Efficiency and Price Effects of Horizontal Bank Mergers

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Abstract: This study provides an empirical assessment of the efficiency and interest rate changes occurring during 61 UK retail bank mergers. Key findings of the work include the general efficiency enhancing influence of UK bank mergers and the limited effect of merger on retail interest rates. Furthermore, different banking products appear to be influenced differently by mergers. It is proposed that future assessments of bank competition and mergers require an accommodation of different types of bank customer.

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Introduction

Comprehending the degree to which efficiency improvements from mergers are passed onto customers is a central concern when determining whether a merger may be legally undertaken. Further, the relationship between the efficiency and price changes which emerge from mergers is subject to much theoretical consideration (e.g. Davis and Wilson 2000, Farrell and Shapiro 1990, Froeb *et al* 2005, Spector 2003, Williamson 1968). Despite this interest, relatively little empirical assessment[1] has yet to emerge directly measuring these combined dynamic price and efficiency effects of mergers. Responding to this paucity of analysis, this study provides an empirical assessment of the degree to which interest rates – the effective prices of many financial services – are influenced by horizontal retail bank mergers.

Three key findings of the study emerge. First, UK retail bank mergers between 1988 and 2004 have led to significantly enhanced cost efficiency for the merging banks. Second, the overall level of retail interest rates for most banking services is not significantly influenced by mergers. Three, contrasting banking products and products with distinct levels of financial involvement are affected differently by mergers.

This empirical assessment develops from an academic literature which has investigated the effect of mergers on retail interest rates and efficiency separately. Many studies have investigated the influence mergers have had on the efficiency of merged banks (see Amel *et al* 2004, Berger *et al* 1999 and Campa and Hernado, forthcoming). While this extensive international literature indicates that the efficiency

[1] For example Pesendofer (2003) provides an assessment of the US paper industry. Further NEIO studies have been undertaken by Azzam (1997), Azzam and Rosenbaum (2001), and Lopez *et al* (2002) as to the market power and efficiency effects of concentration in a range of markets including Portland cement, beef packing and food processing industries respectively.

gains from bank mergers are limited, this evidence is less than conclusive. Past academic work as to performance changes arising from UK building society mergers (Barnes 1985 and Haynes and Thompson 1999) indicates both negative and positive performance effects of mergers.

Relatively few studies have considered the effects of retail bank mergers on the interest rates received by, or charged to, retail banking consumers.[2] These assessments of consumer deposit (Focarelli and Panetta 2003, Prager and Hannan 1998) or unsecured loan (Kahn *et al* 2005) data have examined how merging banks and their rival banks within local markets change interest rates. This literature indicates that mergers occurring in more concentrated banking markets lead to adverse short-term deposit interest rate change (Prager and Hannan 1998). Longer-term post-merger deposit interest rate change can also be positive due to hypothesised medium-term efficiency changes (Focarelli and Panetta 2003). Additionally, distinct retail banking products are often affected differently by merger actions (Kahn *et al* 2005), with some banking products not being influenced by merger at all.

Despite the importance of all these contributions, a persistent policy concern is the degree to which efficiency gains from mergers are passed on to bank customers. This study addresses this issue through an examination of how both retail interest rates and efficiency changed after 61 UK retail bank horizontal mergers between 1988 and 2004. This examination is undertaken in six sections. After this introduction, a brief review of the wider academic literature is included. The research setting and data used in the study are discussed in section three. Section four provides the empirical testing

[2] A substantial literature has also developed assessing the effects of bank mergers for commercial rather than retail customers. Key recent contributions to this literature include Carrow *et al* 2006, Focarelli *et al* 2002, Karceski *et al* 2005 and Sapanieza 2002.

framework and in section five the results of the analysis are presented. Lastly, a summary of the study is provided, conclusions are drawn and recommendations for policy makers are presented in section six.

2. Literature Review

This empirical investigation of efficiency and interest rate changes by merging banks contributes to the wider banking literature by addressing regulatory and theoretical concerns. These concerns are addressed in turn.

Initially, mergers between banks in many nations are subject to antitrust or competition law.[3] Within the UK legal framework mergers between banks can be blocked when they are viewed to limit competition.[4] Central to improving the competitiveness of a sector is both the achievement of efficiency or synergies from the mergers and the degree to which these efficiency savings will be passed on to customers. For example, a recent large UK bank merger between Lloyds TSB and Abbey National was expected to create substantial efficiency gains. This merger was blocked as the competition authority stated, amongst other reasons, that these efficiency gains would not be passed on to customers (Competition Commission 2001). This decision, emphasising the pass through of efficiency gains to customers over the realisation of efficiency gains alone, is consistent with the social equity and/or consumer welfare concerns which underpin competition law within Europe and the USA (Stuyck 2005). To summarise, an empirical understanding of how efficiency

[3] Over 100 nations have now developed their own antitrust or competition laws, rules and regulations following the US model of competition law (Djelic 2002).
[4] Before the UK Enterprise Act (2002) the criteria was the public interest. A discussion of whether efficiency gains should be incorporated within a merger control regime more generally is given by Röller *et al* (2000).

gains are passed on to customers after bank mergers has a substantial regulatory importance for both those wishing to merge and the regulators of such change.

