Technology and Intermediation: the Case of Banking

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Abstract

The aim of this paper is to look at ways in which the contribution of investment in technology to consumer welfare might be measured. One useful approach to this question is demonstrated by means of a simple spatial model of trade and transportation. The model is used to elaborate on a discussion found in Melvin (1990). The empirical part of the paper deals with the banking sector. A key function of the banking system is to facilitate intermediation between borrowers and lenders. Taking this, perhaps, somewhat restricted view of banks, the measure demonstrated with the spatial model is applied within the framework of a complete banking model to see, specifically, if intermediation costs have been reduced by technology. Using data for the commercial banking sector in Ireland over the period January 1986 to August 1996, we find that the gains from technology in the provision of banking services, provided they exist, have not been passed on to the bank customers in the form of a lower bank interest rate spread.

Keywords: intermediation, interest rate spread, technology, banking

JEL Classification: G21, L11, O3
1 Introduction

Service industries—most notably banking and financial services—are fast becoming very capital intensive as they invest in computers and in other new information technology (IT). It is difficult to show the precise magnitude of this investment in specific instances or over time but the aggregate figures are suggestive. Table 1 illustrates how, across a number of OECD countries, the typical share of investment consumed by the financial services sector now exceeds that of manufacturing as a whole. Static snapshots of investment reveal, for example, that about 80% of information technologies (computers, communications equipment, telephone PBX systems) sold in the United States and nearly three quarters of the computer systems sold in Britain are purchased by service industries. Indeed, six service industries (air transport, telecommunications, retail and wholesale trade, health care, banking and insurance) are estimated to account for half of all IT expenditures by industry. The annual IT investment of these industries grew by 70% over the last decade (Wyckoff, 1996).

The impact of this investment must be significant in the way in which the different service sectors who are making this investment perform. Some of the consequences of technological improvements in the financial and banking sectors can be seen quite readily. The rise of ATM networks in banking has resulted in substantial, though largely unmeasured, time savings for consumers (Griliches, 1994). On the negative side, the inexorable rise of telephone-based financial services has had a serious effect on employment in branch-based banking. This is certainly true of the United Kingdom where it has been recently estimated that the big four UK clearing banks have cut 76,000 jobs and closed 2,000 branches (Sunday Telegraph, August 18, 1996). While it is likely that there are many factors involved in determining the staffing and the branch networks of banks, it does seem likely that information technology is going to be a key driving force in determining both the staffing levels and the distribution strategies of the banking sector.

In response to the argument that new banking products and substantial improvements in convenience for bank customers are the tangible proof of the new technology, Melvin (1990, p. 733) has this to say:

Certainly it is true that there is a wider range of banking services available, and it is generally agreed that a larger choice makes a consumer better off. At the same time it seems clear that the increase in utility very much depends on how these new products differ from the old. Having twelve brands of cornflakes on the supermarket shelf as opposed to four would generally not be
regarded as a great advance.

The managers of firms will say that they invest in IT not only to reduce costs but also to improve quality, increase product variety, speed up responsiveness and enhance customer service (Brynjolfsson, 1996). These intangible benefits are largely ignored in conventional output and productivity statistics because they are difficult to measure, aggregate and value. There is a general measurement problem in relation to the services sectors of the economy (Melvin, 1990). This problem has become more significant with the growth in importance of services in the economy (Griliches, 1994). The standard issue in relation to services has always been how we might measure the output. A trickier problem is how to measure any improvements in that output or in consumers welfare that might be due to new investment or innovations. The technical issues involved are addressed in Brynjolfsson (1996) and in Bresnahan (1986), and in references therein. This is a topic that can, perhaps, be best discussed within the framework of intermediation activities and intermediation costs in the economy. Intermediation, including especially intermediation in the nonfinancial sectors, is a very significant part of the modern economy. Intermediation activity includes retail trade, wholesale trade, financial services, transportation and some business and other services. Spulber (1996) has recently suggested that intermediation accounts for over a quarter of the U.S. economy. Thus, the impact of technological improvements on the performance of the intermediation sector is clearly an important issue.

