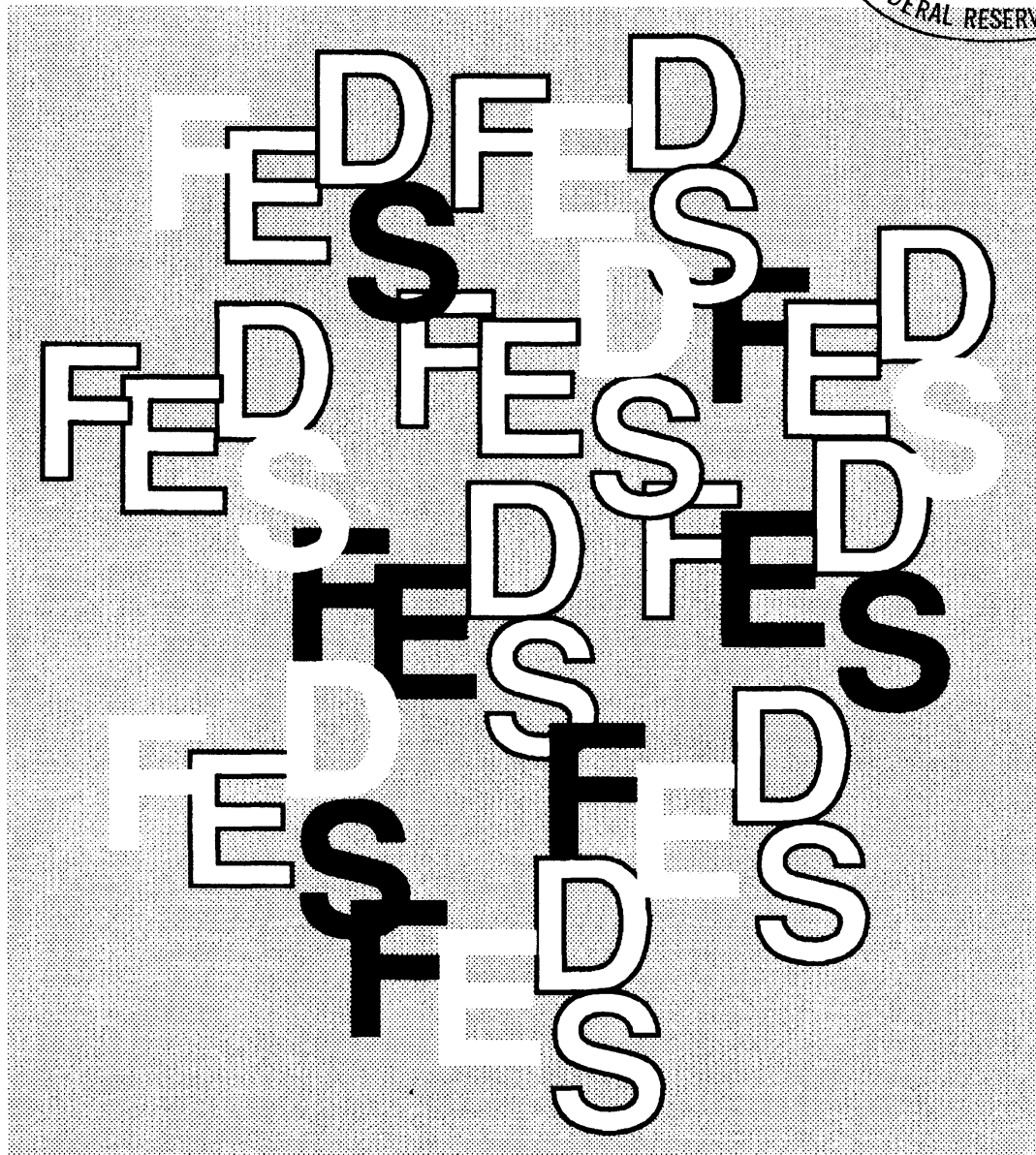
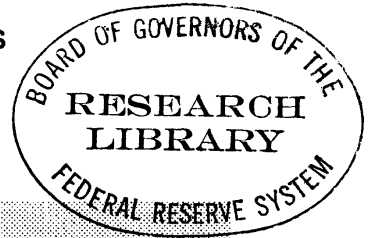




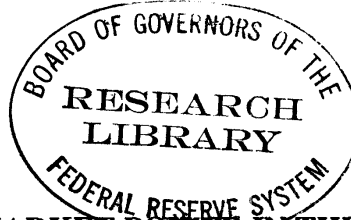
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**THE EFFICIENCY COST OF MARKET POWER IN
THE BANKING INDUSTRY: A TEST OF THE
'QUIET LIFE' AND RELATED HYPOTHESES**

Allen N. Berger and Timothy H. Hannan

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**THE EFFICIENCY COST OF MARKET POWER IN THE BANKING INDUSTRY:
A TEST OF THE 'QUIET LIFE' AND RELATED HYPOTHESES**

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Abstract

Traditional concerns about concentration in product markets have centered on the social losses associated with the mispricing that occurs when market power is exercised. This paper focuses on a potentially greater loss from market power -- a reduction in cost efficiency brought about by the lack of market discipline in concentrated markets. We employ data from the commercial banking industry, which produces very homogenous products in multiple markets with differing degrees of market concentration. We find the estimated efficiency cost of concentration to be several times larger than the social losses from mispricing as traditionally measured by the welfare triangle.

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"The best of all monopoly profits is a quiet life." - Hicks (1935,p.8)

I. Introduction

Traditionally, research and public policy concerns about concentration in product markets have focused on the social costs associated with the exercise of market power at high levels of concentration. The higher prices in concentrated markets bring about a restriction of output relative to the competitive level and thereby misallocate resources. The social cost of this misallocation has been approximated by the familiar welfare triangle representing the difference between the loss in consumer surplus and the gain in producer surplus occasioned by noncompetitive pricing. Attempts to measure this loss have generally resulted in exceedingly low estimates. Harberger's (1954) celebrated work suggested that eliminating monopolistic resource misallocation in manufacturing during the 1924-28 period would have increased social welfare by less than 0.1% of GNP. Rhoades (1982) applied the same methodology to the banking industry and concluded that the "deadweight welfare loss due to monopoly in banking is undeniably very small." (p. 385).

The possibility of a much more significant social loss associated with the exercise of market power has also long been recognized, but not so often measured or focused upon for policy purposes. As suggested by the quote from Hicks above, the reduction in competitive pressure in concentrated markets may result in lessened effort by managers to maximize operating efficiency and minimize costs. Thus, in addition to the traditionally recognized higher prices and reduced output from market power, there may also be more factors of production employed per unit of output in concentrated markets because of slack management. In addition to this "quiet life" effect, there are also several other related mechanisms described below through which market power may result in reduced operating efficiency, increasing the chances that these efficiency losses are economically significant.