Secondly, assessment of the relationship between efficiency and price changes after mergers has been the focus of much theoretical examination. Farrell and Shapiro (1990) assert that prices will only fall after a merger if substantially lower marginal costs exist relative to the marginal costs of the two merging firms before the merger. Conversely if a merger generates no efficiencies (synergies) then prices faced by customers will rise. Within this framework a profitable merger will only be socially beneficial in a limited number of cases where efficiency has risen substantially and this benefit has been passed on to consumers. Thus the relationship between efficiency and price change should be positive when interest rates represent a benefit to the customer, as is the case for deposits, and negative when they represent a cost to the customers, as is the case for lending.

This contribution has led to a range of theoretical developments. In assessing the link between pricing, efficiency and competition, Davis and Wilson (2000) indicate that the initial efficiency levels of the merging firms have a substantial influence on the level of competition engendered by the merged firm. As a result the degree of pass through of efficiency after mergers may be influenced by the initial efficiency endowment of the merging firms. Further contributions from Bulow and Pfleiderer (1985) and Ten Kate and Niels (2005) emphasise the limited influence that price elasticity of demand or market share imposes on the degree of efficiency gains passed on to the consumer in different competition forms. This last position indicates the

market structure often has a negligible influence on the pass through of efficiency gains. From this literature, three hypotheses can be defined and subsequently tested:

- Bank mergers will generally result in adverse conditions for consumers if a merger has no efficiency gains.
- Relative price improvements for customers will occur only when substantial efficiency gains are recorded after a merger event.
- The duration over which efficiency and interest rates change after mergers have occurred can be substantial and different banking products may be affected by bank mergers in different ways.

The approaches through which these hypotheses are empirically assessed are examined in the next section.

3. Research Setting and Data

3.1 Research Setting

The assessment of the research hypotheses is undertaken in the setting of the UK retail banking market. This relatively concentrated market, with a limited number of large banks and a large fringe of smaller banks, has appreciated a considerable amount of merger activity during the last decade. To illustrate the relationship between interest rates and efficiency in bank mergers, UK retail banks and building societies are examined. UK building societies are mutually-owned financial institutions, similar to US savings and loans institutions; and retail banks are shareholder-owned large banks. All these institutions generally offer a wide array of different retail banking services.

In generating the sample of UK merging banks between 1988 and 2004 we employ a number of screens. Initially only banks involved in the UK domestic retail banking market are included. Secondly, only horizontal mergers are considered. As only those banks are selected for which a panel of accounting and price data could be obtained, two bank mergers are excluded as the data was unavailable. In total this selection leaves 105 banks and building societies which are involved with 61 banking mergers.[5] This selection is viewed to constitute close to the wider population of domestic bank mergers undertaken in the UK over the period 1988 to 2004.

This selection includes mergers which occurred most frequently between relatively small institutions, particularly mutually-owned building societies. Only a limited number of very large domestic mergers, such as that between Natwest and the Bank of Scotland, were recorded. Within the selection process acquiring and target banks are identified. This classification is made to reference the definitions of acquiring and target banks used by the British Bankers Association and the British Building Societies Association.[6] In addition, a number of proposed bank mergers have been investigated and in some cases blocked by the UK competition authorities. While this potential bias is acknowledged, most of the mergers considered in this assessment have not been subject to this process due their relatively small scale.

3.2 Data used in the study

The data for this study comes from three sources. Annual reports and accounts of 105 individual banks over the period 1988 to 2004 are used to provide most of the data for the examination of efficiency. Additional data on staff numbers is provided by the

[5] The 61 mergers assessed are reported in Appendix 1.
[6] In cases where such definition is not possible reference to contemporary press commentary and scale of partners involved in the mergers are used to define targets and acquirers.

British Bankers Association Annual Abstract of Statistics. To assess the interest rate changes substantial data sets of interest rates for deposits, unsecured lending and mortgages are employed, which were provided by Moneyfacts PLC, a widely used data provider for the UK financial services industry. This data source is also employed in regulatory and academic examinations of the UK financial services industry (e.g. Competition Commission 2001, Cruickshank 2000, Heffernan 2005, 2006) and provides a comprehensive survey of all market participants in the UK deposit, mortgage and unsecured personal lending markets. The data sets are contiguous yet unbalanced due to the entry and exit of both financial products and banks from individual markets (see Costanzo and Ashton 2006).

The deposit interest rate data are provided for instant access accounts and notice accounts. These two deposit products are issued by 104 banks, for 3 different deposit values ranging from small (£500), medium (£5,000) and large (£50,000) deposits. These values are chosen as they are distinct and do not overlap due to the effect of inflation. The mortgage data are the reference interest rates from which the interest charged on different mortgage contracts for existing mortgage customers is assessed. These data are provided for 99 banks in total. The unsecured personal lending data are provided at three levels of lending for relatively small (£1,000), medium (£5,000) and large quantities (£10,000). These data are recorded for 52 banks in total. All the interest rate data are provided at monthly intervals over an 18 year period from 1988 to 2004, providing 162,972 observations for deposits, 14,455 observations for mortgages and 4,249 observations for unsecured lending. The product data are pooled for different product characteristics and forms of distribution.

