Switching Cost and the Deposit Demand in China*

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Abstract

This paper develops and estimates a dynamic model of consumer demand for deposits, in which banks provide differentiated products, and product characteristics evolve over time. Consumers choose their banks based on the utility received from using their services, and incur a fixed cost when they switch banks. Consequently, consumer choices include which bank to use and when to switch. Utilizing the dynamic structural model, I analyze the impact of forward looking behavior on understanding consumer preferences. The main finding is that switching costs have significant impacts on consumer's choice of deposit institutions. Consumers adjust their bank choices gradually when there are changes in bank attributes. The fixed cost incurred to switch banks leads the static demand model understating the price elasticity of service fees and overstating the willingness to pay of consumers on product characteristics.

Keywords: Banks in China, Demand Estimation, Switching Cost.

JEL classifications: G21, L11

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1 Introduction

Banking sectors are important in fostering economic development. Banks mobilize saving from consumers by providing deposit services, and then use the deposits as a source of funding for the allocation of credit. Empirical research indicates that greater banking competition improves banking system efficiency in developing countries (Demirguc-Kunt et al, 2004) and supports growth of financially dependent industries (Claessens and Laeven, 2005). Examining the demand for deposits is useful for understanding the driving forces behind resource mobilization.

In the deposit market, the relationship between consumers and banks is expected to be long-term. For example, using survey data in the United States, Kiser (2002a,b) report that the median duration of the relationship of consumers with their primary bank is about 10 years and 32% of the people stay in their first bank forever. The primary reason consumers give for staying with their current bank is the location of bank offices and ATMs, or the quality of customer service, and the second most important reason is the cost of switching. The reasons for such costs arise include: (1) redirecting ingoing and outgoing payments; (2) searching for new options in the market; (3) building up a bank-customer relationship with a new bank; and (4) facing monetary penalties for terminating the existing contract. Consumers in the deposit market are less price sensitive and concerned more with future changes in service quality by banks. As a result, static demand model may underestimate the elasticity on product characteristics, which biases the estimated willingness to pay on those attributes. This motivates the development of a dynamic model to capture these features of deposit demand.

There are two reasons to study the relationship between switching cost and deposit demand in China, a large developing country. First, switching costs are expected to be sizable in China because the household registration system restricts migration across provinces which in turn reduces the changes of bank choice due to relocation. Sharpe (1997) and Hannan (2008) use migration rate as a measure of switching cost and find that there is a positive relationship between migration and deposit rates in the U.S. Second, the participation of deposit market in China is relatively high among developing countries because the state-owned enterprises distribute salary to their employees through the state commercial banks (SCBs). The Chinese banking sector has been deregulated in order to promote competition and efficiency of the banks. Particularly, there was a restructuring of banks by cutting back on branches and laying off employees during 1998-9. Consumers may not change their banks to respond the decline in service quality because of switching cost and uncertainty about service quality in the future. Ho (2009) analyzes the welfare changes in deposit market after the banking deregulation in China using the demand framework of differentiated products suggested by Berry et al. (1995). If there are substantial effects of switching cost on the consumer preferences over prices and product characteristics, it is important to incorporate switching cost in the demand framework for estimating price elasticity and analyzing welfare changes of policy intervention.

This paper develops and estimates a dynamic model of consumer demand for deposits, in which banks provide differentiated products, and product characteristics evolve over time. Consumers choose their banks based on the utility received from using their services, and incur a fixed cost when they switch banks. Consequently, consumer choices include which bank to use and when to switch. Utilizing the dynamic structural model, I analyze the impact of forward looking behavior on understanding consumer preferences. My empirical strategy makes inference about consumer preferences based on bank-level data from four Chinese state commercial banks in the deposits market during $1994 - 2001$ and estimates switching cost using the information on probability of switching banks. This approach of estimating switching cost is different from that utilizing micro panel data of purchase at individual level. In that approach, switching cost is identified with the switching behavior of consumer's choice in response to changes in price while controlling for unobserved heterogeneity.

The main finding is that switching cost is an important determinant for consumers to make bank choices. Thus, consumers adjust their bank choices gradually when there are changes in bank attributes. The low price elasticity of service fees in the static demand model can be explained, in part, by the fixed cost incurred to switch banks. Banks reduce their service fees to attract consumers and expect to earn service fees from consumers for an extended time period.[1] Moreover, switching

[1] Using a theoretical framework that incorporates fixed costs consumers face in order to switch products, Klemperer (1995) argues that a firm faces a tradeoff between lowering prices to attract new customers and raising prices to extract rents from existing customers.

cost affects consumers' decision in response to changes in service quality such as branching. My results suggest that the static model overstates the willingness to pay of consumers on product characteristics due to the low price elasticity.

Recent empirical literature on demand estimation for banking services employs the econometric models developed in the industrial organization literature to analyze consumer preferences on various product characteristics. Examples include: Ishii (2005), Adam et al. (2007), Dick (2008), Knittel and Stango (2008) and Zhou (2008) for the U.S., Nakane et al. (2006) for Brazil, Ho (2007) for Hong Kong, Molnar et al. (2007) for Hungary, Ho (2009) for China and Molnar (2008) for Finland. In contrast to previous works, which employ static demand models, my paper uses a dynamic model of consumer demand. My results suggest that it is important to incorporate forward-looking consumer behavior to analyze consumer preferences on bank characteristics and rationalize the low service fees charged by banks. In particular, I contribute a model to estimate switching cost with aggregate data and information on consumers' switching probability across banks.

The dynamic model developed in this paper also contributes to the literature on the impacts of switching costs in banking markets using bank-level data.[2] Sharpe (1997) shows that bank retail deposit interest rates are more competitive if switching costs exist and banks are competing for new depositors. Gondat-Larralde and Nier (2004) use bank-level data in the United Kingdom and find that switching costs are important for banks to maintain their market shares in the current account business of deposit services. Those papers argue that service quality and switching costs contribute to consumers' bank choices, but none employ a structural model to investigate the relative importance of each factor. Kim et al. (2003) use a structural model and examine switching costs in the market for bank loans in Norway. They find that the costs are substantial and contribute to about a third of the average interest rate on loans. However, as they do not model consumer preferences, they are unable to analyze consumer willingness to pay for bank attributes, quantify switching cost and examine the impacts of switching cost on the price elasticity of demand. To overcome this shortcoming, this paper provides a dynamic structural model of deposit demand in

[2] In the credit card market, Ausubel (1991) provides some evidences that switching costs may explain the high interest rates on credit card balances, and Stango (2002) finds that switching costs have a significant impact on pricing in that market.

which service quality and switching costs are important factors in their decisions.

The remainder of the paper is organized as follows: Section 2 provides an introduction to Chinese banking industry. Sections 3 describes the data and descriptive statistics. Section 4 discusses the dynamic structural model. Section 5 presents the estimation procedures. Section 6 report the empirical results. Section 7 concludes.

2 Chinese Banking Industry

China has a two-tier banking system.[3] The People's Bank of China (PBC) is the central bank of China, and supervises the banking industry. There are several types of financial institutions, including SCBs, joint-stock banks (JSBs), city commercial banks, and non-bank financial institutions. Non-bank financial institutions include trust and investment companies, the rural credit cooperative societies, and urban credit cooperative societies. The main players of the banking sector are four SCBs: Agricultural Bank of China (ABC), Bank of China (BOC), China Construction Bank (CCB) and Industrial and Commercial Bank of China (ICBC).[4] The deposit and loan markets were highly regulated, and the SCBs have occupied a large share of these two markets.

