Cross-Selling, Switching Costs and Imperfect Competition in British Banks

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Abstract

This paper attempts to evaluate the competitiveness of British banking in the presence of cross-selling and switching costs during 1993-2008. It presents estimates of a model of banking behaviour that encompasses switching costs as well as cross-selling of loans and off-balance sheet transactions. The evidence from panel estimation of the model lends support to our theoretical priors on the cross-selling behaviour of British banks, which helps explain the rapid growth of non-interest income during the last two decades. We also find that the consumer faced high switching costs in the loan market in the latter part of the sample period, as a result of lower competitiveness.

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I. Introduction

The global financial crisis that broke out in 2007 has resulted in momentous changes to banking in the UK. The initial changes included the hastily approved acquisition of HBOS by the Lloyds group in 2009; the injection of state capital into Lloyds and Royal Bank of Scotland (RBS) which resulted in 40% and 80% public ownership of the two banks, respectively; and the wholesale nationalisation of Northern Rock. Indeed, recently the Independent Commission on Banking (ICB), set up in 2010, has placed British banking in the spotlight. The ICB Interim Report (2011) identifies switching costs and barriers to entry as key elements in the weakened state of competitiveness in British banking, with adverse implications for consumer welfare. However, there is a gap in empirical research such that there is no evidence on how banking competitiveness has impacted on cross-selling and switching costs in the UK.

This paper seeks to fill the gap in empirical work, motivated by the ICB Interim Report (2011), by evaluating the competitiveness of British banking in the context of cross-selling and switching costs during 1993-2008[1]. The evaluation is conducted by estimating and testing an empirical model of bank behaviour in the presence of switching costs and where there is contemporaneous cross-selling of loans against off-balance sheet business (OBS) but the loan decision is intertemporal. The results suggest that as a result of weakening competition in the loan market, the banking consumer faced higher switching costs and higher lock-in of bank services in the latter part of the sample period.

The remainder of the paper is organised as follows. Section II presents a review of recent developments in British banking and the relevant literature on switching costs and

[1] We define cross-selling as the sale of a core good or service that induces an opportunity for sale of a follow-on good or service, while switching costs refer to the costs borne by the consumer associated with cross-selling of the core product over multiple periods. Hence, while cross-selling may be static, switching costs invariably involve a dynamic process.

cross-selling. The theoretical framework and derivation of the empirical model are outlined in Section III. The data and variables used in estimation and testing are discussed in Section IV and the results are presented in Section V. Section VI concludes.

II. British Banking 1993 - 2008

The period of deregulation in British banking, in the 1980s, was followed by two decades of demutualisation of Building Societies and a spate of bank mergers and acquisitions. The Lloyds and TSB merger occurred in 1995, Bristol and West was acquired by Bank of Ireland in 1997, Woolwich was acquired by Barclays in 2000, NatWest merged with Royal Bank of Scotland in 2000, and Halifax and Bank of Scotland merged in 2001. There are some specific examples where during the 1990s demutualisation simply gave way to acquisition. The examples include acquisition of National and Provincial by Abbey National in 1996, Cheltenham and Gloucester by Lloyds in 1995, and Leeds Permanent by Halifax in 1995[2]. The result was a tendency towards concentration, as measured by the Herfindahl-Hirschman Index (HHI) for total assets. As shown in Figure 1, the high HHI levels recorded during 2005-2008 suggest anti-competitive practice in the loan market in British banking during the period[3].

[insert Figure 1 about here]

Also, the latter half of the 2000s witnessed a record number of bank customer complaints to the Financial Ombudsman[4]. The occurrence of these complaints is consistent with the empirical findings by Matthews et al (2007), which showed worsening of

[2] Ashton and Pham (2007) list 61 M&A activities between banks and Building Societies during 1988-2006.
[3] According to the current screening guidelines of the US Department of Justice, the banking industry is regarded as competitive if HHI is less than 1000, somewhat concentrated if HHI lies between 1000 and 1800, and highly concentrated if HHI is larger than 1800.
[4] The Guardian Newspaper 14 September 2010.

competitiveness in British banking during the 1993-2005 periods in terms of supply of other financial services rather than lending and deposit taking.

[insert Figure 2 about here]

It may be argued that deregulation of the British banking system has led to the growth of non-interest earning business and off-balance sheet services. Figure 2 shows the evolution of non-interest earnings as a proportion of total operating income by the British banks since 1993. It is shown that non-interest income reached a peak of nearly 59% of gross income in 2006, fell slightly in 2007 to 54% and then plummeted to 36% in the depth of the banking crisis of 2008. Hence, following deregulation, the growth of non-interest earning business and off-balance sheet services occurred during 1998-2005 and was checked by the outbreak of the global financial crisis.

Banks have developed a strategy of providing a bundled product (Llewellyn, 2005). Arguably, such a strategy offers the banks increased scope for locking-in of the consumer, which specifically amounts to retention of their consumers, and therefore facilitates banks' cross-selling across products. Limited competition in the lending market may lock-in the bank consumers' demand for loans as well as their demand for other financial services, where the purchase of one bank service may be conditional on the purchase of another, which may deter the customers from searching for the best individual product..

Previous research has found that switching costs and cross-selling have an impact on the pricing strategy of suppliers and competitiveness in the market place (Farrell and Klemperer, 2006). In addition to the repeat-purchase of identical good over periods in the case of single product producers, an additional dimension that influences the pricing strategy of the multiple product firms is contemporaneous selling of the follow-on goods (i.e. cross-

selling). The underlying implication is that the holding-up problem as the result of switching cost has dynamic and cross-section static dimension for multiple product firms. With respect to the former, producers compete on the lifecycle prices of the identical goods; a supplier prices low if they recognise that their current market share would be helpful in holding on to their existing customers in the future. The lower price in the current period can be viewed as front-loaded compensation, where the producer uses the current price as a loss-leader. Such a strategy can work if only the producer can effectively transform rent across periods. The strength of the "lock-in" effect in the future determines the "market share" competition in the present and reflects the pricing behaviour. The increase in the value of the market share that would be locked into the future would enhance supplier's incentive to carry out such a strategy. With respect to the latter, producers compete on the bundle of products; multi-product producers advertise their loss-leader core products but expect consumers who buy their advertised products to buy other products too (Farrell and Klemperer, 2006). A supplier reduces price of the core product than it would be if the supplier perceives the value of transforming rent across products. Again, the likelihood of cross-selling other products to recoup cost of the loss-leader core product would lead to the change in the producer's strategy. Such a strategy can work if only the producer can effectively transform rent across products. Taking into account those two dimensions, switching costs and cross-selling offer a means for suppliers to design a pricing strategy to a particular customer not just for a single product but for a bundle of products, for multiple periods. The pricing behaviour of multiple product firms motivated by the overall profit maximization over the long-term relationship with their consumers has a bearing on the intrinsic inter-temporal pricing of suppliers and also predicts the contemporaneous cross-subsidization across different products (Ausubel, 1991; Stango, 1998).

