ONLINE BANKING SECURITY INDUSTRY IN EMERGING CHINA MARKET

by

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Abstract

In China, although traditional banks are still taking a wait-and-see approach in terms of offering their customers authentication tokens, online security technology is gaining momentum among Internet banks. During the last 15 years, technology for online banking security has undergone remarkable progress. The number of online banking users and the volume of transactions are increasing daily. Moreover, Chinese customers are paying more attention to online banking security issues, and are gradually becoming willing to pay more for online security hardware such as authentication tokens.

This project analyzes the overall industry of online banking security technology within China, including IT companies that specialize in financial technology, such as Gemplus, G&D, RSA, and Huahong. Furthermore, this thesis discusses both the opportunities and risks faced by incumbent firms and new entrants in this expanding market.

Keywords: China; commercial banking; internet banking; online security; digital certificate; RSA; USB key; E-token

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Glossary

Digital Certificate	In terms of cryptography, a digital certificate is an electronic document that uses a digital signature to bind together a public key with an identity — information such as the name of a person or an organization, their address, and so forth.
RSA	An algorithm for public-key cryptography. It is the first algorithm known to be suitable for signing as well as encryption, and one of the first great advances in public-key cryptography
e-Token	Sometimes listed as a hardware token, hard token, authentication token, USB token, cryptographic token or key fob; it is a physical device that an authorized user of computer services is given to ease authentication
ICC	Also called a smart card; it is a pocket-sized card embedded with integrated circuits that contain encrypted data.

1: Introduction

The topic of this thesis pertains to an industry analysis of internet banking security products in China.

The author's personal experience in the commercial banking business within China has given him the inspiration to pursue this research topic. China as an emerging market contains a vast amount of business opportunities in the commercial banking industry. Along with the growth of online banking services, the security of the banking system has become a top issue for both traditional banking and online banking users. However, the capability of banks to repeal attacks by online criminals remains weak without help from specialized online security companies. Therefore, banks have begun to employ third party companies to enhance the security of their online banking services.

1.1 Past Research on Chinese Online Banking

Previous research details the overall picture of the Chinese commercial banking industry from its establishment in 1949 through to reforms issued in 1978. The reforms encouraged both state-owned banks and share-holding commercial banks to engage in organizational reconstructing, which resulted in changes to the cost structure as well as improvements in banking competence. In addition, commercial banks in China started to demonstrate significant economies of scale as they expanded nationwide (Xiaoqing Fu and Shelagh Heffernan, 2008)

In 2001, China opened her markets to foreign competition, and the inflow of foreign banks has had a dramatic impact on China's domestic banks. To cope with this increase in competitive pressure, China's financial institutions have had to make adjustments in structure, and have begun to focus on strengthening their core capabilities by adopting new techniques and developing innovative new products and services that boost competitiveness (Loong, Pauline, 2000).

One such innovation pertains to online banking. Numerous industry reports and surveys exist that present quantitative data for evaluating the entire online banking industry. In addition, these reports also highlight some important milestones in the history of online banking in China. The growth rate of the online banking market in China in 2008 was 30.6% with a transaction volume of over 320 trillion Yuan. However, the USB-token adoption rate is still very low (iResearch, 2008) even though online banking security remains the key concern of Chinese consumers.

Existing research in terms of online banking security technology, products and suppliers remains insufficient. Banking security knowledge in China is rather limited and this has led to the slow adoption of security technologies in the Chinese banking industry.

1.2 The Purpose of the Study

Owing to the lack of research on the online banking security industry in China, online security technologies are not widely accepted in Chinese banks. Therefore, the detailed and informative industry analysis presented in this study provides not only a general idea about the industry and its technological innovations, but also implications pertaining to the competitive advantages of online banking in China. Moreover, an

understanding of the trends regarding online banking security technologies should provide a better forecast of technology use and competition in online banking. A bank that has the capability to adopt state-of-the-art technology is likely to acquire a larger market share and to pre-empt its customers from switching to competitors. Finally, this study presents some recommendations for both traditional banks and new online banks in terms of better positioning their firms in the growing online banking market.

1.3 The Organization of the Study

Chapter 2 provides a brief introduction of commercial banks in China, where commercial banks are classified into three main categories. Moreover, the history of several banks is outlined. The author also gives a comparison between typical Chinese banks and US banks to help develop a general idea of how well Chinese banks have performed to date. Chapter 3 discusses the current situation regarding the Chinese online banking industry. The total market is depicted and milestones in Chinese online banking history are demonstrated. In addition, the key issue of online banking in China – security – is discussed in terms of a case study of ICBC that illustrates how a major bank in China has improved its online banking security. Chapter 4 shifts to investigating existing online banking security companies. Michael E. Porter's "5 Forces" model provides a detailed analysis of this industry. In Chapter 5, the latest issues and developments in the online banking security industry provide information about potential future developments. Finally, Chapter 6 offers recommendations and solutions for incumbent companies and new comers within the online banking security industry in terms of different strategies and technologies based on the analysis in the previous chapters.

2: Commercial Banks in China

2.1 Overview of Commercial Banks in China

Many years after the Communist Party began governing in the year 1949, the Chinese banking industry remained an industry isolated from foreign capital markets. Due to the opening policy of 1979 and an agreement with the World Trade Organization (WTO) in 1999, the Chinese banking industry has gradually opened to foreign banking investors. Today, with rapid economic development, the banking industry has become one of the most important industries in Mainland China.

Generally, Chinese banks can be classified into three main categories based on their ownership: the central bank, commercial banks and policy banks. The central bank, which is called the People's Bank of China, is run by the Chinese central government. It plays a role of policy-maker, which has nothing to do with specific banking business. Commercial banks including state-held commercial banks, share-held commercial banks and local commercial banks are the main players in the Chinese banking business. Table 2-1 below provides some examples of major commercial banks in each category. Policy banks like the National Development Bank provide funds to not-for-profit projects directed by the government. These banks rarely involve themselves in any type of market competition.

Table 2-1 Major Commercial Banks in China (Rank in Total Assets 2007)

	Bank	Total Assets in RMB Billions
State-owned Commercial Banks	Industrial and Commercial Bank of China (ICBC)	9574
	China Construction Bank (CCB)	7058
	Bank of China (BOC)	6483
	Agricultural Bank of China (ABC)	6050
Share-holding commercial Banks	Bank of Communication (BOCOM)	2431
	China Merchants Bank (CMB)	1396
	CITIC Industrial Bank (CITICIB)	1117
	China Minsheng Banking Corporation (CMBC)	1063
	Shanghai Pudong Development Bank (SPDB)	1003
	Industrial Bank (IB, known as Fujian Industrial Bank before March 2003)	917
	China Everbright Bank (CEB)	817
	Hua Xia Bank (HXB)	628
	Guangdong Development Bank (GDB)	485
	Shenzhen Development Bank (SDB)	442
Local Commercial Banks	Bank of Beijing	363
	Bank of Guangzhou	341
	Bank of Shanghai	336
	Bank of Hangzhou	326
	Bank of Ningbo	217

Source: Adapted from People's Bank of China (2008)

Starting in 1987, in an effort to introduce competition into the commercial banking business, the Chinese government approved 12 share-holding commercial banks for commercial banking operations around China. The largest, China Merchant Bank, has total assets of over 600 billion Yuan, and ranked among the top 200 of "the world 1000" by British financial journal The Banker in 2008 (Banker, 2008). While these 12 share-held banks have a long way to go to catch the state-held banks in terms of deposits, loans and geographical coverage, they compete based on their value-added services in intermediary businesses such as collection, factoring, consulting and credit card services.

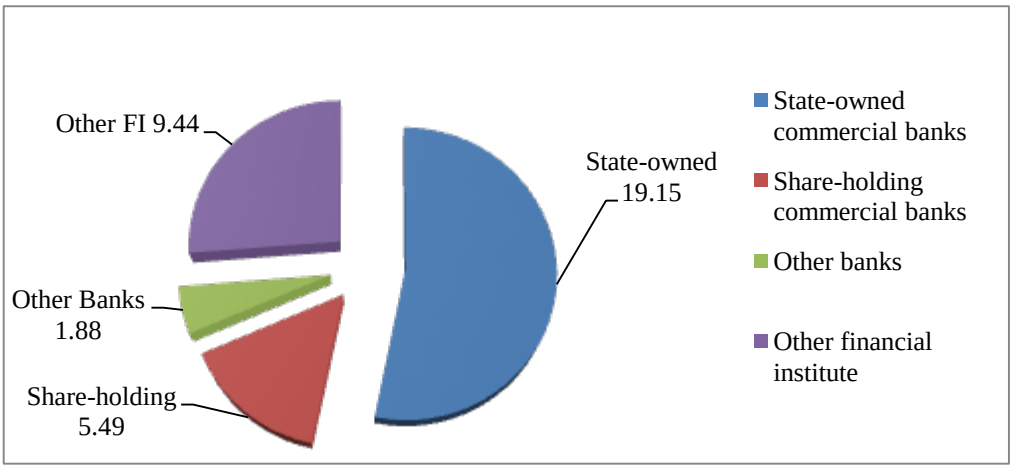
There are great differences between Chinese banks and western banks in terms of intermediary business. The revenue from intermediary business in China is currently very low, making up only 6% on average (Finance Basics: Intermediary Business, 2007). China Merchant Bank recently has a successful credit card promotion that saw them overpass ICBC, the largest bank in China, to become the No.1 credit card service provider. Other share-holding commercial banks also have their own strengths. Moreover, many of them have enlarged their market share by competing with state-held banks.

Aside from the national commercial banks, 112 local commercial banks operate only within one city or nearby areas. They focus on local commercial banking services and benefit from their flat organizational structures, better efficiency and local government background.

In rural areas where large banks are unwilling to set up branches, there are Rural Credit Unions nationwide to provide specific banking services to small enterprises and numerous farmers. Last year, China Post was authorized to conduct commercial banking business through its post offices. The greatest advantage of China Post is that its post offices are already set up in numerous places, from Shanghai to remote rural areas.