4. The Testing Framework

Two approaches are employed to test for the effects of bank merger on interest rates and cost efficiency. First, the cost efficiency of both merging and non-merging banks is calculated. Second, a regression model is estimated to ascertain the link between interest rates and merger events for all the banks in our sample. These procedures are discussed in turn.

4.1 Efficiency Estimation

The level of bank-specific annual cost efficiency is estimated using a stochastic frontier model, where productive technology is represented by a flexible Fourier functional form. The model is estimated using an unbalanced data panel including banks which have and have not merged over the period 1988 to 2004. This approach is deemed to be superior to other methods of estimating efficiency, such as data envelopment analysis[7] (Charnes *et al* 1978, Banker *et al* 1984) due to the stochastic form of the frontier estimated. Cost efficiency is estimated in this study, rather than alternative efficiency measures such as profit efficiency (see Berger and Humphrey 1997), as the sample of banks have a variety of objective functions. For example while retail banks may be assumed to be profit-maximising institutions, mutually-owned building societies may be maximising a range of alternative objectives (see Drake and Llewellyn 2001 and Nichols 1967).

[7] Efficiency was also estimated using this DEA approach. Whilst the findings were broadly similar to the estimates recorded here, this approach was viewed to be less able to accommodate a diverse range of productive technologies and subsequently is not reported in this study.

Table 1: Descriptive Statistics (adjusted for inflation)

Definition	Mean	Std. Dev.	Min.	Max.
Total cost – operating and financial costs (£m)	1224.85	3389.22	0.61	24095
Total Fixed Assets (£m)	375.80	1930.84	0.02	33870
Total Staff Employed	4918.491	14893.61	4	98400
Total Borrowings (£m)	15849.73	47148.56	0.00	464271
Management Expenses (£m)	404.70	1349.54	0.07	14653
Staff Costs (£m)	156.03	555.07	0.31	5231
All Loans (£m)	12529.94	35307.12	4.18	345469
Liquid Assets (£m)	4328.84	17314.15	1.35	212742
Total Assets (£m)	19412.90	59565.80	0.00	583467
Depreciation (£m)	36.444	127.649	0.007	1686.170
Profits or Reserves Retained (£m)	127.965	452.192	-1208.511	4762.000
Provisions for bad and doubtful loans (£m)	65.372	258.986	-48.556	3331.216
Interest Received (£m)	1128.56	2963.52	0.18	22449
Interest Paid (£m)	820.15	2180.75	0.44	17318
Obs. 1394				

Within the efficiency model total costs include both the bank's operating and financial costs following an intermediation approach (Sealey and Lindley 1977). Outputs are quantified by their value. The price of labour (P_1) is proxied by the total wage bill divided by the number of full time equivalent employees. The price of capital (P_2) is represented by the total capital expenses including depreciation costs, divided by total fixed assets. The price of deposits (P_3) is represented by total interest payable divided by the quantity of deposits. These definitions of inputs and outputs are broadly consistent with other European and UK studies of bank efficiency (e.g. Altunbas *et al* 1997, 2001, Ashton 2001a, Casu and Girardone 2006). Descriptive statistics adjusted for 2004 prices[8] of these data are provided in Table 1.

[8] Adjusted using the Retail Price Index including the costs of mortgage payments. This data series was provided by the Bank of England.

The procedure for estimating the model follows the general frontier cost function proposed by Aigner *et al*. (1977) and Meeusen and Van den Broeck (1977). This stochastic frontier, estimated using panel data can be represented as:

$$C_{it} = C(P_{ijt}, Y_{igt}).e^{V_{it}+U_{it}} \quad j = 1,2,...N; g = 1,2,...N \qquad (1)$$

and represented as (2) in logarithmic form:

$$LnC_{it} = f(P_{ijt}, Y_{igt}) + \ln V_{it} + \ln U_{it} \qquad j = 1,2,...N; g = 1,2,...N \qquad (2)$$

where: C_{it} represents a scalar cost of i^{th} bank in the t^{th} period; and f denotes a functional form. P_{ijt} is a vector of the j^{th} input price used by i^{th} bank in the t^{th} period; Y_{igt} is a vector of i^{th} bank's output in the t^{th} period. The error term V_{it} assumed to be independently and identically distributed represents the effect of random shocks (noise) and is independent of U_{it}, the inefficiency term which represents technical inefficiencies. Following the Battese-Coelli (1992) parameterisation of time effects, the technical inefficiency term is assumed to have a truncated-normal distribution.

After estimating a particular cost function using a maximum likelihood estimator, the individual cost efficiency for bank i^{th} in the t^{th} period relative to cost frontier is estimated according to the ratio between the minimum cost (C_{min}) necessary to produce that bank's output and the actual cost (C_i), such as:

$$Cost\ Efficiency_{it} = \frac{C_{\min}}{C_{it}} = \frac{\exp[f(y,w,z)]}{\exp[f(y,w,z)]} \frac{\exp(\ln u_{\min})}{\exp(\ln u_{it})} = \frac{u_{\min}}{u_{it}} \qquad (3)$$

The productive technology in this model is represented by a flexible Fourier functional form (see Gallant 1981, 1982). The flexible Fourier functional form is a second order polynomial with a combination of sine and cosine functions in the explanatory variables. This form is Sobelev flexible form, estimates elasticities consistently and reduces specification bias when representing diverse productive technologies (Gallant 1981, 1982, Ivaldi *et al* 1996).

