The Foreign Bank Effect on
the Diffusion of Financial Innovations in Thailand

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Abstract

This paper examines the diffusion of two major financial innovations, namely internet banking and organisational restructuring, across commercial banks incorporated in Thailand and attempts to contribute to the financial innovation literature as well as the literature concerned with foreign bank entry by linking foreign bank presence and foreign ownership to the diffusion process. A logit model is estimated, using quarterly bank-level data over the period 1997 to 2005. The estimation results suggest that hybrid banks tended to be more likely to adopt both innovations than their domestic-owned counterparts. In addition, increases in the asset share of hybrid banks are found to have increased the probability of adoption of either innovation, indicating a positive foreign bank effect on the diffusion of financial innovations. The mode of entry, the organisational form as well as the ownership structure are found to be of importance.

JEL classification: E44, G21, O31

Keywords: Foreign Bank Entry, Thai Banking Sector, Diffusion of Innovation

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1. Introduction

This study is concerned with the consequences of further opening the Thai banking sector to foreign direct investment in 1997, when the ceiling on foreign ownership of locally incorporated banks was raised to 100 percent of paid-up registered capital for a period of ten years on a case-by-case basis. As market access through the establishment of branches has remained heavily restricted, further liberalising foreign equity investment in locally incorporated banks following the outbreak of the Thai financial crisis has given foreign banks for the first time the opportunity to compete on an almost level playing field. Four locally incorporated banks were subsequently acquired by foreign banks in 1998 and 1999 respectively. In addition, foreign participation in four domestic banks has reached up to 49 percent.

These structural changes raise important policy concerns since they have significant implications for domestic financial intermediation. The effects of foreign bank entry are highly controversial and manifold. Existing literature on foreign bank entry primarily deals with efficiency comparisons of domestic and foreign banks as well as bank efficiency spillovers and, albeit to a lesser extent, the implications of foreign bank entry on credit supply and the stability of the domestic banking sector. Most studies reviewed suggest that competitive pressures exerted by foreign banks have led to improvements in the efficiency of domestic banking systems in developing countries, with the evidence of the impact of foreign bank entry on credit supply and the stability of the domestic banking sector to date being rather ambiguous. (Claessens, Demirgüç-Kunt and Huizinga, 1998, 2000; Clarke et al., 1999; Barajas, Salazar and Steiner, 2000; Sullivan and Unite, 2003; Scher and Weller, 1999; Dages, Goldberg and Kinney, 2001; Arena, Reinhart and Vazquez, 2006 among others)

To make further progress in understanding the effects of foreign bank entry, this study advances in areas that have not been quantified so far, namely the quality and availability of banking services and organisational restructuring. Foreign banks contribute to improving
the quality and availability of financial services in the domestic market by (i) directly introducing new techniques, technology and products and (ii) indirectly by exerting pressures on domestic institutions to improve (Levine, 1996). By exerting competitive pressures, foreign bank entry may inter alia also trigger restructuring processes and changes in corporate culture within existing domestic institutions.

A framework for systematically analysing and quantifying these effects of foreign bank entry does not exist in literature as yet and so far they have only been implicitly considered in studies that examine efficiency comparisons of domestic and foreign banks and/or analyse the impact of foreign entry on financial sector efficiency. Direct measures are often not readily available and -if they are- suffer from a lack of accessible data. Drawing on the literature on financial innovation, the approach chosen in this study is based on analyses of inter-firm patterns of adoption of financial innovations, the focus being on transactional internet banking and organisational restructuring. The idea of linking ownership to the diffusion process of innovations is not new, the novelty, however, is to introduce foreign ownership and foreign bank presence as a determinant thereof and to analyse the diffusion of an organisational innovation. Although technological innovations, especially in the form of electronic banking, are in general a global phenomenon and cannot be solely attributed to foreign bank entry, foreign banks are often found to have initially taken the lead (Denizer, 2000), which is also true for the case of Thailand. Analogously, organisational restructuring and changes in corporate culture may be crisis-induced. The competitive pressures exerted by foreign banks (and other non-bank financial institutions) along with the rapid changes in IT, however, have forced financial institutions to innovate as well as to adopt either innovation.

The objective of this paper is to analyse the foreign bank effect on the diffusion of financial innovations in Thailand, the focus being on innovations in the form of transactional internet banking and organisational restructuring.
This paper proceeds as follows. Section 2 contains the literature review. Section 3 briefly describes the role of foreign banks in the Thai banking sector and Section 4 discusses financial innovations in the form of internet banking and organisational restructuring. Section 5 outlines the research methodology and Section 6 presents data and sources. The estimation results as well as an assessment thereof are presented in Section 7. Section 8 concludes.

2. Literature Review

This paper seeks to establish a link between two lines of research, namely the literature on the effects of foreign bank entry on the quality and availability of financial services provision and the literature on the inter-firm diffusion of financial innovations, both of which are briefly reviewed in the following sections.

2.1 Foreign Banks and the Quality of Financial Services Provision

The direct impact of foreign bank entry on the quality and availability of financial services has been widely neglected in existing literature and only some descriptive assessments are available.

Levine (1996) examines the role that foreign banks can play in promoting growth-enhancing financial development and inter alia argues that easing restrictions on foreign bank entry should improve the pricing and also the quality and availability of financial services by (i) directly introducing new and better know-how, training procedures, technology and products to the domestic market and (ii) indirectly by exerting pressures on domestic institutions to improve operations. Regarding the latter, the author links foreign bank entry to five financial services identified as being crucial determinants of economic growth -namely facilitating transactions and risk management, mobilising savings, allocating funds and monitoring firm managers- and concludes that foreign bank entry may improve transaction services (e.g. payment systems) and risk management mechanisms (e.g. enhanced credit assessment procedures and information gathering.
techniques), intensify competition of mobilising domestic resources, promote better resource allocation as well as improve monitoring of management performance. Denizer (2000), in a country-case study on the impact of foreign bank entry on the efficiency of the Turkish banking sector, supports the above and reports that foreign banks had a strong impact on credit evaluation and marketing as well as improved recruitment and staff quality. Similarly, focusing on Thailand, Montreevat and Ramkishen (2001) find that the entry of foreign banks has been a catalyst for change in domestic banks, inter alia altering corporate governance structures, improving operational efficiency and introducing new technologies and skills. Another analysis of the impact of foreign bank entry on the Thai domestic banking sector (Herberholz, 2002) inter alia shows that the impact of foreign bank entry is most felt in areas such as product innovation, technology, marketing, operational processes and human resources.

2.2 Inter-firm Diffusion of Financial Innovations

Due to the lack of accessible data, few quantitative studies of financial innovations and the inter-firm diffusion thereof exist and most studies use data on automated teller machines (ATM). Some studies link the adoption of new technologies to ownership (although not foreign ownership) and market structure, however, none of the studies reviewed considers foreign bank entry a determinant of the diffusion process of financial innovations.

