The relationship between the adoption of Internet banking and electronic connectivity: - An international comparison

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Abstract

This paper is concerned with the relationship between the adoption rate of Internet banking and electronic connectivity. Electronic connectivity is measured using three components: personal computer connectivity, Internet connectivity and mobile phone connectivity. Regression is used to analyse these relationships for a sample of developed and developing economies. The results indicate that changes in electronic connectivity, however defined, have a significant impact on the adoption rate of Internet banking. The most significant influence on the adoption rate of Internet banking would appear to be the increase in the percentage of the population owning personal computers.

Keywords: Internet banking; Electronic connectivity; Information technology

1. Introduction

Commerce is increasingly open as a result of the Internet and World Wide Web (WWW). As part of this process, fundamental changes are affecting the global banking industry with the ongoing shift to Internet (or Online) banking in many economies. As early as 1995, banks such as Wells Fargo in the United States and the Advance Bank in Australia launched their first Internet banking and bill pay services. Initially, these investments in the Internet were principally restricted to increasing distribution channels and providing information to consumers. However, the success of these early applications and the ongoing improvements in Internet security and the growth in consumer demand for these services, these banks and many others around the world have now moved to offer full account access and transactions via the Internet. Sophisticated functionality is now routinely offered to Internet banking customers. Customers can not only check their account balances and transaction history, but also make transfers between accounts and pay bills online using bill pay services. They can also easily download their account history into a variety of formats for inclusion in popular

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financial software packages, safe in the knowledge that these functionalities are backed by a relatively high level of security.

While Internet banking offers institutions a new distribution channel for augmenting competition in the global banking market, measured the success of internet banking in terms of banking products and services is complicated. Sullivan (2000), for example, has claimed that banks generally have been neither helped nor harmed by an early commitment to the Internet as a delivery channel. Similarly, De Young (2001) has showed that Internet-only banks have been substantially less profitable: generating lower business volumes with any savings generated by lower physical overheads offset by other non-interest expenditures, especially marketing to attract new customers. However, Internet-only banking could still prove a viable business model. For instance, De Young (2001) also found that profitability improves more quickly over time for Internet-only start-ups and these may benefit more from gaining experience and be better placed to realise economies of scale than their late-starting peers.

Nevertheless, Internet banking has relatively high initial set-up costs (both technological and marketing) with savings following later and it appears, at present, that no major banks have achieved significant cost reductions through its provision (Lin et al, 2001). That said, Internet banking has grown dramatically in the past decade: growth that is likely to continue in the foreseeable future (Sato and Hawkins, 2001 and Claessen et al, 2000). Surveys by the American Bankers Association and Grant Thornton, a leading accounting, tax and management consulting firm, present evidence that four out of five community banks in the US had websites in 2002 and that nearly twenty percent of US bankers believe the Internet will be their leading consumer banking channel by 2005 (Poqette, 2002).

A key feature affecting the adoption rate of Internet banking in the past has been the level of electronic connectivity. While high levels of electronic connectivity in developed economies such as the United States, Australia and the United Kingdom have assisted the shift to Internet banking, it is argued that the lack of development in electronic connectivity in developing economies and indeed some developed economies is a major limitation on the international expansion of Internet banking Unfortunately, while some within-economy evidence exists on the relationship between Internet banking and electronic connectivity, little is known on the differing relationships, if any, in an international context. The purpose of this paper is to investigate such issues across a cross-section of developed and developing economies.

The paper itself is structured as follows. Section 2 provides a brief literature review concerning electronic connectivity and Internet banking and develops testable hypotheses. Section 3 presents the regression models used to test these hypotheses. The requisite data is discussed in Section 4 and the results are dealt with in Section 5. The paper ends with some brief concluding remarks.