The method for defining variables follows the approach established by Mitchell and Onvural (1996). The trigonometric transformations of the variables are functions that re-scale the periodic sine and cosine values so that they fall within a sample-specific domain of (0, 2π). Chalfant and Gallant (1985) and Mitchell and Onvural (1996) indicate that the semi-non-parametric sample-specific scaling procedure may be simplified through the imposition of a number of *a priori* assumptions allowing the flexible Fourier series expansion to be used as an effective expansion technique (Rossi 1985). The non-parametric sample-specific scaling procedure employed is denoted:

p_r^{min} , p_r^{max}= sample minimum/maximum for the r^{th} input price

y_j^{min}, y_j^{max}= sample minimum/maximum for the j^{th} output quantity

$Wp_r = 0.00001 - Lnp_r^{min}$, $\quad Wy_i = 0.00001 - Lny_j^{min}$

$M = Lnp_r^{max} + Wp_r$, $\quad \lambda = 6/M$, $\quad \mu = 6/[Lny_j^{max} + Wy_j]$,

Input price $l = \lambda[Lnpr + Wp_r]$, Output quantity $Z = \lambda\mu[Lny_j^{max} + Wy_j]$

Subsequently the cost efficiency model (1) can be represented as:

$$
\begin{aligned}
\mathrm{L}nC= & \sum_j \alpha_j Ln Y_j + \sum_r \beta_r Ln P_r + 1/2 \sum_j \sum_s \chi_{js} Ln Y_j Ln Y_s + \\
& 1/2 \sum_r \sum_q \omega_{rq} Ln P_r Ln P_q + \sum_j \sum_r \delta_{jr} Ln Y_j Ln P_r + \sum_j \zeta_j (Cos Z_j + Sin Z_j) + \\
& \sum_r \phi_r (Cos l_r + Sin l_r) + \sum_{js} [\varphi_{js} Cos(Z_j + Z_s) + \pi_{js} Sin(Z_j + Z_s)] + \\
& \sum_{js} [\varpi_{js} Cos(Z_j - Z_s) + \eta_{js} Sin(Z_j - Z_s)] + \sum_{rq} [\gamma_{rq} Cos(l_r + l_q) + \tau_{rq} Sin(l_r + l_q)] + \\
& \sum_{rq} [\psi_{rqr} Cos(l_r - l_q) + \sigma_{rqr} Sin(l_r - l_q)] + \\
& \sum_{rq} [\kappa_{rqr} Cos(l_r - l_q + Z_j) + \vartheta_{rqr} Sin(l_r - l_q + Z_j)] + \\
& \sum_{rq} [\theta_{rqj} Cos(l_r - l_q - Z_j) + o_{rqj} Sin(l_r - l_q - Z_j)] + \upsilon_i + v \qquad (4)
\end{aligned}
$$

where j, s = 1, 2, r, q = 1, 2, 3 and α, β, χ,ω δ, ζ, ϕ, φ, π, ϖ, η, γ, τ, ψ, σ, ,κ, ϑ, θ and o are coefficients to be estimated. $\upsilon_i + v$ denotes non-random disturbance of the individual banks and random error respectively. Symmetry is imposed on the translog portion of the model. The trigonometric vectors within the model are chosen *a priori* as opposed to pre-testing. Linear homogeneity is imposed through the use of opposite signs in the input price vectors and imposing the restriction that parameters of the input price vector sum to zero (Mitchell and Onvural 1996). Monotonicity and quasi-concavity in input prices are not imposed due to the semi-non-parametric (non-multiplicative) technique underlying the flexible Fourier functional form.[9] The coefficient estimates for the cost model are reported in Appendix 2. The values of the inefficiency scores can be interpreted as follows: an efficiency score of 1.11 means that the bank's costs are 11% higher than the costs of an equivalent bank that is efficient.

[9] Gallant (1981) stressed this does not hinder the flexible Fourier form from closely approximating the true cost function.

4.2 The relationship between interest rates and merger

A time series, cross-sectional regression model is employed to consider the effect of merger on the level of interest rate change. The continuously compounded rate of interest is assessed following an approach suggested by Kim and Singal (1993), Prager and Hannan (1998) and Kahn *et al* (2005).[10] For the different banking services considered the following equation (5) is estimated for all banks:

$$ratchg_{it} = \alpha + \sum_{m=1}^{M} \delta_m M_{it} + \sum_{n=-24}^{+72} \beta_n A_{it} + \sum_{n=-24}^{-1} \chi_n T_{it} + \varepsilon_{it} \qquad (5)$$