Based on published statistics from the Central Bank (People's Bank of China, 2005), Figure 2-1 demonstrates assets of different financial institutions in the year of 2005. The total assets of all financial institutions totalled 35.96 trillion RMB Yuan, which increased by 19.3% from the total in 2004. The assets of state-held commercial banks, share-held commercial banks and other banks were 19.15 trillion Yuan, 5.49 trillion Yuan, and 1.88 trillion Yuan, respectively.

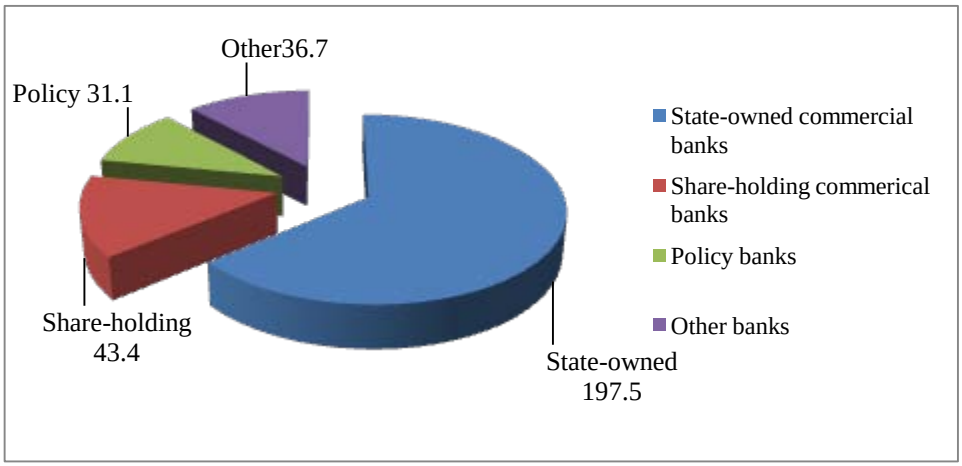
Figure 2-1 Assets of All Financial Institutions in 2005 (trillion Yuan)



Source: Adapted from the People's Bank of China (2005)

In the year 2006, the assets of the Chinese banking industry grew at a tremendous speed. The total assets of the Chinese banking industry reached a high of 43.95 trillion Yuan, a 22.21% increase compared to the figure for 2005. Figure 2-2 shows the profits before tax of the banking industry in 2006. The total profits before tax in 2006 totalled 3379.2 billion Yuan, which was a 30.2% increase compared to the figure for 2005.

Figure 2-2 Profits before Tax of Chinese Banking Industry in 2006



Source: Adapted from People's Bank of China (2006)

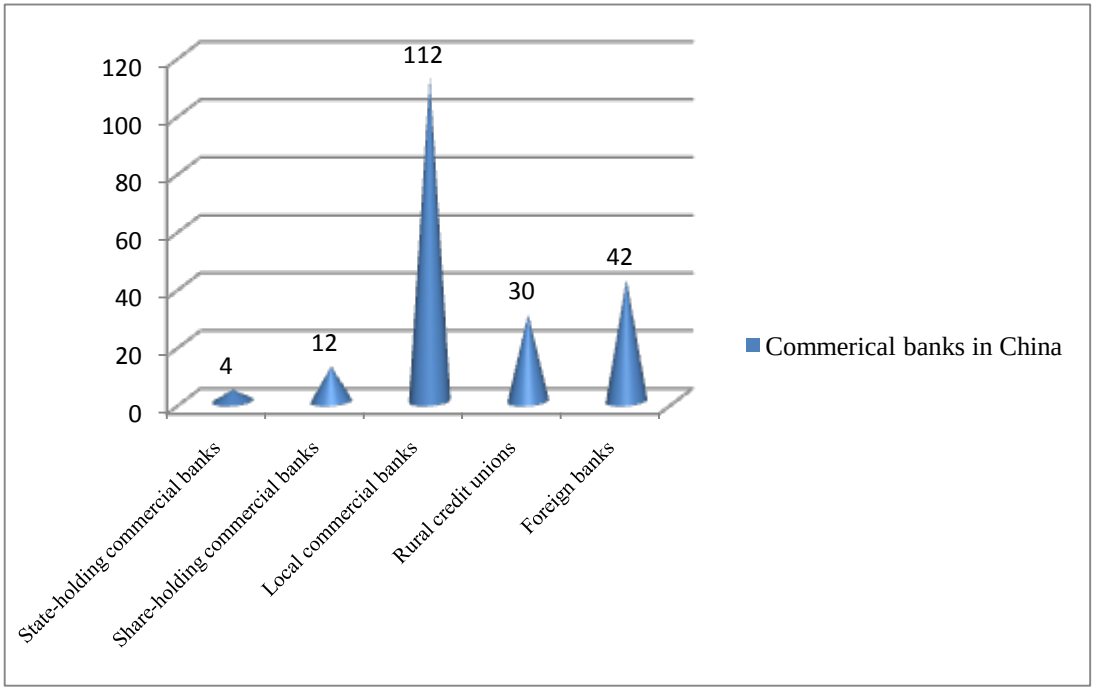
In comparison, figures as of the end of 1999, collated from central bank disclosures to Asiamoney and official publications (Asiamoney, 2000), show that:

- total assets of foreign banks (RMB 263 billion) accounted for just over 2% of the entire system;
- total loans by foreign banks (RMB 178 billion) accounted for 1.7% of the national total – of which foreign-currency loans accounted for 12.8%; and
- total deposits of foreign banks (RMB 48 billion) accounted for just 0.4% nationally.

At the beginning of 2007, China further opened its banking industry to all foreign banks and removed restrictions on foreign investors. In response, banking groups like Citibank Group, HSBC and Standard Charted started to do business in China. By 2008, nine foreign banks were qualified to conduct all types of commercial banking business in China and 33 foreign banks were permitted to conduct banking business in limited fields. Figure 2-3 provides data on the number of banks in different categories in 2008.

The Chinese commercial banking market is believed to be the biggest emerging market in the world, with over 1 billion potential consumers and US$2 trillion in household savings. In the next few years, the competition among banks for these customers will be fierce. According to the Report on Foreign Banks in China (PricewaterhouseCoopers, 2008), there will be at least 100 foreign banks operating in China by 2010.

Figure 2-3 Number of Commercial Banks in China



2.2 Reform of the Chinese Banking Industry

The Chinese banking industry has developed based on a series of reforms instituted by Central Bank of China in 1979. Before that time, there was only one major bank in China, the People's Bank of China (PBC), which played the roles of central bank and commercial bank. Previous Chinese banking industry research described a two-phase reform from 1979 to 2006 (Xiaoqing Fu and Shelagh Heffernan, 2008). After 2006, when China completely opened its financial markets to the western world, a third phase emerged.

Phase one (1979-1992): In 1949, when the Chinese banking industry was originally established, the PBC was the only major bank. A "two-tier" model was introduced to improve the mobilization and allocation of financial resources. One tier concerned the PBC working as the central bank of China. The other tier concerned the

newly introduced state-owned commercial banks. State-owned specialized banks like the "big four" banks – Bank of China (BOC), Agricultural Bank of China (ABC), China Construction Bank (CCB), and the Industrial and Commercial Bank of China (ICBC) – were separated from the PBC and operated in different domains nationwide. At this time, the concept of commercial banks was first introduced to the banking industry. However, competition during this period was very low due to the oligarchic set-up.

Phase two (1993-2006): This phase saw the transformation of state-owned specialized banks to state commercial banks, which coexist with policy banks, joint-stock commercial banks, city and rural commercial banks, urban and rural credit cooperatives and foreign banks operating in their respective authorized business domains. It is obvious that the Chinese banking reforms started in this period have achieved moderate success in preparing the Chinese banks to enter the international arena (Baradwaj, Flaherty and Li, 2008).

Phase three (2007-present): The revised commercial banking law of China lowered the bar for new entrants, as well as encouraged and protected competition. The law also leaves room for commercial banks to have mixed operations (Yongxiu, 2003). All foreign banks are treated according to the agreement with the WTO. In 2009, the state council of China decided to develop Shanghai as an international financial centre (Sina, 2009).

2.3 The "Big Four" and Other Commercial Banks

The Industrial and Commercial Bank of China (ICBC), Bank of China (BOC), China Construction Bank (CCB) and Agricultural Bank of China (ABC) comprise the

four financial magnates in China following the 1980's. For instance, in 2007, ICBC had 81.99 billion Yuan in after-tax profits, which represented 65.9% growth on the figures for the previous year. ICBC also had 381,713 staff providing various financial products and services for 170 million individual customers and 2.72 million corporate customers in China (ICBC, 2009). All four of these banks were listed in the Fortune's Top 500 of 2008 (Fortune, 2008). Table 2-2 shows these four major banks' position in Fortune's Top 500 ranking in terms of income.

Table 2-2 Chinese Banks in Fortune's Top 500

Fortune's Ranking	Bank	Income (100 million USD)
133	Industrial and Commercial Bank of China	515.26
171	China Construction Bank	413.07
187	Bank of China	389.04
223	Agricultural Bank of China	340.59

Source: Adapted from Fortune (2008)

Since October 2005, the top three Chinese banks have raised over US$40 billion in a fifteen-month period, ranking them in the top-ten largest banks in the world by market capitalization. The successful initial public offerings (IPOs) of the top banks in Shanghai and Hong Kong drew significant interest from investors in capital markets all over the world. The China Construction Bank (CCB), the third-largest IPO, raised $9 billion in October 2005; the Bank of China (BOC), the second-largest, raised $11 billion

in May 2006; and the Industrial and Commercial Bank of China (ICBC), the largest IPO, raised about $22 billion in December 2006 (Baradwaj, Flaherty and Li, 2008).