In one of the early studies, Hannan and McDowell (1984) use annual observations of ATM adoptions in the US and bank and market characteristics for the period 1971 to 1979 to examine the relationship between the decision to adopt ATM and its determinants. Their results from estimating a duration model show that larger banks, banks operating in more concentrated local banking markets and banks that are part of a bank holding company exhibit a higher conditional probability of adoption. The wage rate prevailing in the market as well as the ratio of demand deposits to total deposits also tended to have a positive impact on the conditional probability of adoption, with the
regulatory environment found to be of importance as well. Similarly, Sharma (1993) examines the impact of firm characteristics, market structure and state regulations on the adoption of ATM in the US over the period 1971 to 1979 using a grouped duration data framework and annual intervals. Firm size, ownership by a bank holding company, location, deposit growth and the proportion of prior adopters in the market are found to increase the likelihood of adoption by non-adopters, whereas market concentration is found to increase the hazard rate only if a small proportion of firms in the market are using ATM. State-regulations prohibiting or restricting branching, but allowing stand-alone ATM are found to increase the conditional probability of adoption.

Akhavein et al. (2001) examine the diffusion of innovation in the form of credit scoring models for small business lending in the US over the period 1993 to 1997, using annual data. The results obtained from estimating a duration model of technology adoption with time-varying covariates indicate that larger banks and banking institutions located in the New York Federal Reserve district were early adopters. In addition, estimation of the tobit model shows that organisations with fewer separately chartered banks but more branches also belong to the circle of early adopters.

Turning to internet banking, Furst, Lang and Nolle (2002) use a logit model to identify factors affecting the adoption of internet banking in the US in the late 1990s. The key bank characteristics explaining which banks have chosen to offer internet banking are size, membership in a bank holding company, location of the bank in an urban area, age, expenses for premises and fixed assets and non-interest income (the latter scaled by net operating revenue), thus basically confirming the above.

3. Role of Foreign Banks in the Thai Banking Sector

Commercial banking in Thailand actually commenced with the establishment of a branch of a foreign bank, namely the Hong Kong and Shanghai Banking Corporation, in 1888 and foreign banks played
a significant role until World War II, when most foreign banks were closed, resulting in a shift from a foreign-bank dominated system to a domestic-bank dominated system. (Traisorat, 2000) After World War II, foreign banks resumed their operations and new foreign and domestic banks were set up. In the late 1970s, however, entry became highly restrictive and no new bank license was granted between 1978 and 1996, when 7 foreign banks were granted licenses to operate branches in Thailand. (Traisorat, 2000; Bangkok Bank, 1997) Although branches of banks incorporated abroad (hereafter referred to as foreign branches) are allowed to undertake the business of commercial banking, they have been exposed to substantial operating and other restrictions such as a limitation of a maximum of three branches, with ATM being regarded as branch, limited hiring of foreign professionals and a withholding tax on the repatriation of profits. (Dobson and Jacquet, 1998; Bank of Thailand, 1996). As reported by inter alia Kasikorn Research Centre (2004), foreign branches thus generally focus on certain types of business, which require specific skills, such as foreign exchange, underwriting of debentures, custodian services and cash management.

In November 1997, following the outbreak of the financial crisis, Guidelines for Equity Holdings in Financial Institutions (Bank of Thailand, 1997a) were announced to allow foreign investors with a sound financial status and a high potential to help increase the efficiency in the management of financial institutions to hold up to 100 percent of the shares of a financial institution for a period of 10 years, after which the amount of foreign shareholdings must fall below 49 percent of total shares. (Bank of Thailand, 1997, 1997a) This temporary, case-by-case relaxation of restrictions on foreign equity participation in commercial banks incorporated in Thailand led to a relatively intense period of foreign bank entry through acquisitions of majority stakes in locally incorporated banks since it has given foreign banks for the first time the opportunity to compete, especially in retail banking (Nakornthab, Pootrakool and Rodprasert, 2004), on an almost level playing field with domestic banks (note that the term domestic
banks refers to domestic-owned banks incorporated in Thailand). In January 1998, the Development Bank of Singapore (DBS) acquired a majority stake (50.03 percent) in the Thai Danu Bank and in June 1998 ABN Amro Bank secured a 75 percent stake in the Bank of Asia (BOA). Nakornthon Bank and the Radanasin Bank were acquired by Standard Chartered Bank (75 percent) and United Overseas Bank (75 percent) in September and November 1999 respectively. (Asian Development Bank, 1999; Nakornthab, Pootrakool and Rodprasert, 2004) Upon acquisition of majority stakes in locally incorporated banks, foreign parent banks immediately addressed those areas exhibiting the strongest weaknesses such as risk management, information technology and products and services. Despite their small size, the four hybrid banks (i.e. banks incorporated in Thailand that are majority-owned by a foreign block-holder), led by the BOA, were thus able to secure a first-mover advantage in certain areas. Within a short period of time, these banks introduced weekend banking and extended banking hours, expanded distribution channels, upgraded and redesigned branches and offered customised solutions. Two of these hybrid banks, however, have already been resold since then: one to a domestic bank and the other to one of the remaining hybrid banks.²

Market entry through acquisitions of majority stakes in commercial banks incorporated in Thailand can be viewed as part of the so-called “third wave” of expansion of international banks. Whereas the first and second internationalisation waves were rather wholesale oriented, the third wave is generally characterised by a more frequent use of market access through locally incorporated banks, resulting in a retail banking orientation. (Herrero and Simón, 2003)

² The Development Bank of Singapore sold its majority stake in the DBS Thai Danu Bank to the Thai Military Bank in 2004 and the two institutions were subsequently merged. Also in 2004, ABN Amro Bank sold its majority stake in the Bank of Asia to the UOB Radanasin Bank. The two entities were merged to create United Overseas Bank (Thai).
In addition, foreign participation in four domestic banks has reached up to 49 percent. (Jittamai, Nakornthab and Posayananda, 2005) Some of these private domestic banks, however, have placed internal restrictions on the size of individual shareholdings and foreign banks have mostly participated as non-strategic investors, with control of operations vested in the Thai controlling or strategic partner.3

Foreign-owned assets in commercial banks incorporated in Thailand (calculated as the ratio of the sum across all banks of the assets of each bank multiplied by the percentage of equity held by foreigners to total bank assets as at year-end4) increased from 38 percent at the end of 1997 to 46 percent at the end of 2005. Whereas the asset share of foreign branches decreased from 21 percent to 12 percent, the asset share of foreign banks in locally incorporated banks increased from 17 percent to 34 percent.

The 2004 Financial Sector Master Plan (FSMP) introduced two types of foreign bank licenses, namely subsidiaries of foreign banks and full branches of foreign banks. (Bank of Thailand, 2004)5 Although these licenses were designed to expand the role of foreign financial institutions in the Thai banking sector (Bank of Thailand,

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3 The Stock Exchange of Thailand’s definition of strategic shareholders includes shareholders who have a holding of above 5% of votes. Note that the DBS held 18.5 percent of the TMB Bank as of November 10, 2006.