Where $ratchg_{it} = ln(rate_{it}/rate_{i(t-1)})$ is the continuously compounded rate of interest rate change for the end of the month *t-1* for the interest rate by bank *i* for a particular type of banking service and quantity invested or borrowed, α is a constant value, specific to the type of banking product. These 194 monthly variables (*M*) denote the monthly periods, where when *M* equals *t* a value of 1 is recorded. This is the period when the monthly dummy variable and the observed month coincide. All other periods are recorded as *M* equals 0. These variables are employed to reflect the effects of time on the degree of change in bank-specific interest rates, such as the effects caused by a change in official interest rates for example. Assessing whether an acquiring or target bank has merged within the sample period is indicated by the dummy variables $\beta_n A_{it}$ or $\chi_n T_{it}$ where *A* indicates an acquiring bank and *T* denotes a target bank. These dummy variables have a value of 1 if the merger has occurred in either the 24 months before the merger event for both acquiring (*A*) and

[10] This examination of interest rate change does not use econometric time series techniques such as co-integration to quantify the speed of interest rate changes. These statistical techniques are not employed as product-specific retail interest rate data displays a substantial degree of clustering, around certain digits and factions (see Ashton and Hudson 2006, Kahn *et al* 1999). The non-random and discrete data characteristics associated with data clustering are inconsistent with co-integration methods, which depend on random and continuous data for non-biased estimation.

target (*T*) banks, and in the 72 months after the merger event for acquiring (*A*) banks. These time periods where chosen arbitrarily yet are informed by past evidence (Focarelli and Panetta 2003) which recorded that interest rate changes from mergers can develop over substantial periods of time. In total 97 monthly variables for acquiring banks and 24 variables for target banks are estimated. ε_{it} is a non-zero error term. Following Prager and Hannan (1998) the model is estimated using an OLS estimator with Huber-White robust standard errors. This approach is adopted to overcome the potential problem of similar levels of interest rate change being reported for different banks in repeated time periods. These models are estimated for both distinct banking products and different levels of financial involvement by customers.

From this model the coefficients of particular interest are the estimates for acquiring banks (β's) and target banks (χ's). These coefficients indicate the direction and statistical significance of the influence of merger events on interest rate change. For deposits a positively signed and statistically significant β or χ would suggest merger has lead to a better rate of interest for the customer. Conversely for credit products a positively signed and statistically significant β or χ would suggest an increase in the cost of borrowing. A zero value for β or χ, or a value which is not statistically significant, would indicate no change in interest rates for both deposit and credit products. A negatively signed and statistically significant β or χ would indicate worse rates for investors or depositors and better rates for borrowers. The values for the β's or χ's are collated to provide cumulative measures of the effect of mergers on interest rates. The pre-merger effect of merger on interest rates 24 months before the merger event are recorded for both acquiring banks and the target banks as $\Sigma\beta_{(n=-24 \text{ to } -1)} = 0$. Intermediate influences of merger recorded from 0 to 24 months after the merger

event for acquiring banks are assessed as $\sum\beta_{(n=\ 0\ to\ 24)} = 0$. Long-term influences of merger recorded from 25 to 72 months after the merger event for acquiring banks as $\sum\beta_{(n=24\ to\ 72)} = 0$. Total effects of the bank merger on interest rate change are recorded as $\sum\beta_{(-24\ to\ +72)} = 0$ values for the acquiring bank. Total effects of the bank merger on interest rate change for target banks in the 24 month prior to the merger event are recorded as $\sum\chi_{(n=24\ to\ -1)} = 0$.

5. Results

The assessment of cost efficiency and bank-specific characteristics for merging and non-merging banks is displayed in Table 3. The pertinent findings considering the pre-merger, intermediate, long-term and total effects of merger on interest rates are displayed in Table 4 for all banks. Due to space constraints the regression coefficient values for the interest rate models are not reported and are available on request from the corresponding author.

5.1 Cost Efficiency and Bank Characteristics

Table 3 reports the frequency of UK bank mergers, the average levels of bank efficiency for each year, and the average levels of cost efficiency, for merging and non-merging banks. Within this table it is identified that most UK bank mergers occurred in the first half of the sample period. Further, the average level of interest paid or payable on three representative banking services and quantities are reported. These rates display a strong decline across the sample period, making meaningful

comparisons of interest rates at different time periods problematic. Overall, the level of bank efficiency averages 1.17 indicating a 17% efficiency difference exists between the average efficiency bank and a bank with best practice efficiency characteristics. The relative level of dispersion in the level of efficiency remains fairly constant in most years. Overall the merging banks are viewed to have higher levels of cost efficiency over the entire sample period and acquiring banks are seen to have higher cost efficiency than target banks.

Within the lower panel of Table 3 differences between bank-specific variables and efficiency for merging and non-merging banks are recorded five years before and after mergers for target and acquiring banks respectively. Acquiring banks have a statistically significant higher average level of efficiency, which improves in the years after the merger event. This finding is consistent with both previous empirical evidence (Haynes and Thompson 1999) and with past regulatory assessments (e.g. Competition Commission 2001) which have emphasised the efficiency enhancing potential of UK bank mergers. This efficiency profile is also representative of merging banks appreciating longer-term efficiency gains in the manner predicted by Focarelli and Panetta (2003). For target banks efficiency improvement is observed prior to merger, with target banks on average having lower levels of average efficiency than acquiring banks.

