor on the adoption rate of Internet banking is quantified.

### 1. Introduction

Banks such as Wells Fargo in the United States and Advance Bank in Australia launched their first Internet banking and bill pay services in 1995. Initially, investments in the Internet related principally to increasing distribution channels and providing information to consumers. Based on the success of these applications, coupled with the improvement in Internet security and consumer demand, many banks around the world have made major strides by offering full account access and transactions on the Internet.

Many banks have offered sophisticated functionality to their Internet banking customers. Customers can check their account balances and transaction history going back a few months, make transfers between accounts, pay bills online using bill pay services. They can also easily download account history into variety of formats for inclusion in many popular financial software packages. All these functionalities are backed by a high-level security.

There have been many studies on issues related to Internet banking. For example, KPMG [14] investigated the status of Internet banking in Australia in the late 1990s. Studying the adoption of Internet banking in Australia, Sathye [22] reported that security concern and lack of awareness stand out as the reasons for no-adoption of Internet banking by Australian customers. Balachandher and Balachandran [2] provided an understanding of the factors that affect the adoption of Internet banking in Malaysia. Jun and Cai [13] attempted to identify key quality attributes of the Internet banking products and services by analysing Internet banking customers' comments on their banking experiences. Howcroft et al [12] explored consumers' existing financial services behaviour and assessed their attitudes towards home-based services, i.e., telephone and Internet banking. They found that branch network is still the most popular delivery channel in the acquisition of current accounts, credit-based and investment-based services. Moreover, consumer preferences reveal that they are not generally predisposed to change their behaviour radically and adopt widespread usage of telephone and Internet banking. Changes in the use of delivery channels will occur naturally as the population matures and computer usages "seep up" into the older age groups, but this process will undoubtedly take time.

However, there has been little empirical study on how the connectivity factors impact the consumers' adoption factors of Internet banking. This paper aims to fill this gap and to shed some light on this issue by establishing a regression model on the relationship between electric connectivity and the adoption of Internet banking.

The paper is organised as follows. First, the nature of Internet banking and analyse its business rationale is addressed. Second, a regression model is proposed and conducted. Then, the empirical results are reported and analysed. Finally, the results are summarised and their implications are suggested.

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## 2. The Nature of Internet Banking

Strictly speaking, Internet banking is not the same as banking via on-line services. Internet banking means that [see e.g. 7, p51]:

- Consumers do not have to purchase any additional software (the web browser is sufficient), store any data on their computers, back up any information or wait months for new versions and upgrades, because all transactions occur on a secure server over the Internet.
- Consumers can conduct banking anywhere as long as they have computers (not necessarily their own) and modems---whether it is at home, at the office or virtually anywhere in the world.
- Consumers can download their account information into their favourite programs, which means that they do not have to follow the dictates of the service provider.
- Internet banking allows banks to break out of the hegemony of software developers.

However, in recent years, Internet banking has become the dominant form of all electronic banking. Thus, in the context of this paper, "Internet banking" and "Online banking" are used interchangeably.

The world is becoming increasingly open as a result of the Internet and the World Wide Web (WWW). Internet banking has been gaining ground around the globe. For example, a recent survey by online financial services provider Egg indicating that British Internet users are becoming more likely to use financial services on-line [1]. This offers banking institutions a new frontier of opportunities and challenges further augmenting competition in the global banking market. However, the success of this new distribution channel for banking products and services depends on many factors. For example, Sullivan [24] claimed that in general banks have been neither helped nor harmed by their early commitment to the Internet as a delivery channel.

The opinion that traditional banks were "dinosaurs" that the Internet would drive to extinction is no longer widely held. A study comparing new Internet-only banks with a peer group of new branch banks by De Young [8] showed the Internet-only banks have been substantially less profitable. They generate lower business volumes and any savings generated by lower physical overheads appear to be offset by other types of non-interest expenditures, notably marketing to attract new customers. However, Internet-only banking could eventually prove to be a viable business model. De Young [8] found that profitability improves more quickly over time for the Internet only start-ups and they may benefit more from gaining experience and be better placed to realise economies of scale than their peers.