4 This foreign penetration measure is inter alia used by Mathieson and Roldós (2001).

5 Société Générale International Banking Facility and UFJ International Banking Facility were subsequently granted full branch licenses, whereas the International Commercial Bank of China (renamed Mega International Commercial Bank on August 21, 2006) was granted a subsidiary license. In compliance with the “one presence policy” Standard Chartered Bank bought all remaining shares in Standard Chartered Nakornthon Bank (SCNB), integrated its Standard Chartered Bank Bangkok Branch into SCNB and renamed the new entity Standard Chartered Bank (Thai) on October 1, 2005. After the acquisition of Bank of Asia in 2004, United Overseas Bank announced the merger of UOB Radanasin Bank and the Bank of Asia as well as the creation of the new entity United Overseas Bank (Thai) in November 2005.
they basically seem to maintain the status quo. As noted by Kasikorn Research Centre (2004), although the subsidiary status may be beneficial for operations, few changes in the business strategies of foreign banks are expected. Foreign financial institutions with either a subsidiary or a full branch will not be able to compete with locally incorporated banks due to substantial branching restrictions, unless they choose to enter into co-operative agreements with locally incorporated banks.  

Hybrid banks are not addressed by the FSMP, which indicates that they continue to be considered Thai banks, operating under special regulations, rather than foreign banks, despite their ownership structure. The concept of the hybrid bank, however, has implicitly been extended to retail banks through the FSMP. Shareholders in the remaining two hybrid banks, namely Standard Chartered Bank (Thai) and United Overseas Bank (Thai), as well as in the hybrid retail bank will eventually be grandfathered. The second phase of the FSMP, scheduled to be finalised at the end of 2007 and expected to broaden the scope of activities as well as to prepare for new domestic and foreign entry and passage of the bill on Financial Institution Business are expected to remove existing uncertainty.

Since foreign banks entered the Thai market through the establishment of full branches and subsidiaries as well as via the purchase of minority (non-strategic and strategic) and majority stakes in locally incorporated banks, it is possible to make a clear distinction between different forms of foreign bank presence, which is important given that the impact of foreign entry will differ depending on the mode of entry, the organisational form as well as the size of the shareholding.  

6 In January 2007, GE Capital International Holdings finalised the purchase of a 25 percent equity stake in the Bank of Ayudhya and GE Money Retail Bank eventually returned its retail bank license to the Bank of Thailand. In March 2007, Bank Thai sold a 24.99 percent stake to the private equity firm TPG Newbridge and Nova Scotia Bank announced plans to buy a 24.99 percent stake in Thanachart Bank.

7 Note that only few studies distinguish between mode of entry, organisational form and size of the shareholding.
Hence, the “trial period” of foreign majority equity holdings in locally incorporated banks together with the different forms of bank presence make Thailand a particularly good country to study.

4. Technology Transfers between Domestic and Foreign Banks: Theoretical Background and the Case of Thailand

Financial innovations can be classified as (i) new ways of designing financial contracts, (ii) new production processes, (iii) technological innovations, and (iv) organisational innovations (Sinkey, 2002; Frame and White, 2002), the focus of this study being on the latter two.

Internet Banking

Technological innovations in the financial services industry have primarily taken place in the form of e-banking\(^8\), the major components being (i) automated clearing houses, (ii) ATM, (iii) point-of-sale terminals and (iv) internet banking. (Nsouli and Schaechter, 2002)

Internet banking has evolved from dial-up home banking services using banks’ proprietary software and -at a later stage- off-the-shelf home financial software packages. (Frei, 1997) Although financial software, either proprietary or off-the-shelf, offers a broad range of services, customers and banks operate systems that do not or not fully interact, with the processing often running in batch-mode. Internet banking, on the other hand, represents a move to an open environment, which allows the bank to operate in real-time, reducing overlaps. (Centeno, 2003) Internet services offered by banks have evolved from simple access and informational services to a full range of transactional banking services. As an alternative remote delivery channel, internet banking improves operational procedures, reflected in increased speed

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8 Electronic banking, or e-banking, is defined as "the use of electronic methods to deliver traditional banking services using any kind of payment media" (Fullenkamp and Nsouli, 2004).
and convenience and decreased cost, as well as strengthens the interaction between a bank and its customers and it can thus not only be seen as a technological innovation, but also as a process innovation. Furthermore, as banks also use the internet to offer new services, which are only available online, such as customised financial information menus and real-time brokerage, internet banking can also be viewed as a product innovation. (Corrocher, 2002)

All commercial banks incorporated in Thailand have invested in internet banking services as an alternative remote delivery channel and combined electronic delivery channels with “bricks and mortar” delivery channels such as full branches, kiosk and mini-branches to become “bricks and clicks” banks, in line with the prevailing view of internet banking being a complement rather than a substitute.
Figure 1 shows that despite massive branch re-positioning programmes the number of branches of commercial banks in Thailand increased from 3,853 at the end of 1999 to 4,231 at the end of 2005, while the number of ATM, which were introduced in Thailand in 1982, nearly tripled over the same period to reach 15,784 at the end of 2005. The marked year-on-year increase in branches and ATM can be partially attributed to the establishment of new banks. However, locally incorporated banks have continued to invest heavily in ATM and ATM seem to be considered a substitute for counter services since bank branches have increasingly become smaller in size and their focus has shifted to advisory services. (Bank of Thailand, 2006) Besides, mini-branches (so-called sub-branches) in strategic locations such as shopping centres, office buildings and tourist attractions have been increasing.

Over the same period, the number of payment cards increased from 19.1 million to 38.7 million as shown in Figure 2. The number of internet agreements, however, increased from 21,102 at the end of 2000 to 348,965 at the end of 2003 and then jumped to 1.5 million at year-end 2004 and 1.8 million at the end of 2005 as also shown in Figure 2, which reflects the increased quality of services, while the value of transactions increased from THB 0.3 billion at the end of 2000 to THB 638 billion at the end of 2003 before reaching THB 1,139.2 billion at year-end 2004 and increasing more than double in 2005 (THB 2,722.4 billion).
Regarding the technological infrastructure, the proportion of landline phone subscription equalled 11 percent of the total population or 7 million subscribers as shown in Figure 3. The penetration rate of mobile phones on the other hand reached 50 percent or 31.3 million people in 2005 compared to a mere 5.9 percent or 3.6 million in 2000, whereas the number of internet users increased from 1.5 million in 1999 to 7.1 million in 2005, thus reaching a penetration rate of 11.4 percent. Despite this increase, the level of internet subscription in Thailand is still relatively low compared to 60 percent in Korea and 34 percent in Malaysia (Bank of Thailand, 2006) indicating the potential for the development of internet banking services.