The aim of this paper is to look at ways in which the contribution of investment in technology to consumer welfare might be measured. One useful approach to this question is demonstrated by means of a simple spatial model of trade and transportation. The model is used to elaborate on a discussion found in Melvin (1990). The empirical part of the paper deals with the banking sector. A key function of the banking system is to facilitate intermediation between borrowers and lenders (Jayaratne and Strahan 1996, Spulber 1996). Taking this, perhaps, somewhat restricted view of banks, the measure demonstrated with the spatial model is applied within the framework of a complete banking model to see, specifically, if intermediation costs have been reduced by technology. The data and the econometric evidence relate to the commercial banking sector in Ireland over the period January 1986 to August 1996.

The paper is organised as follows: Section 2 analyses a model of trade and transport, section 3 introduces a complete banking model of the determination of the bank spread and estimates the determinants of the spread for the Irish banking system with special emphasis placed on the technology factor. Finally, Section 4 incorporates our main conclusions.
2 A Simple Model of Trade and Transport

The treatment of the trade and transport model presented here follows that found in O'Sullivan (1981). It is assumed throughout the discussion that perfect competition and constant returns to scale apply in both production of the product and in transport. It is standard to describe the demand for transport as a derived demand. Transport is not desired for its own sake; rather, its worth derives from the access it provides to other goods and services. The derived nature of the demand for transport can be seen most clearly if we take the simple example of trade in a good between two regions. Suppose the product is bread, which is produced and consumed in both regions \( A \) and \( B \). Without any trade between the two regions the price in each region will be determined by local supply and demand conditions.

The two prices can be defined as \( P_A \) and \( P_B \). If a price difference exists between the two regions there is an incentive to buy the product in the low priced region, transport it, and sell it in the high priced region as long as the price difference is greater than the cost of transport i.e., \( P_A - P_B > T_{AB} \), where we assume that price is higher in region \( A \) than in region \( B \). Thus the two prices, \( P_A \) and \( P_B \), and the cost of transport, \( T_{AB} \), determine the effective price gap and the likelihood that a certain amount of trade will occur. If the cost of transport between region \( A \) and region \( B \) decreases, due perhaps to investments in improved facilities or increased efficiency, then the effective price gap between \( A \) and \( B \) increases and along with it trade and the volume of transport. Furthermore, one would expect trade to persist, increasing price in region \( B \) and lowering it in region \( A \), until the price difference just equalled the cost of transport.

To analyse this last result it is useful to first draw excess supply and demand curves for the two markets jointly (Figure 1). In Figure 1 the two markets are placed back to back. At every price we can read off how much demand exceeds supply or vice versa in each market and construct the excess supply and excess demand curves, shown as \( XS \) and \( XD \) in Figure 1. The equilibrium level of trade between the two regions is now found as the position where the gap between excess supply and demand equals the cost of transportation. We now look at variations in the cost of transport. In the limit, when transport costs are zero, the maximum amount of trade will occur and is given by the intersection of \( XD \) and \( XS \) corresponding to point \( R \) on the quantity axis. This point can be projected down onto the transport quantity/costs graph, quadrant iv in Figure 1, at \( T_m \). If transport costs exceed \( FH \) (\( OC_m \) in quadrant iv), then no trade will occur and the demand for transport will also be zero. The demand curve for transport may be constructed by joining the two points \( C_m \) and \( T_m \) in Figure 1, quadrant
(iv). If transport costs are $C^*$, then $T^*$ is the quantity of transport used and the equilibrium prices for the two goods in the two regions, $P_A^*$ and $P_B^*$, can be determined simultaneously. If the cost of transport falls to $C^{**}$, again because of investment in improved facilities or increased efficiency, then $T^{**}$ is the quantity of transport demanded and the equilibrium prices are $P_A^{**}$ and $P_B^{**}$ (see Figure 1). The output of the transport sector can be measured by multiplying the commodity price difference between the two regions by the total number of units transported, i.e., $(P_A^{**} - P_B^{**})T^{**}$. The second measurement issue is the value of the technological improvement in terms of the welfare of the general consumer.