The literature on switching costs and cross-selling in banking is sparse (Li et al., 2005). Empirical studies on cross-selling of commercial banks attempt to address the incentives and outcomes of commercial banks to offer concurrent lending and investment-banking services within the context of relationship banking. The general finding derived from the literature is that banks price loans and underwriting services in a strategic way so as to gain competitive advantage and extract value through their relationship with their consumers (Laux and Walz, 2009; Calomiris and Pornrojnangkool 2009). With respect to switching costs, Sharpe (1997) tests for the effects of switching costs on the pricing behaviour of banks in the retail deposit market in the US. The research shows that the retail deposit rate is positively related to household in-migration, which is consistent with the idea that the faster growing market enhances the value of the current market share in the future and incentivises banks to set interest rates that are more attractive to new consumers. A similar result is confirmed by Hannan et al., (2003) and Hannan (2008). Shy (2002) uses an undercut-proof equilibrium model to estimate switching cost in the market for deposits in Finland and suggests that switching costs could be as high as 11% of the average balance of deposit account. Kim et al. (2003) develop an empirical model which fits data to directly estimate the magnitude and significance of the switching cost. Kim et al (2003) apply a transition probability model of switching providers in the market for bank loans to the Norwegian banking industry over the period 1988 to 1996[5]. It is found that switching costs are about one-third of the average interest rate on loans, which suggests creation of a significant lock-in of bank consumers. The principal aim of this paper is to accommodate the multiple-production characteristics of banks in the theoretical framework set up in Kim et al

[5] Arguably, the switching cost faced by a borrower in the lending market would be non-negligible due to the asymmetric information between borrowers and lenders. Borrowers face switching cost when they change to a new lender since they are informationally captured by the existing lender (Sharp, 1990). Due to switching costs, products which are homogenous *ex ante* become heterogeneous *ex post* (Klemperer, 1995).

(2003)[6] to evaluate the development of competitiveness in British banking as a result of cross-selling and switching costs.

III. The Theoretical Model

Kim et al. (2003) provides the theoretical framework for the presence of switching costs for loans across time[7]. Consider *n* banks competing in a given lending market, with different interest rates on loans. The consumers (i.e. borrowers) are assumed to have an imperfectly elastic demand for loans[8]. Each consumer borrows a quantity of loans in each of the infinite discrete periods. The borrower maximizes his utility by choosing a bank, taking into account the interest rate on loans charged by all banks in the market. Borrowers are allowed to switch among banks in any period. However, switching is costly; the magnitude of the switching cost is common knowledge to banks and borrowers. The probability of switching (i.e. transition probability[9]), is a function of the interest rate on loans and switching costs. The demand for loans faced by each bank can be derived by aggregating the transition probabilities over all borrowers even if the switching decision is not observable. The changes in the market share of each bank across time are partly driven by borrowers' switching.

Following the derivation in Kim et al. (2003)[10], it can be shown that bank *i*'s market share in the lending market at time *t* follows a law of motion given by[11]:

[6] A salient merit of the model in Kim et al. (2003) is that it provides a plausible theoretical underpinning for estimation of the magnitude and significance of switching costs without requiring customer-specific data.
[7] In what follows, we refer to the switching costs across periods as dynamic cross-selling while the cross-selling from the provision of loans to OBS is referred to as static contemporaneous cross-selling.
[8] The assumption is that a given bank and its rivals have the same sensitivity of the transition probability of randomly selected borrowers to changes in the interest rate on loans.
[9] The transition probabilities are assumed to be Markovian.
[10] Kim et al., (2003) theoretical framework indicates that a bank has to decrease its interest rate on loans lower enough to compensate for switching costs in order to successfully poach its rivals' consumers. On the other hand, once the bank has successfully poached its rivals' consumers it can charge an interest rate on loans slightly higher than its rivals without losing the consumers, ceteris paribus, due to switching costs.
[11] The effect of switching cost on the market share of the bank at time *t* varies with the size of the bank. In particular, larger than average banks would benefit from the switching costs since they have a larger consumer base to lock in, while smaller than average banks would be worse off because more consumers are locked out.

$$\sigma_{i,t} = -\sigma_{i,t-1}\frac{n}{n-1}Sa_1 + a_0^i + a_1\left(P_{i,t} - \overline{P}_{i,R,t} + \frac{S}{n-1}\right) \qquad (1)$$

Where $\sigma_{i,t}$ denotes the market share of bank *i* at time *t*; and $\sigma_{i,t-1}$ refers to time *t-1*; *S* is the magnitude of switching costs; a_1 is the sensitivity of the transition probability to the bank's interest rate on loans. It is assumed that $a_1 < 0$ since the higher probability of borrowing from bank *i* is associated with a lower relative interest rate charged by the bank; a_0^i is the bank-specific intercept, which captures bank heterogeneity; $P_{i,t}$ is the interest rate on loans charged by the bank ; and $\overline{P}_{i,R,t}$ is the interest rate charged by bank *i*'s rivals[12].

Using a static representation of the familiar Monti-Klein model for bank *i*, the profit of the bank at any point in time can be written as[13]:

$$\pi = P_L L + P_o O + r_S GS - C(L, O, GS, D, w) - \gamma_D (L + GS) \qquad (2)$$

Subject to balance sheet identity: *L+GS=D*, where *L* refers to the quantity of loans, *GS* denotes the quantity of government securities, and *D* is the quantity of loanable funds. $P_o O$ refers to non-interest fee-based income, while *O* refers to the quantity of fee-based activities (i.e. OBS). r_S is the interest rate on government securities and assumed to be bank-invariant and exogenously given. P_L is the interest (price) rate on loans. $C(L, O, GS, D, w)$ is the non-interest operating cost. Cost of funds (γ_D) and labour costs (*w*) are assumed to be exogenously given in line with the standard banking model.

From the first-order conditions for profit maximization with respect to the price at any point in time, we obtain:

[12] As suggested by Kim et al. (2003), equation (1) remains valid where the econometricians observe only a noisy version of the prices, such as prices which are unadjusted for output characteristics since the noises can be absorbed by the bank-specific intercept.
[13] Subscripts are omitted for simplicity.

$$L\frac{\partial P_L}{\partial L}+P_L-\left(\frac{\partial C}{\partial L}+\gamma_D\right)=-\left(\frac{\partial P_O O}{\partial O}-\frac{\partial C}{\partial O}\right)\frac{\partial O}{\partial L}$$

i.e.

$$MR_L-MC_L=-\left(MR_O-MC_O\right)\frac{\partial O}{\partial L} \qquad (3)$$

Rearranging (3) we have:

$$MR_L+MR_O\frac{\partial O}{\partial L}=MC_L+MC_O\frac{\partial O}{\partial L} \qquad (4)$$

Equations (3)-(4) indicate that being a multiple-output producer, the bank would use loans as loss-leader as long as the loss in revenue of loans can be compensated by the gain in cross-selling off-balance sheet (OBS) services.

In a multiple-period setting, the necessary condition for the bank to maximize the present value of its life time profit $V_{i,\tau}=\sum_{t=\tau}^{\infty}\delta^{t-\tau}\pi_{i,t}$ at any point in time (denoted byτ) by setting up the interest rate on loans at time τ(i.e. $P_{i,\tau}$) is $\frac{\partial V_{i,\tau}}{\partial P_{i,\tau}}=\sum_{t=\tau}^{\infty}\delta^{t-\tau}\frac{\partial \pi_{i,t}}{\partial P_{i,\tau}}=0$. $P_{i,\tau}$ affects not only the time τ profit but also the profits in the subsequent periods. The reason for this is that the quantity of loans at any period affects the demand for loans in the period that follows and also the demand for loans in the period that follows influences the demand for OBS services contemporarily. Allowing for contemporaneous cross-selling from the provision of loans to fee-based non-interest income, the optimal interest rate strategy can be expressed as.[14]

[14] The optimal interest rate strategy given by Kim et al., (2003) only contains the first two components of Equation (5) in the case of the presence of switching cost across periods. In our framework, the contemporaneous cross-selling is conditional on the quantity of loans demanded at any period, the principal of the optimal path of the interest rate on loans as elaborated in Kim et al., (2003) holds.

$$PCm_{i,t} = -\delta\sigma_{i,t+1}\frac{n}{n-1}Sg_{t+1} - \frac{\sigma_{i,t}}{a_1} - \left(\frac{\partial P_O O_t}{\partial O_t} - \frac{\partial C_t}{\partial O_t}\right)\frac{\partial O_t}{\partial L_t} \qquad (5)$$

Where $PCm_{i,t}$ is the spread between the interest rate on loans and the marginal cost of loans of bank *i*, i.e. $PCm_{i,t} = P_{i,t} - \left(\left(\frac{\partial C}{\partial L}\right)_i + \gamma_{i,D}\right)_t$ and δ is the one-period discount factor; $\sigma_{i,t+1}$ is the market share of loans for bank *i* at time *t+1*, $\sigma_{i,t}$ refers to time *t*, *S* indicates the magnitude of the switching cost and g_{t+1} is the market growth rate for loans at time *t+1*, and *n* is the number of banks in the lending market.