Numerous observations of efficiency costs have also been made over the years. Indeed, three decades ago, Williamson (1963), Leibenstein (1966), and others found very substantial cost differences within industries owing to inefficiencies. Scherer (1970) speculated that efficiency

losses from concentration may be as high as 10% of costs -- which would greatly exceed the social value of losses from mispricing as measured by the welfare triangle -- but the reasonableness of this educated guess has still not yet been firmly established. It seems quite plausible that the losses in cost efficiency associated with market power would exceed the social losses measured by the welfare triangle, since the cost efficiency losses may apply to every unit of output in an industry, not just to the marginal change in output associated with an elevated price. That is, the extra revenue raised from the higher prices on every unit of output in a concentrated market may possibly be lost to cost inefficiency, whereas the traditional social losses from mispricing measured by the welfare triangle apply only to the units of output that were not produced and consumed as a result of the higher prices.

Some efforts have been made to estimate directly the relationship between cost efficiency and concentration or other measures of market structure, but data problems make it difficult to draw definitive conclusions from this research. Studies such as Carlsson (1972) and Caves and Barton (1990) have compared efficiency and concentration across industries, but it is difficult to compare relative efficiencies across industries in which products and production technologies are dissimilar. Efficiencies are measured by how close units of production (plants or firms) are to the best-practice units of production observed in the industry, rather than by how close they are to the technological frontier. On purely statistical grounds, this tends to make average industry efficiency higher when the number of units observed is smaller. The statistical properties of small samples are such that the observed best-practice unit will tend to have worse performance when the number of units sampled is small, making all the rest of the units appear to be more efficient. Since concentrated industries tend to have smaller numbers of production units, this may bias estimates of the relationship between market structure and efficiency, or at least complicate their interpretation.

An even larger problem inherent in the interindustry studies is the fact that the measured efficiencies of the different industries may not be comparable to each other at all. Since efficiencies are measured by how close the production units within each industry are to the best-practice units in the industry, measures based on these comparisons may not be indicative of relative efficiencies across industries that each have different frontiers. If there is a relationship

between market concentration and efficiency, then the performance of the best-practice units in each industry are likely to be affected by concentration and market power in a manner similar to other units. In this event, a measure of the average deviation from the best-practice frontier within an industry may not reflect the efficiency effects of market power. For example, if market power raises costs by 10% for every firm in a concentrated industry, there will be no effect on the measured efficiencies of these firms relative to those in an unconcentrated industry, since the frontier moves along with the other firms. We solve this problem in our empirical application by measuring the efficiencies of firms located in markets with different degrees of market concentration against the same frontier.¹

Some studies have taken a different approach and focused on public utilities, avoiding the problems of interindustry studies. For example, Primeaux (1977) and Stevenson (1982) examined utilities producing electric power, which is a homogeneous product. However, data limitations have often allowed for only crude comparisons of regulated monopoly versus some degree of competition, rather than comparisons across the broad range of concentration typically found in product markets. Perhaps a more important problem for these studies is that the prices of public utility products such as electric power are regulated. An important maintained assumption of the quiet life and related hypotheses is that market power allows firms to raise prices and provide extra revenues that may be lost to cost inefficiencies. For this reason, public utility industries may be unrepresentative of the general relationship between market structure and efficiency.

In this study, we try to overcome these potential shortcomings in the extant empirical literature. We focus on a single industry, commercial banking, that produces very homogeneous products with access to virtually the same technologies by all firms. We are able to estimate the efficiency of each of over 5,000 firms by applying frontier efficiency techniques to a very detailed data set that covers a 10-year period. Banking is an industry in which the same products are produced in many geographically limited markets with varying degrees of market concentration.

1. There may also be problems comparing concentration across industries in which the degree of external competition from other industries and nations may differ substantially. For example, the firms in a very concentrated industry may have less market power than those in a relatively unconcentrated industry if the concentrated industry is subject to more competition from imports.

Prices are unregulated in banking, and competition from outside the banking industry is reasonably constant across banking markets. Thus, the effects of concentration on efficiency can be well isolated from confounding influences of interindustry differences in products, technologies, and external competition. Also, unlike the interindustry studies, we do not have the problem of small numbers of observations affecting the location of the best-practice unit, since thousands of observations are used in constructing the efficient frontiers. In addition, we avoid the problem of comparing production units that are measured against different frontiers. We use data on firms that operate in markets with different levels of concentration, but compute their efficiencies against the same frontier so that the measured efficiencies reflect relative performance across markets. In this fashion, we are able to capture the influence of market power on every firm, including the best-practice firm in each market. Presumably, the effects found here translate to other industries and help answer the question of how efficiency varies with concentration, all else held equal.

In addition to the general interest in this topic, the question of whether increased concentration and market power reduces firm cost efficiency may be particularly important to policy analysis of the banking industry. The recent wave of mergers among large banking organizations, particular "horizontal" or "within-market" mergers between banking organizations situated in the same local markets raises concerns about the increase in local concentration. If the "quiet life" and related efficiency-reducing effects of concentration are substantial, they might be considered in the merger approval process along with the traditional concerns about the welfare loss due to mispricing and the safety and soundness of the consolidated enterprise. As well, the effects of market power on bank efficiency could be considered in other legislative and regulatory decisions that affect banking market contestability, such as geographic restrictions on banking, impediments to the issuing of bank charters, and barriers to entry into the production of traditional banking services by nonbank competitors and vice versa.

We estimate how bank efficiencies are affected by local market concentration, controlling for number of factors, including region, state regulation, size, and corporate governance. The data employed in this regression analysis cover 5,263 banks, almost half of all U.S. commercial banks. These banks represent over two-thirds of all U.S. banking assets, since most of the very largest

banks are included. Using multiple samples, multiple estimation techniques, and multiple characterizations of the concentration variable, we find evidence consistent with the hypothesis that firms in more concentrated markets tend to have poorer cost efficiency than other banks, all else held equal. Using the estimated relationship between concentration and efficiency, we estimate the total effect on U.S. banking costs by applying the relationship to the data on all of the over 12,000 commercial banks in the nation. For comparison purposes, we also compute the social welfare loss from higher prices attributable to concentration, as captured by the traditional welfare triangle analysis, using a variety of assumptions.

By way of preview, we find the estimated efficiency cost of concentration to be quite large -- several times larger than the social losses from mispricing as measured by the welfare triangle. The implications of this finding are discussed, along with potential qualifications. This finding, if confirmed by future research, may suggest that policy makers consider efficiency cost implications when making antitrust decisions, merger approvals, and other legislative and regulatory decisions concerning the freeness of competition and the contestability of banking and other markets.

II. The Relationship Between Market Structure and Cost Efficiency

Market structure may influence cost efficiency for one of several related reasons.² First, if market concentration is high and firms are able to charge prices in excess of competitive levels, there may be less pressure on managers to keep unit costs at or near their competitive levels. This lack of market discipline may allow managers to take part of the benefits of the higher prices not as profits, but as a "quiet life" in which they need not work so hard to keep costs under control. Thus, the difference between the actual price and the competitive price provides a "cushion" or comfort zone, and managers may allow unit costs to rise to consume part of this cushion and still allow owners to earn economic rents without the full effort of cost minimization.³

Second, market power may allow managers to pursue other objectives besides raising profits and reducing their own efforts. Managers may engage in expense preference behavior, in which

2. We defer consideration of the causation that may run from efficiency to market structure, which is discussed and addressed empirically below.