Source: Own representation based on data obtained from the Bank of Thailand

Figure 2 Number of payment cards and internet banking agreements

9 Note that the number of payment cards at the end of 2005 is preliminary and that the data include non-bank institutions since 2002. Data on the number of internet banking agreements have only been compiled since 2000 and data on debit cards since 2004. (Bank of Thailand, 2006). Note that the fall in ATM cards in 2004 resulted from statistical adjustments.
Figure 3 Technological infrastructure (million)

The services offered by commercial banks incorporated in Thailand have evolved from purely informational to advanced transactional functions. Whereas informational web sites may be operated without permission of the Bank of Thailand, transactional web sites require prior approval. (Bank of Thailand, 2000) Most commercial banks incorporated in Thailand now offer comprehensive internet banking packages allowing customers to conduct a range of banking transactions such as balance inquiries, fund transfers, payments for products and services and loan applications from wherever they have access to the internet. Foreign-owned BOA was the first bank in Thailand to launch internet banking services in the form of B2B and B2C e-commerce, namely Asia Cyber Banking, in 1999, giving it a head-start in terms of information technology and targeting affluent customers, and a sophisticated financial portal web site was eventually launched in September 2000. (BOA, 12 September 2000: Press Release; BOA, Annual Report 2002) Moreover, BOA in effect initiated a shift
from “one-size-fits-all” concepts to customised solutions, segmenting customers and leveraging existing relationships through cross-selling via new and expanded delivery channels. Although Siam Commercial Bank (SCB) had ventured into e-commerce services in 1998, its own internet banking service was only launched in November 1999 and SCB Easy Banking one year later.10 (SCB, Annual Report 1998, 1999, 2000) The DBS Thai Danu Bank was among the first to upgrade key systems in 1999 and replaced 120 ATM nationwide to offer ATM with an internet interface.11 (Bangkok Post, 2 July 1999, 4 May 1999) In 2001, BOA again became the first bank to offer wireless application protocol services. (Bangkok Post, 10 April 2001)

Organisational Restructuring

Organisational innovations cover a broad spectrum, which runs from the recreation of a financial institution through e.g. the redesign of branch delivery systems or the redesign of organisational structures to the creation of a virtual bank. Since 1997, all commercial banks incorporated in Thailand have initiated numerous organisational restructuring processes, however, for the purpose of this study, the focus is on major restructuring programmes, consisting of a reorganisation in new business groups and improvements in reporting structures. In 1998, the BOA again took the lead and became the first bank post-crisis to initiate a redesign of its organisational structures aimed at upgrading them to global standards following its acquisition by ABN Amro. Similarly, the DBS Thai Danu Bank dedicated the first year after its acquisition by the DBS to restructuring and upgrading its internal infrastructure, rather than expanding operations. (Bangkok Post, 5 October 1999) It inter alia introduced a top management open

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10 Note that SCB, however, was the first bank in Thailand to introduce informational internet banking in 1996. (Ongkasuwan, 2002)

11 In 2000, DBS Thai Danu Bank became the first bank to sell a significant portion of its non-performing loans at market price to third parties, thus radically clearing its balance sheet allowing a refocus on core activities.
door policy and thus flattened established hierarchies. (DTDB, Annual Report 2000) Similarly, UOB Radanasin Bank (UOBR) and Standard Chartered Nakornthon Bank (SCNB) launched re-branding and restructuring programmes in 1999 and early 2000 respectively. In an attempt to pave the way for privatisation, Krung Thai Bank (KTB) announced the introduction of seven independent profit centres at the end of 1998, with each being supervised by a president, as part of a comprehensive restructuring plan. (Bangkok Post, 28 December 1998) KBank reorganised its operations into eight groups in 1999, each headed by an executive vice-president, to improve management structures. (Bangkok Post, 26 March 1999) Also in 1999, SCB reorganised its operations into six business groups on the basis of customer focus and function. (SCB, Annual Report 1999) Similarly, Bank Thai (BT), TMB Bank, Bank of Ayudhya (BAY), Bangkok Bank (BBL) and Siam City Bank (SCIB) restructured their operations over the period.

5. Methodology

In this section, the regression model is developed, the estimation technique chosen and hypotheses formulated that allow an assessment of the possible impact of foreign bank presence on the diffusion of financial innovations in Thailand.

5.1 Regression Model and Estimation Technique

The foreign bank effect on the inter-firm diffusion of financial innovations in Thailand is analysed using a logit model to examine the determinants of the probability of adoption of the innovation. The pooled logit model is specified as follows:\textsuperscript{12}

\[ P_{it} = \text{Prob} \left( y_{it} = 1 | x_{it} \right) = F(z) = \frac{\exp(z)}{1 + \exp(z)} \]

\textsuperscript{12} Variables are indexed by an i for the individual bank (i = 1,...,N) and a t for the time period (t = 1,...,T).
with \( z \) being defined as \( \beta_0 + \beta_1 FO_{it} + \beta_2 FS_t + \beta CV_{it} \) in the first set of regressions, \( \beta_0 + \beta_1 FS_t + \beta CV_{it} \) in the second set of regression and \( x_{it} \) denoting the explanatory variables.

\( P_{it} \) denotes the probability of having \( y_{it} = 1 \) at time \( t \) given \( x_{it} \). \( y_{it} \) is the binary dependent variable (\( y_{it} = 1 \) if bank \( i \) had adopted the innovation in quarter \( t \) and 0 if not). \( CV_{it} \) is a vector of explanatory variables to control for other factors and \( \beta \) a vector of unknown parameters, with the elements in \( \beta \) being indexed as \( \beta_3 \) (\( \beta_2 \) in the second set of regressions) to \( \beta_K \). The log-likelihood function can be formulated as:

\[
\log L = \sum_{i=1}^{N} \sum_{t=1}^{T} [y_{it} \log F(z) + (1- y_{it}) \log (1-F(z))]
\]

The models are estimated by maximum-likelihood. Variable definitions are given in Section 5.2.

### 5.2 Variables and Hypotheses

To examine the possibly different probability of adoption of hybrid and domestic banks as well as the impact of foreign bank presence on the probability of adoption of the innovation, two sets of regressions are run. In addition to running regressions for the whole sample (1\(^{st}\) set of regressions), regressions for those banks that remained domestically-owned are run separately (2\(^{nd}\) set of regressions). As mentioned above, the binary dependent variable \( y_{it} \) assumes the value of 1 if bank \( i \) had adopted the innovation in quarter \( t \) and 0 if not. Independent variables include a foreign ownership dummy variable to capture the effect of foreign ownership. The foreign ownership dummy variable, however, is only used in the first set of regressions. Second, the asset share of foreign banks is used as measure of foreign bank presence, with four alternative measures of foreign bank presence being employed, which differ in their computation of asset share of foreign banks. Third, a set of bank-specific regressors is included in order to control for bank characteristics other than foreign ownership. Fourth, a control variable that is relevant for domestic and foreign banks is included. Variable definitions are given in Table 1.
Table 1 Variable definitions

