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Abstract

This paper examines the effects of market deregulation on consumers and state commercial banks in China, a large developing country. I jointly estimate a system of differentiated product demand and pricing equations under alternative market structures. While China's banking reforms overall have achieved mixed results, the consumer surplus of the deposit market has increased. The welfare effects from reforms are unevenly distributed, with losses skewed toward inland provinces and certain consumer groups. There is no clear evidence that the pricing of banking services has become more competitive after the reform, and such pricing remains subject to government intervention. Encouragingly, the price-cost margins of some state commercial banks have fallen over time.

Keywords: Banking Reform, Banks in China, Demand Estimation, Market Structure

JEL Classification: G21, L11

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1. Introduction

The contribution of saving and investment to economic growth is well established (Barro, 1991). Recent research identifies a number of specific roles of the financial sector in fostering growth. In addition to such benefits as mobilization of savings, improved capital allocation, monitoring the use of funds, and managing risk,[1] several empirical studies affirm the importance of financial development in determining macroeconomic outcomes at various stages of economic development (King and Levine, 1993; Rousseau and Wachtel, 1998). These potential benefits have enticed many governments to deregulate their banking sectors to make them competitive and efficient.

What is less clear, however, is the extent to which regulatory structures facilitate economic growth by influencing financial intermediation, particularly the regulatory structures of developing countries. Understanding the influence of such structures seems especially worthwhile in the case of China as the effects of an underperforming financial system on per capita income are potentially large enough to affect the entire global economy.

This paper attempts an examination of China's banking industry from the standpoint of consumer welfare and market structure during a period with significant and continuous banking reforms. My empirical strategy relies on inferences for consumer preferences and market structure based on observations of China's four large state commercial banks (SCBs) during the period 1994-2001. I propose an oligopolistic framework in which banks offer differentiated products. Facing asymmetric costs, these banks seek to maximize their dual objectives of profitability and securing deposits through price-setting. Since product differentiation is an important determinant of market power, Chinese banks have created broad assortments of products and services to carve out market share. I jointly estimate (i) a random coefficient model of differentiated product demand system based on utility maximization, and (ii) first-order conditions derived from maximizing the dual objectives of China's SCBs: mandated profitability and securing deposits in order to fund state-owned enterprises (SOEs). A structural model is used to analyze changes in consumer welfare and market structure after reform.

The overall results are mixed. Although the consumer surplus of the deposit market increases, some consumers experience welfare losses. An encouraging finding is that the price-cost margins of SCBs have shrunk over time.[2] This would seem to indicate the presence of competition even if the market is dominated by SCBs. (Of course, intensification of competition is limited by high administrative barriers to entry and the poor financial performances of many of the SOEs that borrow from the SCBs.) Moreover,

[1] Levine (1997) provides an excellent review of the role of financial intermediation for economic growth. Beck *et al.* (2007) consider evidence that financial intermediation reduces income inequality and poverty.

[2] Following the IMF convention (1996), I use the term “state commercial bank” rather than “state-owned bank” to emphasize the commercial nature of state-owned banks in the post-reform period.

consumers appear to be the biggest beneficiaries as prices in the deposit market are too low to be consistent with simple profit maximization. I suggest several explanations for the observed pricing behavior, most notably subsidized government lending in the form of interest rate regulation, the pursuit of deposits by SCBs in order to fund SOEs, and the high fixed costs consumers encounter if they attempt to switch banks. On the other hand, cost-cutting measures such as branch consolidation clearly erode consumer welfare as consumers prefer the convenience of nearby branches. Welfare costs are found to be unevenly distributed with losses falling disproportionately on China's inland provinces.

Recent empirical literature on banking market structure draws largely upon econometric models developed in the industrial organization literature for assessing market power through demand estimation. Examples include Adam *et al.* (2007), Ishii (2007), Dick (2008) and Knittel and Stango (2008) for the US, Nakane *et al.* (2006) for Brazil, Molnar *et al.* (2007) for Hungary, Molnar (2008) for Finland, and Ho (forthcoming) for Hong Kong. This paper suggests a framework based on first-order conditions to test the extent of government interventions in the banking market. The results here for demand systems and testing government interventions are robust to alternative supply models. The GMM-based non-nested test proposed by Rivers and Vuong (2002) is also shown to be useful in selecting the market structure that best describes the data.

Perhaps the most important aspect of this paper is that it takes on the deposit market -- a subject long neglected in the literature on Chinese banking reforms. This oversight is quite striking, and to some extent puzzling as many authors have readily commented on the failure of the loan market to improve allocative efficiency in the 1990s (e.g. Cull and Xu, 2000, 2003; Park and Sehrt, 2001). Yet it is the deposit market that has been, and remains, the motor of resource mobilization. Banks provide a huge share of the capital financing underpinning China's growth.[3] In 2005, for example, Chinese banks intermediated about 72% of the capital in China, more than double the US percentage, and 1.5 times higher than in other Asian countries (Farrell *et al.*, 2006). Hao (2006) further points out that Chinese provinces with a higher ratio of saving deposits to GDP have experienced higher economic growth, implying that deposit services that encourage saving have been crucial to economic growth in China.[4] My analysis of the deposit market in post-reform China suggests that changes in consumer welfare have been uneven and that post-reform government interventions have had a strong influence on the pricing of bank products.

I also consider the welfare implications of banking deregulation, drawing on the work of Fu and Hefferman (2009), who employ a structure-performance approach to show SCBs have market power despite poor

[3] Maddison (1998) notes that China's share of world GDP increased from 5% in 1978 to 10.9% in 1995. China became the world's second largest economy in 2006 (IMF, 2006).

[4] Drawing on historical evidence from the Dutch Republic, England, and the United States, Rousseau (2003) argues that resource mobilization can be crucial in the early stages of development. Looking at Indian development from 1951 onwards, Bell and Rousseau (2001) suggest that saving is a precondition for improving resource allocation in developing countries.

efficiency and low profitability,[5] and Zhao *et al.* (2005) and Yuan (2006), who apply a Panzar-Rosse model (Panzar and Rosse, 1987) to demonstrate that the degree of competition diminishes over time in a banking industry characterized by monopolistic competition.[6] Using a structural model of demand and pricing, I construct a unified framework to analyze the effects of banking reform after 1994 by examining the overall impact on consumer welfare and bank competition.

China's experience with banking reform is relevant for many developing countries. The banking sector in a country with an underdeveloped capital market typically acts as the main channel for financial intermediation as it centralizes lending and maximizes the effectiveness of talent. Moreover, Barth *et al.* (2001) and La Porta *et al.* (2002) note government ownership of banks is pervasive in developing countries. Banking sectors with a high proportion of government-owned banks are generally less stable and less efficient markets for financial intermediation, and thereby tend to restrain economic and productivity growth, as well as financial development (La Porta *et al.*, 2002). In examining China's developing economy, which is dominated by large state-owned banks, I attempt to tease out the effects of policy changes in alternative institutional environments.

The remainder of the paper is organized as follows. Section 2 introduces the Chinese banking industry. Sections 3 and 4 describe the structural model and data. Section 5 presents the estimation procedures. Section 6 reports the empirical results and section 7 discusses the robustness of the results. Section 8 concludes.

2. Reforming China's Banking Industry

Reform of China's banking industry, which commenced in 1978, continues to this day.[7] The early reforms created a two-tier banking system. In the top tier, the People's Bank of China (PBC) became the central bank. Several large, specialized banks were also created, including the Agricultural Bank of China (ABC), Bank of China (BOC), China Construction Bank (CCB), and Industrial and Commercial Bank of China (ICBC).[8] The lower tier consisted of joint-stock banks (JSBs), city commercial banks, and non-bank financial institutions such as trust and investment companies, rural credit cooperative societies, and urban

[5] In the structural-performance approach, profitability is regressed on concentration and efficiency indices to examine the market power and efficient structure hypotheses. Bresnahan (1989), however, argues that price, profit, and concentration are jointly determined in equilibrium, i.e. the regression in the structural-performance approach is endogenous.

[6] Panzar and Rosse (1987) perform a regression of total bank revenue on input prices of capital, deposits, and employees. The sum of the coefficients of the input prices from the revenue regression -- the Panzar-Rosse statistic -- is the sum of the elasticity of total revenue with respect to input prices. A statistic value below one indicates monopoly power. However, this approach requires the market be in long-run equilibrium and places restrictive assumptions on cost structure to infer market structure.

[7] I focus here on market structure of deposit market and interest rate deregulation. See Shirai (2002), Dobson and Kashyap (2006), Podpiera (2006) and Allen *et al.* (2008) for detailed discussions of China's banking industry.

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

credit cooperative societies. Prior to the 1978 reforms, banking was highly regulated and the deposit and loan markets were monopolized by the PBC. As reforms moved ahead, SCBs gradually assumed the lion's share of both markets.

The first phase of the reforms span the years 1979 to 1993.[9] During this period, SCBs were heavily involved in lending to infrastructure projects and SOEs in priority sectors. Most project funding was provided by SCBs regardless of their earning prospects. As a result, the four SCBs accumulated large stocks of non-performing loans. At the start of the second phase of reforms in 1994, three policy banks (the China Development Bank, Export-Import Bank of China, and Agricultural Development Bank of China) were created to take over the role of government lending from the SCBs. Reforms continued with the passage of the 1995 Commercial Banking Law, which charged banks with a duty to show a profit and reasonably assess the creditworthiness of potential borrowers.[10] As can be seen in Table 1, the lending interest rate was deregulated gradually from 1996. However, bank deposit rates had to follow the official benchmark rate set by the PBC until 2004. During this period, the PBC allowed a positive interest rate spread between the benchmark rates of lending and the deposit as a way to subsidize SCBs and encourage lending to SOEs.[11]

Although banking seeks in principle to maximize profits, China's SCBs as state entities were, and remain, creatures of state policy.[12] This creates an internal contradiction (Dobson and Kashyap, 2006). On one hand, SCBs have a mandate set forth in the law to exercise their dominance in the market by charging the highest prices the market will bear. On the other hand, policy-directed lending means SCBs should do all they can to attract deposits in order to fund lending to finance programs championed by the state. State interest-rate subsidies, for example, are used to reduce the effective marginal costs of banks, and thereby undermine the incentive of SCBs to set margins in the deposit market high enough to assure a profit. This conundrum has meant that SCBs have largely struggled to maintain profits through exploiting opportunities in the credit market.[13]

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9 The Almanac of China Finance and Banking (1994) reports the State Council announced the second stage of banking reform in its 1993 “Decision on Financial System”. For the purposes of this paper, I assume the second stage of banking reform started in 1994.