Equation (5) captures the relation between the price-cost margin of loans and the current market share in the lending market, the market share in the future period and the reimbursement from the cross-selling of OBS activities. It accommodates both dynamic and contemporaneous cross-selling. Both types of cross-selling induce a smaller price-cost margin of loans at time *t*, *ceteris paribus*. The first type refers to the inter-temporal supply of loans due to switching cost (the first term). The bank believes that the current market share in the loan market is valuable for future market share because the bank is able to lock in its existing consumers. Hence, the bank sets a lower interest rate on loans in the current period. Put differently, the lower interest rate on loans at time *t* is a loss-leader of the future market share in the lending market. The second type of cross-selling is between loans and OBS activities contemporaneously (the third term). The bank sets a lower interest rate on loans since the bank believes that the demand for loans at time *t* would lead to the contemporaneous demand for OBS services at the same time, which would bring in net revenue associated with OBS to compensate for the loss of the revenue in the provision of

loans. The lower interest rate on loans at time t is a loss-leader of the demand for OBS services at time *t*.

In the absence of both types of cross-selling, the optimization problem of the bank reduces to the conventional case of a one-period oligopoly (i.e. the second term) in the lending market. The oligopoly power of the bank, however, is subject to consumers' sensitivity of the transition probability to interest rate on loans (i.e. a_1 <0).

To link the magnitude of switching cost to the degree of competition in the loan market, we model S as a time-varying industry-specific bank-invariant switching cost variable:

$$S_t = C_0 + \beta_0 M_t \qquad (6)$$

where C_0 represents time-invariant psychological elements relating to inertia and M_t is the time-varying industry-specific bank-invariant degree of competition in the lending market. The sign of C_0 indicates the impact of psychological elements on the magnitude of switching cost. The coefficient β_0 indicates the impact of the change of competition on the switching cost in the lending market; its sign a priori is indeterminate. On the one hand, the industry organization literature tends to suggest that an increase in competition induces a decrease in the switching cost, i.e. $\beta_0 < 0$, and hence reflects increased fragility of long-term relationships in a more competitive environment (Petersen and Rajan, 1995). However, the "winner's curse" hypothesis suggests $\beta_0 > 0$ due to the concern of banks to win a "lemon" in a more competitive lending market[15]. Moreover, banks' endogenous effort to enhance the capital value of relationship with borrowers in order to protect the bank-borrower tie in competition would also induce a higher switching cost in competition (Elasa, 2005).

[15] It is hypothesized that "bad" borrowers have more incentive to exploit the "shopping around" freedom among banks induced by the increase in competition. This increases the difficulty by banks to distinguish between the "good" borrowers, who switch in order to mitigate the "holding-up" problem of the existing lending relationship, and the "bad" ones (Northcott, 2004).

Equation (5) contains a component representing contemporaneous cross-selling. Similar to the dynamic cross-selling of loans across multiple periods, the intention of banks using loans as a loss- leader to cross-sell OBS activity contemporaneously has to be accommodated by the demand side of OBS activities. In what follows, we use the transitional probability of loans across periods of time, presented in Kim et al., (2003), to capture consumers' utility maximization.

We assume there are differences across banks in the quality of fee-based services. Consumers value quality. Further, we assume there is an incompatibility cost borne by the consumer at time *t* in the case of switching to another bank in which the consumer does not purchase loans at the same period of time; we denote the incompatibility cost as m[16].

Thus, the probability of purchasing fee-based services in the same bank which provides loans is:

$$\mathrm{Pro}_{i \to i,t} = f\left(q_{i,t}, q_{j,t} - m\right) \tag{7}$$

$q_{i,t}$ is the quality indicator of bank *i* in providing fee-based services and $q_{j,t}$ is the quality indicator of the rival bank *j* in providing fee-based services.

The probability of bank *i* to attract consumers who purchase loans from rival banks to purchase OBS services from *i* is;

$$Pro_{j \to i,t} = f\left(q_{i,t} - m, q_{i,R,t} - m_j\right) \tag{8}$$

[16] As explained by Farrell and Klemperer (2006), such incompatibility cost is essentially an endogenous switching cost. In order to increase the difficulty borne by their consumers to purchase the follow-on products from other providers, producers have incentives to manipulate compatibility costs by making their follow-on products more compatible with their core product and less compatible with their rivals' products.

m_j is an *(n-1)* vector of incompatibility costs, in which each of the elements equal to *m* except for *j*.

In aggregate, transitions are unobserved. Thus, the formulation of the probability of switching to purchase fee-based services from *i*, even if bank *i* is not a supplier of loans, unconditional on the rival's identity, is given by:

$$Pro_{iR\to i,t} = \sum_{j\neq i} \left\{ f\left(q_{i,t} - m, q_{i,R,t} - m_j \right) \frac{L_{j,t}}{\sum_{K\neq i} L_{K,t}} \right\} \tag{9}$$

Where $L_{j,t}$ is the quantity of loans of bank *j* at time *t*; $\frac{L_{j,t}}{\sum_{K\neq i} L_{K,t}}$ is the probability that a randomly selected rival's consumer is one who purchases loans from bank *j*. Therefore, the demand for OBS activities faced by bank *i* at time *t*, induced by selling loans of the bank at time *t*, is[17]:

$$O_{i,t} = L_{i,t} Pro_{i\to i,t} + L_{i,R,t} Pro_{iR\to i,t} \tag{10}$$

$L_{i,t}$ is bank *i*'s output of loans at time *t*, while $L_{i,R,t}$ is the rival's (of bank *i*) output of loans at time *t*.

Using a first-order linear approximation on the transaction probabilities, we have:

$$Pro_{i\to i,t} = b_1 \left(q_{i,t} - \bar{q}_{j,R,t} + m \right) \tag{11}$$

$$Pro_{iR\to i,t} = b_1 \left(q_{i,t} - \bar{q}_{j,R,t} + \frac{m}{n-1} \right) \tag{12}$$

[17] Noticeably, the $O_{i,t}$ does not represent the total OBS activities provided by bank *i*; it is the part which is relevant to contemporary cross-selling from loans to OBS services. Essentially, it presents a threshold that stops the borrowers of bank *i* from purchasing OBS services from rival banks.

where $\bar{q}_{j,R,t}$ is the average quality of the rivals of bank *i*. Similar to Equation (9), Equation (12) describes the transition probability of a randomly selected rivals' customer. We assume that the sensitivity of the transition probability to bank *i*'s quality of services equals to that of the rivals of bank *i*. Substituting (10) and (11) into (9), we have:

$$O_{i,t} = b_1 (q_{i,t} - \bar{q}_{j,R,t})(L_{i,t} + L_{i,R,t}) + b_1 m(L_{i,t} - \frac{L_{i,R,t}}{n-1}) \quad (13)$$

From (13), $$\frac{\partial O_{i,t}}{\partial L_{i,t}} = b_1 (q_{i,t} - \bar{q}_{j,R,t} + m) \quad (14)$$

$b_1 > 0$ if customers value the quality of fee-based financial services. In the case where incompatibility cost exists, $m \geq 0$. We further allow ***m*** to be time-varying and bank-invariant and model it as a function of the degree of competition in the lending market.