2.4 Foreign Banks

Due to the agreement with the WTO, all foreign banks in China have enjoyed national treatment which ensured foreign banks could operate nationwide like Chinese banks under the same laws and regulations since 2006. Nine top banks in the world already operate nationwide and more than 30 foreign banks have begun their business by opening offices in major cities. Investment banks compete for ownership in insolvent regional lenders such as Guangdong Development Bank. One high-ranking central banker in Beijing commented: “We are happy for foreign banks to come in. However, at the same time we are very concerned about the impact of WTO. Our banks lag behind the foreign banks on almost every front: capitalization, overseas networks, services and modern management expertise. Many foreign institutions are already making significant inroads into our markets” (Loong, Pauline, 2000).By the end of 2006, foreign investors had gained complete access to the Chinese commercial banking industry. By 2007, 193 banks chartered in 47 countries or regions had established 242 representative offices in China (CBRC, 2008). Foreign banks account for RMB 1252.5 billion in assets, 2.38% of China’s total banking assets.

Following the 1980s, China removed all the restriction placed on foreign banks in three stages.

The first stage (1980-1993): In 1980, Japan Import and Export Bank set up its first representative office in Beijing. In 1981, Japan’s Nanyang Commercial Bank

established a branch in Shenzhen. In 1985, the Chinese government officially opened special economic zones (SEZs) including Shenzhen, Zhuhai, Shantou, and Xiamen in China's eastern coastal area to foreign banks to operate in limited banking business. Then other coastal cities (outside the SEZs) were opened to foreign banks. In 1990, Shanghai was opened along with additional five cities. By 1993, there were a total of 76 foreign bank branches in 13 cities, with combined assets of US $8.9 billion (CBRC, 2007).

The second stage (1993-2001): In December 1993, the Chinese government issued a regulation called Decision of the State Council on Reform of the Financial System. This decision emphases the reform of the foreign exchange mechanism of commercial banks in China. The unification of exchange rate began in 1994. In December 1996, foreign banks were for the first time allowed to engage in RMB business transactions involving foreign enterprises and overseas residents of a Chinese city (Shanghai). By 1997, there were 175 foreign bank branches in China (an increase of 99 over the first stage), and the total foreign assets in China's banking sector tripled between 1994 and 1997 (CBRC, 2007). However, due to the Asian financial crisis of 1997, only 15 new foreign banking institutions were established from 1998 to 2001 (CBRC, 2007). Then, the government selected Shenzhen as a second city permitted to conduct RMB business.

The third, post-WTO period (2002-present): This stage has featured amendments to existing laws as well as the issuance of new laws and regulations governing foreign financial institutions based on commitments made by China during a five-year grace period allowed under its WTO accession agreement (CBRC, 2007). These commitments included a phased-in liberalization of foreign banks' access to the Chinese banking

market through the elimination of all geographic and customer restrictions on their business activities within five years (WTO, 2001; Nanto and Sinha, 2002). After Shanghai and Shenzhen, foreign banks in Tianjin, Dalian, Guangzhou, Zhuhai, Qingdao, Nanjing, Wuhan Jinan, Fuzhou, Chengdu, Chongqing Kunming, Beijing, Xiamen, Shenyang, Xi'an, Shantou, Ningbo, Harbin, Changchun, Lanzhou, Yinchuan, and Nanning were permitted to conduct RMB business by 2005. Table 2-3 provides some information on the multinational banks that already operate in China.

Table 2-3 Multinational Banks with Five or More Business Establishments in China, 2006

Bank	Origin	Branches	Sub-branches	Rank in total assets	Years in China
BNP Paribas	France	4	0	3	15
Citigroup	U.S.	8	12	4	19
Hong Kong and Shanghai Banking Corp.	Hong Kong	14	19	5	21
Hang Seng Bank Limited	Hong Kong	7	7	5	22
Credit Agricole Group	France	5	0	6	22
Mitsubishi UFJ Financial Group	Japan	6	0	8	24
Deutsche Bank	Germany	3	2	9	13
ABN AMRO Bank	Netherlands	6	7	12	14
Societe Generale	France	5	0	13	15
Mizuho Financial Group	Japan	5	0	14	23
Sumitomo Mitsui Financial Group	Japan	5	0	22	22
Nanyang Commercial Bank	Hong Kong	5	1	30	26
Bank of China (Hong Kong)	Hong Kong	4	2	30	22
Standard Chartered	UK	10	9	60	22
United Overseas Bank	Singapore	7	1	135	22
Overseas Chinese Banking Corp.	Singapore	4	1	146	16
Bank of East Asia	Hong Kong	12	14	229	20
Wing Hang Bank	Hong Kong	3	1	468	14

Source: Adapted from Canfei He and Rong Fu (2007)

2.5 A Comparison between Chinese and U.S. Banks

To better understand the "Big Four", Baradwaj, Flaherty and Li (2008) conducted research comparing four Chinese stated-own commercial banks to four U.S. banks. The U.S. banks included the Bank of America, Wells Fargo & Co., Wachovia, and Citigroup. The four Chinese banks included the Bank of China (BOC), Agricultural Bank of China (ABC), China Construction Bank (CCB), and the Industrial and Commercial Bank of China (ICBC). All of the following comparisons in this section pertain to these eight banks.

Bank size, as shown in Table 2-4, is comprised of total assets, total deposits and total loans. From 2001 to 2005, mean total assets of the Chinese banks were about 66% of those of the U.S. banks. However, the Chinese banks had greater deposits and offered fewer loans than the U.S. banks. One reason why Chinese banks carry more deposits is that Chinese people have a money deposit culture and are relatively unwilling to borrow money from banks. In terms of efficiency of managing banks' risk, the loan-to-deposit ratio is one of the most important benchmark. The more loans are offered from a certain amount of deposit, the more efficient of a bank to manage its risk. This is also evident when companies Chinese and U.S. companies – the former opt for leveraging far less than the latter. In terms of the Chinese banks' ability to manage risk, they are weaker than U.S. banks in terms of managing loans. Therefore, Chinese banks are less efficient.

Table 2-4 Mean Total Assets (US billions)

Chinese Banks					
	Mean Total Assets	Mean Total Deposits	Mean Total Loans	Loans to Assets	Loans to Deposits
2001	$411.779	$333.301	$237.204	57.60%	71.17%
2002	$427.157	$374.545	$239.573	56.09%	63.96%
2003	$492.254	$425.434	$287.836	58.47%	67.66%
2004	$520.255	$474.257	$291.297	55.99%	61.42%
2005	$635.261	$546.117	$295.706	46.55%	54.15%
All years	$494.432	$429.733	$272.975	55.21%	63.52%
U.S. Banks					
	Mean Total Assets	Mean Total Deposits	Mean Total Loans	Loans to Assets	Loans to Deposits
2001	$588.231	$288.097	$270.308	45.95%	93.83%
2002	$621.821	$314.100	$301.683	48.52%	96.05%
2003	$707.340	$346.053	$325.657	46.04%	94.11%
2004	$892.406	$447.539	$401.336	44.97%	89.68%
2005	$947.148	$465.601	$433.801	45.80%	93.17%
All years	$751.389	$372.278	$346.571	46.12%	93.09%

Source: Adapted from Babu G. Baradwaj, Susan Flaherty and Joanne Li (2008)

From the liquidity risk perspective shown in Table 2-5, Chinese banks' total assets grew slower and total deposits and loans grew quicker than for their U.S. counterparts. However, the liquidity risk for U.S. banks is larger than for Chinese banks if we look into the loan-to-deposit ratios. U.S. banks' loan-to-deposit ratios, shown in Table 2-6, are about 90 percent, which means those banks operate very efficiently, but they face more liquidity risk if their loans cannot be collected. Chinese banks have excess liquidity that results in less risk.

Table 2-5 Liquidity Risk in terms of Growth Rate(%)

	Chinese Banks			U.S. Banks		
	Growth Rate of Total Assets	Growth Rate of Total Deposits	Growth Rate of Total Loans	Growth Rate of Total Assets	Growth Rate of Total Deposits	Growth Rate of Total Loans
2001	-	-	-	-	-	-
2002	11	14.7	14	6.3	8.7	11.7
2003	16.2	13.8	15.9	13.6	10.9	7.6
2004	6.9	11.5	4	26	28.9	24.6
2005	18.8	12.6	4.8	5.7	4.2	8.7
All years	13	16	16	12.9	13.2	13.1

Source: Adapted from Babu G. Baradwaj, Susan Flaherty and Joanne Li (2008)

Table 2-6 Loan-to-Deposit Ratio

	Chinese Banks	U.S. Banks
	Mean (%)	Mean (%)
2001	70.95	92.70
2002	66.18	95.00
2003	67.10	92.50
2004	62.16	89.18
2005	54.90	92.85
all years	64.14	92.45

Source: Adapted from Baradwaj, Flaherty and Li (2008)

Although Chinese banks have less liquidity risk, their profitability ratios fluctuate from year to year. There was a jump in 2003 in Chinese banks' ROA and ROE ratios according to Table 2-7. The reason is based on preparations made for international competition after their entry into the WTO; in 2003, the Chinese government helped many banks strike bad assets off by establishing four bad asset management companies for those banks. Comparatively, U.S. banks have proven quite stable in terms of their profitability.

Table 2-7 Profitability Measure

	Chinese Banks		U.S. Banks	
	Mean (%)		Mean (%)	
	ROA	ROE	ROA	ROE
2001	1.33	11.57	1.14	14.02
2002	1.35	-3.46	1.32	15.76
2003	4.07	6.63	1.4	18.09
2004	3.44	13.19	1.27	14.92
2005	4.76	12.86	1.4	16.46
all years	2.98	7.71	1.3	15.85

Source: Adapted from Babu G. Baradwaj, Susan Flaherty and Joanne Li, (2008)

To prevent bank insolvency, the Chinese government actively peeled off bad assets of state-owned banks to increase capital adequacy. From Table 2-8, we see that in 2004, the core capital adequacy and capital adequacy ratios of Chinese banks were much lower than those of the U.S. banks and failed to meet the Basel Agreement of 1988, which require at least 8% as capital adequacy. However, those Chinese banks' ratios increased very quickly in 2005. In terms of the core capital adequacy ratio, Chinese banks proved to outdo the U.S. banks. The drive behind this is that those "Big Four" banks were preparing their IPOs with the help of the Ministry of Finance to meet international banking industry standards like the Basel Agreement.