2. Literature review and research questions

There have already been a number of studies related to Internet banking covering a range of research dimensions. For example, Pyun et al. (2002) assessed the status of Internet banking in the U.S., Japan and Europe, Gurau (2001) investigated Internet banking in Romania, and Waite and Harrison (2002) explored factors contributing to customer satisfaction and dissatisfaction with the online information provided by retail banks. Research on the adoption of Internet banking has been also active in the past few years. A significant part of this work has also focused on the process by which adoption occurs or the demand aspect of diffusion (Brown, 1981; Roger, 1995). In a study on the adoption of Internet banking in Australia, Sathye (1999) reported that security concerns and the lack of awareness stand out as the main reasons for the failure to adopt Internet banking by customers. Polatoglu and Ekin (2001) undertook a similar study on the acceptance of Internet banking services in Turkey while Balachandher et al (2000) examined the factors that affect the adoption of Internet banking in Malaysia.

As an alternative, Jun and Cai (2001) attempted to identify key quality attributes of the Internet banking products and services by analysing Internet banking customers' comments on their banking experiences. Finally, Howcroft et al (2002) explored consumers' existing financial services behaviour and assessed their attitudes towards home-based services, i.e., telephone and Internet banking. Howcroft et al (2002) concluded that branch networks are 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, however changes in the use of delivery channels occurs naturally as the population matures and computer usages seeps into older age groups.

In a recent study by Liao et al (1999) the theory of planned behaviour (Benham & Raymond, 1996) was applied to study the adoption of virtual banking. This theory assumes that behaviour is determined by intention to perform the behaviour and in turn intention is determined by three factors: namely, attitude, subjective norms and perceived behavioural

control. Each of these factors in turn is generated by a number of beliefs and associated evaluations. Following from this, Liao et al (1999) set up some testable hypotheses for virtual banking adoption and examined them in conjunction with survey data from Hong Kong.

However, there has clearly been little study on the relationship between the electronic connectivity and the adoption rate of Internet banking and almost none concerning international comparisons. This paper aims to fill this empirical gap. Recognising three key electronic connectivity components: namely, personal computer connectivity, Internet connectivity and mobile phones, we are concerned with the following research questions. First, how important is aggregate electronic connectivity in explaining the adoption rates of Internet banking in different countries? (Q1). And second, how important is each electronic connectivity component in explaining the adoption rates of Internet banking in different countries? (Q2).

3. Empirical methodology

While Internet banking is a relative novel service, much has been written on the factors affecting adoption or usage of other new products or services. Various theoretical models of adoption can be found, for example, in Rogers (1995). More specifically, Mantel (2001) evaluates the factors associated with the usage of electronic bill payment based on survey evidence. Some of the major psychological and behaviour factors which affect the adoption of any new innovation, including Internet banking, then include: consumer awareness, ease of use, security, accessibility, 'technophobia' or simple reluctance to change, preference for personalised services and the cost of adopting the innovation. The measure of Internet banking used in this study is the proportion of all banking transactions undertaken using Internet banking (IB).

Of course, in an international context, most of these factors are likely to vary from one economy to the next. However, electronic connectivity is still likely to be an important factor concerning the Internet banking adoption rate. The connectivity factor can be divided into three components: personal computer connectivity, Internet connectivity and mobile phone connectivity. Respective proxies for these factors are as follows: personal computer connectivity can be measured as the percentage of the population owning personal computers in a country (PC); Internet connectivity can be measured as the number of Internet hosts for a given population (IC); and mobile phone connectivity can be measured by the percentage of inhabitants with mobile phones (MP).

To establish a model for best predicting the adoption rate of Internet banking, all of the above factors are included in a regression model. However, this is not the primary focus of the paper and our more specific concerns are the research questions Q1 and Q2. To answer Q1, we need to evaluate if aggregate electronic connectivity is significant in explaining the variation in the adoption rates and if so, what percentage of variation can be allocated to the level of electronic connectivity. That is, we need to assess the relationship between the adoption rates of Internet banking and electronic connectivity with all other factors held constant. The following multivariate regression model is defined:

$$IB_i = \alpha + \beta_1 PC_i + \beta_2 IC_i + \beta_3 MP_i + \varepsilon_i \quad (1)$$

where IB is the adoption rate of Internet banking in country I, α is the constant, PC is personal computer connectivity in country i, measured as percentage of the population owning personal computers, IC is Internet connectivity in country i, measured as Internet hosts per 10,000 people, MP is mobile phone connectivity in country i, measured as the percentage of people who are mobile or cellular subscribers, ε is the error term and β are parameters to be estimated.