The conventional approach to see if some innovation serves to lower the price of a consumption good, is to look at the resulting area under the demand curve for the good (adjusted for income effects). This area defines the total value of consumer's surplus and is a welfare index.

$$\text{Surplus} = \int_{P_0}^{P_1} \text{Demand}(\text{Price}, \text{Income}) \ d(\text{Price}) \quad (1)$$

Bresnahan (1986), see also Brynjolfsson (1996), has shown that the area under the derived demand curve for an intermediate input (adjusted for income effects), i.e., the area defined as $C^*ESC^{**}$ in Figure 1, is a welfare index as well. As Brynjolfsson (1996, p. 284) notes:

In a competitive market producers who purchase an intermediate good act as proxies for the ultimate consumers: they will purchase exactly the quantity that maximizes consumer welfare at any given price. Therefore, the area under the derived demand curve for the intermediate good furnishes a correct estimate of consumers' surplus from the intermediate good. Furthermore, when competition is imperfect, producers will also get benefits in the form of profits from selling a good so the area under the demand curve will generally underestimate total surplus created by a price change.

For the trade and transport model, O'Sullivan (1981, p.90), based on a paper by Harrison and Holtermann (1973), also provides a specific demonstration of the equivalence of transport benefits and final market benefits.

Similar to the role of transport discussed above, a key function of the banking system is to facilitate intermediation between borrowers and lenders (Spulber, 1996). Investment in IT should reduce the cost of this intermediation, and it should be possible to gauge the contribution of this investment.
to consumer welfare through the measure of consumer surplus. The consumer surplus, in the case of the transport innovation, is given by the area under the derived demand curve, $C^*E S C^*$, in Figure 1. There is, however, an alternative way of looking at the impact of the transport improvement (Melvin, 1990, p.732). With competitive conditions and constant returns to scale, a doubling, say, of the efficiency of transport will mean that the same output can be produced with exactly one-half of the previous factor requirements. The output of the transport sector, as noted above, is found by multiplying the commodity price difference by the total number of units of output transported. If the efficiency of the transport sector doubles, then this implies that the per unit cost of transporting a unit of bread must be halved. Thus, the comparison of the price spreads for bread between regions A and B before and after the technological change gives an exact measure of technological improvement. In an analogous fashion, a measure that indicates how beneficial investment in technology has been to bank customers is the extent to which the loan deposit interest rate difference is reduced as a result of technological investment. The empirical analysis in the next section models the behaviour of this interest rate difference.

3 Determinants of the bank interest rate spread

3.1 A simple theoretical framework

As the size of the bank loan-deposit interest rate spread depends on a host of other economic variables, in addition to the state of technology in the provision of banking retail services, the regression model should account for these control variables. Intermediation is the most important function of banks and arises from the existence of transactions costs and information costs. Benston and Smith (1976) claim that the raison d'être of financial intermediaries is transactions costs. On the other hand, Leland and Pyle (1977) and Diamond (1984), among others, emphasise information costs. The cost of transacting is dependent upon the state of technology and government regulation. Technology in the provision of retail banking services (e.g., ATM networks) is expected to reduce the unit cost of transactions and hence the cost of intermediation and the size of the spread\(^1\). The logic of this argument was illustrated in the previous section. Regulation (e.g., price controls, supervision) restricts intermediaries from operating as efficiently as they otherwise would. Due to the existence of asymmetric information,\(^1\)

\(^1\)Becsi and Wang (1997) model, in an endogenous growth framework, the relationship between technology and the size of the spread. One implication of their model is that the loan-deposit interest rate differential is a positive function of the costs of intermediation.
banks would necessarily be exposed to default risk. This risk would add on a risk premium to loan rates and the spread.

In addition, the size of the spread would be determined by market concentration and bank's exposure to interest rate risk. As discussed in the next section, the direction of the effect of market concentration on the spread is ambiguous. Banks may adjust their loan-deposit interest rate margin (weighted by the volume of loan and deposits) to minimize their exposure to interest rate risk arising from fluctuations in market interest rates.

In summary, economic theory suggests that the spread's size would be affected by (a) technological developments that affect the cost of the bank's issuing of deposit and loan accounts and reduce the cost of intermediation, (b) the degree of market concentration that affects bank profitability, (c) regulatory constraints that prohibit the bank from undertaking certain profitable activities and increase the cost of providing permissible activities (d) credit risk that reduces expected profits and (e) interest rate risk\(^2\) (Jaffee, 1989). The higher the size of the spread, the higher the cost of intermediation and the less efficient intermediation is.