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**Alternative measures of foreign bank presence**

| FMSH<sub>i</sub> | assets of foreign banks (where foreign banks refer to hybrid banks) in percent of total commercial bank assets at time t (+) |
| FMSA<sub>i</sub> | assets of foreign banks (where foreign banks refer to hybrid banks and foreign branches) in percent of total commercial bank assets at time t (+) |
| FMSB<sub>i</sub> | assets of foreign banks (where foreign banks refer to foreign branches) in percent of total commercial bank assets at time t (+) |
| FOBA<sub>i</sub> | the sum across all banks of the assets of each bank multiplied by the (+) percentage of equity held by foreigners in percent of total commercial bank assets |

**Other control variables<sup>14</sup>**

| SOI<sub>it</sub> | state ownership dummy variable for bank i at time t which takes the value of one if at least fifty percent of the bank’s shares are owned by the government; used to account for differences in business motives and goals (-) |
| LA<sub>it</sub> | liquid assets in percent of total assets of bank i at time t; used to account for liquidity constraints (+) |
| DA<sub>it</sub> | deposits in percent of total assets of bank i at time t; used to account for their role in the production process, with increases in deposits expected to make adoption of innovations more likely to expand capacity (+) |
| NPL<sub>it</sub> | non-performing loans in percent of total loans of bank i at time t; aimed at capturing bank health since healthy institutions may be better positioned to adopt innovations (-) |

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<sup>13</sup> A controlling stake is commonly assumed if a shareholder’s participation exceeds 50 percent. (Bank for International Settlements, 2003)

<sup>14</sup> Contrary to the literature, a proxy for innovative environment such as the number of ATM is not included, due to a lack of quarterly data. For the same reason, it is also not possible to control for the technological infrastructure.
It has been argued that foreign banks may contribute to improving the quality and availability of financial services in the domestic market by (i) directly introducing new techniques, technology and products and (ii) indirectly by exerting pressures on domestic institutions to improve (Levine, 1996). By exerting competitive pressures, foreign bank presence may in addition also trigger restructuring processes and changes in corporate culture within existing domestic institutions. In line with these claims it is expected that increases in foreign bank presence exert a positive effect on the probability of adoption.

6. Data

The foreign bank effect will be analysed in the context of the Thai commercial banking sector, the focus being on the mode of entry in form of acquisitions of established banks by foreign banks over the period 1997 to 2005. Foreign branches are considered on the basis of aggregate data only since bank-level data are not available on a quarterly basis.

The data used consist of quarterly (i) bank-level data from financial statements for 12 commercial banks incorporated in
Thailand\textsuperscript{15} and (ii) selected aggregate data as explained below. Bank-level data are obtained from the Stock Exchange of Thailand’s Listed Company Info as well as SETSMART.\textsuperscript{16} Whereas other studies use unconsolidated financial statements to ensure consistency, both consolidated and unconsolidated financial statements are used here, with unconsolidated financial statements only being referred to if consolidated financial statements are not available. Data on adoption of the new technology (i.e. transactional internet banking (transactional web sites that allow customers to at least conduct balance inquiries and make fund transfers) and organisational restructuring) were compiled from banks’ web sites, annual reports, press releases and telephone interviews. Since data on adoption was compiled from several (including non-official) sources, they should be understood as indicative. It is assumed that regulatory approval of transactional web sites was given on an objective basis.

7. Estimation Results

The first set of regressions uses quarterly data for 12 locally incorporated banks over the period 1997:2 to 2004:1, given that the first exit of a hybrid bank occurred in 2004:2, and the second set of regressions uses data for those 8 locally incorporated banks that have remained domestic-owned throughout the period. To acknowledge that only hybrid and domestic banks compete on an almost level

\textsuperscript{15} Banks included are BBL, BAY, SCB, KBank, TMB Bank, BT (created through the amalgamation of Union Bank of Bangkok, Krung Thai Thanakit and 12 finance companies in 1998), KTB, SCIB (merged with Bangkok Metropolitan Bank in 2002) as well as the four hybrid banks, SCNB, DBS Thai Danu Bank, UOBR and BOA. Bangkok Metropolitan Bank, Thanachart Bank, TISCO Bank, Kiatnakin Bank, ACL Bank, Land and Houses Retail Bank, GE Money Retail Bank, Thai Credit Retail Bank and AIG Retail Bank are not included since sufficient data are not available.

\textsuperscript{16} Data on non-performing loans are not available for all banks for the third quarter 1997 and the first quarter 1998. For these missing data, data averaged across prior and following periods are used to create a balanced panel. Also due to a lack of disclosure, data on non-performing loans for the second and fourth quarter 1997 were partially obtained from Fitch Ratings (1998). The remaining data were obtained from the Bank of Thailand.
playing field and to disentangle the effects of hybrid banks from those of branches, the asset share of hybrid banks (FMSH) is first used as foreign penetration measure. Subsequently, an alternative foreign penetration measure is introduced, namely FMSA, to capture any potential benefits derived from the presence of foreign branches. The estimation results from running both sets of regressions are presented in column per dependent variable.

### 7.1 First Set of Regressions

Using the asset share of hybrid banks as foreign penetration measure and focusing on the probability of adoption of internet banking (organisational restructuring), the estimation results are reported in the first (second) column of Table 2. Alternatively, the asset share of hybrid banks and foreign branches is used as foreign penetration measure, with the results regarding the probability of adoption of internet banking (organisational restructuring) being reported in the third (fourth) column of Table 2. IB and OR denote the binary choice variables, where IB refers to internet banking and OR to organisational restructuring.

**Adoption of Internet Banking**

The estimation results in Table 2 show a statistically significant and positive coefficient on the asset share of hybrid banks (FMSH), which, ceteris paribus, indicates that increases in foreign bank presence have tended to make adoption of internet banking more likely. The foreign ownership dummy variable is also statistically significant and its coefficient enters with the expected positive sign, indicating that hybrid banks tended to adopt internet banking faster.

The statistically significant negative coefficient on the state-ownership dummy variable is consistent with a priori expectations and indicates that state-owned banks have tended to be less likely to adopt internet banking, probably reflecting that procurement tends to be more difficult for state-owned banks. The estimation results further reveal a statistically significant and positive relationship
between deposits (as a percentage of total assets) and the probability of internet banking adoption as expected, highlighting the importance of deposits as a banking input under the intermediation approach.

Also in line with expectations, the estimation results further suggest that healthy banks have been more likely to adopt internet banking since healthy institutions may simply be better positioned to adopt innovations.