Most researchers and practitioners believe that disintermediation is unlikely to occur and financial intermediation is still essential in the age of the Internet. Internet banking requires high initial setup costs (both technological and marketing) with savings following later. But it appears that no major banks had achieved cost reductions through Internet banking [cf. 15].

According to the KPMG [14] survey, the rapid growth of Internet banking was due to a number of factors:

- Availability of service
- Evolving Internet technology and standards
- Customer acceptance
- Industry consolidation.

Internet banking has grown dramatically in the past decade. It is likely to continue to grow in the future [23, 6]. In a nutshell, surveys by the American Bankers Association and Grant Thornton, a leading accounting, tax and management consulting firm, say four out of five community banks in the US have websites in 2002 and nearly 20% of bankers believe the Internet will be their leading consumer banking channel by 2005 [19]. As in the past, technological developments will play an important role in the future growth of Internet banking. For example, the following developments trends are predicted:

- "Foundation" technologies such as the web, XML, OFX and IFX and upgraded middleware will improve data access and integration
- Hot applications areas will include internal data security and authentication of customers and employees and risk management across the enterprise. Customer analytics and wealth management tools will also proliferate.
- Banks will retool websites and remote channels to offer better customer service. As part of this, more intelligently designed self-service will be featured.
- Payments-oriented middleware will get more sophisticated permitting such as cash management services as real time, comprehensive positive pay. Electronically bill payment and presentment and online procurement will, after a slow start, take off.
- The banks that will win will re-engineer their tools, process, and management to permit lifecycle marketing, or programs based on detailed customer knowledge.

In sum, it appears that the Internet banking still has a great growth potential due to technology development and the further acceptance of ecommerce by consumers. But Internet-only banks would not replace the traditional banking business completely. Instead, they would rather co-exist.

# **3.** The Business Rational for Internet Banking

The Internet has emerged as a key competitive arena for the future of financial services.

The reason behind the rapid development of Internet banking lies primarily in the (potential) benefits it offers to business and customers. These benefits are reflected in the following aspects: increased revenue, reduced costs and improved customer satisfaction [cf. 13, 16].

## 3.1 Increased revenue

On the revenue side, Internet banking does have the following impacts.

- More account sales.
- Increased customer retention, on the accepted principle of "get them now, have them forever".

- Wider market reach. The Internet does not restrict banks to areas where they have a physical presence.
- Entry into new market opportunities. The provision of Internet share trading positions banks to tap into the fast growing online market. According to widely publicised statistics, online trading accounted for 30% of all discount trades in the United States in 1997.

Online services are a must for banks that have to compete with a growing number of services from other financial institutions, investment concerns, and insurance companies.

#### **3.2 Decreased costs**

Internet banking requires high initial set-up costs (both technological and marketing) with savings following later. Once marketing and set-up costs have been incurred, transaction costs (admittedly, excluding the cost of customer support) appear much lower for Internet banking, especially in high-wage economies as illustrated in Table 1.

Table 1.	Relative cost	ts of banking	transactions
I GOIC II	Iterative cost	o or semining	u anoucuono

	United States	India		
Physical branch	100	100		
Postal		40		
Telephone	50	18		
ATM	27	18		
PC dial –up	8	na		
Internet	1	12		
Sources: Sato et al [23]				

The cost reduction associated with Internet banking comes from several aspects as follows.

- Reduction in traditional branch network infrastructure.
- Reduction in customer service staff as customers service themselves.
- Reduction in cheque processing costs due to increases in electronic payments.
- Decreased mail and distribution costs as statements, disclosures and other current paper items are delivered online.
- Less data entry as customers complete forms such as loan applications, changes of address and the like online.

In sum, the more transactions that can be converted to electronic form, the more money will be saved. The cost of an electronic transaction is dramatically less when done online, and customers do most of the work themselves.