Empirical evidence also suggests that bank deposit rates, loan rates and the spread would be sensitive to changes in market interest rates (Hannan and Berger, 1991; Heffernan, 1993). Heffernan (1997) reports that the popular press in the UK has criticized banks for not passing declines in the base rate on to their loan customers. Similar concerns have been expressed by the Irish press in recent years where declines in market interest rates have been associated with possible increases in the bank spread. However, from a theoretical point of view, the effect of changes in market interest rates on the spread is ambiguous.

Based on the above analysis, we formulate the following model:

\[
S_t = \alpha_0 + \alpha_1 C_t + \alpha_2 T_t + \alpha_3 R_t + \alpha_4 I_t + \alpha_5 C_t
\]

(2)

where \(S_t, C_t, T_t, R_t, I_t, C_t\), stand for the interest rate spread, market concentration, technology in the provision of banking services, bank regulation, market interest rate and credit risk, respectively. The anticipated signs of the \(\alpha\)'s are discussed below.

\(^2\)Zarruk (1989), Zarruk and Madura (1992) and Wong (1997) explore the determinants of optimal bank interest rate margins using simple firm-theoretical models under one or more sources of uncertainty and risk aversion. Their theoretical findings have been supported by empirical evidence (e.g., Ho and Saunders, 1981; Angbazo, 1995).
3.2 Variable measurement and data

In the model, the degree of competition is measured by the Herfindhal index and a market share variable, technology is proxied by the number of ATMs operated by the Associated Banks and a linear time trend, changes in regulation are proxied through the inclusion of dummy variables, credit risk is measured by the bank private loan/asset ratio and the market rate is measured by the one-month interbank rate. All series are taken from various issues of the *Quarterly Bulletin* of the Central Bank of Ireland except for the interest rate spread that has been calculated by the Central Bank staff.

As said earlier, this study focuses on the Associated Banks, i.e., the largest four banks in the Irish banking market. To calculate the spread, we proceed as follows: first, the weighted deposit rate is calculated by multiplying the deposit rate in each particular category of deposits by the proportion of the particular bank’s total deposits accounted for by that category of deposits. In other words, the weighted deposit rate reflects both the rate paid on each deposit category and the pound amount in each deposit category. The same procedure is applied to the bank’s loan portfolio where loan categories differ in terms of default risk and term to maturity. To derive the interest rate spread, we subtract the weighted deposit rate from the weighted loan rate\(^3\). Even though our data frequency is monthly, data on interest rate spreads are not available for each month as the Central Bank calculates the weighted loan and deposit rates only at periods (months) when the Central Bank adjusted its short-term facility rate, i.e., the rate at which it lends to the banking sector. In total we have 44 time series observations for the period January 1986 to August 1996. The beginning of the sample is chosen to coincide with the changes in the arrangements effective until 1986 that provided for consultation with the Central Bank whenever Associated Banks adjusted their retail deposit and loan rates. According to the new mechanism in place since the beginning of 1986, changes in the retail rates were linked to movements in market rates, in particular the one-month interbank rate (Kelly, 1993).

Two proxies are used in measuring concentration in the retail banking markets. First, in agreement with the literature on the profits/price-concentration relationship in banking, we use the Herfindhal index (\(H\)-index) for deposits and loans, defined as follows:

\[
H = \sum_{i=1}^{3} a_i^2
\]

\(^3\)Due to data confidentiality, these calculations were performed by the Central Bank of Ireland.
where \( c_z \) stands for the share of the total volume of loans plus deposits of the \( z \)th group of financial institutions. As we are concerned with the provision of banking services to the private sector, our proxy for loans is the non-government credit and our proxy for deposits is the value of non-government deposits. Our focus on the values of loans and deposits is in agreement with the intermediation approach in measuring bank output where bank output is treated as a stock variable (Heffernan, 1996). The three groups of banking institutions we consider are the Associated Banks, the Non-Associated Banks and the Building Societies. These three groups of institutions accounted for more than 90\% of the total non-government deposits and non-government loans of all Credit Institutions in the Irish banking market in August 1996. The group ‘Other Credit Institutions’ is not included in the construction of the \( H \) index since these institutions were formed in the late 1980s and hence the data on them are not available across the full sample period\(^4\). A larger value for the \( H \) index would imply a higher level of concentration in the banking industry. A plot of the time series for the \( H \) index (Figure 2) shows that even though concentration fell around the middle of the sample period, it started increasing again towards the end of the sample period. Our second proxy for market concentration is the share in total deposits and loans of the three groups of banking institutions that is accounted for by the Associated Banks.