**Table 2** Estimation results: Adoption of financial innovations (1st set of regressions)

<table>
<thead>
<tr>
<th></th>
<th>IB LOGIT</th>
<th>OR LOGIT</th>
<th>IB LOGIT</th>
<th>OR LOGIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>FMSH</td>
<td>1.330 *** 0.454</td>
<td>1.776 *** 0.291</td>
<td>-0.526 *** 0.185</td>
<td>-0.292 ** 0.136</td>
</tr>
<tr>
<td>FMSA</td>
<td></td>
<td></td>
<td>-6.250 *** 0.920</td>
<td>2.644 *** 0.465</td>
</tr>
<tr>
<td>FO</td>
<td>2.083 *** 0.679</td>
<td>2.096 *** 0.590</td>
<td>3.089 *** 0.652</td>
<td>2.644 *** 0.465</td>
</tr>
<tr>
<td>SO</td>
<td>-5.852 *** 0.920</td>
<td>0.196 0.554</td>
<td>-6.250 *** 0.920</td>
<td>2.644 *** 0.465</td>
</tr>
<tr>
<td>LA</td>
<td>-0.008 0.014</td>
<td>-0.023 0.016</td>
<td>0.020 0.014</td>
<td>0.016 0.014</td>
</tr>
<tr>
<td>DA</td>
<td>0.376 *** 0.068</td>
<td>-0.008 0.045</td>
<td>0.459 *** 0.068</td>
<td>0.156 *** 0.027</td>
</tr>
<tr>
<td>NPL</td>
<td>-0.179 *** 0.028</td>
<td>-0.055 *** 0.012</td>
<td>-0.171 *** 0.025</td>
<td>-0.052 *** 0.010</td>
</tr>
<tr>
<td>PEX</td>
<td>-0.004 0.008</td>
<td>0.004 0.005</td>
<td>-0.003 0.008</td>
<td>-0.002 0.004</td>
</tr>
<tr>
<td>BRA</td>
<td>-0.104 0.116</td>
<td>-0.226 * 0.119</td>
<td>-0.100 0.109</td>
<td>-0.239 *** 0.080</td>
</tr>
<tr>
<td>GDPCAPG</td>
<td>0.045 0.046</td>
<td>0.010 0.042</td>
<td>0.065 0.045</td>
<td>0.084 ** 0.037</td>
</tr>
</tbody>
</table>

*, **, *** indicate significance levels of 10, 5 and 1 percent respectively.

Using the asset share of hybrid banks and foreign branches (FMSA) as foreign penetration measure reveals a statistically significant, but unexpected negative coefficient on the alternative foreign penetration measure. In light of the branching restrictions foreign branches face, this result is surprising, but may reflect that locally incorporated banks and foreign branches do not compete in the same lines of business, especially given that transactional web sites as defined in this study are rather focused on the retail market.17 The foreign ownership dummy variable is again of statistical significance and its coefficient enters with the expected positive sign.

17 An analysis of the adoption of internet banking services for corporate customers would be interesting, but is not feasible due to a lack of data.
Regarding control variables, the estimation results confirm the statistically significant and negative coefficient on the state ownership dummy variable as well as the positive association between deposits (as a percentage of total assets) and the probability of internet banking adoption. Moreover, the estimation results again suggest that healthy banks have been more likely to adopt internet banking.

Running auxiliary regressions with the asset share of foreign branches (FMSB) as foreign penetration measure confirms these results and reveals a significant, but negative relationship between the foreign penetration measure and the probability of internet adoption. The results are reported in Appendix A.

To acknowledge that foreign investors not only acquired majority stakes in locally incorporated banks but also minority stakes, another alternative measure of foreign bank presence, namely the ratio of the sum across all banks of the assets of each bank multiplied by the percentage of equity held by foreigners to total commercial bank assets, is used. The results are reported in Appendix B and reveal that the change in the foreign penetration measure is significant, but enters with a negative sign with respect to the probability of internet banking adoption.18

**Adoption of Organisational Restructuring**

The estimation results in Table 2 show that the foreign penetration measure FMSH is of statistical significance and enters with the expected positive sign, which indicates that increases in foreign bank presence have tended to make adoption of organisational restructuring more likely. The foreign ownership dummy variable is also statistically significant and its coefficient enters with the expected positive sign. This indicates that hybrid banks have tended to be more likely to adopt organisational restructuring than their domestic-owned counterparts, as expected.

---

18 Due to a lack of data availability, year-end data or data for the third quarter 1997 are used for missing quarters in 1997.
Regarding control variables, bank health as well as branch intensity turn out to be statistically significant and the coefficients of both variables, non-performing loans (in percent of total loans) as well as the ratio of branches to total assets, have a negative sign, the latter indicating that banks with a large branch network tended to be less likely to adopt organisational restructuring.

Using the alternative foreign penetration measure to acknowledge any potential benefits derived from the presence of foreign branches shows that the change in the asset share of hybrid banks and foreign branches (FMSA) is statistically significant, its coefficient, however, enters with an unexpected negative sign.

To check robustness, auxiliary regressions using the asset share of foreign branches (FMSB) as foreign penetration measure are run and the results confirm a negative association between the foreign penetration measure and the probability of adoption of organisational restructuring. The estimation results are presented in Appendix A.

Using the ratio of the sum across all banks of the assets of each bank multiplied by the percentage of equity held by foreigners to total commercial bank assets to acknowledge that foreign participation in four private banks has reached up to 49 percent over the period, does not show a statistically significant association between the change in the foreign penetration measure and the probability of adoption of organisational restructuring as shown in Appendix B.

7.2 Second Set of Regressions

Using the asset share of hybrid banks as foreign penetration measure and focusing on the probability of adoption of internet banking (organisational restructuring) in domestic banks, the estimation results are reported in the first (second) column of Table 3. Alternatively, the asset share of hybrid banks and foreign branches is used as foreign penetration measure, with the results with respect to the probability of adoption of internet banking (organisational restructuring) being reported in the third (fourth) column of Table 3.
IB and OR denote the binary choice variables, where IB refers to internet banking and OR to organisational restructuring.

**Adoption of Internet Banking**

Focusing on those banks that remained domestically owned throughout the period, the estimation results in Table 3 basically confirm the findings from the first set of regressions and show a significant and positive association between the asset share of hybrid banks (FMSH) and the probability of internet banking adoption, interpreted to mean that increases in foreign bank presence have tended to make adoption of internet banking more likely.

Also consistent with the findings above, state-owned banks have been less likely to adopt internet banking. The coefficient of the variable liquid assets (in percent of total assets) is statistically significant, but enters again with an unexpected negative sign. Increases in deposits (in percent of total assets) have tended to make adoption of internet banking more likely as expected. The variables non-performing loans (in percent of total loans) as well as branch intensity are both statistically significant and enter with the expected negative sign. The latter result suggests that internet banking is viewed as a substitute rather than a complement for branch activities, analogous ATM as mentioned in Section 4. The remaining variables turn out to be statistically insignificant.

Using the asset share of hybrid banks and foreign branches as foreign penetration measure (FMSA), confirms the findings obtained from running the first set of regressions and reveal a statistically significant, but negative association between the foreign penetration measure and the probability of adoption of internet banking. Running auxiliary regressions, using the asset share of foreign branches (FMSB) as foreign penetration measure, confirms this negative association. The estimation results are reproduced in Appendix C.