5.2 Regression Model Findings

The regression models reported in Table 4 are estimated for all banks and provide an indication as to the effect of merger events on the pricing of banking products. The model fit for the regression models using deposits and mortgage data is far more

robust than that observed for unsecured loans; probably a result of the lower level of significant coefficient estimates obtained for this model and the smaller number of observations considered for unsecured loans. For most models the restrictions imposed are significant, and relatively high values of the coefficient of determination are recorded relative to those reported by Prager and Hannan (1998) and Kahn *et al* (2005).

The strongest finding from this assessment is that for most banking services, including instant access deposits, mortgage lending and unsecured lending, the effect of merger events on interest rate setting is not significantly different from zero. This finding is consistent both before mergers, in the immediate zero to two year merger period and up to and including six years after the merger.

The effect of merger on notice deposit accounts in contrast to the other banking products does appear to be statistically significant. For larger quantities (£5,000 and £50,000) invested in notice deposit accounts, a consistent negative change in the interest rates received by customers is recorded. This reduction in the level of interest received by these customers occurs both immediately after the merger event and up to six years after the merger event. In total the effect of this change on notice deposit interest rates can be interpreted as a major decline in the level of interest received by customers relative to non-merging banks. Clearly, this provides strong evidence that merging banks compete far less aggressively in the market for notice deposits. Conversely, before mergers, target banks appear to be pricing their notice deposit account for smaller quantities (£500 and £5000) relatively aggressively and providing significantly higher rates of interest in the two years before the merger occurs.

Overall, we suggest that the process of merger appears to be associated with a strategic change away from the competitive provision of notice deposits.

Table 3: The Distribution of Efficiency and Average Interest Rates

	Frequency of Mergers	Average Cost Efficiency All banks	St. Dev. Cost Efficiency All banks	Average Cost Efficiency Acquiring banks	Average Cost Efficiency Target Banks	Average Cost Efficiency Non-Merging Banks	Average Instant Access Deposit Rate (£500 Invested)	Average Notice Deposit Rate (£10,000 invested)	Average Mortgage Rate (Existing customers)
1988	8	1.059	0.049	1.055	1.045	1.061	7.066	8.345	12.848
1989	3	1.200	0.171	1.156	1.194	1.199	7.903	9.321	13.738
1990	10	1.402	0.535	1.254	1.446	1.493	9.056	10.796	15.147
1991	7	1.341	0.420	1.210	1.432	1.406	8.843	11.435	12.851
1992	5	1.291	0.336	1.201	1.354	1.337	6.159	9.081	10.590
1993	4	1.247	0.272	1.167	1.294	1.282	3.305	6.072	8.095
1994	2	1.212	0.222	1.172	1.166	1.237	2.784	5.373	7.830
1995	3	1.180	0.182	1.203	1.163	1.200	3.081	5.591	8.249
1996	2	1.158	0.153	1.165	1.140	1.170	2.274	4.654	7.132
1997	4	1.134	0.127	1.130	1.119	1.144	2.594	5.191	7.651
1998	0	1.115	0.107	1.109	1.106	1.124	3.467	6.148	8.486
1999	2	1.101	0.091	1.093	1.091	1.109	2.181	4.508	6.876
2000	2	1.087	0.077	1.075	1.084	1.094	2.809	4.945	7.453
2001	4	1.075	0.065	1.064	1.076	1.080	2.446	4.247	6.779
2002	1	1.065	0.056	1.048	1.059	1.069	1.689	3.008	5.633
2003	3	1.056	0.048	1.039	1.047	1.059	1.534	2.779	5.518
2004	0	1.047	0.038	1.043	1.042	1.052	2.207	3.274	5.753

Years After Merger	Acquiring Bank Mean	St Dev	No. Obs	Target Bank Mean	St Dev	No. Obs
1	0.905	0.072	30	0.893	0.063	31
2	0.917	0.064	26	0.881	0.082	30
3	0.918	0.054	21	0.879	0.093	27
4	0.931	0.048	19	0.886	0.096	21
5	0.935	0.040	15	0.851	0.116	16
Total	0.919	0.060	111	0.880	0.088	125

Table 4: Impact of Mergers on Bank Deposit Interest Rates: All Banks

		Instant access						Notice accounts			
		£500		£5,000		£50,000		£500		£5,000	
Target Bank		Coef.	t	P>t	Coef.	t	P>t	Coef.	t	Coef.	t
	Before Merger Target	0.123	1.150	0.251	-0.008	-0.130	0.893	0.614*	1.690	1.487*	3.560
Acquiring Bank	Before Merger	0.006	0.100	0.923	-0.005	-0.130	0.897	-0.266	-1.120	-0.465	-1.160
	Intermediate Change	-0.084	-0.910	0.362	0.045	0.980	0.325	0.113	0.550	-0.321	-0.680
	Long-run Change	0.125	0.600	0.546	-0.002	-0.020	0.983	-0.253	-0.810	-1.927*	-2.780
	Total Change	0.073	0.350	0.726	0.033	0.370	0.710	-0.581	-1.580	-2.895*	-3.620
	Observations	13015		136439		13660		11667		10668	
	F test	F(312, 12702)=18.54**		F(312, 13336)=30.32**		F(312, 13347)=21.64**		F(312, 11354) = 2.71**		F(312, 10355)=8.79**	
	R^2	0.1720		0.2601		0.2760		0.1509		0.2242	