From a theoretical point of view, the effect of concentration on the spread is ambiguous. According to the structure-performance hypothesis, the association between deposit rates and a measure of concentration would be negative and hence the association between the spread and concentration would be positive. More concentration implies more market power and, therefore, less favourable prices to consumers. In the case of the banking industry, this takes the form of a higher interest rate spread. In contrast, according to the efficient-structure hypothesis, concentrated markets are dominated by efficient firms. If greater efficiency is reflected in lower marginal cost of production, banks would offer more favourable interest rates to their customers; hence, a smaller spread (Berger and Hannan, 1989). In summary, this theory predicts a negative relationship between concentration and the spread\(^5\). This approach has been recently criticised (Berger, 1995) as, by

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\(^4\)The reporting institutions to the Central Bank of Ireland are classified under five headings: Associated Banks, Non-Associated Banks, Building Societies, Other credit institutions and the Hire-Purchase Finance Companies. ‘Other credit institutions’ includes the ACC bank, the ICC Bank, the ICC investment bank Limited and the TSB bank. Since the share of these institutions and the finance companies in the total volume of loan and deposits is very small, they are excluded from our study in measuring bank concentration. Note that since 1997, the Central Bank has changed the classification of reporting institutions. However, as our sample stops in August 1996, this change does not affect the construction of our data series.

\(^5\)Note that here we focus on the price-concentration relationship as opposed to the
not explicitly measuring efficiency (both scale efficiency and X-efficiency), the model is misspecified and conclusions drawn can be misleading. However, as our objective is not to test for the structure-performance or the efficient-structure hypothesis, this criticism does not apply in our case.

Measuring technology represents a challenging issue. We have decided to use the number of ATMs operated by the Associated Banks as a proxy. This approach is also followed by Melnick (1995) in dealing with a different topic. It is expected that improvements in technology are reflected in the growth in the number of ATMs. Heavy use of ATMs should be expected to lead to a lower per unit cost of transactions because of the network effects (economies of scale) associated with the ATM network. Since the cost of an ATM transaction is significantly lower than that of a cashier transaction, bank operating costs arising from transactions costs should be falling over time. As the available data start only in April 1988, we provided for the missing observations before this date by fitting a linear trend to the available data and replacing the missing values with the fitted values. Since data on ATMs are unavailable for some months, we have filled in the gaps in each case using the figure for the most recent available month. To check on the robustness of our results, we have followed the empirical literature on money demand (Goldfeld and Sichel, 1990) and employed also a linear time trend as an alternative proxy for technology. It is anticipated that improvements in technology would imply lower bank operating costs and, provided banks pass on their cost savings to their customers, a smaller interest rate spread.

Changes in the regulatory environment affecting the behaviour of banks in the loan and deposit markets are captured through the use of dummy variables. Two crucial changes in Central Bank regulation of bank activities took place during our sample period. First, starting on 20 March 1991, there was a gradual reduction in the standard primary liquidity ratio from 10% to 8%. This was followed by a further seasonal reduction to 6% in November 1991 that became permanent in February 1992 (Kelly, 1993). This reduction in the liquidity ratio was designed to improve the capacity of the Irish financial institutions to compete against institutions from other member states following the launch of the Single Market programme. To capture this fall in the reserve requirement (the ‘tax’ on bank reserves), we included a dummy that takes a value of 1 starting in April 1991, our first observation following the March 1991 change in the reserve requirement. It would be expected that the lax regulatory environment would allow banks to profit-concentration relationship. In the latter, both structure-performance and efficient-structure hypotheses would predict a positive association between bank profits and concentration (Berger and Hannan, 1989).

It has been estimated that the cost of an ATM transaction in the US is about 50% of the cost of a teller-assisted transaction whereas in the UK the figure is around 25%.
pass on the 'tax' savings to their customers in the form of a lower interest rate spread. Hence, the dummy should have a negative sign. The second major change in regulation was the additional discretion given by the Central Bank to the Associated Banks in setting their retail rates effective July 1991. This change is captured by a second dummy that takes the value of 1 starting in December 1991, the first available observation following the change. It would be expected that following this, banks were given more freedom in setting their retail rates and the spread would widen as banks tried to increase their profit margins; hence a positive sign for the estimated coefficient of the second dummy variable.