3. See Shepherd (1979, pp. 36-7, 132-34) and Caves and Barton (1990) for further discussions and some examples.

they purposely expend resources on some activity that raises costs more than revenues (see Hannan and Mavinga 1980, Rhoades 1980, Mester 1989). These managers might also act in a more risk-averse fashion than preferred by shareholders, expending additional resources to reduce the variation in earnings to protect their own positions, even though this may also substantially reduce the expected value of shareholder earnings (see Rhoades and Rutz 1982). Hermalin (1992) recently established sufficient and quite plausible conditions under which a decrease in competition induces managers to engage in non-profit-maximizing behavior to a greater degree.

Third, there may be further cost efficiency losses associated with the obtaining and defending market power gains (see Tullock 1967, Posner 1975). For example, banks might spend resources on lobbying efforts to restrict the number of bank charters or to preserve geographic restrictions on branching in order to maintain barriers to entry and impediments to competition. Such lobbying efforts would directly reduce operating efficiency by increasing costs expended per unit of output, but might increase profitability by raising prices.

Fourth, the price "cushion" provided by market power may simply allow inefficient managers or practices to persist without any particular purposeful action by bank managers to live a quiet life, to pursue other objectives, or maintain market power gains. Rather, the lack of market discipline in concentrated markets may simply blunt the usual economic signals that would normally force changes in management to keep costs low, leaving managers in positions for which they do not have comparative advantages. Thus, market power may allow managerial incompetence to persist without any willful shirking of work effort, pursuance of other goals, or efforts to defend or obtain market power.

Because it is difficult to distinguish econometrically among these four mechanisms linking high concentration to low cost efficiency, we test them as a joint hypothesis. Each of these alternative explanations presumes that the well-known Structure-Conduct-Performance paradigm (SCP) is at least somewhat true -- that firms in markets with higher concentration exercise more market power in the determination of prices. Otherwise, there would be no price cushion to exploit when concentration is high. Prior evidence in banking suggests that concentration does explain some of the pricing behavior for deposits and loans in the manner predicted by SCP, but that concentration

generally does not increase profitability as predicted by SCP, or the effect is very weak (see Gilbert 1984, Berger and Hannan 1989,1993, Hannan 1991, Berger 1995). In light of the arguments given here, a likely explanation of these seemingly contradictory SCP findings in prior research is that banks in concentrated markets take advantage of market power in pricing, but that much of the benefit of this power does not result in higher profits because of efficiency effects.⁴

Divergence from profit maximization under conditions of market power is more likely to occur or be strengthened if there is a principal-agent problem in the governance of the firm (see Smirlock and Marshall 1983). Managers are more likely to engage in non-profit-maximizing behavior that suits their personal preferences if it is difficult for owners to monitor their behavior. A lack of market discipline created by market concentration can worsen the agency problem because managers who exercise market power in pricing can allow costs to rise somewhat and still earn economic rents for the owners. If owners cannot observe the actions of the managers, the owners may be unaware that their super-normal profits are a result of market power rather than managerial effort. In our empirical analysis below, we control for corporate governance factors to try to account for some of the likely agency effects.

Thus, the extant literature which relates market structure to cost efficiency provides the setting and motivation for the empirical analysis in this paper. Prior research predicts that firms with market power in setting prices may take part of the benefit of this price cushion as an opportunity to reduce effort in controlling costs or to pursue some other goal not consistent with profit maximization. The structure-conduct-performance literature provides a direct link between market structure and the ability to exploit market power in price setting. The empirical result in banking -- that market structure affects prices more than profits -- is consistent with the prediction that part of the price gains are consumed by efficiency losses. In addition, the corporate governance and principal-agent literatures provide predictions about the conditions under which the effects of concentration on efficiency may be most likely to occur. Finally, the problems encountered by the

4. Market concentration is of course only an imperfect indicator of market power. Other factors which may affect market power in banking include the availability of close substitutes for banking products and differences in branching regulations across states which affect the contestability of the markets for banking services. In the empirical section below, we try to control for some of these factors.

studies described above that tried to estimate directly the relationship between cost efficiency and concentration have left unresolved how empirically important the cost efficiency effects of market power are, and how they compare with the losses from mispricing under market power as measured by the welfare triangle.

III. The Empirical Model

In order to test whether operating in concentrated product markets results in poorer cost efficiency, and to evaluate how strong this relationship might be, we estimate equations of the form:

$$EFF_i = f_1(CONC_m, X_{1i}) + \varepsilon_{1i}, \quad (1)$$

where EFF_i is a measure of firm i 's efficiency, $CONC_m$ is a measure of concentration of the market m in which firm i operates, X_{1i} represents a vector of other characteristics likely to influence firm i 's measured efficiency (discussed below), and ε_{1i} is a mean-zero error term. A statistically significant negative relationship between EFF_i and $CONC_m$, controlling for other factors, would be consistent with the quiet life and related hypotheses.

At least two issues must be addressed before inferences can be drawn from estimation of equation (1). The first concerns the possibility that disciplining mechanisms designed to align the interests of managers and shareholders differ across the sample banks. Thus, we include control variables in the X_1 matrix for some of the mechanisms used to solve these agency problems. Specifically, we control for differences in the bank's current ownership structure and its perceived takeover threat in some of the estimations reported below, as well as other environmental variables that are likely to affect bank efficiency.

The second issue concerns the possibility of "reverse causation," since efficiency EFF may affect concentration $CONC$ and thereby bias any estimate of the effect of $CONC$ on EFF in (1). Such reverse causation is an integral part of the Efficient-Structure paradigm of Demsetz (1973) and others. This hypothesis, which is often presented as an alternative to the Structure-Conduct-Performance (SCP) hypothesis to explain the commonly observed positive relationship between

profits and market concentration, suggests that efficiency is the primary exogenous variable creating both profits and concentration. Under the Efficient-Structure paradigm, more efficient firms compete more effectively and increase their market shares, which may increase market concentration. To the extent that this hypothesis is correct, it creates a positive causal relationship running from EFF_i to $CONC_m$, which would bias an OLS estimate of the causation running from $CONC_m$ to EFF_i . We address this issue below through the use of a two-stage-least-squares (2SLS) estimation procedure.

The efficiency measure employed in this analysis is a measure of frontier efficiency, or the closeness of the bank costs to the minimum costs for the bank's output that could be achieved on the efficient frontier. In practice, the efficient frontier is defined in terms of the best-practice firms in the sample, rather than the minimum technologically achievable costs, since information on the underlying technology of banks is not available. Fortunately, the hypotheses tested here that link efficiency to concentration depends only on relative efficiencies, since competitive pressures can force managers only to reduce costs to the minimum achieved by their best-practice competitors.

We focus on operating cost frontier efficiency, rather than scale, scope or other types of efficiency for several reasons. The primary reason is that frontier efficiency incorporates the types of technical and allocative cost inefficiencies that are usually referred to in the quiet life and related hypotheses. Technical inefficiency, which includes a general overuse of all inputs, corresponds well to the concept of lax management referred to by Hicks (1935). Allocative inefficiency, which incorporates errors in the choice of input mix, can reflect either lax management or expense preference behavior in which one input is preferred over another.⁵ We ignore scale efficiency in this paper because it is less relevant than frontier efficiency and because (unlike frontier efficiency), it has been found to account for little of the difference in overall efficiency across banking organizations.⁶ Scope or product mix efficiency is also less relevant than frontier efficiency, and is exceedingly difficult to estimate because very few observed banks actually

5. The current use of the term "allocative inefficiency" as reflecting misallocation of resources within a firm differs from Leibenstein's (1966) use as reflecting misallocations across firms, industries, and nations.