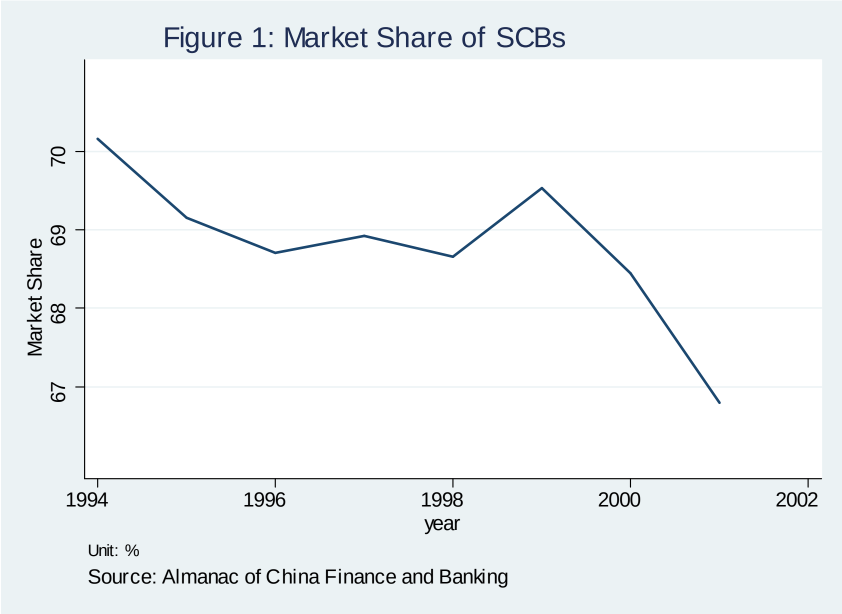
Since 1994, three policy banks – China Development Bank, Export-Import Bank of China, and Agricultural Development Bank of China – were set up to take up the role of government lending for the aforementioned four SCBs. Reforms continued with the passing of the 1995 Commercial Banking Law which placed responsibility for profitability and assessment of credit worthiness on banks (See IMF, 1996). The interest rate was deregulated gradually for lending in 1996, but banks can only set their deposit rates at the official benchmark rate chosen by the PBC until 2004. However, the PBC maintains a positive interest rate spread between the benchmark rates of lending and deposit in order to provide subsidies to SCBs and encourage lending to SOEs.

As shown in Figure 1, SCBs maintained 70% market share of the deposit market through 1994, which is beginning of the second stage of reform.[5] Despite the banking reform involves removal of

[3] In this section, I focus on market structure of deposit market. See Dobson and Kashyap (2006) and Allen et al. (2008) for detailed discussions on banking industry in China.

[4] The BOC established as a private bank in 1912. The ABC, CCB and ICBC were established in 1951, 1954, and 1984, respectively.

[5] In 1993, according to Almanac of China Finance and Banking (1994), the State Council announced the second



government lending from SCBs, entry deregulation and interest rate partial-liberalization, the total market share of SCBs was still about 67% in 2001.[6] Since consumers do not have strong preference in using other financial institutions, this paper analyzes the changes in market shares among SCBs. More specifically, I examine the effects of consumer forward looking behavior in explaining the changes in market shares and bank pricing behavior.

3 Data and Descriptive Statistics

The empirical analysis is based on a novel dataset which combines the provincial banking and economic data with the balance sheet information of banks. I collect the data from various issues of *Almanac of China Finance and Banking* (the Almanacs, hereafter) and *China Statistics Yearbook* (the Yearbooks, hereafter). Data from balance sheets, income statements, provincial deposits, provincial branches and provincial employees are obtained from the Almanacs. Provincial demographic and economic data are obtained from the Yearbooks. The sample includes annual

stage of banking reform in the "Decision on Financial System". Thus, I refer the first stage of banking reform was from 1979 to 1993, abd the second stage of banking reform started in 1994.

[6] Most of the loss in SCB market shares was acquired by JSBs, the primary domestic competitors. Market shares of JSBs in year 1994 and 2001 are 7% and 12%, respectively. Moreover, foreign Banks have less than 1% of market share. Source: Almanac of China Finance and Banking.

observations from 1994 to 2001.[7] Owing to the problem of missing data for ICBC, I exclude (1) year 1997; (2) the Tibet province and (3) Chongqing for year $1994-1996$. Consequently, the sample has 828 observations at the level of bank-market-year. Appendix 1 reports the descriptive statistics of variables used in the empirical analysis.

3.1 Definition of a Market

SCBs provide deposit services in each provincial market in China.[8] In 1997, Chongqing was redefined to be a municipality and hence there are 30 provinces before 1997 and 31 thereafter. The definition of a market at the provincial level is supported by two reasons. First, competitors are more homogenous within a province than across provinces. Many domestic or foreign banks only operate in limited number of provinces, thus SCBs face different sets of competitors in different provinces. Second, banks in different provinces are separated by a huge geographical distance, which imposes a high transaction cost on potential consumers to deposit in a bank in another province. However, my definition of geographical market is larger than those shown in other countries, such as the US, because the data availability limits defining market size at the city or county level.[9] The descriptive statistics on real GDP per capita and population density (i.e., population per square kilometer) suggest that it is important to control for market characteristics in the estimation.

3.2 Market Size and Market Share

I use total deposits in SCBs from the Almanacs to measure market size of market m in year t, H_{mt}. To compute market share, I divide the deposits of each SCB by the market size in each market-year. Let q_{jmt} be the quantity of deposits held by bank j, $S_{jmt} \equiv q_{jmt}/H_{mt}$ is the market share of bank j. Note that there is no outside good in this paper so as to simplify the structural model and focus on consumer switching behavior. The market shares in Table 1 are computed by averaging the market shares of each bank across provinces. In year 1994, the market shares of ABC

[7] The sample period is restricted by the data availability on branches and employees at the provincial level.

[8] The People's Republic of China administers 33 provincial level divisions, including 22 provinces, 5 autonomous regions, 4 municipalities, and 2 special administrative regions. I exclude the special administration regions, namely Hong Kong and Macau, due to their different economic structures.

[9] In the case of the U.S., Amel and Starr-McCluer (2002) document that people open their deposit accounts in a bank close to their home.

(27%) and the ICBC (43%) were larger than the other two banks. Over the sample period, the BOC and the CCB acquired more market share from the ABC and the ICBC, and the market share among the SCBs became more even in year 2001.

Table 1
Sample Statistics, 1994-2001

	Market Share		**Branch**		**Employee**		**Service Fees**	
Bank	**1994**	**2001**	**1994**	**2001**	**1994**	**2001**	**1994**	**2001**
ABC	27%	24%	2182	1464	18840	16198	0.05%	0.09%
BOC	10%	12%	435	417	6357	6051	0.29%	0.21%
CCB	21%	25%	361	429	11018	10857	0.13%	0.14%
ICBC	43%	38%	1277	945	19323	14284	0.04%	0.09%

Note: Branch and Employee are computed by averaging across provinces; Market shares in 1994 do not add up to 100% due to rounding error

3.3 Price

The service fee is computed as the ratio of income from commissions to total deposits. The income from commissions are obtained from income statements and total deposits from balance sheets.[10] The service fee includes fees for transferring money between accounts, trading securities and foreign currencies, managing assets and using bank cards. Admittedly, the price variable is imperfect because it cannot show the price variation over a range of services provided by banks. Similar to other studies on demand estimation for deposit services, the data on service fees come from financial reports aggregated across provinces at the bank level. Thus, the service fee of each bank does not vary across provinces (i.e. $p_{jmt} = p_{jt}$). The average service fee is 0.14% and the benchmark rate of deposit 1.9%. In other words, consumers pay about 7% of their deposit interest as service fees.[11]

[10] The BOC's commission fee during 1994-1996 has been included in official figures with other income sources such as non-operating income. To extract the commission income from the data, I use the ratio of commission fee to other income in 1996, i.e. 0.2.

[11] All banks provide the same deposit rate to consumers in accordance with the benchmark rate set by the PBC. Price competition in deposit rates is restricted to SCBs and non-interest-bearing investment instruments. Moreover, the deposit rate is not used in the estimation as time dummies are employed.

3.4 Observed Characteristics

I use two bank characteristics, namely branches and employees at provincial level, to proxy service quality provided by SCBs. Since the branch and employee data is available at the provincial level, it has variation at the level of bank-market-year. The observed characteristics included are employees per branch and branch density (the ratio of the number of branches in a province to the area of that province in square kilometers). The density of branches and employees per branch captures the convenience of banks' location and the efficiency of branch operation, respectively. Second, I sum the number of branches across the country to obtain the total number of branches, which proxies for the branch network size provided to consumers. This characteristics varies across bank-year observations, but not across provinces. Table 2 reports that the percentage reductions in average number of branches and employees are larger for the ABC and the ICBC than those for the composite bank over the sample period. Moreover, the service fees of the ABC and the ICBC becomes higher but that of the composite bank become lower in year 2001. Since the demand system suggests that changes in market share can be driven by changes in service quality and price, Table 2 provides preliminary evidence that changes in market shares of these two banks are related to changes in service quality and service fees.