Table 2-8 Capital Adequacy (%)

	Chinese Banks		U.S. Banks	
	Core capital adequacy ratio	Capital adequacy ratio	Core capital adequacy ratio	Capital adequacy ratio
2001			7.72	11.32
2002			8.18	11.8
2003			7.72	12.03
2004	4.09	5.84	7.72	11.71
2005	9.09	11.29	8.2	11.39

Source: Adapted from Babu G. Baradwaj, Susan Flaherty and Joanne Li, (2008)

As China further opens her markets, the inflow of foreign banks will have a dramatic impact on China's domestic banks. Adjustments have been made to cope with the increase in competitive pressure that this market opening has brought about, and China's financial institutions will need to continue to focus on strengthening their core capabilities, adopting new techniques and developing innovative new products and services in order to boost competitiveness. If not, they will find it difficult to compete with the flood of foreign entrants. While investment by foreign banks may have had a negative impact on the operational performance of Chinese banks, foreign investment has helped Chinese banks to see where their weaknesses lie, and has given them the opportunity to learn from the foreign banks' strengths (Wu, Chen and Lin, 2007).

2.6 Summary of China Commercial Banking Industry

After 30 years' reform, Chinese commercial banking system has evolved from a Two-tier system to a more diversified industry with growing competition. Although this industry is still dominated by four big state-owned banks, more commercial banks including foreign competitors are flooding into China. Traditionally, China commercial banks' efficiency of operation and risk management is quite low comparing with foreign banks due to lack of experienced employees, modern technologies and financial instruments. In terms of bank size, Chinese banks are not so fall behind foreign counterparts. However, in terms of efficiency of using banks' assets, Chinese banks still have a long way to go. To face the competition from foreign banks, Chinese banks are work hard to improve their competence by hiring experienced banking experts, introducing advanced technology and innovating more financial products. Like in the

field of online banking, Chinese banks are stick close to the latest development which will be discussed in the following chapter.

3: Online Banking in China

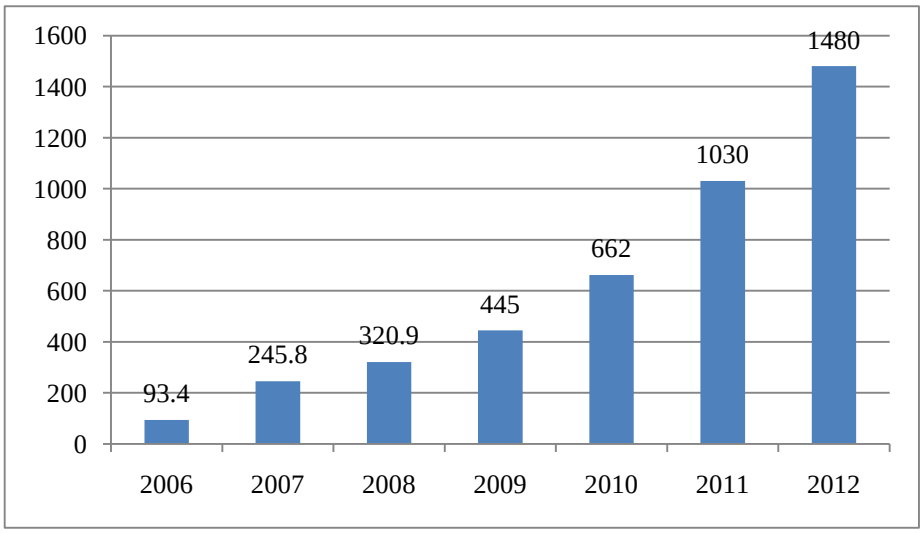
Online banking is deemed as one of the most important growing area in Chinese commercial banking business. Traditional Face-to-Face banking services in branches could not meet customers' growing need of diversified and tailor-made banking services. With the increasing popularity of Internet in China, it is crucial for banks to seize this opportunity to attract more customers and enhance their loyalty by providing convenient, instant and secure online banking services.

3.1 Online Banking in Chin

3.1.1 Market overview

The Chinese online banking market has the potential to thrive in the future. There is a trend that more people in China prefer online transactions to traditional commerce due the fast-paced urban life. China's Customer to Customer C2C market rose from 0.4 billion Yuan in 2001 to 67.8 billion Yuan in 2008 in terms of total transaction volume (iResearch, 2008). According to the 23rd Report (CNNIC, 2009) on China Internet Network Development issued by the China Internet Network Information Centre (CNNIC), the population of Internet users in China was 298 million by the end of 2008, an increase of 42% from 2007 and is still increasing.

Figure 3-1 iResearch Report on Transaction Volume of Online Banking



Source: Adapted from iResearch (2008)

Meanwhile, the CNNIC's annual research report on Internet Banking Adoption Rates shown in Table 3-1 states that although the number of internet users in China is the largest in the world, the internet banking service adoption rate is comparatively low.

Table 3-1 Internet Banking (IB) Adoption Rate in China

	2007		2008			
	IB Adoption rate	IB Users in millions	IB Adoption Rate	IB Users in millions	Growth in millions	Growth Rate
Internet Banking	19.2%	4.00	19.3%	5,80	1,80	45.0%
Internet Stock Investment	18.2%	3.80	11.4%	3,40	-40	-10.5%

Source: Adapted from CNNIC (2008)

This low adoption rate provides clues about the immaturity of the Chinese online banking market and the huge potential for future development. The source of market

growth comes from the increase in total internet users, internet banking users and internet banking adoption rates. In addition, with the fast economic development of China, consumer incomes are increasing, their internet knowledge and skills are growing and their need for banking services is also increasing tremendously.

3.1.2 The development of Chinese Online banking

Although the world's online banking history can be traced to the early 1980's when home online banking services were first introduced by four major banks (Citibank, Chase Manhattan, Chemical and Manufacturers Hanover) in New York (Internet_bank, www.wikipedia.com), the first real modern internet banking service was developed by Stanford Federal Credit Union in October, 1994. During the same year, ICBC, as a Chinese commercial banking leader, introduced the online banking concept to Chinese customers. It is no surprise that Chinese banks are not so far behind the world banking industry in terms of Internet banking adoption because Chinese banks are more likely to adopt new technology to reduce their costs and promote their services.

Only two years after the introduction of online banking to the world, more commercial banks in China, like Bank of China and China Merchant Bank, began to realize its potential and invested heavily in online banking. It took only eight years (1994-2002) for all state-owned and share-held commercial banks in China to establish their online banking systems.

After 2002, together with the burst of e-commerce and credit card transactions, the need for online banking increased greatly in terms of total online banking users and total online banking transaction volume (CNNIC, iResearch, 2008). All banks began to differentiate their brand image of online banking to enhance customer loyalty.

Another issue that arose after 2002 concerned online banking security, which represented a bottleneck in terms of online banking development. Online banking thefts increased yearly in terms of the total amount of money stolen (Li Shusheng, 2008). The traditional password authentication method was easily hacked by Trojan and Phishing methods. Therefore, Chinese banks sought new technologies to ensure the safety of their online banking services.

During the latest ten years, the world's online banking services have developed into three models: the sole-online banking model, the traditional banking plus online banking model and the separate traditional and online banking model (Kuaijiren, 2008). In China, all online banking services are classified as part of the traditional banking plus online banking model. Table 3-2 provides an overview of key milestones in China's online banking development.

Table 3-2 Milestones in the Development of Chinese Online Banking

Year	Features	Key Events
1994-1997	R&D	1994: ICBC first introduced the online banking concept in China 1996: BOC began to develop an online banking system 1997: BOC and CMB published their online banking websites
1998-2002	Promotion of online banking services	1998: CMB launched their online banking brand "All in one net" in Shenzhen 1999: CMB started promoting online services in Beijing 1999: BOC officially provided online services including information enquiries, online payment, money collection etc. 1999: CCB promoted online services in Beijing and Guangzhou 2000: ICBC began to provide online banking services in Beijing, Shanghai, Tianjin and Guangzhou 2001: ABC launched 95599.com online service website 2002: ABC officially started online banking services 2002: All state-held and share-held commercial banks had established online service systems
2003-2010	Brand image, after sale services, fast development	2003: ICBC launched brand "ICBC Banking@Home" 2005: Bank of Communications "Finance Express" 2006: ABC "Golden E-Banking" 2007: The burst of online mutual funds sales 2008: The upgrade of online security technology
2010-	Stability period along with further legal improvements related to online banking	

Source: Adapted from iResearch (2008-2009)

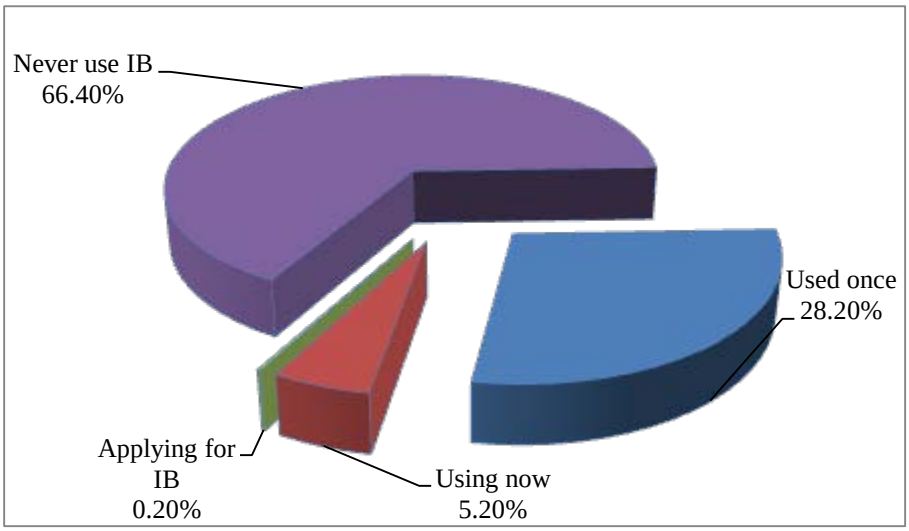
3.2 Online Banking Security Key Issues

3.2.1 Concerns from Internet Banking Users' Perspective

Security concerns (Laforet and Li, 2005) are the most important factor associated with Chinese consumers' adoption of online banking. Other factors affecting consumers' attitudes toward online banking include education, awareness, possessing a credit/debit card and past experience with computers/new technology and personal banking. The main barriers to using online banking pertain to the perception of risk, a lack of computer and technological skills and the traditional Chinese cash-carry banking culture.