6. See Berger et al. (1993) for a detailed summary of the financial institutions efficiency literature.

specialize. In addition, we exclude efficiencies related to bank revenues and to bank interest expenses because these revenues and expenses would likely be tainted by the price "cushions" provided by market power, which would be difficult to disentangle from inefficiencies. The use of operating cost efficiency does not create this problem because banks are unlikely to have market power in the markets for physical inputs such as labor and capital. Thus, we focus exclusively on frontier efficiency in minimizing operating costs, since this is the type of efficiency most relevant to the quiet life and related hypotheses and it creates the fewest measurement problems.

To estimate operating cost efficiency, it is assumed that the cost function has a composite error term that includes both efficiency deviations from the efficient frontier as well as short-term differences in luck or measurement error that temporarily give banks relatively high or low costs. The difficulty in estimating efficiency is in disentangling the two elements. While most studies must impose distributions in order to separate them, we are able to use a "distribution-free" approach by virtue of having a long time-series of cost function data for each of our banks. The key assumption is that cost differences owing to efficiency are relatively stable and should persist over time, while those owing to random error are ephemeral and should average out over time. See Berger (1993) for more details on the methods employed here.

A cost function applying to each of the ten years of the 1980s is specified as:

$$OC_{it} = C_t(Y_{it}, w_{it}) \bullet x_i \bullet v_{it}, \text{ or} \quad (2)$$

$$\ln OC_{it} = \ln C_t(Y_{it}, w_{it}) + \ln x_i + \ln v_{it},$$

where t denotes time, OC is operating costs, $C(Y, w)$ is a cost function with output quantity vector Y and input price vector w as arguments, x is a multiplicative efficiency factor, and $\ln v$ is a mean-zero random error. All the components in (2) vary over time except for the efficiency factor x_i , which is assumed constant for bank i . Equation (2) is estimated for each of the ten different years

from 1980 to 1989. Since banks are multiproduct firms, we use a multiproduct translog specification with 5 outputs and 2 input prices, treating $\ln x + \ln v$ as a composite error term.⁷

To construct the efficiency measure, an average of the residuals from (2) for each bank taken over the ten years of the 1980s is formed. This average residual, $\hat{\ln x}_i$, is an estimate of $\ln x_i$, given that the random errors $\ln v_{it}$ will tend to cancel each other out in the averaging. We transform $\hat{\ln x}_i$ into a normalized measure of efficiency, denoted EFF, as follows:

$$EFF_i = \exp(\hat{\ln x}_{\min} - \hat{\ln x}_i) = \hat{x}_{\min} / \hat{x}_i, \quad (3)$$

where $\hat{\ln x}_{\min}$ indicates the minimum $\hat{\ln x}_i$ for all i . This is an estimate of the ratio of costs for the most efficient bank in the sample to produce bank i 's outputs using bank i 's input prices to the actual costs for bank i , i.e., $OC_{\min}(Y_i, w_i) / OC(Y_i, w_i)$, where $OC_{\min}$ is the minimum cost function that follows the efficient frontier where $\ln x = 0$. This corresponds with the conventional notion of efficiency as the ratio of the minimum resources needed for production to the resources actually used, and ranges over $(0,1]$ with higher values indicating greater efficiency.⁸

The $\hat{\ln x}$ contain some error from the $\ln v$ not fully cancelling out over the 10-year period, especially for banks near the extremes of the $\hat{\ln x}$'s, which may have had persistently "lucky" or "unlucky" errors that did not fully average out. To alleviate this problem, we assigned the extreme values of $\hat{\ln x}$'s slightly less extreme values. In particular, values of $\hat{\ln x}$ below the fifth percentile in the sample distribution of $\hat{\ln x}$ were assigned the value at the fifth percentile, and similarly for values above the 95th percentage point. All the regressions reported below use this method to

7. The five outputs are 1) demand deposits, 2) time and savings deposits under \$100,000, 3) real estate loans, 4) commercial loans, and 5) installment loans. The two inputs are 1) labor and 2) physical capital.

8. If the assumption that firm efficiency is constant over time does not fully hold, then EFF_i gives an estimate of the predicted costs for the bank with best average efficiency relative to the average predicted costs for bank i . This efficiency, which is measured relative to the best average practice frontier, will be higher than efficiency measured relative to best absolute practice frontier. However, it is still a valid efficiency ordering that corresponds to the underlying concepts of the quiet life and related hypotheses, under which firms in concentrated markets will have lower average efficiency.

compute EFF, although it turns out that this truncation and other levels of truncation that were tried had virtually no effect on the regression results.

The efficiency variable is calculated separately for banks operating in unit banking, limited branching, and statewide branching states because differences in regulatory environments have been found to affect cost relations [e.g., Berger, et al. (1987)]. Thus, cost functions are estimated separately for each of the ten years for each of the three groups of states. In order to have the full ten residuals available to compute the efficiency measure and to assure homogeneity within each regulatory environment, only banks that were in existence for all ten years and whose state had the same branching restrictions in at least 9 of the 10 years are included in the sample.⁹

IV. The Explanatory Variables and the Data

A number of explanatory variables are included in the model. We measure market concentration -- CONC in the model above -- by the Herfindahl index (HERF), defined as the sum of squared market shares of all banks operating in the market. For a bank operating in more than one local market, HERF is calculated as the weighted average for the bank over all the markets in which it operates, with the proportions of the bank's deposits in these markets serving as the weights. These computations use branch deposit data reported in the Summary of Deposits. Local banking markets are defined as Metropolitan Statistical Areas (MSAs) or counties in the case of locations outside of MSAs. As discussed below, we also experiment with market share as a measure of market power.

Because the governance structure of the firm may play a role in determining the firm's efficiency, we employ in some of the regressions variables indicating the importance of inside ownership and the concentration of outside ownership of the firm. The variable INSIDE is defined as the proportion of common stock owned by all board members plus the proportion owned by their relatives with shares exceeding 5% of the company. The variable OUTBLOCK is defined as

9. The exclusion of failed banks, other banks that entered or exited the industry, and banks in states that changed branching regulations during the period may create biases in the results. However, inclusion of these banks would likely create more problems than it would solve because there is no simple way to compute comparable efficiency estimates using our approach when there are different numbers of observations for some banks.

the total share of outside owners with more than a 5% block of the common stock (except for relatives of the board of directors, who are counted as insiders). If in fact it is an agency problem that accounts for lower levels of efficiency in some firms, then one might expect a positive relationship between OUTBLOCK and firm efficiency, all else equal, since greater concentration of outside ownership may result in greater incentives to monitor the performance of the firm's managers. It has been suggested that the relationship between INSIDE and firm efficiency under these circumstances is more complex and may be nonmonotonic (see Gorton and Rosen 1992). This is because at some low range of ownership by the firm's insiders, increases in the share of insider ownership may serve to further insulate managers from the pressure to maximize firm value exerted by outside owners, while increases at some higher range of insider ownership may cause managers to adhere more closely to value-maximization. Estimations discussed below address this possibility. Because these data pertain to the beginning of 1988, data for all explanatory variables (unless otherwise indicated) refer to that year.¹⁰

In a recent contribution, Schranz (1993) reports a statistically significant relationship between bank profitability and the existence of state statutes that allow for takeover activity among banks, suggesting that the threat of takeovers provides managers with an incentive to maximize firm value. To test this hypothesis as it applies to measured bank efficiency, regressions reported below include a dummy variable (TTHREAT) that receives a value of one (and zero otherwise) if the state is one that does not restrict takeovers by other banking organizations. This is deemed to be the case if any of the following three conditions are met: (1) there are no restrictions on multi-bank holding companies, (2) statewide branching and branching by merger are allowed, or (3) acquisitions by at least some out-of-state banking organizations are allowed.