From Equation (1) we will be able to observe the significance of aggregate electronic connectivity. However, it is likely that the independent variables (PC, IC and MP) may be highly correlated and we may encounter multicollinearity. However, since our primary concern is the overall impact of electronic connectivity on the adoption rate of Internet banking, the levels of significance for individual parameters is less problematic. To address Q2, we need to assess the relationship between the adoption rate and with each of the connectivity components, with all else being held constant. The following univariate regression models are defined:

$$IB_i = \alpha + \beta_1 PC_i + \varepsilon_i \quad (2)$$

$$IB_i = \alpha + \beta_1 IC_{ii} + \varepsilon_i \quad (3)$$

$$IB_i = \alpha + \beta_1 MP_i + \varepsilon_i \quad (4)$$

where all variables are as previously defined. The results for equations (2), (3) and (4) will indicate the relative importance of each electronic connectivity component, all else being the same. All other things being equal, an increase in electronic connectivity should be associated with an increase in Internet banking adoption. Positive coefficients are hypothesised for PC, IC and MP.

4. Data

To estimate the models (1) to (4), we require data on electronic connectivity and Internet banking for various economies. The most current available cross-sectional data from Claessens et al. (2001) is employed and relates to twenty-seven economies, comprising fifteen developed (Australia, Belgium, Denmark, Finland, France, Germany, Italy, Japan, Netherlands, Norway, Portugal, Spain, Sweden, the United Kingdom and the United States) and twelve developing (Argentina, Brazil, China, Czech Republic, Hong Kong, Hungary, India, Korea, Mexico, Poland, Singapore and Thailand) economies. Selected descriptive statistics for these economies are presented in Table 1.

As shown in Table 1, and all other things being equal, Internet banking in developed economies is relatively advanced when compared with developing economies. For example, and on average, 7.93 percent of developed economy customers use Internet banking as compared to just 4.50 percent in developing economies. Among developed economies, Sweden has the highest rate of internet adoption (31 percent) while Korea leads the developing economies (13 percent). Internet banking adoption is also relatively high in India (11 percent) and Hungary (6 percent).

Electronic connectivity also varies markedly across the sample, but with similar differences between developed and developing economies. The percentage of the population in developing economies owning personal computers ranges between nine percent (Portugal) and fifty-two percent (the United States) with a mean of 32.40 percent; Internet connections between 50 and 1,123 (Portugal and the US) and mobile phones between 3 and 65 percent (Spain and Finland). By way of comparison, the highest percent of personal computers in developing economies is 44 percent in Singapore, 208 Internet connections also in Singapore and 63 percent of inhabitants in Hungary own a mobile phone.

That said, electronic connectivity has increased sharply in recent years. Between 1995 and 1998 the percentage of people owning a personal computer in the selected developed economies rose almost 60 percent, while the same measure increased by 150 percent in developing countries, albeit from a low base (Claessen et al, 2001). Increased connectivity is also not limited to advanced emerging markets, but is also becoming important in some of the world's least developed countries. Access to telecommunications is being aided by new technology, such as mobile phones with increasingly large bandwidths. Around the world, connectivity is also enhanced by rapid improvements in telecommunications regulation.

There is also a close correspondence between the alternative measures of electronic connectivity with the correlation coefficients all more than seventy percent.

5. Empirical results

Table 2 presents the estimated coefficients, standard errors and p-values from the regression equations. We first present the results of multivariate regression model (1). It should first be noted that contrary to *a priori* reasoning the coefficient for the independent variable PC is negative, though none of the coefficient estimates is significant at any conventional level. This clearly illustrates potential multicollinearity. Nonetheless, electronic connectivity explains approximately 29 percent of the variation in the Internet banking adoption rates across different countries, both developed and developing.