10 The law, passed on May 10,1995 in the People Congress, took effect on July 1, 1995 (chapter 1, articles 4 and 9 of the law). See IMF (1996) for details.

11 Central planning based on a credit quota for SCBs ended in 1998. Park and Sehrt (2001) and Podpiera (2006) suggest the importance of policy lending by state banks remained pervasive after the banking reform. As a result, lending by financial institutions continued to ignore economic fundamentals.

12 Banking reform did not involve privatization sales.

13 Certain short-term policies further reduce the incentive to increase margins. In 1995, for example, the Ministry of Finance subsidized interest as part of a value guarantee program that had indexed the deposit rate to inflation since 1988.

3. Data and Descriptive Statistics

The empirical analysis here is based on a novel dataset that combines the provincial banking and economic data with bank balance sheet information. The data structure is similar to that used for studying the banking market in the US. I collect the data from various issues of *Almanac of China Finance and Banking* (Almanac) and *China Statistics Yearbook* (Yearbook). Data on balance sheets, income statements, provincial deposits, branches, and employees are obtained from the Almanac. Provincial demographic and economic data are obtained from the Yearbook. The sample includes annual observations from 1994 to 2001.[14] Because of missing data for ICBC, I exclude 1997, the Tibet province, and Chongqing for the years 1994-1996. The sample contains a total of 828 observations at the level of bank-market-year. Appendix 1 reports the descriptive statistics of variables used in the empirical analysis.

3.1 Defining a Market

SCBs provide deposit services in each provincial market in China.[15] In 1997, Chongqing was redefined as a municipality. Hence, China had 30 provinces before 1997, and 31 thereafter. The definition of a market at the provincial level is justified for two reasons. First, competitors are more homogenous within a province than across provinces. Many banks only operate in a limited number of provinces, so SCBs face different sets of competitors in each province. Second, banks in different provinces may be separated by huge geographic distances. This imposes high transaction costs on potential consumers considering placing their deposits with a bank in another province. Due to the limited availability of data that would allow defining markets at the city or county level, my definition of geographic market is broader than what would be applied in, say, the US.[16] The descriptive statistics for real GDP, real GDP per capita, agricultural share of GDP, population, and population density (population per square kilometer) suggest it is important to control for market characteristics in the estimation.

[14] The sample period is restricted by data availability for branches and employees at the provincial level. Because provincial-level data is only available for the four SCBs, I cannot compare different types of financial institutions as Adams *et al.* (2007) did for the US.

[15] 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, Hong Kong and Macau, due to their different economic structures.

[16] Amel and Starr-McCluer (2002) report that people in the US tend to open deposit accounts with banks close to home. Thus, the wider definition of market here may inflate the elasticities of consumers on product characteristics.

3.2 Market Size and Market Share

I use total provincial deposits in financial institutions from the Yearbook to measure the market size of market m in year t, H_{mt}.[17] To compute market share, I divide deposits of each SCB by market size for each market-year.[18] 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.

The market shares in Table 2 are computed by averaging the market shares of each bank across provinces. In 1994, SCBs held over 70% of deposits, with ICBC controlling the largest market share in the deposit market. Over the sample period, the market share of the SCBs fell from about 72% to 67%. Most of the lost SCB market share went to JSBs, their primary domestic competitors.[19] In particular, the market shares of ABC and ICBC declined by over 3%.

3.3 Price

The service fee is computed as the ratio of income from commissions to total deposits. Income from commissions is obtained from income statements and total deposits reported on balance sheets.[20] The service fee includes fees for transferring money between accounts, trading securities and foreign currencies, managing assets, and bank-card transactions. Admittedly, the price variable is imperfect, since it cannot show price variations across the 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 fees of individual banks do 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%, i.e. consumers give back about 7% of their deposit interest as service fees.[21]

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[17] Since I only observe total saving deposits for each province, I compute total provincial deposits by computing the ratio of savings to total deposits for each market-year for SCBs. The provincial saving deposits figure is then divided by that ratio to obtain total provincial deposits.

[18] I can also define quantity by the number of depositors, i.e. deposits held by a bank divided by deposits per capita. The market share is thus defined as the number of consumers divided by the total population. The empirical results are robust under this alternative definition and available upon request.

[19] Market shares of JSBs in 1994 and 2001 were 7% and 12%, respectively. Moreover, foreign banks have less than 1% of the market share. Source: Almanac of China Finance and Banking. Research also shows SCBs are less efficient and profitable than their competitors. Li *et al.* (2001) report that the return on assets and return on equity of joint stock banks are higher than those of SCBs. Ariff and Can (2008) and Berger *et al.* (2008) determine that SCBs are less profit-efficient than JSBs.

[20] The BOC's commission fee during 1994-1996 is embedded in official figures along 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.

[21] 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, branches and employees at the provincial level, to proxy for service quality provided by SCBs. Since branch and employee data is available at the provincial level, variations at the level of bank-market-year can be readily tracked. The observed characteristics include employees per branch and branch density (the ratio of the number of branches in a province to province area in square kilometers). The density of branches captures the convenience of bank locations; the number of employees per branch suggests the efficiency of branch operations. I sum the number of branches across the country to obtain the total number of branches as a proxy for the size of the branch network size provided to consumers. This characteristic varies across bank-year observations, but not provinces. The choice of observed characteristics also follows the literature to allow for comparability. Table 2 indicates the average number of branches and employees are lower at the end of the sample. Service fees are generally higher in 2001. The demand system suggests changes in market share can be driven by changes in service quality and price, so Table 2 offers preliminary evidence that changes in market shares relate to lower service quality and higher service fees. I use figures for total assets of each SCB as a control variable to capture the size effect of bank related to deposit demand, and construct this variable by computing the deviation of total asset of each bank to the average total asset.

3.5 Demographic Variable

Household income is used to introduce heterogeneity in consumer preferences. Following Nevo (2001), I simulate draws for the income of household i in province m, y_{im} from an empirical distribution. The distribution is taken from the *Household Income Distribution Survey 1995* conducted by the Institute of Economics of the Chinese Academy of Social Sciences. The survey covers 6,930 households in eleven provinces: Beijing, Shanxi, Jiangsu, Liaoning, Anhui, Henan, Hubei, Guangdong, Yunan, Sichuan, and Gansu. Meng (2004) compares the survey distribution to summary statistics from the confidential population distribution held by the National Bureau of Statistics and finds a close match. Since there are 31 provinces in the bank sample and only 11 provinces in the income survey, I match provinces in the survey to the closest province in my sample by categorizing the provinces into three groups: eastern, central, and western regions. Within each of these regions, provinces in the bank sample are matched to provinces in the income survey by income level.[22]

[22] I also experimented with a sampling scheme in which the income of each province was drawn from the empirical distribution of household income. The empirical results are robust under this alternative sampling scheme and available upon request.

4. Model

My specification and estimation of the demand system for deposit services follows Berry *et al.* (1995) and Nevo (2001) and is based on the aggregation of heterogeneous consumers' discrete choices.[23] Employing demand models based on product characteristics has the advantage of avoiding a large number of free parameters due to cross-price elasticities. Rather than rely on predefined classifications, a random coefficients model of demand is used to allow for flexible substitution patterns across banks. Consistent with the demand system, the supply side focuses on interactions among SCBs and introduces the competition from the non-SCBs through outside goods. This simplifying assumption is motivated by the fact that SCBs control over two-thirds of the market, and the market share of an SCB is likely to be several times that of a typical non-SCB in any provincial market. Another supply-side assumption is that banks pursue the dual objectives of maximizing profit and bringing in deposits to fund SOEs. First-order conditions provide the framework for testing whether the bank's behavior is affected by government intervention. I end by outlining a model of demand deposit services and pricing of bank services.

4.1 Demand

The market for deposits is defined as a Chinese province. Thus, the industry consists of four SCBs and M local markets. Provincial markets are indexed by m and banks by j.[24] Consumers in a province can choose deposit services from an SCB (inside good) or the outside good. Consumers with deposit accounts can use saving services and other services provided to account holders such as asset management, trading in securities and foreign currency, and bank-card services. Thus, the indirect utility function of a consumer i using deposit services from bank j in market m is

$$\begin{aligned} u_{ijm} &= \sigma v_{im} - \alpha_i p_{jm} + x_{jm}\beta + \xi_{jm} + \varepsilon_{ijm} \\ &\equiv V_{ijm} + \varepsilon_{ijm} \end{aligned} \tag{1}$$

where p_{jm} is the service fee of bank j, x_{jm} is a K-dimensional row vector of observed product characteristics of bank j (including the benchmark rate of deposit), and ξ_{jm} represents the unobserved product characteristics of bank j. The product characteristics represent the service quality of banks such as the convenience of local branches and waiting time for being served at a branch. The consumer-specific preference is captured by the idiosyncratic component, v_{im}, the income of consumer i, y_{im}, and

[23] The discrete choice is partially justified by the fixed cost incurred by consumers to deal with banks.

[24] I suppress the time subscript in this section to simplify the notation.

a deviation specific to bank j in province m, ε_{ij}. The idiosyncratic component, v_{im}, is drawn from the standard normal distribution, and the deviation, ε_{ij}, is assumed to be a mean zero stochastic term with iid extreme value Type 1 distribution.[25] As a result, the unobserved variance in the idiosyncratic component of the inside good is larger than that of the inside good. The utility for the outside good is $u_{i0m} = \varepsilon_{i0m}$, where the index of the outside good is $j = 0$. The outside good captures utility from using the services of other financial institutions. In high-income provinces, the main competitors for the outside good are JSBs. In the agricultural provinces, competition comes primarily from rural credit cooperatives.