As mentioned above, the low internet banking adoption rate has a direct link to consumers' risk perceptions regarding online banking (Laforet and Li, 2005). Moreover, research by Laforet and Li (2005) concludes that Chinese consumers are very cautious about using internet banking services due to a fear of losing personal control of their money, data, and time, and the risk of system failure. In addition, the USB key adoption rate is also low, as demonstrated in Figure 3-2 "USB Key Adoption Survey".

Figure 3-2 USB Key Adoption Survey



Source: Adapted from CINNC (2008)

The e-banking market in China is still in an early stage. The target market is comparatively small due to security concerns, computer access, skills, and a cash-carry tradition. However, there is great potential in terms of targeting certain customer profiles and female customers. In addition, the bank should put more effort on delivering messages regarding the security of e-banking service to customers.

The reason why internet banking in the early years was not successful is that the security issue was neglected. In Mainland China, the Commercial banking industry was among the first industries to apply Information Technology (IT) to process daily transactions. Therefore, all commercial banks possess their own sophisticated IT systems. Compared with IT systems in other industries, the systems used by banks possess high-level security, fast information processing speeds and a low possibility of malfunction. However, they require large investments in terms of equipment and R&D expenses. Due to the aforementioned security reasons, banks in China used to develop IT systems by

themselves: all banks had R&D departments and employees. However, as China has gradually opened its financial service market to foreign banking institutions over the past ten years, commercial banks in China are facing unprecedented competition. They have a great need to lower operational costs, increase client satisfaction and enhance security. Therefore, the banks have coincidently expanded their business and out-sourced their supporting technology to world-class specialized companies and service providers.

3.2.2 Key Internet Banking Security Technologies

The foundation of today's internet security is the RSA algorithm named after Ron Rivest, Adi Shamir, and Leonard Adleman. According to the definition from Wikipedia.com, RSA is an algorithm for public-key cryptography. It is the first algorithm known to be suitable for signing as well as encryption, and one of the first great advances in public key cryptography. RSA is widely applied in electronic commerce protocols. In the online banking field, RSA prevails on online bank login screens, encrypted data transfer systems and online security hardware for clients. Theoretically, it is very safe if the key is sufficiently long and the bank ensures use of up-to-date implementations.

3.2.3 Generations of Internet Banking Security Technologies and Products

From the introduction of Internet banking until now, there have been a total of four generations of Internet banking security. Table 3-3 summarizes these four generations of online banking security technology. The first generation was very primitive. The safety of client information was based on a simple password. The second generation saw some development in terms of the safety of client passwords using the one time password concept. The third generation technology is currently the most mature and the most

popular. It is based on Digital Certificate technology, and deemed to be the most secure method to protect online banking confidentiality. The fourth generation is not so mature at present. Since RSA provides a new product named SecurID, one future direction may be the concept of a Dynamic Password. This concept is mainly about using unpredictable and changeable passwords generated from a device that has an unbreakable algorithm. These four generations are discussed further in the following paragraphs.

Table 3-3 Generations of Technologies and Products

	Technology & Products	Cost	Risk	Convenience
1st Generation	Password	Very low	Very high	High
2nd Generation	Password Card	Low	Moderate	Moderate
	One-time password-text message	Low	Low-moderate	Moderate
3rd Generation	Soft Digital Certificate	Low	Moderate	High
	IC card	High	Low	Low
	USB-Token	Moderate	Low	Moderate
	Bio-Token	High	Very low	Low
4th Generation	Dynamic Password-SecurID	Moderate	Low	High

3.2.3.1 First Generation - Password Authentication

Password authentication is the most common and basic method that Chinese banks employ in their online banking services. This method is very insecure because it authenticates users to access to their accounts by transmitting passwords in unencrypted ASCII letters through the internet. Hackers can easily steal client passwords by using a Trojan virus or a keyboard monitoring programme. Therefore, password authentication is only useful for account inquiries, not for money transfers.

3.2.3.2 Second Generation - One-time Password

The one-time password concept is based on the idea that Internet banking users should input a different password each time they log in or conduct money transfers to avoid thefts. Several products offer this function. The most popular ones are Password card and text message password.

3.2.3.3 Third Generation - Digital Certificate

The third generation of online banking security products are based on Digital Certificate technology. In terms of cryptography, a digital certificate is an electronic document that uses a digital signature to bind together a public key with an identity — information such as the name of a person or an organization, their address, and so forth. The certificate verifies that a public key belongs to an individual. (Public_key_certificate,www.wikipedia.com) This electronic document can be saved on a computer, an IC card or a USB-Key. It is indecipherable when the private key is kept secret for end users by a Certificate Authority (CA)

Integrated Circuit Card (ICC)

An ICC or smart card is a pocket-sized card embedded with integrated circuits that contain encrypted data (IC_card,www.wikipedia.com). Theoretically, using the RSA method, the data in an ICC, which normally refer to a Digital Certificate file, are impossible to decrypt. Online banking users can set up a password and store it in an IC card. To steal money from other person's bank account, a hacker will first need to physically steal the IC card and decrypt the information in the card, which is nearly impossible. Therefore, IC cards act as a form of double insurance for customers, and are

an ideal choice for banks to protect their customers' online bank accounts. ICBC provides their online banking clients with IC cards manufactured by a French company – Gemplus.

The biggest weakness of an ICC is that it costs a lot to implement it on customer computers, as banks need to provide not only a card but also a card reader to their customers. Moreover, banks need to spend additional money to hire specialists to help their clients install the driver and link the card reader to their computers. Therefore, most Chinese banks stopped providing IC cards to their customers.

USB-token

A USB token is the most popular online banking security device in China. It works as the same as an IC card in that it stores a digital certificate file and requires a password. Unlike the IC card, a USB-token does not require an extra card reader. It is very convenient for users to install on their computer by plugging it into a USB dock. Further, it is portable, which is useful for people who need to use online banking services on computers in different locations. The older version of the USB-token required the installation of a driver before the first use on all computers, even those running Windows XP or Vista. It was not convenient for less technologically inclined users. However, the latest USB-tokens are as easy to use as a USB flash disk. The token can function as soon as users plug it into a USB dock.

Bio Token

A Bio Token is one of the latest USB-token developments. It provides a USB-token with a fingerprinting function. To authorize an online banking transaction, users need to scan their fingerprint as additional identity verification. It has a higher security

level than traditional Digital Certificate products like IC cards and USB-tokens. The fingerprint verification function is designed to be unbreakable within the physical token. Even if the token is stolen, the owner's account is still safe because fingerprints are unique.

3.2.3.4 Fourth Generation - SecurID

The RSA SecurID authentication mechanism consists of a token—a piece of hardware (e.g. a token or USB) or software (e.g. a "soft token" for a PDA or cell phone)—assigned to a computer user that generates an authentication code at fixed intervals (usually 30 or 60 seconds) using a built-in clock and the card's factory-encoded random key (known as the "seed" and often provided as a *.asc file). The seed is different for each token, and is loaded into the corresponding RSA SecurID server (RSA Authentication Manager, formerly ACE/Server) as the tokens are purchased. The token hardware is designed to be tamper-resistant to deter reverse engineering of the token.

3.3 Other Enhancements to Online Banking Security

3.3.1 Authentication of Personal Message

When opening an online banking account, clients are required to leave their personal messages in the bank's information system. The next time they need to transfer money online, they see the personal message in their web browser. Those personal messages are highly confidential such that unless the bank's own system has been cracked by hackers, no one else will see those messages. Therefore, if a bank's website fails to show those confidential messages to the client, it is probably a phishing website.

This method is often used by online banking customers to identify fake bank websites. However, this will never prevent the leakage of customers' personal passwords due to Trojan spyware.

3.3.2 Instant Notification of Balance

This method helps clients to know any change in their account balance by sending them a text message or an email. In this way, customers can distinguish unusual transactions from normal personal transaction instantly. However, instant notification is unable to prevent bank accounts from being stolen. The purpose of this is to let customers know their balance in real time and report the loss of passwords to banks; then banks can freeze the account as soon as possible to prevent further losses.

3.3.3 Free Online Security Test

Some banks like ICBC provide a free online service to help clients check their computer systems. Those programs target bugs, viruses and Trojans. The aim of the program is to enhance the immunity of clients' operation systems. ICBC's free online testing program has been downloaded by online banking users 3.69 million times, including 74 thousand times daily from July to September in 2008 (ICBC, 2008).

3.3.4 Anti-phishing Safe Control

Banks can also provide their customers with anti-phishing safe control programs. These programs are ActiveX controls embedded in users' browsers. The function of these controls is to automatically block phishing websites, which helps online banking users who are not familiar with specialized online security knowledge.

3.3.5 Verified by VISA

Banks can also work with VISA to promote the Verified by VISA function to their VISA cardholders. The essence of this function is a free, simple to use service that confirms the cardholders' identity with an extra password when conducting online transactions. It greatly reduces the risk of credit card theft through online transactions. Because it was launched by VISA, the Verified by VISA function is solely limited to VISA cardholders.