## **3.3 Improved customer satisfaction**

Internet banking services that are well executed do lead to satisfied customers. For example:

- Allowing customers not only to see their account data but also to analyse it and adds value that is not available from a paper statement.
- Setting up of recurring bill payments and account transfers on the Internet allows customers to save time.
- Giving customers access to transactions, account balances and information anywhere offers great convenience than waiting in line at branch during business hours.

Of course, the Internet cannot perform every function for customers. Customers will at times need or want to talk to an actual person, so that option needs to be available (although multimedia may eventually reduce still further the need for person to person contact). Defining which services add the most value on the Internet remains possibly the greatest challenge.

In sum, Online banking has the potential to solidify and extend a bank's relationship with its customers because it brings banking services directly to a customer's home or office. The more services a customer accepts, the more likely that customer will stay loyal to the bank.

Finally, we point out that the above advantages do not come for free. Banks do incur great costs in implementing their Internet banking systems. However, such investments are mostly short term or one-off. In contrast, the benefits are always long lasting. Banks also face enormous challenges from on-line banking (for more details, see e.g. 4, 24].

#### 4. A Multiple Regression Model

The basic research question of this paper is: how important is each of the connectivity to the adoption of Internet banking? To solve this complex question, a multi-regression model need to be established under some assumptions.

The primary factor determining the level of demand for Internet banking services will the number of people connected to the Internet. Internet banking is a relative new service. Much has been written on the factors affecting adoption or usage of new products or services. The adoption or usage of any new products or services has been well studied in the literature. For example, various theoretical model of adoption can be found in Rogers' work [20]. Mantel [17] evaluates the factors associated with the usage of electronic bill payment based on a sample obtained from a large survey. Some of the major psychological and behaviour factors which affect the adoption of any new innovation such as Internet banking includes: consumer awareness, ease of use, security, accessibility, techno phobia or simply reluctance to change, preference for personalised services and cost of adopting the innovation. In this paper, we attempt to examine a number of factors that affect the adoption of Internet banking across different countries. Thus, we can categorise these factors into two groups: national factors that are different from country to country, such as the connectivity, cost of Internet banking, etc.; individual factors that are similar to all countries, such as the security, awareness, etc. We also assume that all countries use a similar technology for Internet banking.

Without any doubt, the electric connectivity is a very important factor impacting the adoption of Internet banking. The connectivity factor can be divided into three parts: PC connectivity, Internet connectivity and Mobile connectivity. PC connectivity can be measured as the percentage of

population owning PCs in a country. Internet connectivity can be measured as the number of Internet hosts for a given number of population. Finally, Mobile connectivity can be measured as a percentage of inhabitants with mobile phones.

Another important factor that explains the adoption difference across different countries is the cost factor. In Internet banking, two types of costs are involved. First, the normal costs associated with Internet access fees and connection charges and secondly the bank fees and charges. Rothwell and Gardiner [21] observed that there are two fundamental sets of factors affecting user needs. namely price factors and non-price factors. To this extent, several researchers [[9, 11, 18] have identified price as a major factor in brand switching. If the consumers are to use a new technology, it must be reasonably priced relative to alternatives. Otherwise the acceptance of the new technology may not be viable from the standpoint of the consumers.

Due to the lack of data on costs, however, we are unable to include the cost factor in our regression model. As a rough model, we are only concerned with how important are the aggregate connectivity and each component of electric connectivity. In other words, we assume the relative cost of Internet banking is similar across different countries.

Based on the above assumptions, we propose the following model:

$$IBC_i = C + \alpha_1 PC_i + \alpha_2 IC_i + \alpha_3 MC_i + e_i \qquad (1)$$

Where:

IBC = Internet banking customer as a percentage of bank customers;

C = constant;

PC = personal computer use, measured as population owning personal computers;

IC = Internet connectivity, measured as Internet hosts per 10,000 people;

MC = Mobile phone use, measured as the percentage of people who are mobile or cellular subscribers.

e = error term.