This specification differs from the literature (e.g. Dick, 2008) in two respects. First, the interest rate paid by SCBs is fixed by the central bank. In contrast to studies of other countries, the rate does not vary across banks, so price competition among banks is restricted to service fees. Second, the specification $\alpha_i \equiv \frac{\alpha}{y_{im}}$ means a high price has less of an impact on the utility of a rich consumer. As a result, consumers with high incomes are less price elastic than consumers with low incomes. In other words, high-income consumers are willing to pay higher service fees as long as the bank offers superior services.

As shown in Nevo (2001), the utility can be decomposed as

$$\begin{aligned} u_{ijm} &= \delta\left(p_{jm}, x_{jm}, \xi_{jm}; \beta\right) + \mu\left(p_{jm}, x_{jm}, v_{im}, y_{im}; \theta_d\right) + \varepsilon_{ijm} \\ &= \delta_{jm} + \mu_{ijm} + \varepsilon_{ijm} \end{aligned} \tag{2}$$

where $\delta_{jm} = x_{jm}\beta + \xi_{jm}$ is the mean utility. The $K+2$ dimensional vector $\theta = (\beta, \alpha, \sigma)$ represents the demand parameters, in which $\beta = (\beta_1, \ldots, \beta_K)$ is the set of parameters that associates mean utility with bank characteristics, and $\theta_d = (\alpha, \sigma)$ is the set of parameters associated with consumer preference. Therefore, $\delta\left(p_{jm}, x_{jm}, \xi_{jm}; \beta\right)$ is independent of consumer characteristics, whereas $\mu\left(p_{jm}, x_{jm}, v_{im}, y_{im}; \theta_d\right)$ is a function of consumer characteristics.

The probability of an individual using bank j can be written as

[25] Arguably, iid is a questionable assumption for ε_{ijm} given that most households make deposits more than once a year. Following Rysman (2004), who contends a less restrictive assumption is justified, I allow ε_{ijm} to be correlated within a household in the case of deposit demand, but require it to be uncorrelated with the amount of money a household needs to deposit.

$$s_{ijm} = \frac{\exp\left(\delta_{jm} + \mu_{ijm}\right)}{1 + \sum_{k=1}^{J} \exp\left(\delta_{km} + \mu_{ikm}\right)} \tag{3}$$

These conditions describe the unit demand of an individual consumer and define the set of unobservables that results in using bank j for deposit services

$$A_{jm} = \left\{ \left(\varepsilon_{ijm}, v_{im}, y_{im}\right) \middle| u_{ijm} \geq u_{ijk} \ \forall k = 0, 1, \ldots, J \right\} \tag{4}$$

Consumer i chooses bank j if and only if u_{ijm} is greater than the utility associated with other alternatives. To obtain aggregate demand, I integrate individual demands over the idiosyncratic variables $\left(\varepsilon_{ijm}, v_{im}, y_{im}\right)$. Assuming ties occur with zero probability, the market share of bank j in market m is determined by the probability ε_{ijm} belongs to the set A_{jm} for all consumers, i.e. $s_{jm}\left(p_{jm}, x_{jm}, \xi_{jm}; \theta_d\right) = \int_{A_{jm}} dP\left(\varepsilon_m, y_m, v_m\right)$, where P is the distribution function of ε_m, v_m, and y_m. The demand of bank j in market m is obtained by $s_{jm}\left(p_{jm}, x_{jm}, \xi_{jm}; \theta_d\right) H_m$, where H_m is the market size of market m. The market share of the outside good is defined as $s_{0mt} \equiv 1 - \sum_{k=1}^{N} s_{kmt}$.

4.2 Supply

Since the price and cost data are at the bank-year level, the pricing competition of SCBs can be examined at the national level as a Nash-Bertrand equilibrium. Banks collect funds by paying the benchmark deposit interest rate r^d, while incurring a marginal cost mc_j. On the revenue side, banks earn the benchmark lending interest rate on loans r^l, and charge a service fee p_j on deposits.

Although profit maximization is the explicit objective of SCBs under the 1995 Commercial Banking Law, the empirical evidence suggests this was not the sole goal pursued by SCBs even after the banking reform. Cull and Xu (2000) and Park and Sehrt (2001) argue that policy-based lending to SOEs remained pervasive throughout the 1990s as a way to support employment. To capture the benefit of deposit acquisition of SCBs for funding SOEs, I include a function $\Phi(\ )$, that is increasing and concave in Q_{jm} in the objective function. Without loss of generality, I simplify the function $\Phi(\ )$ to be homogeneous of degree one in H_m, i.e. $\Phi\left(Q_{jm}\right) = \Phi\left(s_{jm} H_m\right) = \Phi\left(s_{jm}\right) H_m$.

Since interest rates are regulated, each SCB sets its service fee on deposits in a manner that reconciles the dual objectives of pursuing profit and acquiring deposits. To simplify the notation, I use s_{jm} to denote the function of the market share $s_{jm}\left(p, x_m, \xi_m; \theta_d\right)$, where $x_m = \left\{x_{1m},..,x_{4m}\right\}$ and $\xi_m = \left\{\xi_{1m},..,\xi_{4m}\right\}$. The objective function of a SCB is written as

$$\sum_m \pi_{jm} = \sum_m \left\{ \left[(1-res)\left(1-d_j\right)r^l - r^d + p_j - mc_j \right] s_{jm} H_m + \lambda_j \Phi\left(s_{jm} H_m\right) - F_{jm} \right\} \tag{5}$$

where res is reserve ratio, d_j is default rate, F_j is the fixed cost and λ_j is the relative weight on deposit acquisition in the objective function. I assume the lending rate is fixed across banks within a year, even though the lending rate can be set by SCBs within a band around the benchmark lending interest rate. Not surprisingly, Dobson and Kashyap (2006) suggest the lending rates chosen by most banks cluster around the benchmark rate, which, Podpiera (2006) argues, is the result of poor credit pricing. The profit function suggests that bank lending is subject to reserve requirement and the return of lending is adjusted by the probability of default.[26] The first-order conditions for objective maximization of SCBs take the following form[27]

$$\begin{aligned} p_j + \left(\sum_m \frac{\partial s_{jm}}{\partial p_j} H_m \right)^{-1} \sum_m s_{jm} H_m = mc_j - \left((1-res)\left(1-d_j\right)r^l - r^d\right) \\ - \lambda_j \left(\sum_m \frac{\partial s_{jm}}{\partial p_j} H_m \right)^{-1} \sum_m \Phi'\left(s_{jm}\right) \frac{\partial s_{jm}}{\partial p_j} H_m \end{aligned} \tag{6}$$

The terms on the right-hand side of the equation include the marginal cost of bank j, the subsidy from the central bank through the interest-rate spread between lending and deposit rates, $-\left((1-res)\left(1-d_j\right)r^l - r^d\right)$, and the marginal benefit of acquiring deposit for funding SOEs, $\lambda_j \Phi'\left(s_{jm}\right)$. The interest rate spread highlights the connection between lending and deposit markets on bank pricing decisions.

If profit maximization were the sole objective of SCBs, we could use equation (6) to estimate marginal costs. However, the interest rate regulation and the motive for funding SOEs provide incentive for SCBs to underprice service fees relative to the level of profit maximization. Consequently, the marginal cost inferred from the first-order conditions can be underestimated. It suggests that the implied marginal cost provides a test for government interventions in the deposit market. If the government interventions are

[26] For simplicity, the profit function assumes no excess reserves.

[27] Assume the existence of a pure strategy equilibrium and strictly positive service fee at equilibrium.

strong enough, the implied marginal cost from the model can be negative due to the influences from the second and third terms of equation (6). This proposed test is conservative because the implied marginal cost from the Nash-Bertrand equilibrium is the highest among those that can be recovered from models with simultaneous pricing decisions. In other words, negative implied marginal costs provide strong evidence of government intervention in bank pricing behavior.

5. Estimation

In this section, I specify the parametric forms for demand and cost functions. Estimation of the static model can be divided into two parts: demand and pricing. The main task of the demand estimation is to obtain the mean utility of bank services provided to consumers. The estimation is used to identify the preferences of consumers regarding the characteristics of bank services. The pricing side uses the first-order conditions of optimal pricing to estimate implied marginal cost. I also exploit the interaction between the demand and cost (or pricing) side of the problem; both equations are estimated jointly. Note that the first-order conditions are only used to test the extent of government interventions and determine whether the data is better explained by the competitive or the joint monopoly outcome. To maintain the robustness of other results such as demand elasticity, price-cost margin, and consumer welfare, I only apply enough instruments to identify a first-order condition. Thus, the assumptions of supply side do not affect the point estimates of the demand parameters.[28]

5.1 Demand System

The estimation exploits the system of equations provided by $s_{jmt} = s_{jmt}\left(\delta_{jmt};\theta_d\right)$. It searches for a set of parameters θ_d that match observed market share, s_{jmt}, to the predicted market share in the model, $s_{jmt}\left(\delta_{jmt};\theta_d\right)$. Given the initial estimate $\theta_d = \{\alpha, \sigma\}$, the predicted market share is computed by aggregating the potential consumer choices

$$s_{jmt}\left(\delta_{jmt};\theta_d\right) = \int\int \frac{\exp\left(\delta_{jmt} + \mu_{ijmt}\right)}{1 + \sum_{k=1}^{J} \exp\left(\delta_{kmt} + \mu_{ikmt}\right)} dP\left(y_{im}\right) dP\left(v_i\right) \tag{7}$$

Berry *et al.* (1995) suggest this integration can be computed by simulation. Monte Carlo draws from the density $P\left(v_i\right)$ are standard normal; draws from the density $P\left(y_{im}\right)$ are obtained from an empirical distribution in the Chinese Household Income Survey.