In measuring bank credit risk, in agreement with previous literature (Ruthenberg and Elias, 1996), we use the ratio of bank loans to the private sector to total assets. An increase in the size of this ratio would indicate higher bank exposure to risk and therefore loan rates and the spread would be adjusted upwards to compensate for the additional risk taking.

Finally, a proxy for the market interest rate, the one-month interbank rate, is included in the regression to account for the influence of market rate adjustments on the retail interest rate setting. Empirical evidence in the US has concluded that the market rate does not have a proportional effect on the two components of the spread (see Hannan and Berger, 1991, for evidence on the sluggish adjustment of the deposit rate) thus implying that the size of the spread should be sensitive to market interest rate swings. Theoretically speaking, the direction of the influence of changes in market interest rates on the spread would depend on optimal bank setting of their weighted retail rates when minimising their exposure to interest rate risk. Cronin (1995) using Irish bank data finds that in response to changes in interbank rates, the Associated Irish banks adjust their weighted loan and deposit rates proportionally, thus leaving their margin constant.

3.3 Empirical results

Our estimated model is a variant of equation (2). Using two dummy variables to capture the influence of regulation on the bank spread, we formulate the following linear regression model:

$$ S_t = \beta_0 + \beta_1 C_t + \beta_2 T_t + \beta_3 D_{1t} + \beta_4 D_{2t} + \beta_5 I_t + \beta_6 C r_t \tag{3} $$

$D_{1t}, D_{2t}$ are dummy variables that capture the change in the primary liquidity (reserve) ratio and in the framework of setting bank deposit and loan rates, respectively. Our discussion in the previous section implies the fol-
lowing parameter signs: $\beta_2 < 0, \beta_3 < 0, \beta_4 > 0, \beta_5 > 0$. The signs of $\beta_1$ and $\beta_5$ are ambiguous.

We estimate the model in logs using the levels of the series in a time-series framework for the period January 1986 to August 1996\textsuperscript{7}. However, given the shortness of our sample period and the well known low power of unit root tests in small samples (Campbell and Perron, 1991), we have not considered the issue of potential non-stationarity of our time series. Our estimation procedure is the method of OLS. Table 2 reports our results. We report results for six regressions. The regressions differ with respect to whether a lagged endogenous variable is included, the proxy for technology and the proxy for market concentration. In those cases where residual serial correlation and heteroskedasticity apply in our results according to the Godfrey and LM(1) statistics, respectively, we have adjusted the OLS standard errors using the Newey-West (1987) approach with Bartlett weights that provides autocorrelation- and heteroskedasticity-consistent standard errors. This approach is sufficiently general so that standard errors are robust to a variety of forms of heteroskedasticity and autocorrelation of the residuals of the regression. The results turn out to be robust to various choices of the truncation lag. Therefore, Table 2 reports only the results for truncation lag set at 2.

According to Table 2, most variables are highly significant and have the expected signs. The overall fit of the regressions is good as at least 70% of the variability of the spread is explained by the regressors. Several important points arise from Table 2. First, the impact of technology on the spread is positive and in most cases highly significant (at 1%). This result is robust to the choice of the proxy employed for technology. This suggests that the Associated Banks have not passed their cost savings on to their customers in the form of a lower spread. On the contrary, the spread has increased in response to improvements in technology. However, the algebraic effect on the spread is very small and, based on the estimated regressions 3 and 6, has a maximum value of about five basis points.

Second, concentration in the banking market (measured by the $H$-index or the market share) has a negative and statistically significant impact on the spread. As discussed earlier, this result seems to be consistent with the efficient-structure hypothesis. The caveat mentioned earlier should be kept in mind though, i.e., this result does not prove that the efficient-structure hypothesis is true. In general, the international literature on the price-

\textsuperscript{7}A cross-section study would allow for more variability in the regressors provided a large cross-section of banks was available. This does not apply for the Irish banking system that includes a small number of banks. Moreover, most data on individual banks are confidential.
concentration relationship seems to be mixed (e.g., Berger and Hannan, 1989; Ruthenberg and Elias, 1996).