Other variables are employed for the purpose of statistical control. Dummy variables indicating operation in a unit banking state (UNITB) or limited branching state (LIMITB) are included, with operation in a statewide branching state serving as the excluded category. Among other things, these variables should help control for any differences that may result from the fact

10. The INSIDE and OUTBLOCK variables were collected by Gary Gorton and Rich Rosen from bank holding company reports, and we thank them for providing these data.

that the efficiency measures were calculated separately for the three regulatory categories. To control for possible regional differences in measured efficiency not accounted for in the calculation of the efficiency measure itself, four regional dummy variables representing locations in the West (WEST), Great Plains (GP), North Central (NC), and South (SOUTH) are included in all regressions, with locations in the Northeast (NE) representing the excluded category. To control for relevant differences associated with the size of the bank, three dummy variables indicating the general size classification of the bank are also included: SIZE2 indicates between \$100 million and \$1 billion in total assets (1988 dollars), while SIZE3 indicates between \$1 billion and \$10 billion, and SIZE4 indicates more than \$10 billion in total assets. Banks with assets below \$100 million (SIZE1) are in the excluded category.

Finally, one variable is included in the analysis as an instrument to help identify the model. The population of the defined banking market in which each bank is headquartered (POP) is assumed not to affect efficiency directly, but is employed in the model as an instrument for market concentration. This will be explained below.

V. Estimation Results

Because information on the ownership of banking organizations is available only for large bank holding companies, two different samples are employed in the analysis. The "ownership" sample consists of 233 banks that are owned by bank holding companies for which ownership information is available. In the ownership sample, we exclude banks that account for less than 50% of the banking assets of the holding company. This restriction allows for a close relationship between the organization on which we have ownership information (the bank holding company) and the organization for which efficiency estimates are made (the bank). The "full" sample consists of 5,263 banks, more than 20 times the number of observations in the ownership sample. The expanded sample size follows from the fact that the "full" sample is not restricted to those organizations for which ownership information is available. As indicated earlier, both samples are limited to banks that were in existence for the entire decade of the 1980s and located in states whose branching laws remained relatively constant during the decade in order to get complete, comparable samples for estimating efficiency.

Table 1 presents variable definitions and sample means, while Tables 2 through 4 present regression results. The sample means of efficiency presented in Table 1 of .658 and .701 indicate that the output of the average bank could be produced with about 65% to 70% of the resources actually used, i.e., that about one-third of all costs are wasted. This is fairly consistent with or perhaps slightly worse performance than reported in most of the previous bank efficiency studies, which typically report mean cost efficiencies of about .75 to .80 (see Berger et al. 1993). Differences between the two samples in the means of some of the other explanatory variables as presented in Table 1 generally reflect the fact that the "ownership" sample is composed of larger and more urban banks than is the "full" sample.

Table 2 presents regression results obtained using the ownership sample. The first column presents the results of an OLS regression in which EFF is the dependent variable, and all explanatory variables, including the market Herfindahl index of concentration (HERF), are entered linearly. Note first that the coefficient of HERF is negative and highly significant, implying that operation in more concentrated markets is associated with less efficiency, all else equal. The magnitude of the coefficient, -.43, is also economically meaningful. Under the model assumptions, a decrease in concentration from that of the most concentrated market in the sample ($HERF=.60$) to that of the least concentrated market ($HERF=.04$), all else equal, would be expected to cause the efficiency measure to increase by about .24, a savings of almost one-quarter of the costs of the concentrated firm. Thus, the effect of concentration on efficiency is economically significant as well as statistically significant.

The proportion of the firm's ownership accounted for by insiders (INSIDE), the concentration of outside ownership (OUTBLOCK), and the presence of a takeover threat (TTHREAT) are included to account for the role of different disciplining mechanisms that might be important if in fact an agency problem is responsible for observed divergences from full efficiency. Under these circumstances, one would expect positive coefficients of OUTBLOCK and TTHREAT and a coefficient of INSIDE that, as explained above, might vary in a way that depends on the level of insider ownership. As indicated, the coefficient of TTHREAT bears the hypothesized sign, while the coefficient of OUTBLOCK does not, and none of the three coefficients is statistically significant.

Alternative regressions designed to allow for different coefficients of *INSIDE* for various ranges of this variable (not reported) produce similarly insignificant coefficients. Regressions in which these three variables are entered in interaction with *HERF* as well as separately (not reported) also yielded insignificant interaction effects. Thus, we do not find evidence that differences in governance structures as measured influence the relationship between market concentration and bank efficiency. Of the remaining coefficients in column (1), only the coefficients of *LIMITB* and *SOUTH* are statistically significant, suggesting that banks in limited branching states tend to be more efficient than those in statewide branching states, and banks in the South tend to be less efficient than those in the Northeast, all else equal.

Column (2) presents the results of an OLS regression that is identical to the equation in column (1), except that we take the natural logs of the key variables *EFF* and *HERF*. As it turns out, this log-linear functional form will be easier to use to obtain estimates of the effects of concentration on operating costs. This is because efficiency has a constant elasticity effect on operating costs, allowing us to translate efficiency changes from concentration directly into operating cost changes, even for banks not included in the regression model. The main result in column (2), the negative and highly significant coefficient of *HERF*, is consistent with the main result in column (1). The only notable difference in this regression is that the coefficient of *OUTBLOCK* is statistically significant in this regression, whereas it was not significant in column (1). Importantly, when the model was run with interaction effects (not shown), the interactions between the *INSIDE*, *OUTBLOCK*, and *TTHREAT* variables and *HERF* were again small and statistically insignificant, justifying our reported specification that excludes these interactive effects.

Columns (3) and (4) of Table 2 present the results of 2SLS estimations designed to account for the possibility that a firm's efficiency influences the concentration of the market in which it operates. As discussed above, such a reverse causality would occur in the Efficient-Structure paradigm, under which high firm efficiency is postulated to bring about both high firm profits and high market concentration. If such an effect exists, then *HERF* will be correlated with the error terms in the regressions presented in columns (1) and (2), yielding biased coefficient estimates.

In the 2SLS estimations reported in columns (3) and (4), market population (POP) is employed as the instrument to remove this bias. That is, HERF is replaced by its predicted value obtained by first regressing it on POP and the other exogenous variables. POP is an appropriate instrument in this case, since, all else equal, scale considerations make it more difficult for firms to acquire larger shares in larger markets, making market population and HERF highly (and inversely) correlated. The other condition for an instrument, that it does not directly affect and is not directly affected by the dependent variable, should also be satisfied, since there is little reason to believe that market population is directly related in any substantial way to individual firm frontier efficiency.