The F-statistics show that models (2) to (4) are highly significant. This implies that each of the three connectivity components alone is significant (at the .05 level or higher) in explaining the variation in Internet banking adoption rates. Moreover, Internet connectivity (IC) alone accounts for about 23 percent of variation in the Internet banking adoption rates; PC connectivity alone accounts for about 18 percent of variation in adoption rates; while mobile phones (MP) alone accounts for some 20 percent of variation in the Internet banking adoption rates. Furthermore, and all else being the same, each increase of one hundred Internet hosts per 10,000 people leads to a 1.1 percent increase in the proportion of Internet banking customer; a 10 percent increase in the proportion of the population owning a PC leads to a 1.8 percent increase in Internet banking; and a 10 percent increase in mobile phone subscribers leads to a 1.5 percent increase in Internet banking. This suggests that the most critical component of electronic connectivity to influence the international rate of adoption of Internet banking is the percentage of the population owning a personal computer.

6. Conclusion

In this paper, we have quantified the international relationship between the adoption rate of Internet banking and electronic connectivity. Based on a sample of twenty-seven developed and developing economies, it is shown that electronic connectivity is clearly important to the adoption rate of Internet banking. Aggregate electronic connectivity explains some 29 percent of the variation in Internet banking adoption rates. Of this, the IC component alone accounts for 23 percent, the PC component alone accounts for 18 percent and the MP component accounts for 20 percent of variation. Our results then have important implications for the global banking industry as well as policymakers. For example, our results indicate that

the proportion of Internet banking customers will increase at various speeds relative to the increase in Internet connectivity, PC connectivity and mobile phone connectivity. This may help banks to predict their future base of Internet banking customers and thus allocate an appropriate marketing effort and resources towards Internet banking.

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Table 1
Descriptive statistics of Internet banking and connectivity variables

	Statistic	IB	PC	IC	MP
All economies	Mean	6.41	22.85	214.15	32.19
	Std. deviation	6.96	16.76	304.71	20.98
	Minimum	0.00	0.00	0.00	0.00
	Maximum	31.00	52.00	1123.00	65.00
Developed economies	Mean	7.93	32.40	345.67	42.20
	Std. deviation	8.46	12.78	357.30	15.68
	Minimum	0.00	9.00	50.00	3.00
	Maximum	31.00	52.00	1123.00	65.00
Developing economies	Mean	4.50	10.92	49.75	19.67
	Std. deviation	4.03	13.28	62.57	20.50
	Minimum	0.00	0.00	0.00	0.00
	Maximum	13.00	44.00	208.00	63.00

Table 2
Estimated regression models of Internet connectivity

	Model 1			Model 2			Model 3			Model 4		
Variable	Estimated coefficient	Standard error	p-value	Estimated coefficient	Standard error	p-value	Estimated coefficient	Standard error	p-value	Estimated coefficient	Standard error	p-value
CNS.	1.898	2.307	0.419	2.359	2.116	0.276	4.054	1.474	0.011	1.673	2.273	0.469
PC	-0.028	0.132	0.836	0.177	0.075	0.027	–	–	–	–	–	–
IC	0.009	0.006	0.144	–	–	–	0.011	0.004	0.011	–	–	–
MP	0.102	0.085	0.241	–	–	–	–	–	–	0.147	0.059	0.021
R-squared	0.290	–	–	0.182	–	–	0.231	–	–	0.197	–	–
Adj. R-squared	0.198	–	–	0.149	–	–	0.201	–	–	0.164	–	–
AIC	6.635	–	–	6.629	–	–	6.566	–	–	6.611	–	–
SC	6.826	–	–	6.724	–	–	6.662	–	–	6.706	–	–
F-statistic	3.137	–	0.044	5.555	–	0.026	7.525	–	0.011	6.114	–	0.020

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