[28] Note that the estimates of the demand parameters from the joint estimation of demand and pricing equations are almost identical to those obtained from estimation of the demand equation alone. This method is also applied in Rysman (2004), but differs from Berry *et al.* (1995), who use the first-order condition to identify the coefficient on price.

$$s_{jmt}^{ns}\left(\delta_{jmt};\theta_d\right)=\sum_{i=1}^{ns}\frac{\exp\left(\delta_{jmt}+\mu_{ijmt}\right)}{1+\sum_{k=1}^{J}\exp\left(\delta_{kmt}+\mu_{ikmt}\right)} \tag{8}$$

Moreover, Berry *et al.* (1995) show that δ_{jmt} can be found by using the contraction mapping

$$\delta_{jmt}^{new}=\delta_{jmt}^{old}+\ln\left(s_{jmt}\right)-\ln\left(s_{jmt}^{ns}\left(\delta_{jmt}^{old};\theta_d\right)\right) \tag{9}$$

where s_{jmt} is the actual market share of bank j and s_{jmt}^{ns} is the market share predicted by the model based on the random draws $\{y_{im},v_i\}_{i=1}^{ns}$. Normalizing the mean utility of the outside alternative to zero, the linear component to mean utility is

$$\delta_{jmt}\equiv x_{jmt}\beta+\xi_{jmt} \tag{10}$$

where the vector of exogenous bank characteristics and demographic variables x_{jmt} is

$$\begin{aligned}x_{jmt}\equiv\big(&Employee\ per\ Branch_{jmt},Branch\ Density_{jmt},Total\ Branches_{jt},\\&Total\ Asset_{jt},Agricultural\ Share\ of\ GDP_{mt},real\ GDP_{mt}\big)\end{aligned} \tag{11}$$

The demographic variables capture two factors that are important determinants of demand. First, they represent the strength of other competitors included in the outside good (i.e. competitors in poor agricultural areas may have distinctly different characteristics than in wealthy coastal regions). Second, demographic variables capture variation across provinces preferences over SCB characteristics (and thereby encourage people in rural provinces to trust SCBs over other banks). I employ several sets of dummy variables to control for unobserved product characteristics. The unobserved product characteristics can be decomposed as

$$\xi_{jmt}=\xi_j+\xi_m+\xi_t+\zeta_{jmt} \tag{12}$$

where ξ_j is a dummy variable that captures the time-invariant value of bank j relative to other banks in the market, ξ_m is a province dummy that captures heterogeneity in preferences across provinces, ξ_t is a time dummy that captures changes in macroeconomic conditions affecting all banks at time t, and ζ_{jmt} is a bank-market-year dummy for unobserved product characteristics.

5.2 Pricing Equation

To test the extent of government interventions in the banking market, I estimate the implied marginal cost from the first-order conditions. I assume a linear functional form for the implied marginal cost function for bank j in year t

$$mc_j - \left((1-res)(1-d_j)r^l - r^d\right) - \lambda_j\left(\sum_m \frac{\partial s_{jm}}{\partial p_j} H_m\right)^{-1} \sum_m \Phi'(s_{jm}) \frac{\partial s_{jm}}{\partial p_j} H_m = c_{jt}\theta_s + \omega_{jt} \qquad (13)$$

where θ_s is a vector of parameters to be estimated. Implied marginal cost is a function of bank and the time-dummy variables included in the vector c_{jt} and the random cost shock ω_{jt}. The bank dummy captures the effects of unobserved differences in the cost of providing services and the probability of loan default across banks. Both the bank and time dummies capture the subsidy provided by the central bank through the interest-rate spread between lending and deposit rates, and the marginal benefit of deposit acquisition for funding SOEs. The random cost shock includes marginal cost, credit risk, and liquidity risk not captured by bank and year dummies.

5.3 Estimation Methodology

Following Berry *et al.* (1995), I use the Generalized Method of Moments (GMM) estimation procedure. The estimation procedure is as follows: Let $z = (z_d, z_s)$ be the set of instruments to be used, where z_d and z_s are the instruments for the demand and pricing equations, respectively. For the pricing equation, $z_s = c$ as no instrument is required. I assume z is exogenous and independent of the error terms in the demand and pricing equations, and therefore z_d and z_s are correspondingly orthogonal to ζ and ω. Utilizing the conditions $E(z_d'\zeta) = 0$ and $E(z_s'\omega) = 0$, I construct the following set of moments

$$m = \begin{bmatrix} z_d'\zeta \\ z_s'\omega \end{bmatrix} \qquad (14)$$

I define $\theta = \{\theta_d, \theta_s\}$ and the GMM estimator given my moment conditions as

$$\min_\theta \; m'\Omega m \qquad (15)$$

where Ω is the optimal weighting matrix. This joint estimation of demand and pricing equations has two advantages. First, market shares enter both demand equations and first-order conditions, thereby imposing a cross-equation restriction on the coefficient on service fees. Second, there is a gain in efficiency from exploiting the correlation in the error structure induced by the service fee.

5.4 Instruments

Service fees are imputed for the ratio of income from commissions to total deposits. For example, if consumers use remittance services intensively because the fees are low and the service quality is high, the imputed service fees would indicate 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 apply the following set of instruments to identify the coefficients for service fees and consumer heterogeneity:

$$z_{d,jmt} \equiv \left(Interest\ Expense_{jt}, Operating\ Expense_{jt}, Loan/Asset_{jt}, Cash/Employee_{jt}, Equity/Employee_{jt}, rival\ Employee\ per\ Branch_{jmt}, rival\ Branch\ Density_{jmt}\right) \quad (16)$$

Following Dick (2008), the instruments consist of several cost shifters. Cost shifters are valid instruments because they affect service fees through the bank pricing decisions, but are unrelated to the unobserved demand factors.

The first cost shifter is the input price of deposits. Although the deposit rate is fixed by the central bank, this rate is different for different deposit maturities. Bank deposits differ in their maturities, so the effective deposit rate varies across banks at each point in time.

The second 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.[29] Operating expenses are obtained from the income statements of each bank. I normalize these variables in the estimation by total number of employees.[30]

The third cost shifter is the ratio of loans to total assets, which captures the credit risk of banks. Banks with high levels of credit risk may face higher costs of operation and increased auditing needs that boosts

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

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

the cost function. Additionally, liquidity variables are informative about credit risk and hence the cost function. I use the ratio of cash to total employment and equity to total employment to proxy bank liquidity. The variables on credit and liquidity risks are obtained from Almanac data on bank balance sheets.

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 observed characteristics of rival banks in each market. 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, a bank must charge a lower service fee when it faces a close competitor.[31] Appendix 1 reports the descriptive statistics of instruments, and Appendix 2 presents the results from OLS regressions of service fees on bank characteristics and costs instruments. The R^2 statistic is high at 0.46 and an F-test rejects joint insignificance of the all variables at 5% confidence level. Therefore, cost shifters provide exclusion restrictions that can be used to identify service fees.

6. Empirical Results

In this section, I consider the results obtained from the demand model described in the previous section. This is followed by an analysis of the estimated demand elasticities, consumer preferences and consumer welfare. Finally, I employ the structural model to analyze the extent of government interventions in the deposit market. Even though I could compute producer surplus and total surplus from the structural model, it is likely that the first-order conditions do not provide accurate measures of price-cost margin due to the interest rate regulation and other non-profit objectives. Thus, I do not address producer surplus and total surplus here.

Table 3 reports the results from the demand and supply models.[32] I augment the demand model with two alternative pricing equations. I focus on the estimates obtained from the Nash-Bertrand competitive model $(RC-C)$, which is described in the previous section. The results of model $(RC-M)$ are discussed in the section on robustness check.

[31] In practice, the product characteristics of competitors are only useful for identifying the random coefficient on the intercept term.

[32] The J-statistic = N*GMM follows Chi-square distribution with degree of freedom = Number of instruments - Number of parameters = 7-2 = 5. However, the over-identifying conditions are rejected at a 5% level in all cases.

6.1 Consumer Preferences

The coefficients on employees per branch, branch density, and total number of branches are positive, and the coefficient for employees per branch is insignificant. This finding suggests that the ratio of employees to branches in China is higher than consumers desire. It also indicates that SCBs can attract more consumers by expanding their branch networks and increasing branch density. There is an additional reason for branch network to be an important factor in selecting a bank in China. The economic development in China is skewed toward provinces in coastal regions that offer better job opportunities. As a result, migrant workers tend to move from less-developed inland provinces to more-developed coastal regions to seek work. Once a migrant worker gets a job, he or she typically remits a portion of their earnings back to their family in their province of origin. Having an account with a national bank with extensive branch networks facilitates such transactions.

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 ΔUtility of Table 4. The increases in utility are 0.02 for employees per branch, 0.10 for branch density, and 0.14 for the total number of branches. These figures suggest a stronger consumer response to branch expansion than increases in employees at branch offices. To quantify the changes in utility, in the column WTP, I compute the willingness to pay of consumers in exchange for these improvements in service quality reported in the column ΔUtility. A consumer is willing to pay 0.01% of their deposit to enjoy an increase in employees per branch by one standard deviation. Analogously, the willingness to pay for increases in branch density is 0.07% and total number of branches 0.10%. The willingness to pay for these hypothetical changes are significant and range from 9% to 59% of the average service fees. In addition to prices (i.e. service fees), this finding suggests that service quality offers an alterative means to attracting consumers.[33] The demand estimates suggest that the consumer preferences in China are similar to those in the US reported in Dick (2008). Chinese consumers have stronger preferences for more branches than more employees, but they do not have significant preferences for more employees at a particular branch. This is likely related to the low employee efficiency of Chinese banks. Human resource policies such as on-the-job training may be effective for SCBs.