As indicated in columns (3) and (4) of Table 2, the coefficients of both HERF and $\ln(\text{HERF})$ are negative and significant at the 5% level in the 2SLS specifications. The magnitude of the coefficient is little changed from its OLS counterpart in the case of the linear specification, but it is about half the magnitude of the OLS coefficient in the case of the log-linear specification. Other coefficients appear to be roughly the same as those reported in the OLS regressions.

Table 3 presents results obtained by applying the same regressions (less the corporate governance variables INSIDE and OUTBLOCK) -- to the "full" sample of 5,263 observations. As discussed above, this larger sample is possible because it is not restricted to those banks for which ownership information is available. As in Table 2, the coefficients of HERF and $\ln(\text{HERF})$ are negative and highly significant. Magnitudes do appear to be smaller, and quite dramatically so in the case of the OLS regression employing a linear specification. The coefficients of TTHREAT are positive and significant, consistent with the hypothesis that the threat of takeovers induces greater operational efficiency. This finding is also consistent with the findings reported recently by Schrantz (1993), who used profitability as the dependent variable. Additional regressions in which TTHREAT was interacted with HERF (not shown) again yielded an insignificant interaction effect. The coefficients of LIMITB are again positive and significant, implying that banks in states that permit branching but restrict it somewhat exhibit greater efficiency. The negative and significant coefficients of WEST and GP, as well as SOUTH, imply that banks located in the West, Great Plains and South tend to be less efficient than banks located in the Northeast. The negative and

significant coefficients of SIZE2 and SIZE3 suggest that middle-sized banks with assets between \$100 million and \$10 billion are generally less efficient than small banks with assets of less than \$100 million, all else equal.

The functional forms specified for the regressions presented in Tables 2 and 3 assume a continuous monotonic relationship between HERF and EFF over the entire range of the values of HERF observed in the samples. It is possible, however, that the changes in EFF occur only within some relatively narrow range of HERF, above or below which no meaningful marginal relationship between HERF and EFF exists. For example, a quiet life effect could be present in which banks gain increasing market power and work less and less hard at controlling costs as concentration rises to some point, and thereafter, no significant additional market power and ability to relax obtains. To allow for an alternative functional relationship between EFF and HERF, Table 4 reports the results of OLS regressions in which the continuous relationship is replaced by a step function. The HERF and $\ln(\text{HERF})$ variables are replaced by a series of dummy variables indicating various ranges of the concentration measure. The excluded category covers all banks for whom their weighted average Herfindahl index is less than .10, a range the Justice Department's merger guidelines refers to as "unconcentrated." About 12.4% and 10.4% of observations in the "ownership" and "full" samples, respectively, fall into the unconcentrated category. The variable HERF.10-.18 is a dummy receiving the value of one if HERF has a value between .10 and .18 (and zero otherwise), a range considered by the Justice Department to be "moderately concentrated." The highest three ranges, HERF.18-.25, HERF.25-.30, and HERF>.30, are referred to in the Justice Department's guidelines as "highly concentrated."

Table 4 presents the results of these step-function regressions estimated using OLS for both samples, using EFF and $\ln(\text{EFF})$ as the dependent variables. Unfortunately, it is not possible to estimate 2SLS in this case to take care of the possible endogeneity of HERF, since we have four dummy variables and only one instrument. However, as shown above, the 2SLS procedure did not remove the strong negative effect of concentration on efficiency in the continuous case.

In each of the regressions reported in Table 4, the coefficients of all four of the concentration dummy variables are negative and highly significant. This suggests that firms in "moderately

concentrated" and "highly concentrated" markets have lower efficiency than firms in "unconcentrated" markets, consistent with the quiet life and related hypotheses. Moreover, the results suggest what the shape of the concentration-efficiency relationship might be. Although the coefficients vary by sample, with the concentration effects being much larger for the "ownership" sample than for the "full" sample, the shape of the distribution is similar for both samples. In each of the equations, the coefficients of all four HERF dummies are of approximately the same magnitude with no steady trend upward or downward, suggesting that the effect of concentration on EFF is substantial in the neighborhood of $HERF=.10$, but there is little or no additional effect at higher levels of HERF. Put another way, the data are consistent with the hypothesis that moving from an "unconcentrated" local market structure to "moderately concentrated" one lowers efficiency, but the marginal effects of moving from "moderately concentration" to "high concentration" or to greater levels of concentration within the "highly concentrated" range appear to be virtually nil.¹¹ We make use of this apparent functional relationship below to obtain alternative estimates of the increase in costs incurred by the banking industry as a whole as a result of market concentration. It is notable that the adjusted R^2 of all four equations in Table 4 are higher than those of the corresponding continuous function OLS estimates that use the same data and specifications in Tables 2 and 3, suggesting that the step function fits the data better than the continuous function. The coefficients of other variables are little changed from those reported in Tables 2 and 3 and are therefore not discussed.

For further robustness checks, we also reran all the models with market share (MS) replacing HERF as an indicator of market power, as suggested by the Relative Market Power paradigm (see Shepherd 1982). In addition, we reran the models with MS as an additional control variable in the regressions containing HERF as the market power indicator. Neither of these alternative specifications (not shown) yielded results that altered our basic findings.

11. Caves and Barton (1990) similarly find that the efficiency of manufacturing industries is not monotonic in concentration.

Thus, the regression results provide very robust support for the inverse relationship between market concentration and bank efficiency, consistent with the quiet life and related hypotheses discussed above. Whether the regressions are run in linear or log form, whether the specification is continuous or a step-function, whether the "ownership" or "full" sample is employed, whether or not a 2SLS correction is made for possible reverse causation from efficiency to market structure, and whether or not market share was used in the specification, the data suggest that banks in concentrated markets exhibit lower cost efficiency. Moreover, while the concentration effect on efficiency changes numerically with the sample employed, the basic relationship is not affected, nor is it significantly affected by interactions with the governance and threat variables INSIDE, OUTBLOCK, and TTHREAT. In the following section, we shift our focus from statistical significance to economic significance to see how large the efficiency costs associated with concentration are and how they compare to traditional measures of social losses attributable to market power.

VI. A Comparison of Efficiency Costs of Market Power with Losses Measured by the "Welfare Triangle"

In this section, we estimate aggregate efficiency costs attributable to concentration-induced losses in bank efficiency, applying our estimated efficiency-concentration relationship to data covering virtually every commercial bank in the U.S. Similarly, we compute the aggregate social costs due to the mispricing of banking services created by market power as measured by the "welfare triangle." In order to guard against over-reliance on the maintained assumptions of any one model, the efficiency costs are computed 6 different ways and the costs measured by the welfare triangle are computed under 12 different sets of assumptions. As it turns out, the essential finding -- that the efficiency costs associated with market power dominate the mispricing costs measured by the welfare triangle -- is robust to all of the possible pairwise combinations of efficiency costs and the welfare triangle losses from concentration.