4 Model

In this section, I outline the dynamic model of demand for deposit services.[12] Estimating a dynamic model of demand presents well-known complications, both technical and computational. In an effort to reduce the computational burden of estimation, I do not allow consumers switch to outside goods, but only to other SCBs. Under these assumptions, the switching cost is interpreted as the cost incurred when consumers switch from one SCB to another SCB. However, if the losses of market share to outside goods are the same among those four SCBs as non-SCBs improve their service qualities, the switching cost can be under-estimated. Nontheless, my model still provides a

[12] Due to the data limitation, the analysis cannot go further to different types of services such as demand and time deposits as in Nakane et al. (2006). Because provincial level data is only available for 4 SCBs, I cannot compare the demands of different types of financial institutions as Adams et al. (2007) did for U.S.

close approximation to consumer behavior because SCBs have a majority of the market share; and consumers seem to perceive significant differentiation between SCBs and outside goods in that there is little variation in the total market share of SCBs over time.[13] Figure 1 shows that SCBs have more than 65% of the market share during the sample period.[14]

4.1 Consumer Problem

The market is defined as the market for deposits in Chinese provinces, and thus the industry consists of four banks and M local markets. I index provincial markets by m, banks by j and time by t. I suppress the market subscript m in this section for simplifying the notation. In a province, consumers choose to use deposit services from the ABC, the BOC, the CCB and the ICBC. I index the ABC, the BOC, the CCB and the ICBC by a, b, c and d, respectively. Consumers with deposit accounts use not only the saving services, but also other services provided to account holders such as asset management, security and foreign currency trading and bank card services.

In each period, consumers decide whether to stay with their current bank or switch to another bank.[15] They maximize the present expected discounted value of future utilities to make their decisions. For a consumer staying in the same bank, the net flow utility of consumer i who uses deposit services from bank j in market m at time t is:

$$\begin{aligned} u_{ijt} &= -\alpha p_{jt} + x_{jt}\beta + \xi_{jt} + \varepsilon_{ijt} \\ &\equiv \delta^f_{jt} + \varepsilon_{ijt} \end{aligned} \tag{1}$$

where p_{jt} is the service fee of bank j, x_{jt} is a K-dimensional row vector of observed product characteristics of bank j, and ξ_{jt} represents the unobserved product characteristics of bank j. The product characteristics represent the service quality provided by banks, such as the convenience of local branches and waiting time for being served at a branch. The consumer-specific preference is captured by a deviation specific to bank j in province m at time t, ε_{ijt}. The deviation is assumed to be a mean zero stochastic term with i.i.d. extreme value Type 1 distribution.[16] The $K + 2$

[13] Ho (2009) shows that cross-price elasticities between SCBs and other banks are lower than those among SCBs.

[14] However, this assumption is less plausible in recent years because SCBs mainly lose consumers to non-SCBS.

[15] One reason for consumers to use one bank (or have a main bank) is that consumers can exploit economies of scale and scope to reduce the time cost in using the services provided by banks.

[16] It seems iid is a questionable assumption for ε_{ijt} since many households deposit more than once in a year. Rysman (2004) argues that it can be justified by a less restrictive assumption. In the case of deposit demand, I can allow ε_{ijt}

dimensional vector $\theta = (\beta_x, \alpha)$ represents the demand parameters, in which $\beta_x = (\beta_1, ..., \beta_K)$ is the set of parameters that associates mean utility with bank characteristics, and α is the parameter associated with consumers' preference on service fees. Therefore, $\delta(p_{jt}, x_{jt}, \xi_{jt}; \theta)$ is independent of consumer characteristics, whereas ε_{ijt} represents consumer characteristics.

If a consumer switches from one SCB to another, a switching cost τ must be incurred. The net flow utility from deposit services becomes

$$u_{ijt} = \delta^f_{jt} - \tau + \varepsilon_{ijt} \tag{2}$$

The specification of the demand system is based on product characteristics, which has the advantage of avoiding a large number of free parameters due to cross-price elasticities. However, this specification is different from the one used in Nakane et al. (2006) and Dick (2008). The interest rate paid by SCBs is fixed by the central bank and does not vary across banks, in contrast to studies using data from other countries. Consequently, price competition among banks is restricted to service fees.

4.2 The Bellman Equation

In order to evaluate the consumer choice at time t, the expectation of consumer i about future utility from bank services must be formulated. I assume that consumers have no information about the future values of the idiosyncratic shocks ε_{ijt} beyond their distributions. Prices and product characteristics vary across time due to technological progress, product innovation and changes in prices for existing products. Consumers are uncertain about the future product attributes, but rationally expect them to evolve based on the current market information. It follows that the discrete decision of consumer i to stay or switch depends on the following: the switching cost, τ; idiosyncratic preferences, $\varepsilon_{i.t}$; and current and future realizations of product attributes.

Let Ω_t be the information set available to consumers in period t. This set is used to produce information about future product characteristics as a function of current market information. I assume Ω_t evolves according to some Markov process $P(\Omega_{t+1}|\Omega_t)$. Let $\varepsilon_{i.t} \equiv (\varepsilon_{iat}, \varepsilon_{ibt}, \varepsilon_{ict}, \varepsilon_{idt})$ denote the set of idiosyncratic utility components for consumer i at period t. The value function for

to be correlated within a household, but require that is uncorrelated with the amount of money a household needs to deposit.

the current consumers at the ABC,.. and the ICBC is

$$
\begin{aligned}
V_i(\varepsilon_{i.t}, a, \Omega_t) &= Max(\delta^f_{at} + \varepsilon_{iat} + \beta E[V_i(\varepsilon_{i.t+1}, a, \Omega_{t+1})|\Omega_t], \\
&\quad \delta^f_{bt} + \varepsilon_{ibt} + \beta E[V_i(\varepsilon_{i.t+1}, b, \Omega_{t+1})|\Omega_t] - \tau, .., \delta^f_{dt} + \varepsilon_{idt} + \beta E[V_i(\varepsilon_{i.t+1}, d, \Omega_{t+1})|\Omega_t] - \tau) \\
&\quad \vdots \\
and & \\
V_i(\varepsilon_{i.t}, d, \Omega_t) &= Max(\delta^f_{dt} + \varepsilon_{idt} + \beta E[V_i(\varepsilon_{i.t+1}, d, \Omega_{t+1})|\Omega_t], \\
&\quad \delta^f_{at} + \varepsilon_{iat} + \beta E[V_i(\varepsilon_{i.t+1}, a, \Omega_{t+1})|\Omega_t] - \tau, .., \delta^f_{ct} + \varepsilon_{ict} + \beta E[V_i(\varepsilon_{i.t+1}, c, \Omega_{t+1})|\Omega_t] - \tau)
\end{aligned} \tag{3}
$$

, respectively. Following Rust (1987), I reduce the state space relate to the unobservables $\varepsilon_{i.t}$ by integrating the value functions over the realizations of $\varepsilon_{i.t}$. The integrated value function of consumers of the bank j is

$$
EV(j, \Omega_t) = \log\left(e^{\delta^f_{jt} + \beta E[EV(j,\Omega_{t+1})|\Omega_t]} + \sum_{k \neq j} e^{\delta^f_{kt} + \beta E[EV(k,\Omega_{t+1})|\Omega_t] - \tau} \right) \tag{4}
$$

for $j = \{a, b, c, d\}$. If consumers have no switching cost, the integrated value functions are the same for consumers in all banks. To simplify the dynamic optimization problem, I exploit the fact that there is no outside option for consumers and define the difference of value functions as

$$
\Delta EV(j, a, \Omega_t) = \log\left(\frac{e^{-\tau} + e^{\Delta\delta^f_{jat} + \beta E[\Delta EV(j,a,\Omega_{t+1})|\Omega_t]} + \sum_{k \neq a} e^{\Delta\delta^f_{kat} + \beta E[\Delta EV(k,a,\Omega_{t+1})|\Omega_t] - \tau}}{1 + \sum_{k \neq a} e^{\Delta\delta^f_{kat} + \beta E[\Delta EV(k,a,\Omega_{t+1})|\Omega_t] - \tau}} \right) \tag{5}
$$

where $\Delta EV(j, a, \Omega_t) = EV(j, \Omega_t) - EV(a, \Omega_t)$, $\Delta\delta^f_{jat} = \delta^f_{jt} - \delta^f_{at}$ and $j = \{b, c, d\}$. Although the difference of value function has three state variables, the difference of value functions across different combination of banks are connected by several identities, i.e. $\Delta EV(j, a, \Omega_t) = -\Delta EV(a, j, \Omega_t)$. I also exploit this fact for computational simplification in the estimation procedure, in which only $\Delta EV(j, a, \Omega_t)$ for $j = \{b, c, d\}$ are computed.