Note that the impacts of all factors that are common to all countries are reflected in the constant term C. To estimate the model, a number of issues need to be addressed. First, we may encounter the *multicollinearity problem*. For example, the independent variables, PC, IC, and MC might be highly correlated. According to our intuition, this might well be the case and Internet connectivity and Mobile connectivity may be a more appropriate ones to use. To avoid such a problem, we may also need to consider the following simplified regressions:

$$IBC_{i} = C + \alpha_{2}IC_{i} + \alpha_{3}MC_{i} + e_{i}$$
 (2)   
 Or

$$IBC_i = C + \alpha_1 PC_i + \alpha_3 MC_i + e_i \qquad (3)$$

Another problem we may encounter might be the autocorrelation which is data specific. This will be addressed later in the empirical results.

Table 2. Internet banking and connectivity data

rate.

#### 4.1 The Data

To estimate the above models, we need data for various countries, which is hard to obtain. Fortunately, a number of sources, including the data presented in Claessens et al. [5], can be used to compile such data as of the end of 1999. The relevant data for 27 countries are presented in Table 2.

Country	% of banks' customers using on-line banking	Personal computer use (% of population owning PCs)	Internet connectivity (Internet hosts per 10,000 people	% of inhabitants with mobile phones
Australia	4	47	417	34
Beligium	4	32	162	31
Denmark	6	41	72	49
Finland	20	36	1057	65
France	2	22	83	36
Germany	12	30	161	29
Italy	1	19	59	53
Japan	0	29	133	45
Netherlands	15	36	357	44
Norway	8	45	715	62
Portugal	2	9	50	47
Spain	2	12	67	3
Sweden	31	45	488	58
UK	6	31	241	46
US	6	52	1123	31
Argentina	3	5	18	12
Brazil	5	4	13	9
China	0	1	0	3
Czech Republic	1	11	72	19
HK	5	29	120	63
Hungary	6	7	83	16
India	11	0	0	0
Korea, Rep. of	13	18	40	50
Mexico	3	4	12	8
Poland	1	6	28	10
Singapore	5	44	208	42
Thailand	1	2	3	4

A few observations on the data are as follows. Around the world, consumers and countries are There is a significant variation in the Internet increasingly getting connected. Advanced countries banking adoption figures. In some countries, like the United States lead in terms of the industrial as well as developing, Internet banking percentage of the population that owns a personal remains in its infancy. Meanwhile, other countries computer and has the Internet access. The density have a high level of Internet banking adoption. In of Internet services is also the highest in the most Sweden, nearly one third of customers use Internet advanced countries. Among these countries, Nordic banking. In some emerging markets such as Korea, countries stand out with high connectivity. This India, Internet banking adoption is also at a high high connectivity is augmented by the popularity of mobile phones, which are used by almost twothirds of the people in Finland and Norway and three-fifths in Sweden. Connectivity generally decline with income, though there are exceptions. For example, Portugal has low computer ownership and Korea has high connectivity, including through mobile phones--yet the countries' per capita incomes are quite similar (Portugal \$11384 and Korea \$9878 in 1999).

In many countries, connectivity has been increasing sharply in recent years. Between 1995 and 1998 the percentage of people owning a personal computer in selected industrial countries rose almost 60 percent. In a sample of developing countries the rise was 150 percent, albeit from a lower base [5]. Increased connectivity is not limited to advanced emerging markets, but is also becoming important in some of the world's least developed countries. Africa Online, for example, is growing Internet provider in Africa (outside of South Africa). Access to telecommunications is being aided by new technology, such as mobile phones with increasingly large bandwidths. Around the world, connectivity is also being further enhanced by rapid improvements in telecommunications regulation.

Hence it is of vital importance to understand how connectivity impacts Internet banking.

## 4.2 The empirical results

We first run the regression model (1). This is a natural starting point as we do not have prior knowledge such as multicollinearity regarding the data. The regression results are reported in Table 3.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
С	1.898015	2.306937	0.822743	0.4191
PC	-0.027721	0.132247	-0.209618	0.8358
IC	0.008666	0.005725	1.513603	0.1437
MC	0.102130	0.084834	1.203886	0.2409
R-squared Adjusted R-squared S.E. of regression Sum squared resid Log likelihood	0.290411 0.197856 6.236115 894.4500 -85.56636	Mean deper S.D. depend Akaike info Schwarz cri Durbin-Wats	ndent var dent var criterion terion son stat	6.407407 6.962864 6.634545 6.826521 2.039168

 Table 3. Regression result for Model (1)

A few observations are as follows.