To acknowledge that foreign investors not only acquired majority stakes in locally incorporated banks but also minority stakes, the ratio of the sum across all banks of the assets of each bank multiplied by
the percentage of equity held by foreigners to total commercial bank assets, is used as alternative foreign penetration measure. The results, which are reproduced in Appendix D, reveal that the change in the foreign penetration measure is insignificant with respect to the probability of internet banking adoption.\footnote{See footnote 18.}

**Table 3** Estimation results: Adoption of financial innovations (\(2^{\text{nd}}\) set of regressions)

<table>
<thead>
<tr>
<th></th>
<th>IB LOGIT</th>
<th></th>
<th>OR LOGIT</th>
<th></th>
<th>IB LOGIT</th>
<th></th>
<th>OR LOGIT</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Coefficient</td>
<td>Std. Error</td>
<td>Coefficient</td>
<td>Std. Error</td>
<td>Coefficient</td>
<td>Std. Error</td>
<td>Coefficient</td>
<td>Std. Error</td>
</tr>
<tr>
<td>FMSH</td>
<td>0.275 **</td>
<td>0.126</td>
<td>1.010 ***</td>
<td>0.179</td>
<td>-0.762 ***</td>
<td>0.183</td>
<td>-0.478 ***</td>
<td>0.147</td>
</tr>
<tr>
<td>FMSA</td>
<td></td>
<td></td>
<td>-3.570 ***</td>
<td>0.642</td>
<td>0.497</td>
<td>0.440</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SO</td>
<td>-3.256 ***</td>
<td>0.577</td>
<td>0.777</td>
<td>0.546</td>
<td>-3.570 ***</td>
<td>0.642</td>
<td>0.497</td>
<td>0.440</td>
</tr>
<tr>
<td>LA</td>
<td>-0.080 **</td>
<td>0.034</td>
<td>-0.073 ***</td>
<td>0.022</td>
<td>-0.038</td>
<td>0.034</td>
<td>-0.017</td>
<td>0.020</td>
</tr>
<tr>
<td>DA</td>
<td>0.241 ***</td>
<td>0.046</td>
<td>0.027</td>
<td>0.042</td>
<td>0.290 ***</td>
<td>0.047</td>
<td>0.151 ***</td>
<td>0.029</td>
</tr>
<tr>
<td>NPL</td>
<td>-0.095 ***</td>
<td>0.023</td>
<td>-0.086 ***</td>
<td>0.014</td>
<td>-0.057 ***</td>
<td>0.021</td>
<td>-0.040 ***</td>
<td>0.011</td>
</tr>
<tr>
<td>PEX</td>
<td>-0.008</td>
<td>0.007</td>
<td>0.000</td>
<td>0.006</td>
<td>-0.010</td>
<td>0.010</td>
<td>-0.005</td>
<td>0.005</td>
</tr>
<tr>
<td>BRA</td>
<td>-0.356 ***</td>
<td>0.117</td>
<td>-0.443 ***</td>
<td>0.128</td>
<td>-0.248 **</td>
<td>0.113</td>
<td>-0.310 ***</td>
<td>0.095</td>
</tr>
<tr>
<td>GDP CAPG</td>
<td>0.064</td>
<td>0.039</td>
<td>0.048</td>
<td>0.040</td>
<td>0.059</td>
<td>0.042</td>
<td>0.074 *</td>
<td>0.040</td>
</tr>
<tr>
<td>Log likelihood</td>
<td>-104.018</td>
<td>-96.354</td>
<td>-96.752</td>
<td>-118.758</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LR statistic</td>
<td>179.611 ***</td>
<td>167.324 ***</td>
<td>194.1438 ***</td>
<td>122.5153 ***</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*, **, *** indicate significance levels of 10, 5 and 1 percent respectively.

**Adoption of Organisational Restructuring**

The estimation results in Table 3 also confirm the results obtained from the first set of regressions with respect to the probability of adoption of organisational restructuring and show a positive association between the asset share of hybrid banks (FMSH) and the probability of adoption of organisational restructuring by domestic banks.

Statistically significant determinants of the probability of adoption of organisational restructuring are the variables liquid assets (in percent of total assets), non-performing loans (in percent of total loans) as well as branch intensity.

In accordance with the findings in Section 7.1, the asset share of hybrid banks and foreign branches (FMSA) is significant, but
negatively associated with the probability of adoption of organisational restructuring. These results are confirmed when using the asset share of foreign branches as foreign penetration measure (FMSB) as reported in Appendix C.

Finally, the ratio of the sum across all banks of the assets of each bank multiplied by the percentage of equity held by foreigners to total commercial bank assets is used as alternative foreign penetration measure. The results in Appendix D confirm that the change in this foreign penetration measure is insignificant with respect to the probability of the adoption of organisational restructuring.\textsuperscript{20}

8. Interpretation of Results and Summary

This paper examines the diffusion of two major financial innovations, namely transactional internet banking and organisational restructuring, across commercial banks incorporated in Thailand and attempts to contribute to the financial innovation literature as well as the literature concerned with foreign bank entry by linking foreign bank presence and foreign ownership to the diffusion process.

The analysis using a logit model suggests that ceteris paribus foreign ownership has had a positive effect on the probability of adoption of either innovation. The results further show that ceteris paribus increases in the asset share of hybrid banks appear to have increased the probability of adoption of either innovation.

State ownership is found to have a negative effect on the probability of adoption of internet banking, as expected. Whereas deposits and liquid assets (all scaled by total assets), non-performing loans (scaled by total loans) as well as branch intensity are found to be important determinants of the probability of adoption of internet banking and organisational restructuring, personnel expenses (in percent of non-interest expenses) turn out to be statistically insignificant in all regressions.

\textsuperscript{20} See footnote 18.
The estimation results further suggest that the mode of entry and the organisational form matter since the asset share of foreign branches is interestingly found to be negatively associated with the probability of adoption of either innovation, underlining that foreign branches and hybrid banks do not compete in the same lines of business. Moreover, the estimation results imply that a majority stake is of importance.

To conclude, the findings give some supportive evidence that foreign banks may indeed increase the quality and availability of financial services by (i) directly introducing new technology and procedures to the domestic market and (ii) indirectly by exerting pressures on domestic institutions to improve operations as predicted by the literature.

However, the results discussed above must be interpreted with caution since isolation of the effects of foreign bank presence from the manifold changes in the Thai financial sector is not a straightforward task. In addition, due to data unavailability it is neither possible to control for the technological infrastructure nor for the innovativeness of the environment, both of which are identified by the literature as important determinants of the probability of adoption of financial innovations. Hence, it may be misleading to attribute increases in the probability of adoption of especially the technological innovation to increased foreign bank presence. Besides, the study would benefit greatly from a comparison with other, more restricted countries. Nevertheless, the argument gains some support from the finding that foreign ownership appears to have had a positive effect on the probability of adoption of either innovation.

Besides, market shares in terms of internet banking service fees or expenses for organisational restructuring would be more appropriate dependent variables, given the number of cross-sections as well as the time dimension. These data, however, are not available on a quarterly basis.
Moreover, the analysis is impeded by a lack of data availability for other major innovations such as the adoption of ATM, electronic card services and branch re-engineering programmes.