Instead of using the entire state space Ω_t, I assume that consumers use only the difference of net flow utilities to predict the difference of value functions in the future, i.e.

$$
E[\Delta EV(j, a, \Omega_{t+1})|\Omega_t] = E[\Delta EV(j, a, \Delta\delta^f_{jat+1})|\Delta\delta^f_{jat}] \tag{6}
$$

where $j = \{b, c, d\}$. Although it reduces computational burden of the dynamic optimization problem, it imposes some restrictions on consumer behavior. I assume consumers respond to the difference in net flow utility rather than the level of either one of the net flow utilities. This means, for example, the difference of flow utilities $\Delta\delta^f_{dat}$ could be large because the service fee of the ICBC is low or because the service fee of the ABC bank is high. These two situations provide the same information to consumers for predicting the difference of value functions in the future.

To solve the consumer decision problem, I assume that consumers have rational expectations about the stochastic process governing the evolutions of the future value $\Delta\delta^f_{jat}$ for $j = \{b, c, d\}$. In practice, I specify consumer expectation of $P(\Delta\delta^f_{jat+1}|\Delta\delta^f_{jat})$ using a linear forecasting rule

$$\Delta\delta^f_{jat} = \gamma_{j1} + \gamma_{j2}\Delta\delta^f_{jat-1} + u_{jt} \tag{7}$$

where $\{\gamma_{j1}, \gamma_{j2}\}_{j=\{b,c,d\}}$ are the parameters to be estimated.

4.3 Computing Market Share

The probability for staying or switching is determined by the solution to the dynamic optimization problem of consumers. For a consumer in the ABC, the payoff of staying in the same bank is $u_{iat} + \beta E[EV(a, \Omega_{t+1})|\Omega_t]$,whereas the payoff of switching to the BOC is $u_{ibt} - \tau + \beta E[EV(b, \Omega_{t+1})|\Omega_t]$. The difference in payoffs between choosing the BOC and the ABC is

$$\begin{aligned} & \Delta\delta^f_{bat} - \tau + \beta E[\Delta EV(b, a, \Delta\delta^f_{bat+1})|\Delta\delta^f_{bat}] + \varepsilon_{ibt} - \varepsilon_{iat} \\ \equiv \quad & \Delta\delta_{bat} - \tau + \varepsilon_{ibt} - \varepsilon_{iat} \end{aligned} \tag{8}$$

The first term captures the difference in flow utility plus the difference in expected future payoff, the second term is the switching cost and the last term is the difference in idiosyncratic shocks. To simplify the notation, I let $\Delta\delta_{jat} = \Delta\delta^f_{jat} + \beta E[\Delta EV(j, a, \Delta\delta^f_{jat+1})|\Delta\delta^f_{jat}]$ where $j = \{b, c, d\}$. Consequently, the probability that consumer i switches from the ABC to the bank j is

$$P_t(a \to j) = \frac{e^{\Delta\delta_{jat} - \tau}}{1 + \sum_{k \neq a} e^{\Delta\delta_{kat} - \tau}} \tag{9}$$

where $j \neq a$. For the consumer in the BOC, the switching probability from the BOC to the bank j is

$$P_t(b \to j) = \frac{e^{\Delta\delta_{jat} - \tau}}{e^{\Delta\delta_{bat}} + \sum_{k \neq b} e^{\Delta\delta_{kat} - \tau}} \tag{10}$$

where $j \neq b$. The switching probabilities for consumers in the CCB and the ICBC take the same form as those in the BOC. I compute the market share of each bank $j = \{a, b, c, d\}$ by

$$s_{j,t+1} = s_{jt}\left(1 - \sum_{k \neq j} P(j \to k)\right) + \sum_{k \neq j} s_{kt} P(k \to j) \tag{11}$$

The market share of a bank in the following period is the sum of those consumers staying in the same bank and those consumers switching from the other banks.

4.4 Price Elasticity

As shown in the literatures, the elasticity of demand with respect to the service fees is low. One possible explanation is that first-time consumers and bank account holders face transaction costs of switching banks. In the dynamic model, forward-looking consumers determine their switching decisions by trading off the expected sum of benefits and the switching cost. The elasticity of service fee will incorporate this rigidity of consumers' choice and the permanent effects of price changes. If an increase in difference of net flow utility brings up the difference of expected discounted sum of future payoff and consumers have high probability staying in the same bank, the consumers may switch to another bank in the future instead of now. To illustrate these features of consumer choices, I examine two definitions of price elasticity. These two elasticities capture the responsiveness of consumers to changes in price for different time horizons. First, I consider the short-run price elasticity, which is the percentage change of market share in next period in response to one percent permanent change of service fees. The short-run price elasticity of the dynamic model for the ABC is

$$\frac{\partial s_{at+1}}{\partial p_{at}} \frac{p_{at}}{s_{at}} = -\alpha \frac{p_{at}}{s_{at}} \sum_{k \neq a} \left([\sum_{j=a,b,c,d} s_{jt} P_t(j \to a) P_t(j \to k)] \frac{\partial \Delta \delta_{kat}}{\partial \Delta \delta^f_{kat}} \right) \tag{12}$$

Similarly, the short-run price elasticities for the bank $j = \{b, c, d\}$ is

$$\frac{\partial s_{jt+1}}{\partial p_{jt}} \frac{p_{jt}}{s_{jt}} = -\alpha p_{jt} \left(\sum_{k=\{a,b,c,d\}} P_t(k \to j)[1 - P_t(k \to j)] \right) \frac{\partial \Delta \delta_{jat}}{\partial \Delta \delta^f_{jat}} \tag{13}$$

Second, I consider the long-run price elasticity, which is the percentage change of market share in the steady state due to one percent permanent change of service fees.

Proposition: Using the law of motion (11), the market share of each bank in the steady state is given by $s_j = S_j(\tau, \Delta\delta_{ba}, \Delta\delta_{ca}, \Delta\delta_{da})$ *for* $j = a, b, c$ *and* d*. Hence, the long-run price elasticities are* $\frac{\partial s_a}{\partial p_a}\frac{p_a}{s_a} = \alpha\frac{p_a}{s_a}[\frac{\partial S_a(\tau, \Delta\delta_{ba}, \Delta\delta_{ca}, \Delta\delta_{da})}{\partial \Delta\delta^f_{ba}} + \frac{\partial S_a(\tau, \Delta\delta_{ba}, \Delta\delta_{ca}, \Delta\delta_{da})}{\partial \Delta\delta^f_{ca}} + \frac{\partial S_a(\tau, \Delta\delta_{ba}, \Delta\delta_{ca}, \Delta\delta_{da})}{\partial \Delta\delta^f_{da}}]$ and $\frac{\partial s_j}{\partial p_j}\frac{p_j}{s_j} = -\alpha\frac{p_j}{s_j}\frac{\partial S_j(\tau, \Delta\delta_{ba}, \Delta\delta_{ca}, \Delta\delta_{da})}{\partial \Delta\delta^f_{ja}}$ for $j = \{b, c, d\}$.

Proof: See appendix.

5 Estimation

In this section, I specify the parametric forms for demand functions and outline the procedures used for its estimation. The main task of the demand estimation is to obtain the net flow utility of bank services provided to consumers; this is then used to recover the preferences consumers have over bank service characteristics.

5.1 Algorithm

Following Gowrisankaran and Rysman (2009), the estimation algorithm has three-levels of non-linear optimization.[17] The parameters are estimated through a synthetic procedure which combines the demand estimation procedure in Berry (1994) and the fixed point algorithm in Rust (1987). The outer loop is a non-linear search over the parameters of the model, which nests the middle loop with fixed point calculation of the difference of net flow utilities, $\Delta\delta^f_{jamt}$ for $j = \{b, c, d\}$. Inside the fixed point calculation, the predicted market share of each bank must be computed as the solution to the dynamic optimization problem of consumers in the inner loop. There are differences between this model and those used in the recent literature just mentioned. First, their models assume there is no role for heterogeneity of products in addition to product characteristics. There are unobserved heterogeneity in the flow utility and the integrated value function in my model, thus the identities of banks is an important factor in the consumer switching decision. Second, I allow

[17] This methodology is also applied in Lee (2008), Scherbakov (2008), Schiraldi (2009) and Zhao (2008).

product characteristics to be time-varying in contrast to the time-invariant product characteristics in their models.