These results on consumer preferences can help in making inferences about competition in the banking industry since the opening of the market in December 2006 under China's WTO commitments. The strong preferences consumers show for large nationwide branch networks indicate that foreign banks are unlikely to make significant inroads against SCBs in retail banking -- at least, not in the near future. This result also echoes the view expressed by Hansakul (2006) that the lack of branch networks hampers

[33] There is no coefficient for deposit rate as it is substituted by time dummies in the demand equation.

foreign banks such as Citibank and HSBC in developing their consumer banking businesses. On the other hand, domestic banks with high branch density can be strong competitors to SCBs in several provinces. The limited branch networks placed on the competitive effects of new entrants provides incumbents with an opportunity to improve their service quality. In this regard, SCBs have introduced strategic foreign investors to foster their capacities for product innovation, new business development, and technology adoption for internal management.

The demographic variables indicate that the demand for SCBs in a province depends on industrial structure and economic development: market shares of SCBs are higher in provinces with higher proportions of agricultural production and higher real GDP. In provinces with a strong focus on agriculture, the competitors of SCBs are typically the rural credit cooperatives. SCBs are more attractive to depositors who feel SCBs are too big to fail and thus assure depositors their deposits are safe. SCBs also enjoy higher market shares in rich provinces as they are capable of providing a wider range of banking services to wealthy consumers than small- or medium-sized banks.

The bank dummies capture preferences for banks conditional on the same level of service quality. The largest bank dummy is for ICBC (0.73), followed by that of CCB (0.43). The bank coefficients capture preferences for banks relative to ABC. Accordingly, the positive coefficients for ICBC and CCB indicate that consumers value those two banks more than ABC, which is more valuable than BOC (-0.20).

6.2 Demand Elasticity

In Table 5, I compute cross- and own-price elasticities to analyze the price competition among SCBs. The own-price elasticities are less than unity for all markets, indicating banks do not set service fees to maximize profit according to the static Nash-Bertrand equilibrium.

To investigate the bank behavior at the aggregate level, I define market share at the aggregate level s_j as

$$s_j = \frac{\sum_{m=1}^{M} s_m H_m}{H} \tag{17}$$

where H is the total market size of all markets. The elasticity of service fees of aggregate demand is also less than 1 as the elasticity at the aggregate level is related to those at the market level as

$$\frac{\partial s_j}{\partial p_j} = -\alpha p_j \left[\sum_{m=1}^{M} \left(1 - s_{jm}\right) \frac{Q_{jm}}{Q_j} \right] \tag{18}$$

where Q_{jm} is the deposit amount of bank j in market m and Q_j is the total deposit of bank j. This result is consistent with the evidence from Nakane *et al.* (2006), Molnar *et al.* (2007), Dick (2008), and Molnar (2008) indicating banks set service fees in the inelastic portion of the demand curve (i.e. banks have room to increase profits by raising service fees). These authors argue that low service fees are used to attract deposits. Thus, service fees can be set lower than the level derived from static profit maximization when the switching cost for the consumer is significant. The own-price elasticity of service fees is lower for Chinese banks than for US banks, indicating that Chinese banks charge lower service fees than their counterparts in the US. In China, the interest rate spread provided by the central banks provides an incentive for SCBs to attract deposits to finance SOEs. Lardy (1998), for example, notes that the BOC has the highest proportion of funding from the government for lending to SOEs. It is therefore relatively less reliant on deposits for funding loans to SOEs, and accordingly exerts more market power as seen by the fact that it sets service fees closer to the elastic portion of the demand curve. Moreover, SCBs can set low service fees to get more funding to earn profit through the interest rate spread. My results contrast with those of Bichsel (2006), who finds that state-owned banks in Switzerland have the same profit objective as private banks. Comparing bank behaviors between 1994 and 2001, Table 6 indicates that SCBs, with the exception of the BOC, set service fees at levels closer to the elastic portion of the demand. However, the pricing behaviors of SCBs still seem to be affected by government policies and consumer switching cost.

6.3 Consumer Welfare

In this section, I utilize the structural model of demand to evaluate the welfare effects from China's banking reforms. In the random coefficient model, the consumer surplus generated by a set of products can be written as

$$CS_{im} = \frac{\ln\left(\sum_{j=1}^{J} \exp\left(\delta_{jm} + \mu_{ijm}\right) \right)}{\alpha_i} \tag{19}$$

Following Nevo (2001), I use the compensating variation to measure the change in consumer welfare. This measures how much money should be taken away from consumers to leave them as well off as they were before the change. A positive (negative) compensating variation implies the consumer is better off (worse off). McFadden (1981) and Small and Rosen (1981) show that the compensating variation for a representative consumer in market m is given by

$$CV_m = \int\int \frac{CS_{im}^{2001} - CS_{im}^{1994}}{\alpha_i} dP(y_{im}) dP(v_i) \quad (20)$$

where CS_{im}^{1994} and CS_{im}^{2001} are the consumer surpluses in 1994 and 2001, respectively. Therefore, CV_m represents the compensating variation for each dollar deposited in market m, i.e. the percentage gain per yuan deposited.[34] To compute the welfare impact per capita in the market, I multiply the median compensating variation with deposits per capita in market m

$$D_m * Median(CV_m) \quad (21)$$

where D_m is the deposit per capita in market m.

The upper panel of Table 7 displays the lower quartile, median, and upper quartile of the compensating variation for one yuan, $Median(CV_{im})$, and compensating variation per capita, $D_m * Median(CV_{im})$. The results indicate that the changes in consumer welfare vary from -0.48% to -0.06%. In monetary terms, the welfare effect ranges from -46 to -5 yuan (US$ -6.6 to 0.7). Most provinces experience welfare losses. SCBs have consolidated branches and reduced employees since 1998, and SCBs have gradually increased their service fees. To make sense of the distribution of these welfare changes, I examine the median welfare change in the eastern, central, and western regions to understand the distribution of the welfare effects across geographic regions. The median losses in consumer surplus are -0.18% for the eastern region, -0.40% for the central region, and -0.45% for the western region. Again, welfare costs fall disproportionately on the less-developed inland provinces. The Chinese experience contrasts with that of the US during the 1990s, when, Berger and Mester (2003) argue deregulation of branch restrictions allowed US banks to raise their prices and profits by improving product quality. Dick (2008) also finds such quality improvements result in a net welfare improvement for consumers.

Figure 1 shows the percentage change in consumer welfare at the provincial level. It indicates the welfare effects of banking reform on consumers are uneven across provinces. The most dramatic improvement is an over four-basis-point improvement in welfare in the Zhejiang province. Other provinces such as Qinghai and Heilongjiang see their welfare fall by about seven basis points. Shanghai experienced the largest welfare loss due to a sharp reduction in the number of employees per branch (the average employees per branch of the four SCBs in Shanghai decreased from 34.3 in 1994 to 23.1 in 2001).

Overall, the variance of changes in consumer welfare is mainly explained by the demographic variables, time dummies, and unobserved product characteristics. Together these account for about 74% of the

[34] The yuan is the unit of Chinese currency. An exchange rate of 7 yuan to the US dollar is assumed here.

changes. Thus, as GDP has risen, consumers have favored SCBs over alternatives in a way that raised SCB market shares relative to the outside good. To a lesser extent, the changes in observed product characteristics explain the rest of the changes in consumer welfare. However, service fees explain about 6% of the variance of changes in consumer welfare as there is no variation in service fees at the provincial level.

Although some existing consumers experience welfare losses, the increase in market size indicates that more fund access to financial services which enhances welfare. The increase in consumer welfare due to this channel is about 25 billion yuan at 1994 prices or US$ 3.6 billion, which is larger than the loss of consumer welfare due to branch consolidation and layoff, i.e. 5 billion yuan or US$ 0.7 billion. The net gain is 20 billion yuan (US$ 3.5 billion) in total, or 19 yuan (US$ 2.80) per capita.[35] The primary driving force behind the welfare gain is the exogenous increase in the volume deposits that accompanied high GDP growth from 1994 to 2001. The increase in wealth results in more prevalent use of banking services and higher deposit levels, highlighting the importance of financial market participation in improving welfare.

6.4 Testing for Government Interventions

The cost parameters indicate that implied marginal costs vary across banks. In particular, as shown in Table 8, the implied marginal costs are negative for all SCBs. Equation (6) suggests that the negative marginal cost is related to subsidies provided by the central bank through the interest rate spread between lending and deposit rates, $(1-res)(1-d_j)r^l - r^d$, and the marginal benefit of deposit acquisition for funding SOEs, which enter into the marginal cost equation of SCBs negatively.

According to Table 5 and 8, the marginal cost is higher for SCBs with low price elasticity, i.e. SCBs set low service fees, expecting to recoup their losses in the loan market. Furthermore, the year dummies suggest that implied marginal costs do not change after deregulation. The stable estimates of implied marginal costs suggest that government intervention does not diminish after banking deregulation. This is further supported by the facts that (1) the interest rate spread provided by the government regulation increased from 0% to 3.6% over the sample period (see Table 1), and (2) detailed studies on the cost efficiency of Chinese banks (e.g. Chen *et al.*, 2005; Ariff and Can, 2008) indicate SCB cost efficiency stayed about the same after reforms.

6.5 Competitive Effects

To examine the competitive effects of banking reform over time, I compute the price-cost margins of those four SCBs over the sample period in Table 8. The level of competition is similar throughout the sample

[35] Deposits per capita in urban areas in 1994 averaged 4,870 yuan (US$ 696).

period, except that the price-cost margins are reduced by 5% for ABC and 7% for ICBC. The competitive effects of banking reform are less significant than in market economies documented in Shaffer (1993) for Canada; Drees and Pazarbasioglu (1998) for Finland, Norway, and Sweden; Cetorelli and Angelini (2003) for Italy; Gruben and McComb (2003) for Mexico; and Ho (forthcoming) for Hong Kong. China's differences are explained by several factors. First, entry of new banks is limited.[36] The only noteworthy post-reform entrants are Shanghai Pudong Development Bank (established in 1993), and Bohai Bank and Minsheng Bank (both established in 1996).[37] Moreover, the new entrants are much more limited in their geographical coverage than market incumbents, and thereby limited in their ability to compete.