$$m_t = m_0 + \beta_1 M_t \quad (15)$$

m_0 is assumed to be constant across our sample period, indicating the time-invariant incompatibility cost. Such incompatibility cost includes the fixed search cost for a different provider of financial services as well as the transaction cost dealing with multiple bank relationship in providing loans and financial services. M_t is the degree of competition in the lending market. Equation (14) therefore links the time-variant incompatibility cost to the change in the degree of competition in the lending market. Equation (15) sets up a framework to allow us to examine the impact of the change in the degree of competition in the loan market on cross-selling from loans to OBS services. The empirical value of β_1 has

implications for the presence of the endogenous lock-in of OBS services, in response to the change in the degree of competition in the lending market. If $\beta_1 > 0$, the bank strategically increases the incompatibility cost in order to hold their borrowers' consumption of OBS services induced by the provision of loans once the lending market becomes more competitive. Alternatively, $\beta_1 < 0$ suggests that the incompatibility cost faced by consumer (i.e. the bank's ability to cross-sell OBS service from the bank's perspective) is higher when the lending market becomes less competitive. Substituting (15) into (14), gives the extent of contemporary cross-selling undertaken by the bank:

$$\frac{\partial O_{i,t}}{\partial L_{i,t}} = b_1 \left(q_{i,t} - \bar{q}_{i,R,t} + m_0 + \beta_1 M_t \right)$$

Substituting Equation (15), (14) and (6) into (5) yields the first of our estimating equations:

$$PCm_{i,t} = -b_1 m_0 \rho_{O,t} - C_0 g_{t+1} \frac{n}{n-1} \delta \sigma_{i,t+1} - \frac{\sigma_{i,t}}{a_1} - b_1 \rho_{O,t} \left(q_{i,t} - \bar{q}_{j,R,t} \right) - b_1 \beta_1 M_t \rho_{O,t} \quad (16)$$

Where $\rho_{O,t} = \frac{\partial P_o O_t}{\partial O_t} - \frac{\partial C_t}{\partial O_t}$

Substituting Equation (6) into Equation (1) produces the second of our estimating equations:

$$\sigma_{i,t} = \alpha_0^i + a_1 \left(P_{i,t} - \bar{P}_{i,R,t} \right) + C_0 a_1 \left(B \right) + a_1 \beta_0 M_t \left(B \right) \quad (17)$$

Where $B = \frac{1}{n-1} - \frac{n}{n-1} \sigma_{i,t-1}$.

IV. Data and Variables

We collect an unbalanced panel of UK bank level data for the period 1993-2008 from Bankscope[18]. Since our theoretical models of cross-selling require that sample banks operate in the same market, we remove foreign banks and non-conventional banks from our sample. Mergers are dealt with by aggregation of the financial statements to create a single composite bank for the entire period. Since our theoretical model relies on the assumption that changes in the market share of each bank across time imply switching behaviour by borrowers, we filter the change in the market share induced by M & A. Industry level data and macro data are obtained from Bank of England. Nominal data are deflated by the Consumer Price Index (CPI) using 2005 as the base year. Our estimation of the change in the degree of competition in the lending market is obtained from the H-statistic based on the Panzer and Rosse model (1987). The sample is split into two parts of equal length (1993-2000 and 2001-2008) and allows for the variation of H-statistics across the two sub-periods[19].

The test of the H-statistics is based on the properties of a reduced form log-linear revenue equation for a panel data set of banks, hence:

$$\ln R_{it} = \phi_0^i + \sum_{j=1}^{J} \alpha_j \ln w_{jit} + \sum_{j=1}^{J} \lambda_j \, post \ln w_{jit} + \sum_{k=1}^{K} \zeta_k X_{kit} + \varepsilon_{it} \qquad (18)$$

where R represents the interest income of bank i at time t[20], the ws are J input prices for each bank, the K X terms are exogenous bank specific variables that affect the bank's revenue and cost functions. The bank-specific intercept ϕ_0^i captures the heterogeneity across banks and ε is a stochastic term. We adopt a two-input factor specification in our empirical application ($j=1,2$): total loanable funds (the sum of deposits and money market funding and other

[18] Our sample starts from 1993 excluding the 1991-1992 recession, we exclude 2009 because of the low availability of the number of observations in Bankscope and the pollution to the data from further mergers and the banking crisis.

[19] Do we have other motivation for such split?

[20] Interest income includes income on loans and other earning assets, such as government securities. The above definition does not introduce biases into our estimation of competition in the lending market, given in the theoretical literature which assumes that competition in market for other earning assets can be proxied by perfect competition. Arguably, such an assumption is more realistic for advanced financial markets such as the UK.

funding) and non-interest operating cost (the expenditure associated with labour and physical capital). The price for total loanable funds is calculated as the ratio of total interest expenditure to total loanable funds, and the price for non-interest operating cost is given by the ratio between non-interest operating cost and total assets. We adopt the vector of bank-specific variables, X_{kit} , that have been used widely in the literature to estimate the H-statistic. First, we control for the size effect on gross interest revenue by taking the natural logarithm of total assets (LNASSET)[21]. To take into account the influence of revenue generation from the provision of OBS services on interest income, we introduce the ratio of total operating income over total interest income (REOBS). We include the ratio of financial capital over total earning assets to signal the constraint of capital on the supply of credit (CAP). Finally, we consider the quality of the loan portfolio, measured by the ratio of total loan loss reserves over total gross consumer loans (NPL). The idea is that an increase in provisions is a diversion of capital from earnings, which could have a negative effect on revenue. Alternatively, a higher level of provisions indicates a more risky loan portfolio and therefore a higher level of compensating return. The variable *post* is a dichotomous dummy variable, which takes the value zero for the period 1993-2000 and unity for 2001-2008. The *H*-statistic is calculated from the reduced form revenue equation; it measures the sum of elasticities of total revenue of the bank with respect to the bank's input prices. In the context of Equation (18), $H_1 = \sum_{j=1}^{2} \alpha_j$ is the degree of competition for 1993-2000, while $H_2 = \sum_{j=1}^{2} (\alpha_j + \lambda_j)$ is the degree of competition for 2001-2008. Following Olivero, et al.

[21] We are aware of the caution posed by Bikker et al., (2009) regarding the inclusion of scale variables such as total assets in the set of control variables in the revenue equation during the estimation of H-statistics. Bikker et al. (2009) argue that total assets proxy for the quantity of outputs. In our case, the focus is on loans, which form only a part of total assets. The fact that we control for total assets in our equation does not imply a constant quantity of loans, or a constant ratio of loans over total assets.

(2011), among others, we interpret the magnitude of H as a measure of the degree of competition in the loan market, with larger values of *H* indicating stronger competition.