For the inner loop of estimation, I discretize $\Delta\delta^f_{jamt}$ to solve for $\Delta EV(j, a, \Delta\delta^f_{bamt})$ according to equation (5) and (6). More specifically, I estimate the AR(1) processes (7) to get the parameters $(\gamma_{j1}, \gamma_{j2})$ for $j = \{b, c, d\}$. Then, I use these estimates and standard errors to calculate the transition matrix for computing the fixed point of the difference of value functions (5). Then, I compute the probability of switching and market share as solutions of the dynamic optimization of consumers given vectors of $\Delta\delta^f_{bamt}$, $\Delta\delta^f_{camt}$, $\Delta\delta^f_{damt}$ and τ.[18]

For the middle loop of estimation, the estimated unobserved product characteristics, $\xi(\tau)$, is obtained once the difference of net flow utilities is computed using the contraction mapping proposed by Berry et al. (1995). I use the following equations to update the differences of net flow utilities

$$\Delta\delta^{f'}_{jamt} = \Delta\delta^f_{jamt} + \Psi\left(\ln\left(\frac{s_{jmt}}{s_{amt}}\right) - \ln\left(\frac{\widehat{s}_{jmt}(\tau)}{\widehat{s}_{amt}(\tau)}\right)\right) \tag{14}$$

where $j = b, c$ and d, and Ψ is the tuning parameter. The predicted market shares of the ABC, the BOC, the CCB and the ICBC are denoted by $\widehat{s}_{amt}(\tau)$, $\widehat{s}_{bmt}(\tau)$, $\widehat{s}_{cmt}(\tau)$ and $\widehat{s}_{dmt}(\tau)$, respectively. The parameters related to mean utility are estimated through instrumental variable estimation

$$\Delta\delta^f_{jmt} = \Delta x_{jmt}\beta_x - \alpha\Delta p_{jt} + \Delta\xi_{jmt} \tag{15}$$

The parameters β_x and α are parameters to be estimated. The vector of exogenous bank characteristics and demographic variables x_{jmt} is

$$x_{jmt} \equiv (\ \mathit{Employee\ per\ Branch}_{jmt},\ \mathit{Branch\ Density}_{jmt},\ \mathit{Total\ Branches}_{jt}\ ) \tag{16}$$

Furthermore, the unobserved product characteristics can be decomposed as

$$\Delta\xi_{jmt} = \Delta\zeta_m + \Delta\zeta_t + \Delta\zeta_j + \Delta\zeta_{jmt} \tag{17}$$

where $\Delta\zeta_m$ is a dummy variable which captures the time-invariant market fixed effect, $\Delta\zeta_t$ is a dummy variable which captures the year fixed effect, and $\Delta\zeta_{jmt}$ is a bank-market-year unobserved

[18] In case of incorporating random coefficient, there is an additional step of integrating over the simulated draws. Owing to the burden on computing three value functions in the inner loop, I do not allow for random coefficient in the estimation. For static demand model employed in Ho (2009), the random coefficient does not have significant impact on demand parameter.

product characteristics. Since the variables are expressed relative to the ABC, $\Delta\zeta_j$ is a dummy variable which captures the time-invariant difference in utility value between the ICBC (or the CCB) and the ABC relative to that between the BOC and the ABC.

The outer loop estimation of the dynamic model is similar to that of the static model as in Berry et al. (1995). I construct the moment conditions by interacting the unobserved product characteristics with the instruments. The instruments for the composite bank are computed by averaging over variables of banks underlying the composite bank. The estimation procedure is as follows: Let z be the set of instruments to be used for the demand equation. I assume z is exogenous and independent of the error terms in the demand equation and therefore z is orthogonal to $\Delta\zeta_{jmt}$, i.e. $E(z'\Delta\zeta_{jmt}) = 0$. Following Berry (1994), I use the Instrumental Variable (IV) estimation procedure to estimate equation (15).

To estimate the switching cost, I construct the set of moments by interacting a vector of unity, 1, with the unobserved product characteristics $m_1 = 1'\Delta\zeta_{jmt}$. Additionally, I use the information about the consumer switching behavior to add a set of micro moments to the moment condition. This information is useful to identify the coefficient on non-linear part of the model, which characterizes the consumer switching cost. The identification of the parameter τ comes from the information on switching behavior, which require the parameter τ to match the computed switching probabilities (9) and (10) to their empirical counterparts. The importance of the micro moments constructed from the switching behavior can be illustrated by the following example. Consider a situation that the market shares of those four banks remain unchanged over two years. It indicates two possibilities of switching behaviors: (1) there is no movement of consumers among those banks; (2) there is a massive movement of consumers among those banks which does not change the resulting market shares over two consecutive periods. It suggests that the switching cost cannot be identified if the micro moments are not imposed. However, the relevant information is usually be found in survey data which is not available in China. This information, on the other hand, is available for consumers in Canada and the United States. I make use of those information as reference cases and perform sensitivity analysis. For Canada, Allen et al. (2008) use the household financial data, obtained from the Canadian Financial Monitor survey compiled by Ipsos-Reid, and document that the median duration with the main bank more than twenty years. The information for the US comes from the Michigan Surveys of Consumers, which contains information on household switching behavior among depository institutions. The survey was conducted in year 1999 and covered 1500 distinct households. Kiser (2002a, b) documents that median duration with the main bank is ten years.

I convert the median duration with the main bank to a probability of switching bank. For instance, ten years duration is converted to ten percent probability of switching banks. Then, I match this probability with the probability of switching bank implied by the structural model using $\Pr(Switch|\tau) = sp/3$ where sp is the calibrated switching probability. The sp is divided by three to reflect consumers have three alternatives when they switch their banks. As indicated in the Canadian and US surveys, I estimate the baseline dynamic model with expected duration equal to 10 years, i.e. $sp = 1/10$. I call this model Dyn-10. Then, I perform sensitivity analysis with switching probabilities equal to 1/15 and 1/20.

Since I assume consumers only switch among the SCBs in the dynamic model, this condition creates four more moments as follows

$$m_{2-5} \quad = \quad 1' \left[\Pr(j \rightarrow k|\tau) - sp/3 \right] \tag{18}$$

where $j \neq k$ and $j \in \{a, b, c, d\}$. Define $m = [m_1, ..., m_5]$, the GMM estimator given my moment conditions is defined as

$$\min_{\tau} \; m'\Omega m \tag{19}$$

where Ω is the optimal weighting matrix. Consequently, the GMM criterion function is minimized by searching over the parameter space of the switching cost, τ, and this is the only parameter which enters into the utility function non-linearly. Since the parameter on switching cost is identified from the extra moments (18), the model can be extended for heterogeneous switching costs across banks if the distribution of consumer switching behavior is observed. If we observe the switching probability of consumers in each SCB, the moment conditions (18) can be modified to matching $\Pr(j \rightarrow k|\tau_j) - sp_j/3$, $j = 1, .., 4$. As a result, the switching cost for consumers in each bank can be identified and estimated.

Conditional on the vector of parameters, I iteratively update the difference of value functions (6) and (5), difference of net flow utilities (14) and the Markov process until convergence. I compute the market shares from the model in the inner loop of estimation, and then update $\Delta\delta^f_{bamt}$ and $\Delta\delta^f_{camt}$. in the middle loop of estimation. After obtaining convergence in transition matrix, differences of value functions and differences of net flow utilities, I update the parameters in the outer loop of estimation. The initial guess for difference of net flow utilities is obtained by using the static model in which there is no switching costs, $\tau = 0$. In this case, $\Delta\delta^f_{jamt} = \ln\left(\frac{s_{jmt}}{s_{amt}}\right)$ for $j = \{b, c, d\}$. Magnac and Thesmar (2002) argue that the discount factor is difficult to estimate in a dynamic decision model, I do not estimate the discount factor and set $\beta = 0.95$.