Efficiency Costs

To calculate the aggregate efficiency costs from concentration, we apply the coefficients of our 6 models above in which $\ln(\text{EFF})$ is the dependent variable to cost data from all 12,263 U.S. commercial banks in 1988. The 6 models include the continuous function OLS estimation, the

continuous function 2SLS estimation, and the step function estimation, each of which was computed using both the "ownership" and "full" samples. As alluded to above, a log specification allows us to apply the coefficients of these models to operating cost data from all U.S. banks without knowledge of their individual efficiencies, since operating costs has a constant elasticity in efficiency.

Because step-function estimation results reported above suggest a sharp difference in measured efficiency between banks operating in "unconcentrated" markets with $HERF \leq .10$ and "moderately" and "highly concentrated" markets with $HERF > .10$, we measure the aggregate efficiency cost from concentration as the estimated cost savings if all banks in "concentrated" markets experienced a reduction in concentration to the "unconcentrated" region. For the continuous functions, we find the effect of lowering $HERF$ from a higher level down to $.10$, while for the step-function specification, we find the effect of lowering $HERF$ into the $HERF \leq .10$ step. Thus, we estimate the efficiency cost for banks with $HERF$ above $.10$ as that part of current costs that was created by the opportunity to exploit the difference in market power associated with the bank's current market $HERF$ and a $HERF$ of $.10$ or lower. For banks with $HERF$ at or below $.10$, the efficiency cost is assumed to be 0.

The efficiency cost is derived as follows. As noted above, our individual bank efficiency measure EFF_i defined in (3) is an estimate of the ratio of operating costs for an efficient bank on the minimum cost frontier to actual costs for bank i , $OC_{\min}(Y_i, w_i)/OC(Y_i, w_i)$. Since $OC_{\min}$ does not vary with EFF_i , OC_i is inversely proportionate to EFF_i , or $\partial \ln(OC_i)/\partial \ln(EFF_i) = -1$. That is, an $n\%$ decrease in efficiency will raise operating costs by $n\%$. For the continuous log-linear functional form (OLS and 2SLS), the elasticity of EFF_i with respect to $HERF_i$, $\partial \ln(EFF_i)/\partial \ln(HERF_i)$ is a constant β , which is the coefficient of $\ln(HERF)$ from the regression. Therefore, the elasticity of cost with respect to the Herfindahl index, $\partial \ln(OC_i)/\partial \ln(HERF_i) = \partial \ln(OC_i)/\partial \ln(EFF_i) \cdot \partial \ln(EFF_i)/\partial \ln(HERF_i)$, is a constant $-\beta$. Thus, OC is proportional to $HERF^{-\beta}$, so that if bank i 's Herfindahl index were lowered from $HERF_i$ to $.10$, its operating costs

would be expected to fall from its current level of OC_i to $(.10/HERF_i)^{-\beta} \cdot OC_i$. As a result, the efficiency cost of concentration for bank i -- the difference between current costs and what costs would be if HERF were lowered to .10 -- is given by:

$$EFFCOST_i = OC_i - (.10/HERF_i)^{-\beta} \cdot OC_i. \quad (4)$$

For the step-function specification of the $\ln(EFF_i)$ equation, each of 4 ranges of $HERF > .10$ were estimated to increase $\ln(EFF_i)$ over the level it would have at $HERF \leq .10$ by some constant amount γ_j , $j=1, \dots, 4$. Since the difference in $\ln(EFF_i)$ between a bank in a market with HERF in range j and one in an "unconcentrated" market is γ_j , and since $\partial \ln(OC_i) / \partial \ln(EFF_i) = -1$, the difference in $\ln(OC_i)$ caused by the higher concentration is $-\gamma_j$. Thus, if bank i 's HERF were lowered from range j down to the unconcentrated range, its operating costs would be expected to fall to $\exp(\gamma_j) \cdot OC_i$, giving an efficiency cost of:

$$EFFCOST_i = OC_i - \exp(\gamma_j) \cdot OC_i. \quad (5)$$

The summation of $EFFCOST_i$ in either (4) or (5) (depending on functional form) over all U.S. banks for which $HERF > .10$ yields estimates of the industry-wide efficiency cost of concentration.

The estimates of aggregate efficiency costs are shown in Table 5. As noted above, there are 6 separate estimates which are based, alternatively, on 1) the regression coefficient β from the continuous function OLS; 2) the β from the continuous function 2SLS; and 3) the γ_j 's from the step function OLS estimation; each estimated separately using the "ownership" sample and the "full" sample. The results are also presented by range of the Herfindahl index.

The total efficiency cost of bank concentration ranges between the \$1.2 billion per annum (1988 dollars) for the "full" sample continuous function OLS to the \$11.1 billion for the "ownership" sample step function, with most of the estimates clustered in the \$2.5 billion to \$5 billion range. We generally prefer the "ownership" sample results over the "full" sample findings,

since the ownership sample accounts for corporate governance factors and gives a better representation of the large, publicly traded banks that control most of the nation's deposits and loans and will increase in importance in the future under nationwide branching that begins in 1997. The banks in the ownership sample are also much more often located almost exclusively in Metropolitan Statistical Areas -- 83% versus 44% for the full sample -- giving a cleaner market definition for the purpose of measuring concentration. We also generally favor the continuous function 2SLS and the step function OLS over the continuous function OLS because the 2SLS corrects for reverse causality and because the step function fits the data better, having a higher adjusted R^2 in all cases than the continuous function OLS.

In order to assess the economic significance of these numbers, the efficiency costs are also shown in terms of total operating costs of banks (EFFCOST/OC) and in terms of total assets (EFFCOST/TA). The results indicate that between about 1.3% and 11.5% of costs (with most of the estimates in the 2.5% to 5% range) could be saved by eliminating the effects of market power. These estimates appear to be quite economically significant. They are also consistent with Scherer's (1970) educated guess that as much as 10% of costs are lost to concentrated-related efficiency losses, since 10% lies near the top of our estimated range. In terms of assets, between about 4 and 37 basis points of total assets (most estimates in the 9 to 15 basis point range) are lost due to inefficiency created by market power according to these calculations. While this ratio may seem small, it is not. The industry typically earns about 80 basis points return on total assets each year, suggesting that bank profit rates could be raised quite substantially if the efficiency costs of concentration were eliminated, although it is not known how much revenues would change if the market power in pricing were also eliminated.

When the EFFCOST/OC and EFFCOST/TA ratios are broken down by ranges of the Herfindahl index, some further interesting findings appear. As expected, for the two continuous functions, the efficiency cost ratios increase with HERF. However, for the ratios derived from the step function specification, the level of HERF makes very little difference and the effects are not monotonic for values of HERF above .10. This may suggest that market power does not increase

substantially once it reaches a "concentrated" threshold, or that above this threshold further increases in market power do not result in additional efficiency costs.

Table 6 presents the same information as presented in Table 5, except that reported estimates are broken down by the asset size of the bank rather than by the range of the Herfindahl index. For those estimates derived from the continuous functional form, it appears that efficiency costs, expressed as a percentage of operating costs or total assets, are more pronounced in the case of smaller banks. This is not surprising, given that smaller banks tend to be located in more rural locations where market concentration is higher.¹² For those estimates derived from the step function, however, there is no marked relationship between size and efficiency cost ratios, except for the very largest size class. The weaker relationship is consistent with the fact that the use of the step function does not reveal significant differences among the levels of HERF above .10.