References


______. (2000). *BoT Notification Ref. TorPorThor. SorNorSor. (01) Wor. 3097/2543 Regarding Bank of Thailand Notification on the Use of Internet Network In Business Activities, 15 November 2000.*


Appendix A

Estimation results: 1st set of regressions

The asset share of foreign branches (FMSB) is used as foreign penetration measure.

<table>
<thead>
<tr>
<th></th>
<th>IB LOGIT</th>
<th>OR LOGIT</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Coefficient</td>
<td>Std. Error</td>
</tr>
<tr>
<td>FMSB</td>
<td>-1.311 ***</td>
<td>0.277</td>
</tr>
<tr>
<td>FO</td>
<td>2.347 ***</td>
<td>0.689</td>
</tr>
<tr>
<td>SO</td>
<td>-6.509 ***</td>
<td>1.021</td>
</tr>
<tr>
<td>LA</td>
<td>0.011</td>
<td>0.014</td>
</tr>
<tr>
<td>DA</td>
<td>0.376 ***</td>
<td>0.071</td>
</tr>
<tr>
<td>NPL</td>
<td>-0.145 ***</td>
<td>0.027</td>
</tr>
<tr>
<td>PEX</td>
<td>-0.005</td>
<td>0.008</td>
</tr>
<tr>
<td>BRA</td>
<td>0.124</td>
<td>0.129</td>
</tr>
<tr>
<td>GDPCAPG</td>
<td>-0.003</td>
<td>0.052</td>
</tr>
</tbody>
</table>

Log likelihood: -69.480, -80.536
LR statistic: 317.4578 *** 288.2917 ***

*, **, *** indicate significance levels of 10, 5 and 1 percent respectively. IB and OR denote the binary choice variables, where IB refers to transactional internet banking and OR to organisational restructuring.
Appendix B

Estimation results: 1st set of regressions

The ratio of the sum across all banks of the assets of each bank multiplied by the percentage of equity held by foreigners to total commercial bank assets (FOBA) is used as foreign penetration measure.

<table>
<thead>
<tr>
<th></th>
<th>IB LOGIT</th>
<th>OR LOGIT</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Coefficient</td>
<td>Std. Error</td>
</tr>
<tr>
<td>Δ FOBA</td>
<td>-0.176 **</td>
<td>0.082</td>
</tr>
<tr>
<td>FO</td>
<td>1.038 ***</td>
<td>0.292</td>
</tr>
<tr>
<td>SO</td>
<td>-1.934 ***</td>
<td>0.425</td>
</tr>
<tr>
<td>Δ LA</td>
<td>-0.070 ***</td>
<td>0.024</td>
</tr>
<tr>
<td>Δ DA</td>
<td>0.003</td>
<td>0.033</td>
</tr>
<tr>
<td>Δ NPL</td>
<td>-0.028 *</td>
<td>0.016</td>
</tr>
<tr>
<td>Δ PEX</td>
<td>0.001</td>
<td>0.003</td>
</tr>
<tr>
<td>Δ BRA</td>
<td>-0.277</td>
<td>0.221</td>
</tr>
<tr>
<td>Δ GDP/CAPG</td>
<td>-0.010</td>
<td>0.021</td>
</tr>
<tr>
<td>Log likelihood</td>
<td>-184.810</td>
<td></td>
</tr>
<tr>
<td>LR statistic</td>
<td>73.5457 ***</td>
<td></td>
</tr>
</tbody>
</table>

*,**,*** indicate significance levels of 10, 5 and 1 percent respectively. IB and OR denote the binary choice variables, where IB refers to transactional internet banking and OR to organisational restructuring. Dependent and independent variables in first differences (denoted Δ) except the dummy variables.
Appendix C

Estimation results: 2nd set of regressions

The asset share of foreign branches (FMSB) is used as foreign penetration measure.

<table>
<thead>
<tr>
<th></th>
<th>IB LOGIT</th>
<th>OR LOGIT</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Coefficient</td>
<td>Std. Error</td>
</tr>
<tr>
<td>FMSB</td>
<td>-0.660 ***</td>
<td>0.156</td>
</tr>
<tr>
<td>SO</td>
<td>-3.478 ***</td>
<td>0.603</td>
</tr>
<tr>
<td>LA</td>
<td>-0.051</td>
<td>0.033</td>
</tr>
<tr>
<td>DA</td>
<td>0.194 ***</td>
<td>0.045</td>
</tr>
<tr>
<td>NPL</td>
<td>-0.080 ***</td>
<td>0.023</td>
</tr>
<tr>
<td>PEX</td>
<td>-0.011</td>
<td>0.008</td>
</tr>
<tr>
<td>BRA</td>
<td>-0.247 **</td>
<td>0.124</td>
</tr>
<tr>
<td>GDPCAPG</td>
<td>0.033</td>
<td>0.043</td>
</tr>
</tbody>
</table>

Log likelihood: -93.645  -79.911
LR statistic: 200.3587 ***  200.2082 ***

*, **, *** indicate significance levels of 10, 5 and 1 percent respectively. IB and OR denote the binary choice variables, where IB refers to transactional internet banking and OR to organisational restructuring.
Appendix D

**Estimation results: 2nd set of regressions**

The ratio of the sum across all banks of the assets of each bank multiplied by the percentage of equity held by foreigners to total commercial bank assets (FOBA) is used as foreign penetration measure.

<table>
<thead>
<tr>
<th></th>
<th>IB LOGIT</th>
<th>OR LOGIT</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Coefficient</td>
<td>Std. Error</td>
</tr>
<tr>
<td>∆ FOBA</td>
<td>0.072</td>
<td>0.085</td>
</tr>
<tr>
<td>SO</td>
<td>-1.777 ***</td>
<td>0.332</td>
</tr>
<tr>
<td>∆ LA</td>
<td>-0.050 **</td>
<td>0.025</td>
</tr>
<tr>
<td>∆ DA</td>
<td>-0.093 *</td>
<td>0.053</td>
</tr>
<tr>
<td>∆ NPL</td>
<td>-0.034 *</td>
<td>0.019</td>
</tr>
<tr>
<td>∆ PEX</td>
<td>0.002</td>
<td>0.003</td>
</tr>
<tr>
<td>∆ BRA</td>
<td>0.298</td>
<td>0.285</td>
</tr>
<tr>
<td>∆ GDPCAPG</td>
<td>0.003</td>
<td>0.022</td>
</tr>
<tr>
<td>Log likelihood</td>
<td>-166.148</td>
<td></td>
</tr>
<tr>
<td>LR statistic</td>
<td>44.71687 ***</td>
<td></td>
</tr>
</tbody>
</table>

*, **, *** indicate significance levels of 10, 5 and 1 percent respectively. IB and OR denote the binary choice variables, where IB refers to transactional internet banking and OR to organisational restructuring. Dependent and independent variables in first differences (denoted ∆) except the dummy variables.