3.3.6 Professional Anti-malware Software and Firewalls

iResearch's China Personal Online Security Research Report (2007) states that Trojan viruses aimed at personal information and bank account theft has become the biggest threat to internet users in mainland China. Traditional comprehensive anti-virus software cannot counter the growth of specialized Trojan viruses. There are many professional anti-malware programs designed to protect computers from malware including spyware, hijacker and Trojan programs. Banks in China have a strong incentive to collaborate with software companies in terms of assisting online banking users to not fall victim to online banking fraud.

3.4 A Case Study of ICBC's Online Banking Security

3.4.1 The Bottleneck of the Traditional Transaction Method

The Industrial and Commercial Bank of China (ICBC) is a leading commercial bank in China providing financial products and services for 170 million individual customers and 2.72 million corporate customers. However, the bank spends a large amount of resources to provide daily services to its customers, including building

thousands of branches all over the country and hiring half a million staff. In the Chinese banking industry, the Pareto principle (also known as the 80-20 rule, or the law of the vital few and the principle of factor sparsity) is extremely obvious in that the bank wastes 80% of its resource on the 80% of its customers who make little contribution to the bank. Although ICBC keeps expanding nation-wide, it cannot meet the everyday needs of too many clients.

Before 1994, all banking transactions were conducted in physical branches. Although 80% of ICBC's customers were not within the targeted segment of the market, the bank was very cautious to avoid demarketing them directly. The bank tried to charge for some services to offset the costs associated with non-profit transactions and in order to get rid of the price sensitive customers. However, the results were not as expected, as the demand for banking services has increased dramatically with China's economic growth.

The bank tried to introduce telephone-banking service to personal customers. However, it eventually turned out to be a big failure. The reason is that telephone-banking service is extremely difficult to use. It has too many layers for telephone banking users to reach their target functions, and it is extremely time consuming to wait for a representative or an assistant to help customers finish transactions. Moreover, the security was obstacle for people to accept this service. Customers' account numbers and passwords could be easily stolen by just pushing the "redial" button. Finally, major banks' past experiences demonstrate that more people in China call telephone banking hotlines to complain about various issues like waiting too long in a bank branch, which

requires more human resources to solve these issues. Therefore, the telephone banking service became a complaint call service.

3.4.2 ICBC's Introduction of Online Banking in China

In 1994, due to the maturity of internet technology, the first internet banking service in China was introduced by ICBC. The bank figured out that this was a great opportunity to induce lots of customers to use internet banking services. The situation was quite similar with that of Credit Union in the US. The bank began a nation-wide internet banking marketing action to promote this new service. The marketing plan included advertisements on TV, on websites and in newspapers; waived service fees; and promotion of the "fast" and "low cost" image to customers. At first, those actions definitely had an effect on the market. However, like the telephone banking service, the internet banking service of ICBC faced serious security problems. Numerous Trojans and viruses flooded the internet to steal bank account passwords by monitoring keyboard activities. Again, Chinese customers returned to the branches due to the security issues.

3.4.3 The Introduction of e-token Technology

ICBC gradually realized that the key to solving the internet banking bottleneck was security. Although the dynamic password technology was popular in North America and Europe, Chinese customers were too afraid to use internet banking services. In 2004, after comparing different data encryption technologies from around the world, ICBC decided to import e-token technology to enhance its internet security. Theoretically, this technology is the safest in the world. ICBC tried its best to emphasis the high level of security by adopting this technology. In contrast with the increasing internet banking

theft issues common in other banks, there were no thefts associated with ICBC's internet banking service using e-token technology. Intensively promoting this fact, ICBC successfully established its "world-class security" image of internet banking.

Considering the total trading value of internet banking, the trend was quite flat: after ICBC had increased its online banking security level, it failed to increase the use of internet banking services accordingly. The main reason was that Chinese customers have a tradition of using free banking services; meanwhile, this advanced e-token equipment cost customers 98 RMB Yuan. In 2006, in order to encourage people to use internet banking along with the e-token, ICBC carried out a new marketing plan. During the first several months of 2006, ICBC cut the price of e-token in half to 49 YUAN. Afterwards, the bank began to give this e-token to customers for free. Knowing that the Chinese have a gift-giving culture and like anything free, the bank bore the cost of distributing this internet banking security equipment, hoping customers would switch from branches to the internet for daily transactions like transferring money, bill payments and so on. To attract more people to internet banking, ICBC improved its online banking system by enabling almost every service on the website.

3.4.4 The Harvest Period along with the Flourish of e-commerce

After 2006 there was another trend that helped online businesses to flourish. International online businesses like e-bay.com, as well as other local B2B and B2C companies like taobao.com and alibaba.com, began competing for a larger market share in China. The success of electronic commerce depends upon effective electronic payment systems. The internet banking service of ICBC had already realized real-time payment settlement. The bank wanted to establish a partnership with those e-commerce companies

aimed at the younger generation, who are more likely shop online. By advertising the effectiveness and security of online banking, ICBC successfully attracted more youths who had decent salaries but a lack of time to go to branches for daily banking services.

The total internet banking trading volume increased almost 140 times. The attention should be drawn to the year of 2006 when ICBC began its marketing operation for high security e-token for the internet banking. After only one year, the trading volume of internet nearly tripled.

During recent years, due to the security-centred strategy of internet banking, ICBC has achieved a 70% market share. ICBC was also presented with the Best Consumer Internet Banking and Best Corporate/Institutional Internet Banking in China awards by Globe Finance in September 2008 (ICBC, 2008).

4: Online Banking Security Industry

4.1 Industry Overviews

Using Michael Porter's "Five Forces" framework, the whole online banking security industry in China can be depicted as a competitive and promising industry. Figure 4-1"Five Forces" summarizes all the five forces in the online banking security industry. In terms of the core of the five forces, the rivalry within the industry is high. Although the Chinese market is potentially the biggest market in the future, the concentration in this industry is very high. World industry leaders like RSA have already operated in China for many years. In addition, there are at least 20 more medium-sized high tech companies around the country that provide similar products. The bargaining power of buyers is high, because the online banking market is dominated by the four major state-owned banks. There is no direct substitute for incumbent technology. However, those key banks can chose different online banking security companies as suppliers; hence, they have the dominant bargaining power. The threats of new entrants and substitutes are comparatively low in this industry due to the high entry barriers posed by Economies of Scale, capital requirements and insufficient substitutes. The bargaining power of suppliers is low because online banking companies are R&D type companies, and they can find abundant services and hardware suppliers in China. A deeper five forces analysis is developed in following sections.

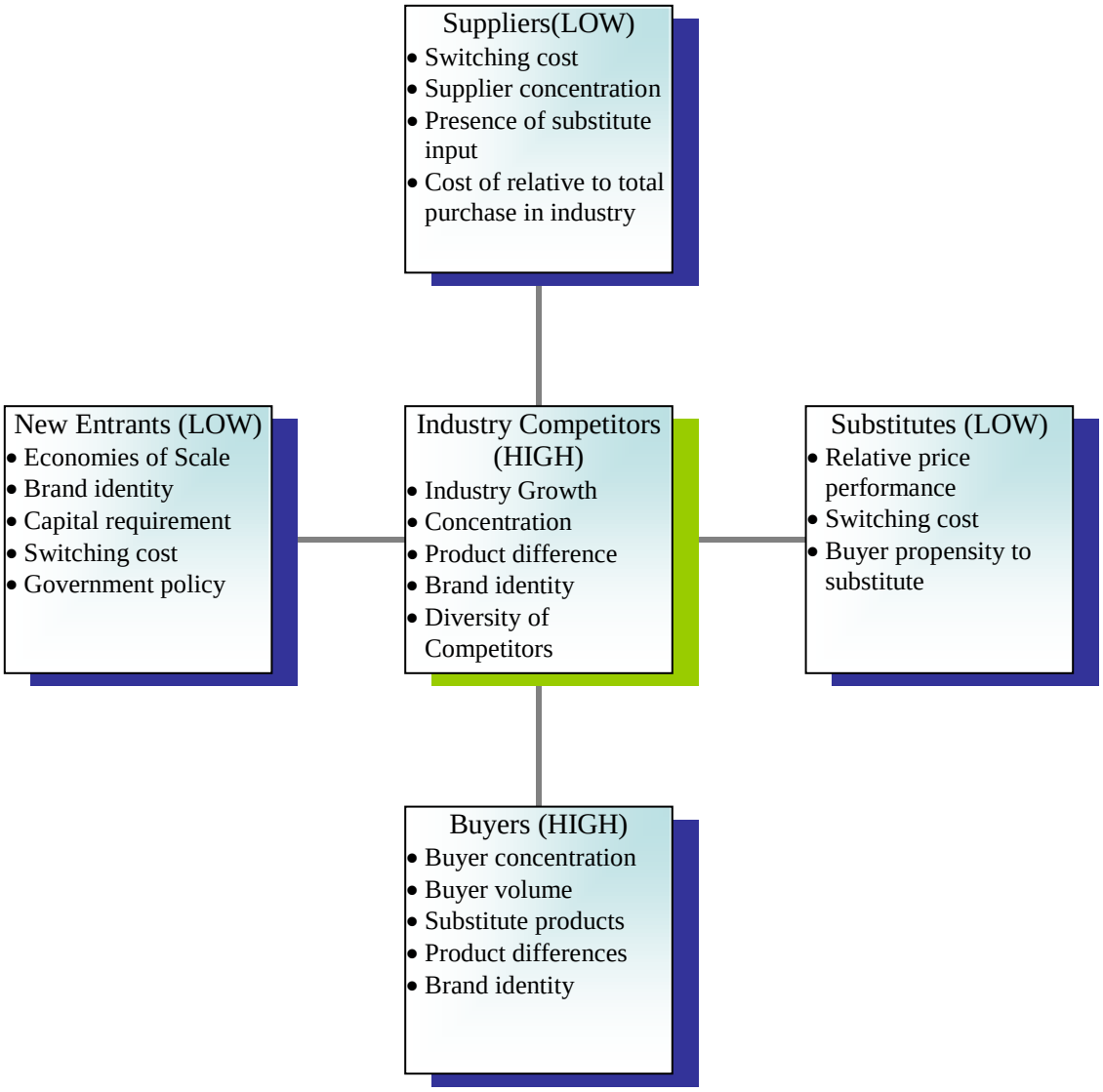


Figure 4-1"Five Forces"

4.2 Industry Competitors

There are five major competitors by revenue and market share in the Chinese market including one US based company – RSA; three European based companies – G&D, Gemplus and Oberthur; and a Chinese local company – Hua Hong Group. Additionally, there are a minimum of 20 small encryption companies that compete in the

Chinese market. However, these small companies control less than 2% of the total market share. Therefore, in next sections, only the five major competitors are discussed.