5.2 Instruments

The service fees are imputed for the ratio of income from commissions to total deposit. For example, if consumers use the remittance services intensively because the fees are low and the service quality is high, the imputed service fees would indicate that the fees are high. Equilibrium prices depend on the observed and unobserved product characteristics, and therefore the regressors p_{jt} are correlated with the unobservables ζ_{jmt}. The correlation is positive and therefore the OLS estimator of α is biased toward zero (i.e. it underestimates own-price elasticity). I handle this endogeneity problem using the instrumental variables approach. To estimate the demand equation, I use the following set of instruments to identify the coefficients on service fees

$$z_{jmt} \equiv (\ Operating\ Expense_{jt},\ Loan/Asset_{jt},\ rival\ Total\ Branches_{jt},\ rival\ Total\ Employees_{jt}\ ) \tag{20}$$

The instruments consist of several cost shifters as in Dick (2008) and Ho (2009). Cost shifters are valid instruments because they affect service fees through the pricing equations but are unrelated to the unobserved product characteristics. The first cost shifter is the input price of labor. Since wage and salary expenses are included in operating costs, I proxy for the input price of labor through the ratio of operating costs to total employees.[19] Operating expenses are obtained from the income

[19] Yuan (2006) and Zhao (2005) use this variable in the Panzar-Rosse regression for input price of labor.

statements of each bank. In estimation, I normalize these variables by total number of employees.[20] The second cost shifter is the ratio of loans to total assets, which captures the credit risk of a bank. Banks with high levels of credit risk may require higher costs of operation and auditing which shift up the cost function. This variable is obtained from the balance sheets of banks in the Almanacs.

I also use a set of markup shifters, which include the product characteristics of other banks as instruments (Berry et al., 1995). I construct this set of instruments using the average total number of branches and employees of rival banks. Given that product characteristics are exogenous, these instruments are orthogonal to unobserved product characteristics. Service fees are determined by the location of banks in characteristics space. For example, the service fee of a bank is lower if it faces a close competitor than if it does not.

Appendix 1 reports the descriptive statistics of instruments, and Appendix 2 presents the results from OLS regressions of service fees on costs instruments. The R^2 statistic is high at 0.67 and an F-test rejects joint insignificance of the all variables at 1% confidence level. Therefore, cost and markup shifters therefore provide exclusion restrictions that can be used to identify service fees.

6 Empirical Results

To explore the relevance of switching costs and their possible effect on the consumer preferences and the elasticity of demand with respect to the service fees, I extend the static model to incorporate these transaction costs. The result is a dynamic model in which consumers are forward looking and make decisions on which bank to use based on service quality, switching costs and an idiosyncratic component to preferences. In this section I discuss the results obtained from a static logit demand followed by a presentation of the results of the dynamic model, as described in the previous section. This is followed by an analysis of the estimated consumer preferences and demand elasticities under those two models.

[20] The non-operating and commission expenses are used to capture other parts of cost. However, they do not provide any further effect on controlling endogeneity in price.

6.1 Static Model

Table 2
Estimation Results

Variable	Static-OLS	Static-IV	Dyn-10
Demand - linear			
Constant	0.83 (0.24)*	0.66 (0.32)*	-2.52 (0.85)*
Pfee	-96.4 (32.8)*	-117 (40.3)*	-664 (90.9)*
Emp per Branch (x100)	-0.29 (0.15)*	-0.30 (0.15)*	-0.82 (0.41)*
Bdensity	7.03 (1.33)*	7.03 (1.33)*	4.92 (3.67)
Total Branches	0.14 (0.05)*	0.12 (0.06)*	0.41 (0.15)*
Real GDP per capita (x1000)	0.00 (0.02)	0.00 (0.02)	-0.62 (0.05)*
Population Density	-0.18 (4.47)	-0.17 (4.47)	106 (12.4)*
Provincial Dummies	*Yes*	*Yes*	*Yes*
Year Dummies	*Yes*	*Yes*	*Yes*
Bank Dummies	*Yes*	*Yes*	*Yes*
Demand - Nonlinear			
Switching Cost			3.29 (0.38)*
R^2 / *J-statistic*	0.902	0.902	0.324

*Observation: 621; * is significant at 5%; ** is significant at 10%*
Note: In the last row, I report R^2 for the static models and J-statistic for the dynamic model with optimal instruments

Before proceeding to the estimation of the dynamic model described in the previous section, I use a static logit demand to analyze the explanatory power of bank characteristics on market shares and to examine the usefulness of the instruments to control for endogeneity. The results from OLS and IV estimations on the static logit demand are reported in Table 2. In this case, the model is simplified to

$$\ln(s_{jmt}) - \ln(s_{amt}) \quad = \quad \Delta x_{jmt}\beta_x - \alpha\Delta p_{jt} + \Delta\xi_{jmt} \tag{21}$$

The R^2 of the OLS estimation is 0.90 which implies about 90% of the difference in mean utility is explained by the observed bank characteristics, service fees and other control variables. More specifically, the high R^2 is mainly due to the provincial and year dummies. A specification with only bank characteristics produce R^2 at 0.49. It suggests that a large part of the variation of the dependent variable is explained by the unobserved components across banks, provinces and year. Since the unobserved product characteristics may create endogeneity for service fees in the OLS estimation, the IV estimation produce a more negative coefficient for the service fees. Thus, I proceed with the IV estimation in the dynamic model.

6.2 Dynamic Model

Table 2 reports that the coefficient on total number of branches is positive and significant in the dynamic model, which indicates that SCBs can attract more consumers by expanding branch network. The negative coefficient on employees per branch suggests that the ratio of employees to branches in China is higher than that is desired by consumers. Furthermore, the parameter estimates are consistent with those in Ho (2009), which apply a static model of deposit demand, but differ in their magnitudes. It is because an increase in bank characteristics raises the net flow utility of consumers. In turn, this improvement in contemporaneous consumer utility also increases the expected consumer utility in the future.

Owing to the differences in scale of each variable, the parameter estimates are not directly comparable with each other. In order to show the importance of various bank characteristics on consumer choices, I compare their impacts on utility by increasing each characteristic above its mean by one standard deviation. The results are presented in the column ΔU of Table 3. The corresponding changes in utility are 0.09, 0.06 and 0.77 for employees per branch, branch density, and total number of branches in the dynamic model. It suggests that forward-looking consumers respond to branch expansion more than increases in employees. The economic development in China is skewed towards provinces in coastal regions and the job opportunities in those provinces are better than those in other provinces. As a result, migrant workers commonly move from less-developed inland provinces to more developed coastal regions to seek work. A portion of their income is frequently remitted back to their family in their province of origin and a larger branch network facilitates transactions like this.

Table 3
Willingness To Pay

Variable	**Static Model** $\triangle U$	$\triangle \$U$	$\triangle \$U(F)$	**Dynamic Model** $\triangle U$	$\triangle \$U$	$\triangle \$U(F)$
Emp per Branch	0.03	0.03%	19%	0.09	0.01%	9.2%
Bdensity	0.09	0.08%	56%	0.06	0.01%	6.9%
Total Branch	0.23	0.19%	138%	0.77	0.12%	83%
Service Fees	0.12	0.10%	71%	0.66	0.10%	71%

Note: $\triangle \$U$ *is changes in utility;* $\triangle \$U$ *is changes in utility in terms of deposit;* $\triangle \$U(F)$ *is changes in utility in terms of service fees; I show absolute value*
Average service fees = 0.14%

To quantify the changes in utility, in the column $\triangle \$U$, I compute the willingness to pay of consumers in exchange for these improvements in service quality reported in the column ΔU. A forward-looking consumer is willing to pay 0.01% and 0.12% of deposit for one standard deviation increases in branch density and total number of branches, respectively. Analogously, according to the dynamic model, the welfare cost for corresponding increase in employees per branch is 0.01% of deposit. The magnitudes of willingness to pay for these hypothetical changes are significant and range from 6% to 73% of the average annual service fees. In addition to prices (i.e. service fees), it indicates that service quality is another effective way to attract consumers. The demand estimates suggest that Chinese consumers have stronger preferences on branches than employees, which is similar to those in the U.S. reported in Dick (2008). Comparing the results from the static and dynamic models, the static model overstates the willingness to pay of consumers on product characteristics. Accordingly, welfare analysis based on the static model will produce correct qualitative results, but the magnitudes of welfare changes in product characteristics need to be revised. This cautious note is particularly important for policy evaluation such as the branch consolidation occurred in 1998.