Berger and Humphrey (1997) argue that the effects of banking deregulation depend greatly on the state of the industry prior to deregulation. For example, the strength of incumbent banks and other barriers to entry (i.e. administrative) may allow incumbent banks to exploit their market shares in a monopolistic way. On the other hand, possible entry or the threat of entry may increase competitive pressures on incumbent banks. The exceptionally high collective market shares of SCBs relative to other banks in China provides unique setting to examine the impacts of regulatory reform on market structure with dominant state-owned firms. The results suggest that the competitive effects of banking deregulation in China are less significant than in developed economies.

7. Robustness Checks

This section provides several robustness checks for the results shown in the previous section. I start by checking whether the results are robust to alternative pricing arrangements, and then explore the implications of alternative demand systems.

7.1 Alternative Pricing Arrangements

To assess the impacts of pricing arrangement among SCBs on the empirical results, I analyze a supply model of a joint monopoly where service fees are determined collusively to maximize a joint objective function. This model is employed as a robustness check on the pricing arrangement as it delivers the lowest marginal costs. This is opposite to the model used in the previous section, $\left(RC - C\right)$. The objective function of the joint monopoly is written as

[36] Cetorelli and Angelini (2003) argue that the removal of barriers to entry contributed to the intensification of banking competition in Italy after its 1993 regulatory reform.

[37] Minsheng Bank is the only domestic private bank entrant.

$$\begin{aligned}\sum_m \sum_j \pi_{jm} = \sum_m \left\{ \left[(1-res)(1-d_j) r^l - r^d + p_j - mc_j \right] s_{jm} H_m + \lambda_j \Phi(s_{jm} H_m) - F_{jm} \right\} \\ + \sum_m \sum_{k \neq j} \left\{ \left[(1-res)(1-d_k) r^l - r^d + p_k - mc_k \right] s_{km} H_m + \lambda_k \Phi(s_{km} H_m) - F_{km} \right\}\end{aligned} \tag{22}$$

I now derive the first-order conditions for objective maximization of the joint monopoly as

$$\begin{aligned}\begin{pmatrix} p_1 \\ \vdots \\ p_4 \end{pmatrix} + \Delta_d^{-1} \begin{pmatrix} \sum_m s_{1m} H_m \\ \vdots \\ \sum_m s_{4m} H_m \end{pmatrix} = \begin{pmatrix} mc_1 \\ \vdots \\ mc_4 \end{pmatrix} - \begin{pmatrix} (1-res)(1-d_1) r^l - r^d \\ \vdots \\ (1-res)(1-d_4) r^l - r^d \end{pmatrix} \\ - \Delta_d^{-1} \sum_{k=1}^{4} \lambda_k \begin{pmatrix} \sum_m \Phi'(s_{km}) \frac{\partial s_{km}}{\partial p_1} H_m \\ \vdots \\ \sum_m \Phi'(s_{km}) \frac{\partial s_{km}}{\partial p_4} H_m \end{pmatrix}\end{aligned} \tag{23}$$

where

$$\Delta_d = \begin{pmatrix} \sum_m \frac{\partial s_{1m}}{\partial p_1} H_m & \cdots & \sum_m \frac{\partial s_{4m}}{\partial p_1} H_m \\ \vdots & & \vdots \\ \sum_m \frac{\partial s_{1m}}{\partial p_4} H_m & \cdots & \sum_m \frac{\partial s_{4m}}{\partial p_4} H_m \end{pmatrix} \tag{24}$$

Collusive pricing enables SCBs to set higher markups than those in the competitive equilibrium. This is because SCBs internalize substitution effects (through the off-diagonal elements in Δ_d) when setting service fees. Furthermore, equation (6) is a special case of equation (23) with the restriction that Δ_d is a diagonal matrix and no cross-price derivative on market share.

I employ goodness-of-fit measures to alternative models to infer the underlying pricing behavior among banks. Here, I apply the Rivers-Vuong (2002) test for model selection among non-nested models. The test statistic is based on the difference between the GMM objective function values, normalized by

sample size, $\sqrt{N}\left(Q(\theta_m)-Q(\theta_c)\right)$, and has an asymptotically normal distribution with variance σ_Q^2.[38] This gives

$$\frac{\sqrt{N}\left(Q(\theta_m)-Q(\theta_c)\right)}{\sigma_Q} \sim N(0,1) \tag{25}$$

where $Q(\theta_m)$ is the GMM criterion for the collusive model and $Q(\theta_c)$ for the competitive model. If $Q(\theta_m)$ is significantly larger than $Q(\theta_c)$, then the test statistics indicate that the competitive model provides a better description of the equilibrium outcome revealed in the data. On the other hand, if $Q(\theta_m)$ is significantly smaller than $Q(\theta_c)$, the test statistics indicate the collusive model better describes the equilibrium outcome revealed in the data.

The empirical results of this model are reported in Table 3 under the column, $(RC-M)$. The estimates of demand parameters of this model are close to those in the model, $(RC-C)$, but there are important differences in the estimates of cost parameters between two specifications which result from alternative pricing arrangements. Since banks set service fees jointly in a way that fully internalizes the effect of their pricing decision on the objectives of other banks, the price-cost margins for service fees are higher in the joint monopoly model than those of the competitive model. Consequently, the implied marginal costs are more negative in the joint monopoly model than those in the competitive model. Although the implied marginal cost increases over time under the model $(RC-M)$, the point estimates are negative for all sample years. Alternative models consistently suggest that government interventions in the deposit market are evident after the banking reform.

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[38] The test statistic is based on the values of the first-step GMM objective function, where both models have the same weighting matrix, A_N. The GMM criteria for the models with competitive pricing and collusive pricing are 0.6081577 and 0.6081583, respectively.

Define m_j to be the vector of moment conditions for observation j, the standard error of the test statistic is given by

$$\sigma_Q^2 = 4\left(\sigma_m^2 + \sigma_c^2 - 2\sigma_{mc}^2\right)$$

where

$$\sigma_m^2 = \left(\frac{1}{N}\sum_{j=1}^{N} m_j(\theta_m)\right)' A_N \left(\frac{1}{N}\sum_{j=1}^{N} m_j(\theta_m) m_j(\theta_m)'\right) A_N \left(\frac{1}{N}\sum_{j=1}^{N} m_j(\theta_m)\right)$$

$$\sigma_c^2 = \left(\frac{1}{N}\sum_{j=1}^{N} m_j(\theta_c)\right)' A_N \left(\frac{1}{N}\sum_{j=1}^{N} m_j(\theta_c) m_j(\theta_c)'\right) A_N \left(\frac{1}{N}\sum_{j=1}^{N} m_j(\theta_c)\right)$$

$$\sigma_{mc}^2 = \left(\frac{1}{N}\sum_{j=1}^{N} m_j(\theta_m)\right)' A_N \left(\frac{1}{N}\sum_{j=1}^{N} m_j(\theta_m) m_j(\theta_c)'\right) A_N \left(\frac{1}{N}\sum_{j=1}^{N} m_j(\theta_c)\right)$$

Under the GMM criteria, the Rivers-Vuong non-nested test statistic is 0.3, which indicates that the model with competitive pricing provides a better description of the equilibrium outcome revealed in the data. However, it is not statistically significant at any conventional confidence level, which suggests that there is no further evidence that the deposit market becomes more competitive after the reform in addition to the results on price-cost margin.

7.2 Decentralized Pricing Model

While the market for demand model is defined at the provincial level, the supply specifications of the previous models assume there is a single price at the aggregate level. There are three justifications for this assumption. First, the model is tailored to fit the data on service fees, which is only available at the national level. Second, the management at SCB headquarters, not local governments, appoint branch managers (see Shirai, 2002). Third, the PBC's local branches are prohibited from relending to SCB branches in their provinces. These policies are expected to reduce the influence of local governments on pricing of bank services as local governments are likely to be more concerned about local welfare than bank profitability. However, Park and Sehrt (2001) show that lending decisions of SCBs are influenced by policy and economic factors at the provincial level. This finding suggests that prices may be set at the provincial level rather than the national level when fund allocation across provinces is imperfect. For this reason, I next consider the effects of aggregation in the supply model on the empirical results.

In a competitive arrangement, each SCB in province m sets its service fee to maximize its objective. The objective function of an SCB is

$$\pi_{jm} = \left[(1-res)(1-d_j)r^l - r^d + p_{jm} - mc_j\right]s_{jm}H_m + \lambda_j\Phi\left(s_{jm}H_m\right) - F_{jm} \tag{26}$$

The first-order conditions for objective maximization of SCBs take the following form

$$p_{jm} + \left(\frac{\partial s_{jm}}{\partial p_j}\right)^{-1} = mc_j - \left((1-res)(1-d_j)r^l - r^d\right) - \lambda_j\Phi'\left(s_{jm}\right) \tag{27}$$

The first-order condition resembles equation (6). However, in this model, each SCB in province m only needs to consider the trade-off between pursuing profit and acquiring deposits in its own province.