4.2.1 RSA

RSA, the Security Division of EMC, is the premier provider of security solutions for business acceleration, helping the world's leading organizations succeed by solving their most complex and sensitive security challenges. RSA offers industry-leading solutions in authentication and access control, data loss prevention, encryption and key management, compliance and security information management, and fraud prevention. (RSA, 2009)

RSA, the Security Division of EMC Corporation, is headquartered in Bedford, Massachusetts, United States, and maintains offices in Australia, Ireland, Israel, the United Kingdom, Singapore, India, China, Hong Kong and Japan.

RSA organizes the annual RSA Conference. RSA's well-known products include the RSA BSAFE cryptography libraries and the SecurID authentication token.

RSA SecurID® two-factor authentication is based on something you know (a password or PIN) and something you have (an authenticator)—providing a much more reliable level of user authentication than reusable passwords (RSA, 2009).

4.2.2 Giesecke & Devrient (G&D)

4.2.2.1 G&D Global

Giesecke & Devrient (G&D), a globally operating hi-tech giant based in Munich, Germany, was founded in 1852 as a secure printing service provider and thereafter as a banknote printing expert. Now, in addition to its banknote printing and sorting business,

smart cards, which ensure e-transaction security and information security, and related solutions have risen to become G&D's leading business unit. G&D is now a leading supplier of smart cards and cutting-edge system solutions in the fields of telecommunications, electronic payments and transportation.

G&D is comprised of 3 divisions and 8 sub-divisions, and its 9000 employees in its 52 subsidiaries and joint ventures around the world created USD 3 billion in corporate earnings in the 2007 financial year.

4.2.2.2 G&D in China

In 1994, G&D officially entered China. Since then China has remained as a significant part of G&D's global expansion strategy. G&D China has set up six joint ventures and/or affiliates with offices and branches in Beijing, Shanghai, Guangzhou, Shenzhen, Hangzhou and Chengdu.

G&D has invested more than $50 million in China setting up modern plants in Nanchang and Huangshi, mainly engaged in the research, manufacture and sale of magnetic cards, IC cards and card systems. Its annual production capacity has hit $500 million and now it has risen to be a leading card manufacturer in China and is G&D's card manufacturing and service centre in the Far East.

In the field of information security, G&D's IC cards, USB tokens, and PKI-based USB keys are identified as the recommended digital signature products for Internet banking and online business security by more than 30 major commercial banks and governmental agencies, and are distributed to tens of millions of customers, claiming a market share of over 70% in China alone

G&D's customer base covers large-sized leading enterprises in banking, telecommunications and government in China, including China Mobile, China Unicom, China Telecom, Industrial and Commercial Bank of China, China Construction Bank, China Merchant Bank and China Financial Certification Center. It has grown to be the first preferred supplier of China's major commercial banks, governmental departments and telecommunications operators.

4.2.3 Hua Hong

Shanghai Hua Hong (Group) Co., Ltd. (hereafter referred to as Hua Hong Group) is an incorporated company engaged in designing and manufacturing integrated circuit (IC) products with the aim to become the leader in providing system integration solutions.

In the decade since its creation, Hua Hong Group has achieved widely-recognized successes in wafer fabrication, IC design, system integration, application service, technology R&D, electronic component trade, and venture capital investment (including overseas investment), etc., bringing to the market its advanced services and technologies such as foundry services, product technologies, design services, and AFC (Automatic Fair Collection) system products. The company has successfully promoted the development of China's IC industry with these achievements made through 10 years of effort.

Hua Hong Group is becoming one of the most competitive IT enterprises in China with its advantages in advanced process technologies, complete semiconductor industrial chain, modern management, core competitiveness, and a quality work team.

4.2.4 Gemplus

4.2.4.1 Gemplus Global

Gemplus' major businesses range from the development of software applications through the design and production of secure personal devices such as smart cards, SIMs, e-passports and tokens, to the deployment of managed services for customers. The company has10,000 employees, 90 nationalities, and is based in 40 countries. It has set up 75 sales and marketing offices, 17 production sites, 30 personalization centers, and nine R&D centers. In 2008, Gemplus had USD3.36 billion in revenues, and produced over 1.4 billion intelligent (microprocessor) cards.

Gemplus' internationally renowned team of security and cryptography experts leads the way in the design and implementation of new anti-fraud solutions certified to the highest standards. It is the largest card and personalization supplier in the Asian Pacific area. In the financial field, Gemplus serves 140 banks all around the word. The company hold an extensive portfolio of patents and security certifications (Gemalto, 2009).

4.2.4.2 Gemplus in China

Gemplus is the only supplier in China that has obtained certificates for VISA, MC, AMEX, JCB, DCI and CUP card production. In terms of online authentication market, the company controls over 40% of the total market. It had established a long-term partnership with ICBC in the e-banking business.

4.2.5 Oberthur

With sales of 882 million Euros in 2008, Oberthur Technologies is a world leader in the field of secure technologies. Its business can be divided into four divisions: Card Systems, Identity, Cash Protection and Fiduciary Printing.

The company is one of the world's leading providers of security and identification based on smart card technology and associated services, such as personalization, for the payment, mobile, identity, multimedia and transport markets.

4.3 Barriers for New Entrants

4.3.1 Industry Standards

The basic entry barrier for this industry is the standards set by China Financial Certificate Authority (CFCA). Established in 2000, CFCA is an organization that has the authority from the Chinese government to offer certificates. After the Electronic Signature Law of the Peoples Republic of China was passed in 2004, CFCA became the first Certification Authority. As a third party online information security authentication organization, CFCA adapted the most advantageous and mainstream Public Key Infrastructure (PKI) technology and issued Digital Certificates to ensure the authenticity, integrity and confidentiality of information transferred through internet. By the end of 2008, all commercial banks in China and 20 encryption technology companies had received certification from CFCA (CFCA, 2009).

Although CFCA is a third party organization, the central government and the state’s Project 863 recognize the standards that CFCA has established to ensure financial information security. Therefore, CFCA has raised the bar to entering this industry by

testing all incumbent and prospective participants' information security technology and hardware.

4.3.2 Capital Requirements

Companies need a huge amount of funds to invest in R&D and to participate in this industry. Similar to the case of G&D, companies spend about 10% of their revenue every year on R&D to keep up with high-tech developments. In 2007, the total revenue of G&D was 1.55 billion EUR. Therefore, its R&D expenses were about 150 million EUR (G&D, 2009). In addition, more funds are needed to employ technicians and engineers and build R&D facilities. It is impossible for a newly established company to catch up with the incumbent players in this field without access to huge amounts of money.

4.3.3 Economies of Scale

As mentioned above, the high capital requirements automatically lead to high Economies of Scale. Multinational security technology companies provide similar products in many countries to cover the huge R&D expenses. The France based company Gemplus provides its products to 140 banks, 40 public transportation clients, and 30 social security clients in more than 40 countries. The major competitors in China are all big companies, which have broad product lines for various clients from different industries. Therefore, new comers to this industry require not only sufficient capital but also a huge customer base to reach similar Economies of Scale, which are required to be financially sustainable in the long run.

4.4 Substitutes

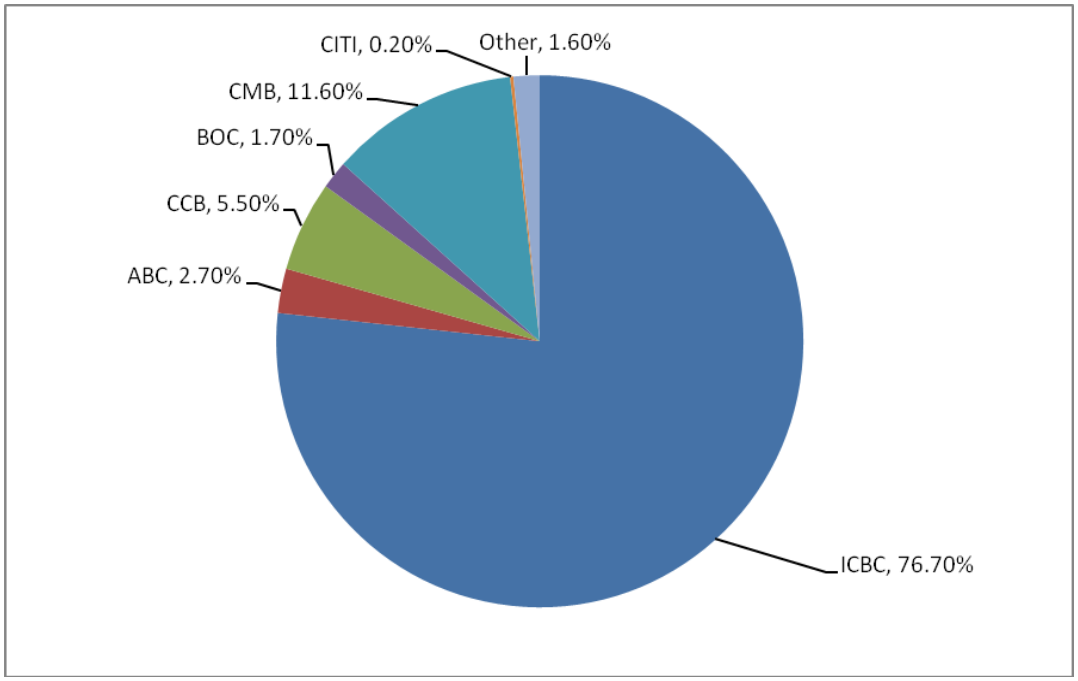
Currently, the Digital Certificate based technology is the most widely used and reliable measure for financial institutions to secure their clients' confidentiality. All banks in China promote Digital Certificate technology based tokens heavily to customers as an insurance of online banking security. Other innovative technologies like dynamic password is not widely accepted by both banks' and customers' perspective. There is no direct substitute for those electronic tokens. Therefore threat of substitutes is very low in short term. However, banks could essentially provide other services to enhance online transaction security. As mentioned in section 3.3, these enhancing services include: authentication of personal message, instant notification of balance, free online security test, anti-phishing safe control, verification by VISA , anti-malware software and firewalls. Moreover, with the development of information encryption technology, more substitutes will be available in this market.