The demographic variables indicate that the consumer switching behavior among depository institutions depends on economic development: consumers have higher probabilities to switch among banks in provinces with higher population density and lower real GDP per capita. In less developed provinces, consumers may have lower opportunity cost for switching banks. Furthermore, consumers in more crowded provinces may find having a bank with high service quality is more valuable and hence more willing to switch. The demographic variables are useful in capturing the provincial variation in the probability of switching banks for consumers. It is consistent with the results on consumer behavior in the US reported in Kiser (2002a,b).[21]

6.3 Switching Cost and its Implications

The coefficient on switching cost is positive and significant, which indicates that consumers need to incur costs for switching banks. As a result, consumers are less responsive to changes in bank characteristics and service fees. To quantify the switching cost, it is useful to compare the relative impact of bank characteristics, service fees and switching cost on consumer utility. The switching cost is equivalent to 0.5% of the deposit value, which is larger than the average annual service fee (0.15%).[22] Using the deposit per capita in urban area in year 1994, which was \$4870 Yuans (\$$US$ 696), the monetary value of switching cost was \$244 Yuans (\$$US$ 35). The switching cost has considerable impact on the household decision of bank choices because the cost is about 7% of the annual disposable income of a household (In year 1994, it was \$3496 Yuans for the urban area, i.e. \$$US$ 499). Consequently, a temporary (one period) change in service fees or service quality does not change market shares of banks very much because the monetary incentive created by the price or quality change is not large enough to compensate the cost that incurred for switching banks.

Table 4
Own-price Elasticity

Bank	**Static**	**Short-run**	**Long-run**
ABC	0.11	0.17	1.51
BOC	0.35	0.66	2.33
CCB	0.12	0.18	0.78
ICBC	0.05	0.08	0.71

Note: The results in the column Static are computed from the estimates using IV estimation

Table 4 reports that the short-run elasticity of demand with respect to the service fees of the dynamic model is similar to that of the static model. It suggests that the price elasticity in the static

[21] Using a survey data at individual level, she documents that age, martial status, education, car ownership and income level affect the decision to stay in the first bank forever.

[22] An one unit increase in service fees implies the service fees increases from the current rate to the current rate plus the whole deposit amount. This dramatic change reduces utility value by 664 units. Therefore, the monetary value of switching cost is computed by 3.29/664 for the dynamic model.

model only reflects the short-run behavior of consumers. Consumers may delay their decisions in switching banks because they prefer to make their decisions later when they have more information on the service quality and fees in the future. Owing to the switching cost, the short-run price elasticity is smaller than the long-run elasticity. According to the long-run price elasticity, the result is more consistent with profit maximization. Service fees set by SCBs are closer to the elastic portion of the demand of deposit. Therefore, it suggests that the elasticity of demand with respect to the service fees in the static model does not accurately reflect the forward looking behavior of consumers. The low price elasticity of service fees in the static model can be partly explained by the transaction cost incurred to switch banks. In addition to the distortion of lending subsidies argued in Ho (2009),[23] banks set their service fees lower than those justified by the static profit maximization with a clear economic rationale: Low service fees are used to attract customers and subsequently banks are compensated by the flow of service fees in the future. This result on bank pricing of service fees is consistent with Klemperer (1995) which suggests that locking in consumers is an important consideration for pricing decision.

6.4 Robustness Check

In this sub-section, I evaluate the estimates produced by the dynamic model of demand under alternative moment conditions and switching probabilities to examine the changes in coefficient estimates and price elasticities. Table 5 shows the estimation results. First, I estimate the dynamic model without imposing the extra moments of switching probability, and report the corresponding results in the column Dyn. Then, I estimate the dynamic model with extra moments under three alternative switching probabilities, namely $sp = 1/10$, $1/15$ and $1/20$. Dyn-10, Dyn-15 and Dyn-20 in Table 5 report the results under $sp = 1/10$, $1/15$ and $1/20$, respectively. Notice that the Dyn-10 is the dynamic model estimated in the previous sub-section. The coefficient estimates become larger when switching cost present in the model. However, the monetary value of switching cost and the willingness to pay of consumer on bank characteristics are similar across specifications with positive

[23] In the sample period, the lending rate is set by the government at a higher level than that of the deposit rate. Therefore, banks try to earn more profit by attracting a large volume of deposits which can be used to earn profit in the loan market.

switching costs. The monetary values of switching cost are 0.50%, 0.50% and 0.51% of deposit value in the model of Dyn-10, Dyn-15 and Dyn-20, respectively.[24]

Table 5
Estimation Results

Variable	Dyn	Dyn-10	Dyn-15	Dyn-20
Demand - linear				
Constant	8.96	-2.52	-2.92	-3.35
	(1.28)*	(0.85)*	(1.06)*	(1.23)*
Pfee	-38.5	-664	-752	-809
	(9.38)*	(90.9)*	(113)*	(133)*
Emp per Branch (x100)	-0.12	-0.82	-0.96	-0.95
	(0.04)*	(0.41)*	(0.51)**	(0.59)
Bdensity	1.77	4.92	5.46	6.06
	(0.38)	(3.67)	(4.58)	(5.36)
Total Branches	0.03	0.41	0.57	0.69
	(0.02)*	(0.15)*	(0.18)*	(0.22)*
Real GDP per capita (x1000)	-0.05	-0.62	-0.80	-0.93
	(0.01)*	(0.05)*	(0.07)*	(0.08)*
Population Density	8.96	106	138	161
	(1.28)*	(12.4)*	(15.4)*	(18.0)*
Provincial Dummies	*Yes*	*Yes*	*Yes*	*Yes*
Year Dummies	*Yes*	*Yes*	*Yes*	*Yes*
Bank Dummies	*Yes*	*Yes*	*Yes*	*Yes*
Demand - Nonlinear				
Switching Cost	0.00	3.29	3.75	4.15
	(0.06)	(0.34)*	(0.43)*	(0.57)*
Expected Duration (Period)	4	10	15	20
J-statistic	0.00	0.324	0.210	0.164

*Observation: 621; * is significant at 5%; ** is significant at 10%*
Note: In the last row, I report J-statistic for the dynamic model with optimal instruments

Using the structural models, I compute the impacts of switching cost on price elasticity. Table 6 reports the own-price elasticities under alternative magnitudes of switching probability. The estimates from the dynamic model without extra moments on switching cost (Dyn) show that the long-run price elasticity are 0.11, 0.31, 0.11 and 0.05 for the ABC, the BOC, the CCB and the ICBC, respectively. In this case, the magnitudes of the long-run price elasticity of the dynamic model are close to those of price elasticity in the static model. Nonetheless, the magnitudes of the long-run elasticities are larger than those of the short-run elasticity. Moving to the dynamic models with positive switching cost, the long-run elasticity increases disproportionately relative to the short-run elasticity because the switching cost discourages consumers to adjust their bank choices fully in

[24] The first stage J-statistics suggest that the model with $sp = 1/10$ fit the data better than other model with switching cost. However, the variation of aggregate data may not reveal the underlying switching behavior at the household or individual level.

the short-run. Thus, the dynamic model with a larger switching cost induces a lower short-run price elasticity. However, the effects on the long-run price elasticity are mixed. The long-run price elasticities of the BOC and the CCB increase, whereas those of the ABC and the ICBC decrease. The contrasting result is due to the computed probability of staying in the BOC and the CCB are higher than the ABC and the ICBC, and hence the long-run effects of switching cost on the BOC and the CCB are stronger than those on the other banks.

Table 6

Own-price Elasticity: Short-run

Bank	Dyn	Dyn-10	Dyn-15	Dyn-20
ABC	0.06	0.17	0.14	0.12
BOC	0.17	0.66	0.56	0.48
CCB	0.06	0.18	0.15	0.13
ICBC	0.03	0.08	0.07	0.06

Own-price Elasticity: Long-run

Bank	Dyn	Dyn-10	Dyn-15	Dyn-20
ABC	0.11	1.50	1.15	1.02
BOC	0.31	2.33	3.47	4.59
CCB	0.11	0.78	1.12	1.47
ICBC	0.05	0.71	0.50	0.16

Note: The results are computed from the dynamic model with optimal weighting matrix

Finally, I report the estimation results of forecasting equation (7) in Table 7. The results indicate that the changes in service quality are decreasing over time. As the switching probability decreases, the estimated changes in service quality deteriorate at a higher rate in order to justify the changes in observed market shares.