	Notice accounts			Unsecured lending						Mortgage lending	
Target Bank		£50,000		£500		£5,000		£10,000			
		Coef.	t	Coef.	t	Coef.	t	0.043	0.520	Coef.	t
	Before Merger Target	0.288	0.570	-0.027	-0.330	0.041	0.550	0.053	0.990	0.002	0.180
Acquiring Bank	Before Merger	-0.052	-0.130	0.018	0.340	0.084	1.410	0.097	1.650	-0.006	-0.810
	Intermediate Change	-0.557	-1.130	0.045	0.670	0.059	1.150	-0.006	-0.060	0.000	0.010
	Long-run change	-3.401*	-4.610	0.002	0.030	-0.024	-0.190	0.133	1.070	0.000	-0.040
	Total change	-4.164*	-4.900	0.075	0.680	0.117	0.840	0.043	0.520	-0.005	-0.480
	Obs.	10446		2102		3555		3307		13764	
	F test	F(312, 10133)=15.29**		-		F(278, 3276)=1.1		-		F(313, 13450) = 42.41	
	R^2	0.2385		0.1027		0.0992		0.1183		0.6774	

* indicates statistical significance at 10 %, ** indicates significance at 1%.

6. Conclusions and Policy Recommendations

This study quantifies the influence of mergers on the level of interest payable on retail deposits and loans, and cost efficiency for UK banks. Initially, UK bank mergers are seen to be cost efficiency enhancing. This finding is consistent with past work of Haynes and Thompson (1991) and indicates that the time over which efficiency gains are realised is substantial, with statistically significant efficiency gains appreciated even five years after the merger event.

The effect of bank mergers on retail interest rates is mostly statistically insignificant. This finding is in many regards at odds with findings reported for the US (Prager and Hannan 1998) or Italian (Focarelli and Panetta 2003) banking markets, where mergers are seen to have a stronger and negative influence on interest rates. This difference may exist for many reasons, including differences in the market structure of the banking markets considered. This study, distinct from past work, considers a large, and in many regards national, banking market (see Ashton 2001b), as opposed to relatively small regional markets. It is also possible that the influence of bank mergers over market power may be far more limited in larger national markets.

The findings for efficiency and interest rates are broadly consistent with the theoretical framework proposed by Farrell and Shapiro (1990). These authors indicated that large changes in efficiency are required to overcome price rising effects of mergers. The situation where interest rates are in many cases unmoved by moderate efficiency improvements as observed in this study is consistent with this perspective.

To conclude, this study assesses the combined efficiency and price effects which follow banks mergers. It is reported that the degree of pass through from efficiency gains to prices is both limited and varies by product type. These findings contrast with contemporary approaches to assessing the impact of mergers through a proxy such as market share (see Werden 2002). It is proposed that the price and efficiency effects which emerge from mergers may not be clearly understood through assessment of market share change alone. Further, future work assessing the impact of mergers may choose to investigate possible differential pricing and efficiency effects which develop from the merger process.

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Appendix 1: UK bank mergers 1988- 2004

Firm acquired	Firm Acquiring	Time	Firm acquired	Firm Acquiring	Time
Essex Equitable BS	Cheltenham & Gloucester BS	Feb. 1988	Lancastrian BS	Northern Rock BS	July 1992
Rowley Regis BS	Heart of England BS	March 1988	Mid-Sussex BS	Cheltenham & Gloucester BS	Aug.1992
Kidderminster Equitable BS	Heart of England BS	March 1988	Haywards Heath BS	Yorkshire BS	Dec. 1992
North Wilts Ridgeway BS	West of England BS	March 1988	Surrey BS	Northern Rock BS	July 1993
Gateway BS	Woolwich Equitable BS	May 1988	Heart of England BS	Cheltenham and Gloucester BS	Oct. 1993
City of London BS	Chelsea BS	July 1988	Bexhill-on-Sea BS	Bradford & Bingley BS	Nov. 1993
Aid to Thrift BS	Cheshunt BS	July 1988	St Pancreas BS	Portman BS	Dec. 1993
Bolton BS	Cheltenham & Gloucester BS	Oct. 1988	North of England BS	Northern Rock BS	Oct. 1994
Bury St Edmunds BS	Cheltenham & Gloucester BS	Jan. 1989	Tynemouth BS	Universal BS	Oct. 1994
Regency	West of England BS	May 1989	Leeds Permanent BS	Halifax	Aug. 1995
Portman BS	Wessex BS	July 1989	Cheltenham and Gloucester	Lloyds	Aug. 1995
Bedford BS	Cheltenham & Gloucester BS	April 1990	TSB	Lloyds	Dec. 1995
Guardian BS	Cheltenham & Gloucester BS	April 1990	City and Metropolitan BS	Stroud and Swindon BS	April 1996
Sheffield BS	Bradford & Bingley BS	June 1990	National and Provincial BS	Abbey National	Aug. 1996
Peckham BS	Cheltenham & Gloucester BS	July 1990	Bristol and West	Bank of Ireland	July 1997
Frome Selwood Permanent BS	Stroud & Swindon BS	July 1990	West Cumbria BS	Cumberland BS	July 1997
Walthamstow BS	Cheltenham & Gloucester BS	Oct. 1990	Greenwich BS	Portman BS	July 1997
Portman Wessex BS	Regency	Oct. 1990	Cater Allen	Abbey National	July 1997
Eastbourne Mutual BS	Sussex	Oct. 1990	Birmingham Midshires	Halifax	April 1999
Portman Wessex BS	West of England	Oct. 1990	Standard BS	Mercantile BS	Sep. 1999
Louth Mablethorpe & Sutton BS	Bradford & Bingley BS	Nov. 1990	Nottingham Imperial BS	Newcastle BS	Feb. 2000
Hendon BS	Bradford & Bingley BS	March 1991	Natwest	Royal Bank of Scotland	Feb. 2000
Hampshire BS	Bradford & Bingley BS	June 1991	Gainsborough BS	Yorkshire BS	May 2001
Portsmouth BS	Cheltenham and Gloucester	June 1991	Derbyshire BS	Ilkeston Permanent BS	July 2001
Leamington Spa	Bradford and Bingley	July 1991	Woolwich	Barclays	Nov. 2001
Bedford Crown BS	Cheltenham & Gloucester BS	July 1991	Bank of Scotland	Halifax	Nov. 2001
Mornington BS	Britannia BS	Oct. 1991	Ilkeston Permanent BS	Derbyshire BS	Aug. 2002
Cheshunt BS	Bristol and West BS	Dec. 1991	Clay Cross BS	Derbyshire BS	Dec. 2003
Southdown BS	Leeds Permanent BS	April 1992	Legal and General Bank	Northern Rock	Dec. 2003
Town and Country BS	Woolwich BS	May 1992	Staffordshire BS	Portman BS	Dec. 2003
			Mercantile BS	Leeds and Holbeck BS	Aug. 2006