- None of the coefficients is significant at 10% level (5% level for one tail, assuming the electric connectivity has a *positive* impact on the percentage of population adopting Internet banking).
- The Durbin-Watson statistic shows that no autocorrelation exists at 5% level (with k'=4, n=27, d<sub>L</sub>=1.084, d<sub>U</sub>=1.753)
- The R<sup>2</sup>=29%, which implies that all connectivity variables aggregately can explain a fair amount of Internet connectivity across different countries.
- The coefficient for the independent variable PC is negative! This is counter to our intuition.

The above evidences show clearly that the regression model (1) suffers from the Multicollinnearity problem. Thus the coefficients are highly misleading [cf. 10].

Hence, we need to try regression Models (2) and (3), The results are shown in Tables 4 and 5.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
С	1.772345	2.182852	0.811940	0.4248
IC	0.007948	0.004497	1.767529	0.0899
MC	0.091127	0.065302	1.395462	0.1757
R-squared	0.289055	Mean dependent var		6.407407
Adjusted R-squared	0 229810	S.D. dependent var		6 063064
, ,	0.220010	O.D. ucpene		0.902004
S.E. of regression	6.110642	Akaike info	criterion	6.562380
S.E. of regression Sum squared resid	6.110642 896.1588	Akaike info	criterion	6.562380 6.706362

 Table 4. Regression result for Model (2)

 Table 5. Regression result for Model (3)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
С	1.285922	2.331502	0.551542	0.5864
PC	0.091964	0.108817	0.845122	0.4064
MC	0.093830	0.086903	1.079708	0.2910
R-squared	0.219730	Mean dependent var		6.407407
Adjusted R-squared	0.154707	S.D. dependent var		6.962864
S.E. of regression	6.401643	Akaike info criterion		6.655426
Sum squared resid	983.5448	Schwarz criterion		6.799407
Log likelihood	-86.84825	Durbin-W	atson stat	2.119692

We can immediately draw the following observations:

All estimated coefficients in both Model (2) and Model (3) have the right signs. This confirms that the Multicollinearity problem existed with Model (1).

Model (2) has a higher  $R^2$  comparing to Model (3).

Both Akaike Information criterion and Schwartz criterion confirm that Model (2) is the preferred model.

Model (2) has an  $R^2$  of 29% approximately the same as Model (1).

Our empirical results show that the most significant variable in explaining the Internet banking adoption is the Internet connectivity. This is consistent with our common sense. The electric connectivity can explain approximately 29% of the variations in the Internet customer proportion across different countries.

According to our estimate, an increase of 100 in Internet hosts per 10,000 people corresponds to about 0.8% increase in the Internet banking customer proportion; an 10% increase in the mobile phone subscribers yields about 0.9% increase in the Internet banking customer proportion.

Of course, our results are subject to the quality of the data used. The data are related to Internet banking are extremely hard to obtain, let alone to have high precision. Thus our estimates can be treated only as a rough guide. As a first such estimate, we believe that the results presented are of high significance, both to the industry and to the policy makers.

#### 5. Summary

In this paper, we have studied the adoption of Internet banking and electric connectivity. First, various issues related to Internet banking are reviewed and analysed. Then a model for the relationship between internet banking adoption and electric connectivity is set up and empirical results are obtained. It is shown that electric connectivity, particularly, Internet connectivity is important to the adoption of Internet banking. To our best knowledge, we are the first to quantify the relationship between Internet banking adoption and the electric connectivity. Our results may have important implications to the Internet banking industry as well as the policy making. For example, our result indicates that the Internet banking customer proportion will increase at various speed relative to the increase in Internet connectivity, Mobile phone connectivity etc. This may help banks to predict their base of Internet banking customers and thus allocate the appropriate marketing effort and resources towards Internet banking.

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