Third, the two dummy variables, that measure the impact of government regulation, have the expected signs across all estimated regressions and are highly significant in most cases. According to the estimated coefficients for the first dummy, the reduction in the liquidity ratio post-1991 led to a decline in the spread to the tune of between 41 and 90 basis points (approximately between one half and one percentage point) depending on the choice of the estimated regression. The impact of the retail bank rate deregulation on the spread was an average increase of 25 to 62 basis points. Fourth, the loan-to-asset ratio measuring credit risk has a positive impact on the spread and is significant in some cases. Fifth, the market interest rate is not statistically significant, a finding that squares with Cronin (1995). Finally, the lagged spread is highly significant indicating a sluggish intertemporal adjustment in the size of the spread.

3.4 Discussion

The results have shown that the productivity gains in intermediation, which should accompany technology, are not being passed on by the banks as cost savings to their borrowers or lenders. There are a number of explanations that might account for where the gains possibly go and these are briefly discussed here. The proliferation of new banking products and other financial services is one obvious area where technology can be seen at work. The introduction and phenomenal growth of the ATM system is the classic example. This has brought substantial convenience benefits to customers but no pecuniary benefits, at least not in the Irish context. Although no direct evidence is available, it would appear reasonable to assume that the per unit cost of servicing an ATM transaction has fallen dramatically, yet the user cost per ATM transaction charged by the Associated Banks has increased over time (Table 3). Thus, pecuniary gains to bank customers, in the form of lower interest rate spreads or lower user charges for technology-supported services, like the ATM, are not there. The exception to this conclusion is the availability, under certain conditions, of free banking services to bank customers.

A second possibility is that, while some of the gains in question may be lost through possible inefficiencies, the bulk of these are being captured by the banks themselves in the form of increasing profits (Table 4). There has indeed been a remarkable growth in the profits of the two major Associated Banks, Allied Irish Bank and Bank of Ireland, since 1992.
The final possibility is that, the banks, in fact, suffer from various inefficiencies — technical inefficiency and scale inefficiencies — which inhibit the realisation of any productivity gains associated with investment in technology. Lucey (1993) has recently reported evidence for extensive technical inefficiencies and scale diseconomies in the Irish banking system which can be used to support this explanation.

4 Conclusions

An important component of the social benefits of investment in new technology is the spillover to the customers of the sectors where this investment is taking place. Investment in IT should, ceteris paribus, result in lower intermediation costs charged by banks to their customers. Based on a earlier discussion by Melvin (1990), this paper has outlined a model that demonstrates the logic of this result and how the benefits to customers might be measured. The empirical evidence presented in the paper on loan deposit interest rate margins suggests that, at least in the Irish banking context, this has not happened. Some tentative explanations are suggested as to where these benefits have gone.

The conclusion of this paper is that, at least in the Irish context, technology has brought no pecuniary benefits to bank consumers. The question of the quality of the intermediation provided by banks through the use of technology is also important as is the increase in customer convenience and in product variety. All of these dimensions must be considered in any debate about banking, investment in technology and possible gains to the consumer. They are dimensions that pose a number of interesting but difficult conceptual and measurement issues for economists engaged in the IT value debate.
## Table I: Gross Fixed Capital Formation by Sector and Country, 1993

<table>
<thead>
<tr>
<th>Country</th>
<th>Manufacturing</th>
<th>Services</th>
<th>Wholesale, retail trade &amp; restaurants</th>
<th>Transport, storage &amp; communication</th>
<th>Finance, insurance, business services</th>
<th>Community, personal services</th>
</tr>
</thead>
<tbody>
<tr>
<td>Australia</td>
<td>9.2</td>
<td>64.1</td>
<td>12.6</td>
<td>12.6</td>
<td>41.3</td>
<td>4.7</td>
</tr>
<tr>
<td>Belgium</td>
<td>18.7</td>
<td>60.7</td>
<td>4.6</td>
<td>10.3</td>
<td>27.3</td>
<td>13.9</td>
</tr>
<tr>
<td>Canada</td>
<td>10.4</td>
<td>50.5</td>
<td>7.6</td>
<td>8.3</td>
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<td>3.2</td>
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<td>58.9</td>
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<td>8.4</td>
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<tr>
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<td>6.1</td>
<td>6.7</td>
<td>27.6</td>
<td>18.4</td>
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</tbody>
</table>