An important feature of the *H*-statistic is that the tests must be undertaken on observations that are in long run equilibrium. This suggests that competitive capital markets will equalise risk-adjusted rates of return across banks such that, in equilibrium, rates of returns should be uncorrelated with input prices. The equilibrium test is performed by recalculating the Rosse-Panzar statistic by replacing total revenue as the dependent variable in equation (18) with pre-tax profit to total assets (ROA) and keeping other specifications unchanged, as shown in equation (19).

$$\ln \pi_{it} = \phi_0^{i'} + \sum_{j=1}^{J} \alpha'_j \ln w_{jit} + \sum_{j=1}^{J} \lambda'_j post \ln w_{jit} + \sum_{k=1}^{K} \zeta'_k X_{kit} + u_{it} \qquad (19)$$

The long-run equilibrium tests for pre- and post- 2000 are done using $E_1 = \sum_{j=1}^{2} \alpha'_j = 0$ and $E_2 = \sum_{j=1}^{2} (\alpha'_j + \lambda'_j) = 0$, respectively. Since our variation of competition in the lending market is related to two sub-periods, Equation (16) and (17) are thus restated as Equation (20) and (21).

$$MAR_{m,i,t} = \varphi_0^i - b_1 m_{ex} \rho_{O,t} - C_{ex} g_{t+1} \frac{n}{n-1} \delta\sigma_{i,t+1} - \beta_0 postg_{t+1} \frac{n}{n-1} \delta\sigma_{i,t+1} - \frac{\sigma_{i,t}}{a_1}$$
$$- b_1 \rho_{O,t} \left(q_{i,t} - \bar{q}_{j,R,t} \right) - b_1 \beta_1 post \rho_{O,t} + v_{i,t}$$

(20)

$$\sigma_{i,t} = \alpha_0^i + a_1 \left(P_{i,t} - \bar{P}_{i,R,t} \right) + C_{ex} a_1 B + a_1 \beta_0 postB + \upsilon_{i,t} \qquad (21)$$

Where $MAR_{m,i,t} = PCm_{i,t} + \frac{\partial C_t}{\partial L_t}$, φ_0^i is the composite intercept term. It includes the non-interest marginal cost of loans at the industry level and bank-specific intercept to catch the

heterogeneity[22]. Notably, $m_{ex} \neq m_0$ and $C_{ex} \neq C_0$ since m_{ex} and C_{ex} include an additional component representing the first sub-period, which is the reference category in our examination of competition. $\omega_{i,t}$ and $\varepsilon_{i,t}$ are the stochastic terms.

The dependent variable in Equation (20), $MAR_{m,i,t}$, is the difference between the interest rate on loans and the interest rate on loanable funds. The interest rate on loanable funds is calculated by the ratio of total interest expenditure to total loanable funds as we did in Equation (18) and (19). The income statements of the banks do not always separate interest revenue between interest earned on loans and interest earned from other earning assets. Thus, the ratio of interest received to the sum of loans and other earning assets is a weighted average of the average return on loans and the average return on other earning assets (R_O). Following Matthews et al., (2007), the average interest on loans is calculated by subtracting the weighted yearly average of the 3-month interbank rate (R_B) from the total interest earnings per interest earning asset.[23] If R_B is a good proxy for R_O, then the P_L will be measured with a non-systematic error, which will be absorbed into the general error in the regression equation and therefore result in unbiased estimates.

Turning to the independent variables of Equation (21), we assume that $\rho_{O,t}$, the difference between the marginal revenue and marginal cost of OBS services, is a constant coefficient across banks (i.e., a time-invariant and bank-invariant coefficient), and therefore it merges with a constant[24].

[22] This is equivalent to the assumption of a linear non-interest cost function.

[23] The calculated series for the full sample are available from the authors on request. Since we use the outstanding stock of net loans which is the difference between gross loans and loan loss reserves, the implicit interest rate on loans has been risk-adjusted.

[24] Allowing for the variation of $\rho_{O,t}$ across banks leads us to estimate a random coefficients model, which would dramatically increase the difficulty of the estimation. We relax this assumption and proxy $\rho_{O,t}$ by the ratio of non-interest income over non-interest operating cost in our subsequent test for robustness.

The market growth rate at time *t+1*, g_{t+1} is calculated as the sum of the quantity of loans of our sample of banks at time *t+1* divided by the same at time *t* and *n* is the number of our sample banks at time *t*. The discount factor, δ_t, is calculated using the three-month interest rate on T-bill in line with Kim et al., (2003). The bank-specific market share at time *t+1* $\sigma_{i,t+1}$ and is given by the quantity of loans of the bank *i* at time *t+1* divided by the sum of the quantity of loans of all our sample banks at time *t+1*. We use the ratio of total operating income over total operating cost as the indicator of the overall quality of OBS services (q). Such choice is mainly motivated by the banking literature using cost-income ratio to measure the operational efficiency of banks. The quality of OBS services of bank *i*'s rival is calculated by $\overline{q}_{j,R,t} = \sum_{j \neq i} s_{j,t} q_{j,t}$, $s_{j,t} = \frac{L_{j,t}}{\sum_{i=1}^{n} L_{i,t}}$, is the share of each rival bank in terms of total loans supplied by the industry as a whole. The difference in the interest rate on loans between the bank *i* and its rivals in Equation (17b) (i.e. $P_{i,t} - \overline{P}_{i,R,t}$) is calculated in a similar way. Table 1 presents the definition and measurement of the variables we used in the empirical analysis.

[Tables 1 and 2 about here]

Table 2 presents the summary statistics of the variables; there are no abnormal patterns reflected in the behaviour of the means and their dispersion.

V. Estimation and empirical results

We jointly estimate Equations (18), (19), (20) and (21) using Nonlinear-Three-Stage-Least-Squares with one-way fixed effects using the LSDV approach[25]. The endogenous variables $\sigma_{i,t+1}$, $\sigma_{i,t}$ and the relative interest rate on loans are instrumented by lead and the lag of market share up to three years[26], one time period lag of the relative interest rate on loans, $\sigma_{i,t}$ t, and the ratio of personal expenditure over total assets of the bank *i* relative to its rivals[27]. As a test for robustness, we report the empirical results of four variants of the model in Table 3. Model 1 assumes a constant ρ_O across banks and time, and imposes long-run equilibrium in the loan market. Model 2 tests for long-run equilibrium in the loan market. Model 3 relaxes the assumption of the constant price of OBS services in both time and bank dimensions and use a proxy variable, the ratio of non-interest operating income over non-interest operating cost[28]. This adds a new coefficient to be estimated in equation (20), namely ($b_1 m_{ex}$), and also allows us to separately identify b_1 (the sensitivity of the transition probability to the bank's quality of OBS services) and m_{ex} (the reference incompatibility cost). Model 4 imposes the restriction of $m_{ex} = 0$.

[insert Table 3 about here]

Concentrating on the estimates for the *H* statistic, it can be seen that the unit price of funds and non-interest operating cost are both positively related to interest revenue at the 1% level, in both periods. The magnitude of the *H*-statistics for the first sub-period, 1993-2000, is 0.629 (H_1), which is significantly different from zero at 1%. While the magnitude of the *H*-statistic for the second sub-period, 2001-2008, is 0.614 (H_2), again is statistically significantly different from zero at 1%. Therefore, the competition in the UK lending market seems to be

[25] While the majority of the banking literature using H-statistics estimates Equation (18) and (19) separately, the Breusch-Pagan test of independence shows the presence of contemporaneous correlation of the residuals of the two equations at 1% significant level, suggesting the need for system estimation.
[26] Kim et al. (2003) also adopt the lead and lag of three years as their instruments motivated by the finding of Degryse and van Cayseele (2000) of a 2.39 year average time length for loans.
[27] Cost variables are appropriate instruments for output price in both homogeneous and differentiated markets (Berry, 1994). It is calculated in the same manner as the relative quality indicator and relative interest rate on loans.
[28] Such treatment is equivalent to assuming the equality between marginal cost (marginal revenue) and average cost (average revenue).

characterised by monopolistic competition throughout 1993-2008, which is consistent with the general finding in previous studies that have used the Rosse-Panzar approach for the UK[29]. The comparison between the magnitude of H_1 and H_2 suggests that the degree of competition in 2001-2008 was lower than in 1993-2000.

The estimation and testing results for Equations (20) and (21) show that the point estimate of α_1, the slope of the transition probability function of bank loans, is less than zero. Therefore, the higher interest rate charged by banks on loans would trigger the incentive of existing borrowers to switch, as required by our theoretical model. The aggregated term of time-invariant switching cost in the lending market and that of the period 1993-2000, C_{ex}, is statistically significant. The significant and positive value of β_0 shows a higher switching cost in the period 2000-2008 compared with the period 1993-2000, suggesting an increase in switching cost in a less competitive lending market. The estimated coefficient on the relative quality indicator of financial services is statistically positive, indicating that banks with higher relative efficiency attract more demand for OBS services, in line with the prediction of the theoretical model[30]. Finally, β_1 is positive and statistically significant, suggesting that the transition probability for the consumer to purchase OBS service from the bank that is not its supplier of credit is lower in the period 2000-2008 compared to the period 1993-2000. This finding suggests that contemporaneous cross-selling is more likely when the competition in the loan market is less intensive.