Similar to the model with centralized pricing, I analyze the effect of the pricing arrangement on the empirical results by using a model with a collusive pricing arrangement. The objective function of the joint monopoly in province m is written as

$$\pi_{jm} = \left[(1-res)(1-d_j)r^l - r^d + p_{jm} - mc_j\right]s_{jm}H_m + \lambda_j\Phi\left(s_{jm}H_m\right) - F_{jm} + \sum_{k\neq j}\left\{\left[(1-res)(1-d_k)r^l - r^d + p_{km} - mc_k\right]s_{km}H_m + \lambda_k\Phi\left(s_{km}H_m\right) - F_{km}\right\} \quad (28)$$

Under the joint monopoly, SCBs in province m agree with each other to set service fees at a level that maximizes the joint objective of all SCBs. The first-order conditions for objective maximization of the joint monopoly are derived as follows:

$$\begin{pmatrix} p_{1m} \\ \vdots \\ p_{4m} \end{pmatrix} + \Delta_d^{-1}\begin{pmatrix} s_{1m} \\ \vdots \\ s_{4m} \end{pmatrix} = \begin{pmatrix} mc_1 \\ \vdots \\ mc_4 \end{pmatrix} - \begin{pmatrix} (1-res)(1-d_1)r^l - r^d \\ \vdots \\ (1-res)(1-d_4)r^l - r^d \end{pmatrix} - \begin{pmatrix} \lambda_1\Phi'\left(s_{1m}\right) \\ \vdots \\ \lambda_4\Phi'\left(s_{4m}\right) \end{pmatrix} \quad (29)$$

where

$$\Delta_d = \begin{pmatrix} \frac{\partial s_{1m}}{\partial p_1} & \cdots & \frac{\partial s_{4m}}{\partial p_1} \\ \vdots & & \vdots \\ \frac{\partial s_{1m}}{\partial p_4} & \cdots & \frac{\partial s_{4m}}{\partial p_4} \end{pmatrix} \quad (30)$$

Collusive pricing enables SCBs to set a higher markup than those in the competitive equilibrium, because SCBs internalize substitution effects (through the off-diagonal elements in Δ_d) when setting their service fees. Furthermore, the first-order conditions (27) are a special case of equation (29) with the restriction that Δ_d is a diagonal matrix.

The empirical results of the models with provincial pricing are reported in Appendix 3. The estimates of demand and marginal cost parameters of those two models described in this section are close to those of the models $(RC-C)$ and $(RC-M)$. The empirical results for demand, consumer welfare, price-cost margins and the extent of government interventions are robust to the aggregation level of supply model. However, the non-nested test indicates that the model with collusive pricing included provides a better fit to the data than the model with competitive pricing.[39] This suggests there is limited evidence that the deposit market will become more competitive.

[39] The GMM criteria for the models with competitive pricing and collusive pricing are 0.6081569 and 0.6081568, respectively.

7.3 Alternative Demands

The estimation of the benchmark model utilizes the technique of random coefficient, which allows for more flexible patterns of substitution among banks. Here, I estimate a commonly used logit model as a robustness check for the demand model. The advantage of the logit model is that there is no need to draw income from the sample only available for eleven provinces. The disadvantage is that the substitution patterns of the logit model exhibit the property of independent of irrelevant alternatives (IIA). Here, the logit model takes the following form

$$\ln(s_{jmt}) - \ln(s_{0mt}) = x_{jmt}\beta - \alpha p_{jt} + \xi_{jmt} \tag{31}$$

The results from OLS and IV estimations on logit demand are reported in Table 9. The results from the IV estimation are close to those in Table 3. Furthermore, the random efficient model provides a slightly larger magnitude on the price coefficient due to the flexible substitution patterns.[40]

Comparing the results obtained from OLS and IV estimations, the coefficient on service fees becomes more negative when IV estimation is used to control for endogeneity. The estimated influence of bank characteristics on mean utility are not affected significantly by the IV estimation. This suggests that unobserved demand factors create endogeneity for service fees in the OLS estimation, and that methods which do not control for endogeneity may understate the importance of service fees.

8. Conclusions

This paper examined demand for deposits and competition in the deposit market in China during a period of banking sector reform. The results indicate that consumers value convenient branch locations, which, in turn, increases demand for deposits. Further, average price-cost margin decreased for some banks, but there is no clear evidence that the market structure of Chinese banking is better characterized by a competitive model rather than a cartel model in the sample period (1994 to 2001). On the consumer side, welfare for existing consumers declined due to branch consolidations. Nevertheless, total consumer welfare increased as more people partook of services in the growing deposit market.

This paper contributes to the discussion in several ways. First, as part of a growing literature on demand estimation for banking services, it considers a joint estimation strategy for determining market structure and develops a test for government interventions using first-order conditions. Second, it extends the banking deregulation discussion, which has traditionally focused on developed economies, to a large

[40] The mean of the income draw is normalized to 1.98, which indicates that the coefficient on service fees in the logit demand need to be multiplied by 1.98 before comparing to that in the random coefficient model.

developing country. Third, it attempts a unified framework for evaluating market structure and welfare implications of Chinese banking during a period of reform.

As in many developing countries, banking reform has been incorporated into development strategies geared to improving access to financial services. The most notable policy implication here was that welfare improvements appear to be linked to promotion of financial market participation. This insight, however, needs to be coupled with an awareness that banking policy can have uneven effects across provinces or states. Moreover, moves to save money by consolidating branches and reducing employees created further disparities in policy implementation across provinces. The consumer welfare analysis here suggests that welfare costs have fallen disproportionately on the inland provinces. Furthermore, uneven changes in deposit services appear to have slowed resource mobilization in the western provinces and increased income inequality across regions.[41]

Deregulation of the banking sector was a condition for China's 2001 accession to the World Trade Organization. The implemented deregulation in 2006 under its WTO commitments opened up the banking market to competition from foreign banks. The structural model developed in this paper provides a useful tool for future research to analyze banking policy such as the introduction of new foreign banks and consolidation through mergers and acquisitions. Future research might also tackle the effects of consumer switching costs as they affect bank behavior.

[41] Using a large panel of countries, Beck *et al.* (2007) provide evidence that financial intermediation reduces income inequality and poverty.

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Table 1. Interest Rate Deregulation

Year	Lending Interest Rate	BR
1993	All banks: 0.9-1.2 of BR	10.98
1996	All banks: 0.9-1.1 of BR	10.08
1998	Medium/large banks: 0.9-1.1; Small banks: 0.9-1.2 of BR	7.92
1999	Large banks: 0.9-1.1; Small/medium banks: 0.9-1.3 of BR	5.85
Jan. 2004	All banks: 0.9-1.7 of BR	5.31
Oct. 2004	0.9 of BR - No upper limit	5.58
Year	**Deposit Interest Rate**	**BR**
1993	All banks: BR	10.98
1996	All banks: BR	7.47
1998	All banks: BR	5.22
1999	All banks: BR	2.25
Jan. 2004	All banks: BR	1.98
Oct. 2004	All banks: No lower limit - BR	2.25

Sources: Shirai (2002) and Podpiera (2006).
BR = Benchmark 1-year rate for lending and deposit rates set by the PBC, %

Table 2. Sample Statistics, 1994-2001

	Market share		Branch		Employee		Service fees	
Bank	**1994**	**2001**	**1994**	**2001**	**1994**	**2001**	**1994**	**2001**
ABC	19%	16%	2182	1464	18840	16198	0.05%	0.09%
BOC	7%	8%	435	417	6357	6051	0.29%	0.21%
CCB	15%	17%	361	429	11018	10457	0.13%	0.14%
ICBC	31%	26%	1277	945	19323	14284	0.04%	0.09%

Note: Branch and Employee are averaged across provinces.

Table 3. Demand and Pricing Equations

Variable	RC-C	RC-M	Variable	RC-C	RC-M
Demand - Linear			Cost		
Constant	-0.954	-0.954	Constant	-0.0137	-0.0391
	(0.224)*	(0.224)*		(0.0004)*	(0.0002)*
BOC	-0.201	-0.202	BOC	0.0027	0.0014
	(0.156)	(0.156)		(0.0003)*	(0.0003)*
CCB	0.432	0.431	CCB	0.0000	-0.0004
	(0.123)*	(0.123)*		(0.0003)	(0.0003)
ICBC	0.732	0.732	ICBC	-0.0035	-0.0011
	(0.080)*	(0.080)*		(0.0004)*	(0.0003)*
Emp per Branch	0.002	0.002	Year 1995	0.0002	0.0011
	(0.002)	(0.002)		(0.0003)	(0.0002)*
Bdensity	8.017	8.017	Year 1996	0.0008	0.0026
	(1.551)*	(1.551)*		(0.0006)	(0.0005)*
Total Branches	0.075	0.075	Year 1998	0.0001	0.0003
	(0.028)*	(0.028)*		(0.0003)	(0.0002)
Total Asset	-0.018	-0.018	Year 1999	0.0001	0.0024
	(0.116)	(0.116)		(0.0003)	(0.0002)*
real GDP	63.74	63.73	Year 2000	0.0001	0.0004
	(27.14)*	(27.14)*		(0.0003)	(0.0001)*
Agricultural share of GDP	2.278	2.278	Year 2001	0.0005	0.0044
	(0.650)*	(0.650)*		(0.0005)	(0.0003)*
Demand - Nonlinear					
Constant, σ	0.150	0.150			
	(0.446)	(0.446)			
Pfee, α	-159.5	-159.3	J statistic	11.2336	11.2337
	(66.69)*	(66.68)*			
Demand - Dummies			P-value(J statistic)	0.05	0.05
Province	Yes	Yes			
Time	Yes	Yes			

Observations: 828 for demand and 28 for pricing.
Dependent variable: Mean utility $\delta_{jmt}(s_{jmt})$ for demand; marginal revenue for supply
Estimated standard error are in parentheses; * significant at 5% level; ** significant at 10% level

Table 4. Marginal Utility

Variables	∆ Utility	WTP	WTP / Service Fee
Emp per Branch	0.02	0.01%	9%
Bdensity	0.10	0.07%	44%
Total Branch	0.14	0.10%	59%

Note: Average service fee = 0.15% of deposit
Unit: % of deposit for WTP; % for WTP/Service fee

Table 5. Demand Elasticity

Bank	ABC	BOC	CCB	ICBC
ABC	-0.067	0.016	0.014	0.013
BOC	0.013	-0.199	0.014	0.013
CCB	0.013	0.016	-0.07	0.013
ICBC	0.013	0.016	0.014	-0.033
Outside	0.001	0.002	0.001	0.001

Note: The element (i,j) indicates the elasticity of market share i with respect to the price of bank j. Average across markets and years

Table 6. Own-Price Elasticity, 1994-2001

Bank	ABC	BOC	CCB	ICBC
1994	0.032	0.202	0.081	0.018
2001	0.056	0.147	0.092	0.049

Note: The number is average across markets within the year indicated.