**Key:**
- Not available
- 1990
- 2 1985 prices
- 3 1991
- 4 1992
- 5 1993

**Source:** OECD.
### Table 2

**OLS estimation: January 1986-August 1996**

**Dependent Variable: Weighted Spread**

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<th>Regressor</th>
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<th>(3)</th>
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<td>(t-ratio)</td>
<td>(t-ratio)</td>
<td>(t-ratio)</td>
<td>(t-ratio)</td>
<td>(t-ratio)</td>
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<td>(3.21***)</td>
<td>(2.72***)</td>
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<td>(3.17***)</td>
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<td>(1.39)</td>
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<td>(3.09***)</td>
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<tr>
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<td>(-2.62**)</td>
<td>(-3.12***)</td>
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<td>.044</td>
<td>.033</td>
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<td>.050</td>
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<td>(2.33**)</td>
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<td>(1.88*)</td>
<td>(3.32***)</td>
<td>(1.81*)</td>
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<tr>
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<td>-.028</td>
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<td>.143</td>
<td>.266</td>
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<td>(1.14)</td>
<td>(1.94)</td>
<td>(2.61**)</td>
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<td>(1.59)</td>
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\[
\hat{R}^2 = 0.70 \quad \hat{R}^2 = 0.90 \quad \hat{R}^2 = 0.73 \quad \hat{R}^2 = 0.90 \quad \hat{R}^2 = 0.69 \quad \hat{R}^2 = 0.71
\]

<table>
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<tr>
<th>Godfrey = 19.42***</th>
<th>Godfrey = .03</th>
<th>Godfrey = 19.49***</th>
<th>Godfrey = .03</th>
<th>Godfrey = 19.51***</th>
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<td>LM(1) = .61</td>
<td>LM(1) = .16</td>
<td>LM(1) = .61</td>
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</table>

**Note:** The Godfrey test statistic for autocorrelation is a Lagrange Multiplier test for first-order serial correlation. The LM(1) statistic for heteroskedasticity is based on the regression of squared residuals on squared fitted values. Both statistics are distributed as \( \chi^2 \) with one degree of freedom. The reported t-ratios are based on the Newey-West heteroskedasticity- and autocorrelation-consistent standard errors. ***, ** and * indicate significance at 1%, 5% and 10%, respectively. The sample size is 44.
Table 3: User Costs* of Banking Transactions: 1988 - 1996

<table>
<thead>
<tr>
<th>Year</th>
<th>Automatic Transaction: ATM cash withdrawal</th>
<th>Paper Transaction: Staff assisted lodgement/withdrawal</th>
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<tbody>
<tr>
<td>1988</td>
<td>15.0p</td>
<td>19.125p</td>
</tr>
<tr>
<td>1990</td>
<td>14.5p</td>
<td>20.00p</td>
</tr>
<tr>
<td>1992</td>
<td>16.5p</td>
<td>23.25p</td>
</tr>
<tr>
<td>1995</td>
<td>17.25p</td>
<td>24.125p</td>
</tr>
<tr>
<td>1996</td>
<td>17.25p</td>
<td>24.125p</td>
</tr>
<tr>
<td>% Δ</td>
<td>15%</td>
<td>26.1%</td>
</tr>
<tr>
<td>% Δ CPI</td>
<td>23.8%</td>
<td>23.8%</td>
</tr>
</tbody>
</table>

* averaged across the four Associated Banks
Source: Consumer Choice, various issues

Table 4: Profits before taxation (£ml)

<table>
<thead>
<tr>
<th>Year</th>
<th>Allied Irish Bank#</th>
<th>Bank of Ireland##</th>
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<tbody>
<tr>
<td>1997</td>
<td>580</td>
<td>-</td>
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<tr>
<td>1996</td>
<td>421</td>
<td>316</td>
</tr>
<tr>
<td>1995</td>
<td>373</td>
<td>322</td>
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<tr>
<td>1994</td>
<td>341</td>
<td>278</td>
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<tr>
<td>1993</td>
<td>196</td>
<td>121</td>
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<tr>
<td>1992</td>
<td>186</td>
<td>70</td>
</tr>
</tbody>
</table>

# year end 31st. December, ## year end 31st. March
Source: Annual Reports of AIB and BOI
Figure 1. Trade and Transport Model
Figure 2
Herfindahl Index
References


The Sunday Telegraph, “Phone deal smash branches,” 18th August 1996.


Department of Economics

National University of Ireland, Galway

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