Appendix 2: Cost Efficiency model coefficient estimates

lnc	Coeff.	Std. Err.	lnc	Coeff.	Std. Err.	lnc	Coeff.	Std. Err.
Constant	-0.218	(0.892)	χ_{11}	-0.238**	(0.054)	θ_{122}	0.007	(0.096)
β_1	0.212	(0.188)	χ_{22}	-0.191**	(0.063)	θ_{131}	0.148	(0.097)
β_2	-0.502	(0.307)	ω_{11}	0.156**	(0.041)	θ_{132}	-0.143	(0.101)
β_3	-0.692**	(0.148)	ω_{22}	-0.122	(0.080)	θ_{231}	-0.454**	(0.103)
α_1	2.651**	(0.282)	ω_{33}	-0.033**	(0.012)	θ_{232}	0.368**	(0.107)
α_2	-1.919**	(0.280)	χ_{12}	0.213**	(0.057)	ϑ_{121}	0.145	(0.089)
γ_{12}	0.014	(0.030)	ω_{12}	-0.091	(0.061)	ϑ_{122}	-0.104	(0.092)
γ_{13}	-0.017	(0.026)	ω_{13}	-0.044*	(0.018)	ϑ_{131}	-0.021	(0.089)
γ_{23}	-0.016	(0.026)	ω_{23}	0.192**	(0.046)	ϑ_{132}	-0.034	(0.094)
ψ_{12}	0.125*	(0.053)	σ_{11}	0.061	(0.042)	ϑ_{231}	0.177*	(0.097)
ψ_{13}	-0.004	(0.039)	σ_{12}	-0.040	(0.097)	ϑ_{232}	-0.066	(0.102)
ψ_{23}	-0.030	(0.049)	σ_{13}	0.200**	(0.042)	o_{121}	0.056	(0.074)
τ_{12}	-0.093*	(0.046)	σ_{31}	-0.058	(0.040)	o_{122}	0.013	(0.077)
τ_{13}	0.000	(0.000)	σ_{32}	0.140	(0.100)	o_{131}	-0.212*	(0.093)
τ_{23}	-0.008	(0.053)	σ_{33}	-0.205**	(0.046)	o_{132}	0.160*	(0.096)
ρ_{12}	0.105*	(0.043)	κ_{121}	0.334**	(0.082)	o_{231}	0.074	(0.099)
ρ_{13}	-0.106**	(0.031)	κ_{122}	-0.251**	(0.082)	o_{232}	0.027	(0.103)
ρ_{23}	0.175**	(0.035)	κ_{131}	-0.185*	(0.096)	ζ_{11}	-0.304**	(0.091)
φ_{12}	-0.020	(0.018)	κ_{133}	0.104	(0.097)	ζ_{22}	0.211*	(0.096)
ϖ_{12}	-1.202**	(0.266)	κ_{231}	0.271**	(0.095)	ϕ_{11}	0.129*	(0.058)
π_{12}	-0.017	(0.018)	κ_{232}	-0.239*	(0.095)	ϕ_{22}	-0.077	(0.060)
η_{12}	-1.353**	(0.118)	θ_{121}	-0.034	(0.090)	ϕ_{33}	0.017	(0.057)
Number of Observations = 1394						Log likelihood = -294.487**		
Wald Test = 46490.77						Number of Parameters = 65		

* indicates statistical significance at 10 %, ** indicates significance at 1%.