Table 7
Forecasting Equation

Dyn-10	**BOC**	**CCB**	**ICBC**
γ_1	-2.285 (0.072)	-1.667 (0.093)	-1.575 (0.378)
γ_2	-0.213 (0.031)	-0.147 (0.056)	0.358 (0.054)
Dyn-15	**BOC**	**CCB**	**ICBC**
γ_1	-2.631 (0.083)	-1.936 (0.111)	-1.987 (0.155)
γ_2	-0.243 (0.032)	-0.160 (0.058)	0.329 (0.058)
Dyn-20	**BOC**	**CCB**	**ICBC**
γ_1	-2.907 (0.095)	-2.162 (0.127)	-2.252 (0.173)
γ_2	-0.254 (0.033)	-0.166 (0.058)	0.281 (0.061)

7 Conclusion

This paper aims to contribute our understanding on the effects of switching costs on behaviors of consumers. Using a dynamic structural model of consumer demand, I examine the demand for deposits in China and evaluate the effects of switching costs on the demand. My results quantify the switching costs that incurred when consumers switch their deposit institutions. I show that consumer switching cost is an important factor for consumers to make bank choices. Thus, consumers adjust their bank choices gradually. Banks reduce their service fees to attract consumers and expect to earn fee income from consumers for an extended time period. As a result, the elasticity of demand with respect to service fees in the static model does not accurately reflect the forward looking behavior of consumers. Comparing the results from the static and dynamic models, my results suggest that the static model overstates the willingness to pay of consumers on product characteristics. Finally, I analyze the dynamic model under alternative consumer switching behaviors. The dynamic model suggests that a higher switching cost induces a larger long-run price elasticity, but the short-run elasticity is less affected. Future research can look into the pricing behavior of banks by enriching the model with supply side, and explore household-level data to investigate the determinants and implications of consumer switching cost.

APPENDIX (Proof of the Proposition)

Using the law of motion (11), the steady state market shares can be solved from the following system of equations

$$\begin{array}{rcl} s_a & = & s_b \dfrac{P(b \to a)}{1 - P(a \to a)} + s_c \dfrac{P(c \to a)}{1 - P(a \to a)} + s_d \dfrac{P(d \to a)}{1 - P(a \to a)} \\ s_b & = & s_a \dfrac{P(a \to b)}{1 - P(b \to b)} + s_c \dfrac{P(c \to b)}{1 - P(b \to b)} + s_d \dfrac{P(d \to b)}{1 - P(b \to b)} \\ s_c & = & s_a \dfrac{P(a \to c)}{1 - P(c \to c)} + s_b \dfrac{P(b \to c)}{1 - P(c \to c)} + s_d \dfrac{P(d \to c)}{1 - P(c \to c)} \\ s_c & = & s_a \dfrac{P(a \to d)}{1 - P(d \to d)} + s_b \dfrac{P(b \to d)}{1 - P(d \to d)} + s_c \dfrac{P(c \to d)}{1 - P(d \to d)} \end{array}$$

. The system can be reduced to

$$\begin{array}{rcl} s_a & = & s_b K_{ba} + s_c K_{ca} \\ s_b & = & s_c K_{cb} + s_d K_{db} \\ s_c & = & s_a K_{ac} + s_d K_{dc} \\ s_d & = & s_a K_{ad} + s_b K_{bd} \end{array}$$

, where

$$\begin{array}{rcl} K_{ba} & = & \dfrac{P(b \to a)[1 - P(d \to d)] + P(b \to d)P(d \to a)}{[1 - P(d \to d)][1 - P(a \to a)] - P(a \to d)P(d \to a)} \\ K_{ca} & = & \dfrac{P(c \to a)[1 - P(d \to d)] + P(c \to d)P(d \to a)}{[1 - P(d \to d)][1 - P(a \to a)] - P(a \to d)P(d \to a)} \\ K_{cb} & = & \dfrac{P(c \to b)[1 - P(a \to a)] + P(c \to a)P(a \to b)}{[1 - P(a \to a)][1 - P(b \to b)] - P(b \to a)P(a \to b)} \\ K_{db} & = & \dfrac{P(d \to b)[1 - P(a \to a)] + P(d \to a)P(a \to b)}{[1 - P(a \to a)][1 - P(b \to b)] - P(b \to a)P(a \to b)} \end{array}$$

and

$$\begin{array}{rcl} K_{dc} & = & \dfrac{P(d \to c)[1 - P(b \to b)] + P(d \to b)P(b \to c)}{[1 - P(b \to b)][1 - P(c \to c)] - P(c \to b)P(b \to c)} \\ K_{ac} & = & \dfrac{P(a \to c)[1 - P(b \to b)] + P(a \to b)P(b \to c)}{[1 - P(b \to b)][1 - P(c \to c)] - P(c \to b)P(b \to c)} \\ K_{ad} & = & \dfrac{P(a \to d)[1 - P(c \to c)] + P(a \to c)P(c \to d)}{[1 - P(c \to c)][1 - P(d \to d)] - P(d \to c)P(c \to d)} \\ K_{bd} & = & \dfrac{P(b \to d)[1 - P(c \to c)] + P(b \to c)P(c \to d)}{[1 - P(c \to c)][1 - P(d \to d)] - P(d \to c)P(c \to d)} \end{array}$$

. The solution of the system of equations is characterized as

$$\begin{array}{rcl} s_a & = & \dfrac{K_{db}K_{ba} + K_{dc}K_{ca} + K_{dc}K_{cb}K_{ba}}{1 - K_{ac}K_{ca} - K_{ac}K_{cb}K_{ba}} s_d \quad = \quad \Delta_a s_d \\ s_b & = & \dfrac{K_{db}K_{ba}K_{ac}K_{cb} + K_{dc}K_{cb} + K_{db}}{1 - K_{ac}K_{ca} - K_{ac}K_{cb}K_{ba}} s_d \quad = \quad \Delta_b s_d \\ s_c & = & \dfrac{K_{db}K_{ba}K_{ac} + K_{dc}}{1 - K_{ac}K_{ca} - K_{ac}K_{cb}K_{ba}} s_d \quad = \quad \Delta_c s_d \end{array}$$

and $s_d = \dfrac{1}{1 + \Delta_a + \Delta_c + \Delta_d}$. As a result, the steady state market shares are $S_a(\tau, \Delta\delta_{ba}, \Delta\delta_{ca}, \Delta\delta_{da})$, $S_b(\tau, \Delta\delta_{ba}, \Delta\delta_{ca}, \Delta\delta_{da})$, $S_c(\tau, \Delta\delta_{ba}, \Delta\delta_{ca}, \Delta\delta_{da})$ and $S_d(\tau, \Delta\delta_{ba}, \Delta\delta_{ca}, \Delta\delta_{da})$.

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Appendix 1
Descriptive Statistics

Variable	Mean (S.D.)	Median	Minimum	Maximum
Market/Demographic Information				
real GDP per capita	4.647 (3.294)	3.482	1.243	21.76
Population Density	0.036 (0.044)	0.025	0.001	0.265
Market Share				
s_{jmt}	0.250 (0.119)	0.237	0.050	0.663
Price				
Service fee	0.0014 (0.0010)	0.0009	0.0004	0.0035
Deposit rate	0.019 (0.009)	0.016	0.010	0.032
Bank Characteristics				
Employees per Branch	17.75 (10.40)	14.46	6.12	84.13
BDensity	0.009 (0.013)	0.005	0.000	0.095
Total Branch	2.99 (1.88)	2.18	1.05	6.60
Instruments				
opexp (1 mil Yuan per employee)	0.066 (0.029)	0.060	0.027	0.141
Loan/Asset (per Yuan asset)	0.590 (0.081)	0.610	0.428	0.701
rival Total Branch	2.99 (0.69)	2.89	1.79	3.97
rival Total Employee	0.40 (0.05)	0.38	0.31	0.49

Unit: GDP per capita = 1,000 Yuan at 1993 price level;
Population density = 10,000 per km^2*;* s_{jmt}*, Service fees and deposit rate = %/100;*
Employees per branch = unit; BDensity (Branch density) = branch per; km^2*;*
Total Branch = 10,000 unit; opexp = Operating expense/employee
Number of observations = 828, except 207 for Market/Demographic Information;
Standard deviations are in bracket; the figures are computed over the sample period

Appendix 2
Price Regression

Variable	
Constant	0.001 (0.001)
operating exp	1.398 (1.200)
Loan/Asset	0.006 (0.003)
rival Total Branches	-0.003 (0.001)
rival Total Employees	0.044 (0.011)
R^2	0.67
P-value(F(4, 16))	0.00

Dependent variable: Δp_{jt}*;*
Observation = 21