[29] For example, Molyneux et al. (1994) and Bikker and Haaf (2002) find improved competition in the 1980s and 1990s. Claessens and Laeven (2004) find relatively strong competition during the 1990s, while Casu and Girardone (2006) find a relatively low level of competition with an H-statistic of around 0.3. The H-statistics estimated by Matthews et al. (2007) for major British banks are in the region of 0.5-0.75.

[30] The result is based on the assumption that OBS services have higher marginal revenue than marginal cost, i.e. $\rho_{O\,i,t} > 0$. While the current specification does not allow us to distinguish between the sensitivity of transition probability of OBS services to the bank's quality of financial services (i.e b_1) and the gap between the marginal revenue and the marginal cost of OBS services (i.e. $\rho_{O,i,t}$), our theoretical framework indicates that cross-selling between loans and OBS services is economically meaningful only if there is a trade-off in revenue between loans and OBS services (Equation (3)).

Our results challenge the conventional view that the increase in competition in the lending market leads banks to exercise a "loss-leader strategy" of reducing the interest rate on loans to attract consumers, and cross-sell other financial products that compensate for the loss in interest income on loans.

Our interpretation of the above evidence is as follows. The intention by consumers to purchase the best quality of fee-based OBS service is tempered by the increase in the likelihood of the rejection of loans by their supplier of loans in the near future. Such a situation is more likely to become a concern for consumers when the competition in the loan market is low and switching costs are high. The insight that switching costs in the loan market and the incompatibility cost of using an alternative provider of OBS services would induce banks to charge lower interest rates on loans in a less competitive lending market sheds doubt on the reliability of using the traditional interest rate spread to measure the degree of competition.

We test for the robustness of the main results in three ways. First, in Model 2 we remove the constraint of long-run equilibrium in the lending market *ex ante* and the test for H-statistics, and test for the presence of long-run equilibrium condition *ex post*. The results show that the equilibrium condition could not be rejected in the sub-periods and the results were unaffected.

Second, to reflect the view that the profitability and revenue of a bank is highly sensitive to the business cycle we add a pure time series variable, real GDP growth rate (GDPG) to our estimation of the *H*-statistics (Eq (18)) and the long-run equilibrium condition (Eq (19)) in the loan market(results not shown)[31]. However, this variable was not statistically significant in each of the model variants and again the main results were unaffected

[31] By allowing for the exogenous market growth rate in Equation (20) and (21), the pro-cyclical pattern of the overall borrowing activity has be controlled.

Third, we relax the assumption of the constant ρ_O in both time and bank dimensions and use a proxy variable, the ratio of non-interest operating income over non-interest operating cost[32]. This adds a new coefficient to be estimated in equation (20), namely ($b_1 m_{ex}$), and also allows us to separately identify b_1 (the sensitivity of the transition probability to the bank's quality of OBS services) and m_{ex} (the reference incompatibility cost). Again the results are largely unchanged

However, the sensitivity of the transitional probability of the bank consumer to the quality of OBS services (b_1) and the impact of the change in competition in the lending market on the incompatibility cost of OBS purchase (β_1) lose statistical significance. A closer examination shows that the insignificant coefficient, m_{ex}, is the main reason for an insignificant coefficient on $\rho_{O,i,t}$ ($b_1 m_{ex}$)[33]. The coefficient m_{ex} represents the sum of time-invariant incompatibility cost and the incompatibility cost for 1993-2000. When both components are negligible, a zero value is a special case and is consistent with the theoretical model. In Model 4 we impose the restriction of $m_{ex} = 0$[34], and re-estimate the model.

The restriction of $m_{ex} = 0$ does not lead to a discernible statistical difference in the estimates. Furthermore, β_1 appears to be statistically significantly at the 10%, implying the contemporary cross-selling situation only occurs in the less competitive lending market (i.e. 2001-2008). The coefficient b_1 has the expected positive sign but it is only significant at 13% level. However, we view this as prima facie evidence for the argument that the bank consumer values the quality of financial services in the purchase of OBS services.

[32] Such treatment is equivalent to assuming the equality between marginal cost (marginal revenue) and average cost (average revenue).
[33] This is judged from the same sign and the similar high p-value (above 0.95).
[34] This is equivalent to excluding $\rho_{O\,i,t}$ from independent variables in Equation (20).

VI. Conclusion

We have estimated and tested an empirical model of banking behaviour that encompasses cross-selling of off-balance sheet services and switching costs in the UK during 1993-2008. In general, the estimated parameters of the model conform to our theoretical priors. We obtain evidence which suggests that the second half of the sample period saw an increase in switching costs between providers of loan products. Also, we find that as a result of weakening competition in the loan market in the second half of the sample period, bank consumers faced higher costs of switching from their loan provider to an alternative provider. In addition, the consumers faced higher costs of purchasing from an alternative provider of off-balance sheet services. Contemporaneous cross-selling is therefore greater when competition in the loan market is weaker. British banks engage more in cross-selling as a means of holding on to their customers by bundling together off-balance sheet services and loans when the loan market is less competitive.

Our findings challenge the conventional view that banks undertake a loss-leader strategy of under-pricing loan products to capture bank customers and cross-sell non-interest financial services in competition. However, our research has three shortcomings. First, the model presented here deals with contemporaneous cross-selling and not inter-temporal cross-selling. It is possible that banks undertake loss-leader strategies in an inter-temporal framework as in the traditional customer-loan relationship model. Second, we assume the price of other financial services is exogenously given, which can be challenged if the bank possesses certain market power in the pricing of OBS. Thirdly, our research employs aggregate bank data rather than disaggregated data relating to bank products. Nevertheless, it is a first step to modelling cross-selling and switching costs in British banking. While

signalling the need for more theoretical and empirical work in the area of strategic behaviour of banks, the findings of this paper have a strong policy resonance that requires further study.

References

Ashton, J. and Pham, K. (2007), "Efficiency and Price Effects of Horizontal Bank Mergers"*CCP Working Paper* 07-09.

Ausubel, L. (1991), "The Failure of Competition in the Credit Market", *American Economic Review*, 81, 50-81.

Berry, S.T., Levinsohn, J., Pakes, A., (1995). "Automobile Prices in Equilibrium". *Econometrica*, 63, 841–890.

Bikker, J.A., Haaf, K., (2002), "Competition, Concentration and Their Relationship: An Empirical Analysis of the Banking Industry", *Journal of Banking and Finance*, 26, 2191-2214.

Bikker, J.A., Shaffer, S., Spierdijk, L., (2009). "Assessing Competition with the Panzar–Rosse Model: The Role of Scale, Costs, and Equilibrium", In: Presented at the 22nd Australasian Banking and Finance Conference, Sydney, Australia, December.

Calomiris, C. W., and Pornrojnangkool, T., (2009), "Relationship Banking and the Pricing of Financial Services", *Journal of Financial Services Research*, 35, 189-224.

Casu, B., and Girardone, G., (2006), "Bank Competition, Concentration, and Efficiency in the Single European Market", *The Manchester School*, 74, 441-468

Claessens, S., and Laeven, L., (2004), "What Drives Bank Competition? Some International Evidence", *Journal of Money, Credit, and Banking*, 36, 563-584.

Degryse, H., and Van Cayseele, P., (2000), "Relationship Lending within a Bank Based System: Evidence from European Small Business Data", *Journal of Financial Intermediation*, 9, 90–109.