Table 7. Consumer Welfare

	25%	Median	75%
$Median(CV_{im})$	-0.48%	-0.33%	-0.06%
$D_m * Median(CV_{im})$	-46	-19	-5
	Eastern	**Central**	**Western**
$Median(CV_{im})$	-0.18%	-0.40%	-0.45%
$D_m * Median(CV_{im})$	-12	-25	-38

Unit: Yuan for $D_m * Median(CV_{im})$. Note: Average deposit per capita in urban areas in 1994 is 4,870 yuan.

Table 8. Implied Marginal Cost, 1994-2001

Bank	**ABC**	**BOC**	**CCB**	**ICBC**
1994	-1.37	-1.10	-1.37	-1.71
2001	-1.32	-1.05	-1.32	-1.67

Price-cost Margin, 1994-2001

Bank	**ABC**	**BOC**	**CCB**	**ICBC**
1994	1.72	1.54	1.64	2.03
2001	1.64	1.56	1.65	1.89
% Changes	-4.65	1.3	0.61	-6.9

Note: The price-cost margin is the markup in the pricing equation. Unit: % of deposit

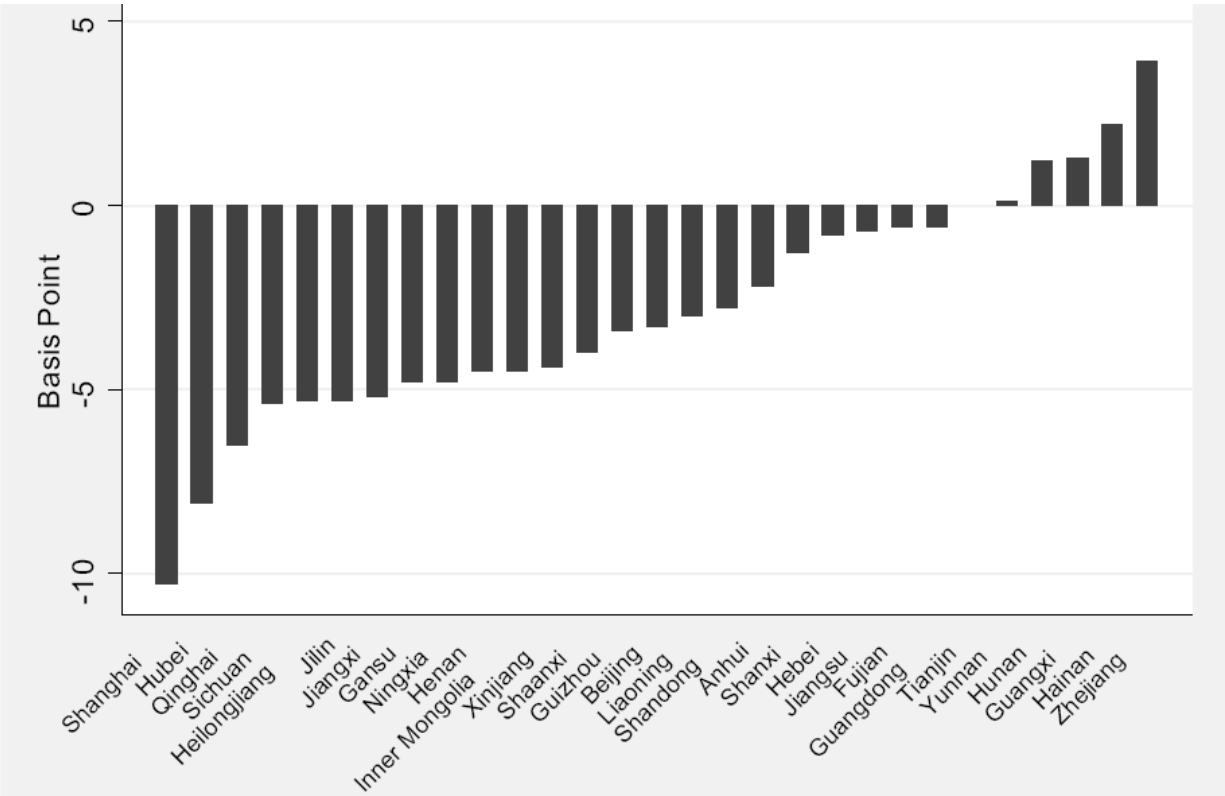
Table 9. Logit Demand

Variable	OLS	IV
Emp per Branch	0.001	0.001
	(0.002)	(0.002)
Bdensity	7.708	7.707
	(1.362)*	(1.363)*
Total Branch	0.067	0.073
	(0.027)*	(0.029)*
Service Fee	-56.29	-76.42
	(16.79)*	(35.27)*
Total Asset	-0.049	-0.027
	(0.108)	(0.114)
Real GDP	61.21	61.18
	(27.71)*	(27.73)*
Agricultural Share of GDP	2.183	2.184
	(0.568)*	(0.569)*
Bank Dummies	Yes	Yes
Province Dummies	Yes	Yes
Time Dummies	Yes	Yes
R^2	0.87	0.87

Observation = 828. Dependent variable: $\ln(s_{jmt}) - \ln(s_{0mt})$.

Note: OLS and IV use total deposit for s_{jmt}; IV-H and IV-E use household deposit and enterprise deposit for s_{jmt}, respectively. Estimated standard error are in parentheses; * significant at 5% level

Figure 1. Welfare Change



Appendix 1. Descriptive Statistics

Variable	Mean (S.D.)	Median	Minimum	Maximum
Market/Demographic information				
Real GDP	1.718 (1.369)	1.350	0.109	7.249
Real GDP per capita	4.647 (3.298)	3.482	1.243	21.76
Agricultural share of GDP	0.199 (0.083)	0.207	0.018	0.379
Population density	0.036 (0.044)	0.025	0.001	0.265
Market share				
s_{jmt}	0.175 (0.089)	0.161	0.04	0.568
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
Total asset	0.000 (0.239)	-0.102	-0.342	0.415
Instruments				
intexp (per yuan deposit)	0.064 (0.041)	0.053	0.019	0.208
opexp (100 million yuan per employee)	0.001 (0.000)	0.001	0.000	0.001
Loan/Asset (per yuan asset)	0.59 (0.08)	0.61	0.43	0.70
Cash/emp (100 million yuan per employee)	0.001 (0.000)	0.001	0.000	0.001
Equity/Emp (100 million yuan per employee)	0.003 (0.003)	0.003	0.001	0.012
rival Emp/Branch (people)	17.75 (10.40)	16.34	8.49	50.89
rival Bdensity (branch per km²)	0.009 (0.011)	0.006	0.000	0.071

Unit: GDP in million yuan. GDP per capita in thousand yuan at 1993 price level. Agricultural share of GDP = %/100. Population density: 10,000 persons per km². s_{jmt}, Service fees and deposit rate = %/100. Employees per branch = unit. BDensity (branch density) = branch per. km². Total Branch = 10,000 unit. intexp = interest expense/deposit. opexp = operating expense/employee. Standard deviation in brackets. The figures are computed over the sample period.

Appendix 2. Price Regression

Variable	
Constant	0.0019
	(0.0029)
Intexp	-0.0145
	(0.0070)*
Opexp	1.1711
	(0.9768)
Cash/Emp	-0.2142
	(0.8442)
Equity/Emp	-0.1053
	(0.1168)
Loan/Asset	-0.0090
	(0.0030)*
Rival Emp/Branch	0.0001
	(0.0000)*
Rival BDensity	0.0904
	(0.0443)*
R^2	0.69
P-value(F(7, 20))	0.00

Dependent variable: P_{jt} . Observations = 28

* significant at 5% level

Appendix 3. Demand and Pricing Equations of the Decentralized Pricing Model

Variable	RC-C	RC-M	Variable	RC-C	RC-M
Demand - Linear			Cost		
Constant	-0.954	-0.954	Constant	-0.0131	-0.0443
	(0.224)*	(0.224)*		(0.0002)*	(0.0017)*
BOC	-0.201	-0.201	BOC	0.0029	0.0016
	(0.156)	(0.156)		(0.0001)*	(0.0013)
CCB	0.432	0.432	CCB	-0.0001	0.0001
	(0.123)*	(0.123)*		(0.0001)	(0.0013)
ICBC	0.732	0.732	ICBC	-0.0031	-0.0004
	(0.080)*	(0.080)*		(0.0002)*	(0.0013)
Emp per Branch	0.002	0.002	Year 1995	0.0003	0.0027
	(0.002)	(0.002)		(0.0003)	(0.0020)
Bdensity	8.017	8.017	Year 1996	0.0009	0.0043
	(1.551)*	(1.551)*		(0.0003)	(0.0019)*
Total Branches	0.075	0.075	Year 1998	0.0003	0.0029
	(0.028)*	(0.028)*		(0.0003)	(0.0020)
Total Asset	-0.018	-0.018	Year 1999	0.0002	0.0052
	(0.116)	(0.116)		(0.0002)	(0.0018)*
real GDP	63.73	63.73	Year 2000	0.0003	0.0037
	(27.14)*	(27.14)*		(0.0003)	(0.0020)**
Agricultural share of GDP	2.278	2.278	Year 2001	0.0006	0.0086
	(0.650)*	(0.650)*		(0.0002)	(0.0017)*
Demand - Nonlinear					
Constant, σ	0.150	0.150			
	(0.446)	(0.446)			
Pfee, α	-159.4	-159.4	J statistic	11.2335	11.2335
	(66.69)*	(66.69)*			
Demand - Dummies			P-value(J statistic)	0.05	0.05
Province	Yes	Yes			
Time	Yes	Yes			

Observations: 828 for demand and 828 for pricing.
Dependent variable: Mean utility $\delta_{jmt}(s_{jmt})$ for demand; marginal revenue for supply.
Estimated standard error are in parentheses; * significant at 5% level; ** significant at 10% level.