4.5 Buyers

4.5.1 Buyer Concentration

Although almost every bank in China offers Internet-banking services, the market is dominated by ICBC. According to a survey by iResearch in 2005, 76.7% of online banking users choose ICBC's services. Therefore, ICBC is the biggest buyer in this market. Three companies provide online security products for ICBC: Gemplus, G&D and Hua Hong (ICBC, 2009). There is no doubt that ICBC has dominating bargaining power over these three companies.

Figure 4-2 Online Banking Market Share in China, 2005



Source: Adapted from iResearch (2005)

From the discussion above, the "Big Four", combined with CMB, control almost 98.2% of the total market. Therefore, the buyers in online banking security products are limited to these five banks.

4.5.2 Buyers' Switching Costs

Buyer switching costs are very low in this market. The reasons are that brand identity is vague and products are not differentiated. The key technology behind online banking encryption products is the same. Therefore, the third generation e-tokens are essentially identical in terms of function and performance. For banks, there is no need to modify their information system significantly if they change suppliers. In addition, it makes no difference for online banking users to choose different brands of e-tokens. For

instance, ICBC offers three brands of e-tokens for its customers who have no preference on specific brand. They normally accept whatever brand ICBC offers to them.

4.6 Suppliers

Because the companies in the online security industry are R&D oriented, their suppliers are mainly IC manufacturers, telecommunication service providers and other operational service providers. The suppliers' bargaining power is low, as the cost of their products and services comprises only a small portion of the total variable cost of online banking products. In China, their concentration is low and choices for online security are abundant.

5: Latest Developments and Trends

5.1 Vulnerability of Digital Certificates

Some incidents happened in 2009 to indicate that digital certificates are not completely safe for online banking users. Although digital certificates are immune from any decryption method without their secret keys, which are highly confidential, hackers have found other ways to gain entrance.

One kind of digital certificate is called a soft certificate, which is a file saved on a users' hard disk. Most people choose to use it due to the low cost. However, Trojan programs can export this file and copy it to other computers. Cao Xiaoqing, the vice president of CFCA, informed all internet-banking users about the risk of soft Digital Certificates (Beijing Evening News, 2009).

Another kind of digital certificate is the hard certificate, like USB keys and IC cards. Those certificates are deemed unbreakable because all the files are stored in the USB Key or the IC card. However, a recent virus called Online Bank Thief not only stole bank account passwords, but also broke through the defence of all e-tokens (Wen Hui Daily, 2009).

Therefore, the third generation of online banking security technology has become insecure in 2009 in of the face of attacks from cybercriminals. The fourth generation SecurID is still the soundest solution to online banking security. However, a new problem concerns the physical theft of SecurID tokens. Because the password is displayed directly on the token, criminals do not need any cutting-edge technology to crack the token.

5.2 RSAs with RSA FraudAction

RSA FraudAction is a proven service geared toward stopping and preventing phishing, pharming and Trojan attacks that occur in the online channel. Offered as an outsourced, managed service, RSA FraudAction enables organizations to minimize resource investment while deploying a solution quickly.

FraudAction offers complete fraud protection against phishing, pharming and Trojan attacks – including 24x7 monitoring and detection, real-time alerts and reporting, forensics and countermeasures, and site blocking and shutdown. Today, more than 300 organizations have selected FraudAction to protect their customers against the latest online threats.

At the core of the FraudAction service is RSA's exclusive Anti-Fraud Command Center (AFCC). Our experienced team of fraud analysts work to shut down fraudulent sites, deploy countermeasures, and conduct extensive forensic work to stop online criminals and prevent future attacks. The AFCC has established direct, open channels with dozens of ISPs around the world and provides multi-lingual translation support in nearly 200 languages to further enhance its ability to detect, block and shut down sites on a global scale (RSA, 2009).

RSA has established many key partnerships with many major banks like Standard Charted, ING direct, Royal Bank of Canada, and Zions Bank all around the world to actively fight against phishing and Trojan attacks.

6: Recommendations

6.1 Relationship with Majors Banks

From the Five Forces analysis in Chapter 4, the bargaining power of the buyers – the major commercial banks – is very high. Therefore, to survive in the online banking security industry, it is crucial for those online banking security companies to establish and maintain long-term relationships with banks. For incumbent companies, maintaining relationships with current bank clients is more important. As the Chinese commercial banking industry is experiencing unprecedented growth, a firm relationship with those major banks is key for online banking security companies to expand. Losing a major bank client like ICBC would be fatal for incumbent companies. Incumbent companies should address several issues. The first is the personal connection to people at the management level. Management preference is important when banks choose suppliers. The second concerns better services. In China, 24-hour service is the norm. Therefore, providing comprehensive after sales service is a minimum requirement. Innovation is extremely important, and this will be discussed in the next section. For potential newcomers, establishing new relationships is very important. Personal connections are also important for newcomers. Those with personal connections to key persons in banks will find it easier to enter the Chinese online banking security market. However, establishing a relationship with big state-owned banks is difficult even with personal connections. Therefore, newcomers should start with smaller commercial banks in China.

6.2 Technology Innovations

Technological innovation is the key competitive advantage in this industry. Companies have already invested huge amounts of monetary and human resources to develop better technologies. Therefore, the recommendation for both incumbent companies and newcomers is to innovate. There are two ways to go about this. One is to start to research a new technology. Current Digital Certificate technology is now believed to be unsafe. Therefore, commercial banks need revolutionary technology to ensure information security. The other way is to combine the current technologies to increase the safety of products; for example, the bio-token is a combination of Digital Certificate technology and bio-identification technology. Although both technologies are mature in the online security industry, the combination has actually gained acceptance by banks and online banking users due to its enhanced security level.

6.3 Brand Identity

At present, online banking users are unclear regarding the brand identities of different products from different companies. Therefore, products are not differentiated. Incumbent companies can promote their brand identity with a reliable image for online banking users. Once those users begin to realize the differences among the different products, they will not simply accept whatever security products banks provide. Companies with a positive brand identity will soon gain market share. For newcomers, the key is to differentiate their products within incumbent products. Reliability is still the number one issue for online banking security products, but inexpensiveness, portability, good appearance and multiple functions are all considerations for new companies as they compete with incumbent companies.

6.4 Cooperation with Foreign Banks

Since 2006, foreign banks have been permitted to operate freely in China. Both incumbent companies and newcomers should cooperate with the foreign banks during the early stage as they enter the Chinese market. Online security companies can enjoy the fruit from the expansion of these foreign banks. Most of the foreign banks start with a single office, but are expected to develop into nationally run banks with hundreds of offices and branches. Therefore, it is easier for online security companies, especially newcomers with an international background, to cooperate with foreign banks as early as possible. As the competition in China is fierce, new opportunities will arise together with the entry of foreign banks.

6.5 Comprehensive Solutions

RSA provides a comprehensive solution for banks to compete against online fraud. There are many benefits for online security companies. The first is to increase the switching cost for banks. Once the solution is integrated with the banks' information system, it becomes increasing difficult for banks to unload in terms of time and cost. The second reason is that, unlike a single product, a solution can be upgraded in real time. This is extremely consistent with the trend of information technology, as it develops very fast. However, to provide sound solutions in terms of online banking security, companies must have a strong background that specializes in this field. Therefore, the recommendation to provide solutions is mainly for large online banking security companies.

7: Conclusions

In conclusion, together with the rapid growth in the Chinese commercial banking industry, there is an increasing need for online banking services and internet banking security products to defend against cybercrimes.

Most online banking users do not use third generation e-tokens to insure their bank accounts even though Digital Certificate based products are mature and perform well. There are two main reasons for this. One is that most customers still have doubts regarding online banking security technology. They still prefer to go to bank branches to conduct transactions. The second reason is that although many people have accepted online banking, they are unwilling to pay for an extra online banking security device. They are quite price sensitive due to the traditional Chinese preference for using free services.

This report makes a start in terms of understanding the evolution of online banking security products in China and future developments in this industry. The third generation Digital Certificate based technology is widely used as an online banking security enhancement. However, some recent cases suggest that this technology is no longer as safe as it used to be. As the technology evolves, some new concepts and solutions provide clues for future developments. The RAS dynamic password technology is a great improvement on current online banking security technology. Because this fourth generation technology is not mature, I cannot conclude that the third generation technology will soon be replaced by the fourth generation technology.

Furthermore, with this latest solution brought by RSA, my research shows that this industry could evolve in two directions. One direction is to develop high performance online banking security products to defend against online banking fraud. The other direction is to provide active solutions for banks to attack online crimes at the source.

Recommendations are provided for both incumbent companies and new entrants at the end in Section 6. For incumbent companies, the key is to maintain long-term relationships with major banks, build a brand identity, and provide a comprehensive solution for banks. For new entrants, potential opportunities are based on establishing a relationship with smaller banks, innovating, and cooperating with foreign banks when they first enter the Chinese market.

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