Elsas, R. (2005). Empirical determinants of relationship lending. *Journal of Financial Intermediation*, 14, 32–57.

Farrell, J. and Klemperer, P., (2006), "Coordination and Lock-in: Competition with Switching Costs and Network Effects", *Competition Policy Centre, Institute of Business and Economic Research, UC Berkeley.* (Available at http://escholarchip.org/uc/item/9n26k7v1)

Kim M, Kliger D and Vale B (2003), 'Estimating Switching Costs: the Case of Banking', *Journal of Financial Intermediation*, 12, 25-56.

Klemperer, P. (1995), "Competition when Consumers Have Switching Costs: An Overview with Applications to Industrial Organization Macroeconomics, and International Trade", *Review of Economic Studies*, 62, 515-539.

Laux, C., and Walz, U., (2009), "Cross-Selling Lending and Underwriting: Scope Economies and Incentives", *Review of Finance*, 13, 241-367.

Li S, Sun B and Wilcox R T (2005), 'Cross-selling Sequentially Ordered Products: An Application to Consumer Banking Services', *Journal of Marketing Research*, XLII, May, 233-239.

Llewellyn, D T., (2005), "Competition and Profitability in European Banking: Why are British Banks so Profitable?" *Economic Notes* 34, 279-311.

Matthews, K., Murinde, V., Zhao, T., (2007). "Competitive Conditions among the Major British Banks". *Journal of Banking and Finance* 31, 2025–2042.

Molyneux, P., Lloyd-Williams, D., Thornton, J., (1994), "Competitive Conditions in European Banking", *Journal of Banking Finance*, 18, 445-459.

Northcott, C., (2004), "Competition in Banking: A Review of the Literature", *Working Paper 2004-2*, Bank of Canada.

Panzar, J., and Rosse, J., (1987), "Testing for Monopoly Equilibrium,". *Journal of Industrial Economics*, 35, 443-456.

Petersen, M.A., and Rajan, R.G., (1995), “The Effect of Credit Market Competition on Lending Relationships”, *Quarterly Journal of Economics,* 110, 406-443.

Sharpe, S. (1990), “Asymmetric Information, Bank Lending and Implicit Contracts: A Stylized Model of Customer Relationships", *The Journal of Finance*, 45, 1069-1087.

Sharpe, S. (1997), “The Effect of Consumer Switching Costs On Prices: A Theory and Its Application to the Bank Deposit Market", *Review of Industrial Organization*, 12, 79-94.

Shy, O. (2002), ‘A Qquick-and-easy Method for Estimating Switching Costs’, *International Journal of Industrial Organization*, 20, 71-87

Figure 1: Herfindahl-Hirschman Index for the Loan Market in UK Banking

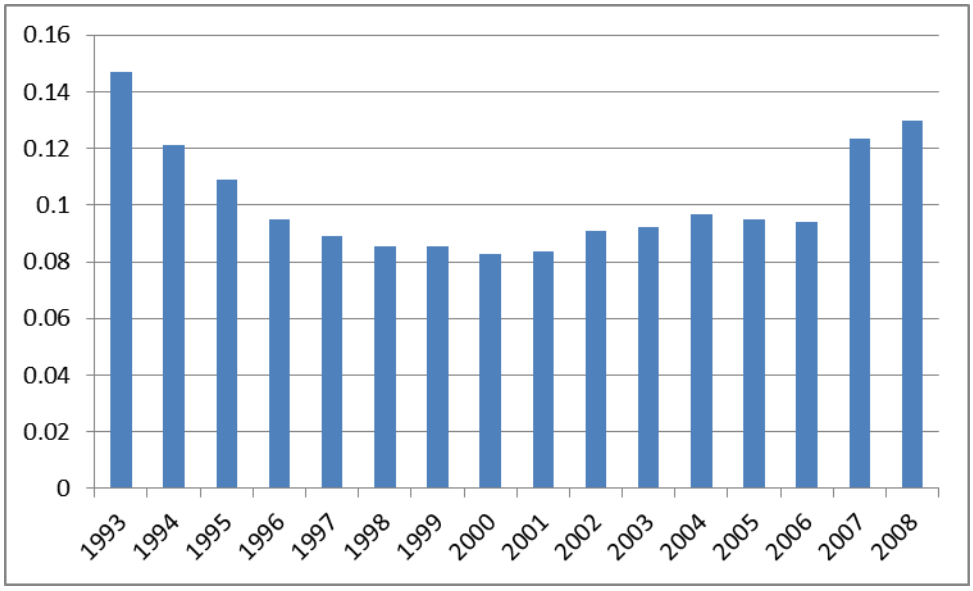
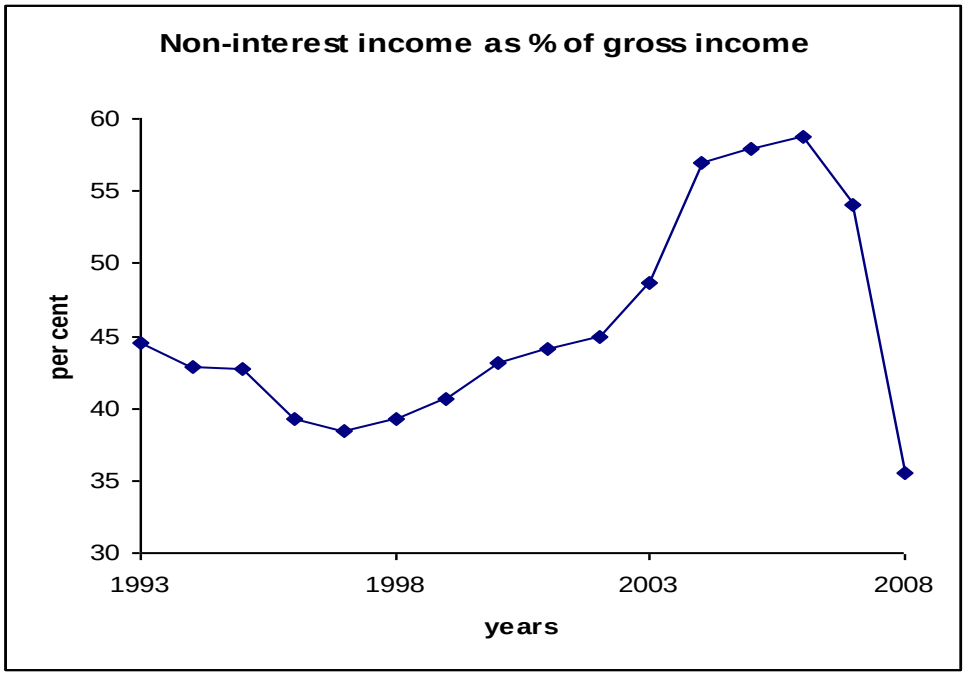


Figure 2 : Non-interest income ratio for UK banking



Source: British Bankers Association.

Table 1: The definition and measurement of variables

Variable name	Definition of each variable
$\sigma_{i,t}$	The market share of bank *i* at time *t*
$P_{i,t} - \overline{P}_{i,R.t}$	The difference in the interest rate on loans between the bank *i* and its rivals
B	$\frac{1}{n-1} - \frac{n}{n-1}\sigma_{i,t-1}$
$MAR_{m,i,t}$	The difference between the interest rate on loans and the interest rate on loanable funds.
$g_{t+1}\frac{n}{n-1}\delta_t\sigma_{i,t+1}$	The product of market growth rate between time *t* and time *t+1* and discount factor and the market share at time *t+1* and $\frac{n}{n-1}$
N	The number of banks at time *t*
δ_t	The three-month interest rate on T-bill
R_B	The 3-month interbank rate
$q_{i,t} - \overline{q}_{i,R,t}$	The ratio of total operating income over total operating cost
$\rho_{O,i,t}$	The ratio of non-interest operating income over non-interest operating cost
ln R	Natural log of the interest income
lnROA	Natural log of pre-tax profit to total assets
$Ln(w_{1,i,t})$	The ratio of total interest expenditure to total loanable funds
$Ln(w_{2,i,t})$	The ratio between non-interest operating cost and total assets
NPL	The ratio of total loan loss reserves over total gross consumer loans
LNASSET	Natural log of total assets (deflated)
REOBS	The ratio of total operating income over total interest income
CAP	The ratio of financial capital over total earning assets
GDPG	Real GDP growth rate
POST	The bilateral dummy variable, which takes the value 0 for the period 1993-2000 and value 1 for 2001-2008.

Table 2: Summary statistics of variables

Variable name	Obs	Mean	Std. Dev.	Min	Max
$\sigma_{i,t}$	1092	0.014	0.036	0.000	0.256
$P_{i,t} - \overline{P}_{i,R,t}$	1092	0.033	0.271	-1.872	5.665
B	1003	0.000	0.036	-0.243	0.017
$MAR_{m,i,t}$	1092	0.032	0.269	-2.501	5.566
$g_{t+1} \frac{n}{n-1} \delta_t \sigma_{i,t+1}$	1003	0.084	0.209	0.000	1.381
N	1092	68.779	5.100	57.000	73.000
δ_t	1092	4.934	1.298	1.240	7.110
R_B	1092	5.463	0.996	3.670	7.340
$q_{i,t} - \overline{q}_{j,R,t}$	1092	0.236	1.829	-10.771	25.913
$\rho_{O,i,t}$	1091	0.703	1.133	-16.158	27.381
ln R	1092	4.771	2.484	-0.693	10.583
lnROA	1092	0.182	0.044	0.000	1.365
$Ln(w_{1,i,t})$	1092	-3.237	0.553	-6.723	0.693
$Ln(w_{2,i,t})$	1085	-3.855	1.012	-7.784	-0.630
NPL	1092	0.027	0.050	0.000	0.457
LNASSET	1092	7.726	2.575	2.238	14.453
REOBS	1092	0.902	1.483	-0.142	24.833
CAP	1092	0.148	0.291	-0.091	6.500
GDPG	1092	0.035	0.012	-0.007	0.045

Table 3: Nonlinear Three-Stage Least Squares; No observations = 586; Standard Errors in parenthesis

Variable	Parameter	Model 1	Model 2	Model 3	Model 4
Equation 18: Dependent Variable lnR_{it}					
$\ln(w_{1,i,t})$	α_1	0.556*** (0.041	0.558*** (0.041)	0.557*** (0.041)	0.557*** (0.041)
$\ln(w_{2,i,t})$	α_2	0.073*** (0.027)	0.074*** (0.027)	0.073*** (0.027)	0.073*** (0.027)
$post * \ln(w_{1,i,t,})$	λ_1	-.087*** (0.019)	-.087*** (0.019)	-.087*** (0.019)	-.087** (0.019)
$post * \ln(w_{2,i,t})$	λ_2	0.071*** (0.015)	0.071*** (0.015)	0.071*** (0.015)	0.071*** (0.015)
$NPL_{i,t}$	ζ_1	0.338 (0.221)	0.339 (0.221)	0.357 (0.221)	0.336 (0.221)
$LNASSET_{i,t}$	ζ_2	0.924*** (0.026)	0.925*** (0.026)	0.926*** (0.026)	0.926*** (0.026)
$REOBS_{i,t}$	ζ_3	-.077*** (0.011)	-.077*** (0.011)	-.077*** (0.011)	-.077*** (0.011)
$CAP_{i,t}$	ζ_4	-.296 (0.249)	-.296 (0.249)	-.294 (0.248)	-.294 (0.248)
Equation 19: Dependent Variable $lnROA_{it}$					
$\ln(w_{1,i,t}/w_{2,i,t})$	α_1^*	0.008 (0.007)	-	-	-
$\ln(w_{1,i,t})$	$\alpha_1^{'}$	-	0.039 (0.035)	0.038 (0.035)	0.039 (0.035)
$\ln(w_{2,i,t})$	$\alpha_2^{'}$	-	0.001 (0.008)	0.000 (0.008)	0.000 (0.008)
$post * \ln(w_{1,i,t}/w_{2,i,t})$	λ_1^*	0.004 (0.005)	-	-	-
$post * \ln(w_{1,i,t,})$	$\lambda_1^{'}$	-	-.008 (0.012)	-.008 (0.012)	-.008 (0.12)
$post * \ln(w_{2,i,t,})$	$\lambda_2^{'}$	-	0.002 (0.007)	0.002 (0.007)	0.002 (0.007)
$NPL_{i,t}$	$\zeta_1^{'}$	0.236 (0.250)	0.248 (0.222)	0.245 (0.221)	0.245 (0.221)
$LNASSET_{i,t}$	$\zeta_2^{'}$	0.004 (0.010)	0.008 (0.012)	0.008 (0.012)	0.008 (0.012)
$REOBS_{i,t}$	$\zeta_3^{'}$	-.001 (0.001)	-.003 (0.002)	-.003 (0.002)	-.003 (0.002)
$CAP_{i,t}$	$\zeta_4^{'}$	0.157 (0.114)	0.150* (0.091)	0.153* (0.090)	0.153* (0.90)
Equation (20): Dependent variable: MAR_{it} and equation (21): Dependent variable: σ_{it}					
$\sigma_{i,t}$	$1/a_1$	-15.56*** (0.690)	-16.42*** (1.026)	-15.53*** (0.951)	-15.63*** (0.944)
$g_{t+1}\frac{n}{n-1}\delta_t\sigma_{i,t+1}$	C_{ex}	3.220*** (0.188)	3.359*** (0.227)	3.167*** (0.210)	3.189*** (0.212)

$post * g_{t+1} \frac{n}{n-1} \delta_t \sigma_{i,t+1}$	β_0	1.188*** (0.109)	1.246*** (0.123)	1.177*** (0.116)	1.185*** (0.115)
$q_{i,t} - \bar{q}_{j,R,t}$	$b_1 \rho_O$	0.014*** (0.005)	0.016** (0.007)	-	-
$P_{O\,i,t}$	$b_1 m_{ex}$	-	-	-.002 (0.027)	-
Post	β_1	1.356* (0.725)	1.138* (0.633)	-	-
$P_{O,i,t} * (q_{i,t} - \bar{q}_{j,R,t})$	b_1	=	=	0.008 (0.005)	0.008 (0.005)
post* $P_{O\,i,t}$	β_1	=	=	3.107 (2.809)	3.004* (1.841)
$H_1 = \alpha_1 + \alpha_2$		0.629*** (0.042)	0.631*** (0.042)	0.630*** (0.042)	0.630*** (0.042)
$H_2 = \alpha_1 + \alpha_2 + \lambda_1 + \lambda_2$		0.614*** (0.037)	0.615*** (0.037)	0.614*** (0.037)	0.614*** (0.037)
$D = \lambda_1 + \lambda_2$		-.016** (0.008)	-.016** (0.008)	-.016** (0.008)	-.016** (0.008)
$E_1 = \alpha'_1 + \alpha'_2$		-	0.039 (0.041)	0.039 (0.041)	0.039 (0.041)
$E_2 = \alpha'_1 + \alpha'_2 + \ell'_1 + \ell'_2$		-	0.033 (0.036)	0.033 (0.035)	0.033 (0.035)
m_{ex}		-	-	-.215 (3.573)	-

Note: The number of observation is different from that in Table 2 due to our employment of instrumental variables. The figures in the parentheses are robust-White heteroscedastic-consistent standard errors. * indicates 10% significant level, ** indicates 5% significant level and *** indicates 1% significant level. Bank-specific fixed effects are included in the estimation.