The "Welfare Triangle"

In order to compare the magnitude of these efficiency cost estimates with traditional measures of the welfare loss attributable to mispricing created by market power in the banking industry, Tables 7 and 8 present estimates of the aggregate loss attributable to the exercise of market power computed under 12 different sets of assumptions. This loss is due to the mispricing of banking products and the resulting underproduction of banking services and is measured by the difference between the loss in consumer surplus and the gain in producer surplus attributable to market power. This is frequently depicted diagrammatically as the area of a triangle bounded in the simplest case by the demand curve, and lines representing the quantity when market power is exercised and the price when it is not. This loss may be measured as:

$$\text{Welfare Triangle Loss} = (1/2) * PQ * \epsilon * \tau^2, \quad (6)$$

where P represents the price of products for which market power is exercised, Q denotes their quantity, ϵ is the absolute value of the relevant elasticity of demand (or supply in the case of

12. The correlation between total assets and HERF is -.053, significantly different from zero at the 1% level.

deposits supplied by the public), and τ is the proportional change in price attributable to the exercise of market power, $\Delta P/P$.¹³

The value of PQ may be observed empirically as the revenues and expenses of assets and liabilities whose prices are likely to be influenced by differences in market power. A unique feature of banking is that banks have been shown to exercise market power in influencing both their revenues and expenses. In particular, banks in concentrated markets have been found to earn higher prices on loans (raising revenues) and pay lower prices on deposits (reducing expenses) relative to banks in unconcentrated markets (see Berger and Hannan 1989,1993, Hannan 1991). However, not all bank assets and liabilities are subject to the exercise of market power. Many items -- such as large loans, securities, and large negotiable certificates of deposit -- are competed for on a national basis and therefore would not be expected to be subject to noncompetitive pricing based on local market concentration.

The choice of an empirical measure of PQ requires a number of decisions regarding which assets and liabilities to include, i.e., the choice of which balance sheet items reflect banking services that are competed for on a local basis and may be subject to noncompetitive pricing. Unfortunately, balance sheet figures do not clearly distinguish among products that are locally versus nationally marketed. When faced with uncertainty, we tried to make "liberal" choices, including more items and biasing PQ upward to make the losses measured by the welfare triangle appear as large as possible to give the estimated efficiency costs of market power as big a hurdle to jump over as possible. In our "liberal" data set, we included in PQ revenues from all real estate loans, all farm loans, all credit cards and related plans, all installment loans, commercial and industrial (C&I) loans estimated to be less than \$250,000,¹⁴ all "Other loans", and all leases, as well as net interest expenses (interest paid less service charges received) on all transaction deposits, all Money Market Deposit Accounts, all certificates of deposit (CDs) less than \$100,000, and all other

13. See Scherer and Ross (1990, pp. 661-2) for a brief description and discussion of the welfare triangle.

14. Since C&I loans are not broken down by size on Call Reports, the proportion of all bank C&I loans less than \$250,000 (7.55%) was inferred from information in the Federal Reserve's Survey of the Terms of Business Lending.

time and savings deposits. Essentially, we included all loans and leases except for very large C&I loans, and all deposits except for large uninsured CDs over \$100,000, both of which may be competed for on a national basis. In order to bias the resulting losses measured by the welfare triangle upward even more, we also employ an "ultra-liberal" data set that doubles the revenues from C&I loans included and counts all expenses from CDs over \$100,000 as well. The total revenues plus expenses in the "liberal" and "ultra-liberal" data sets total \$14.4 billion and \$16.4 billion, respectively.¹⁵

A reasonable value of τ -- the proportional increase in price owing to the exercise of market power -- is suggested by the findings of past empirical studies. In estimations of the relationship between local market concentration and rates that banks charge or pay their customers (rates charged for small loans, rates paid on small deposits), differences of roughly 5% or slightly higher between the observed rates in the most and least concentrated markets have been found (Berger and Hannan 1989,1993, Hannan 1991,1992). To try to cover the range of reasonable possibilities and to allow for a upward bias in the losses measured by the welfare triangle, we report estimates setting τ alternately to .05 and .10. The $\tau = .10$ assumption makes the losses measured by the welfare triangle 4 times as high because τ is squared in the formula in (6).

Little is known about the magnitude of ϵ , which represents the price elasticities of demand and supply relevant to banking products whose prices are likely to reflect noncompetitive behavior. We report estimates under the alternative assumptions that ϵ is 1, 2, and 3. It seems likely that this range of values includes the true elasticities for most of the relevant banking products.

Table 7 presents estimates of these welfare triangle losses measured using equation (6), applying all combinations of $\tau = 1,2,3$ and $\epsilon = .05,.10$ to the "liberal" definition of PQ. Table 8 gives the same 6 sets of calculations to the "ultra-liberal" definition of PQ, which expands the list of assets and liabilities assumed to be influenced by local market power.

Because of the wide range of assumed values of PQ, τ , and ϵ , the largest estimates of this welfare triangle loss are many times greater than the smallest. The range of estimated losses spans

15. These annual revenue and expense flows are of course much smaller than the dollar stocks of the corresponding bank assets and liabilities, which are valued in the hundreds of billions of dollars.

from \$50 million with "liberal" PQ, $\tau = .05$, and $\varepsilon = 1$ to \$680 million with "ultra-liberal" PQ, $\tau = .10$, and $\varepsilon = 3$. However, the more important comparison is between these welfare losses from mispricing and the losses from efficiency costs from market power estimated above. The smallest efficiency cost from Tables 5 and 6 of \$1.2 billion is about twice as large as the largest welfare triangle loss of \$680 million. This difference is likely far understated, not only because it is at the bottom of the range, but because the \$1.2 billion efficiency cost estimate was taken from the least preferred estimation which used the continuous function OLS specification applied to the "full" data sample. At the other extreme, the largest efficiency cost of \$11.1 billion is more than 200 times as large as the smallest welfare triangle loss of \$50 million, which is likely to be a substantial overstatement, given that most of the efficiency costs are clustered in the \$2.5 billion to \$5 billion range. Perhaps the most reasonable point estimate of the ratio of efficiency costs to welfare triangle losses would be the ratio of median estimates, which gives \$3.7 billion/\$186 million ≈ 20 . Thus, even under our assumptions designed to bias upward the losses measured by the welfare triangle, the efficiency cost estimates are in all cases much larger, perhaps about 20 times larger. These results would seem to suggest that efficiency costs of concentration deserve a new look and should at least be considered along with the standard welfare loss approach to merger and antitrust policy.

VII. Qualifications to the Analysis

We have seen that what has been termed the "efficiency cost" of market concentration appears to exceed substantially the deadweight loss from mispricing of banking services, even when the welfare losses from mispricing are purposely biased upward. This perhaps should not be surprising, given that differences in measured efficiency, which can be substantial, apply to all units of output rather than only to the reduction in output resulting from the exercise of market power.

Despite this apparent dominance of efficiency costs, there are two important qualifications to interpreting these efficiency costs as true social losses. The first qualification concerns the fact that it is difficult to account for differences in service quality when measuring cost efficiency.

Thus, part of our measured efficiency costs could in fact be compensated for by unmeasured differences in service quality. The bias created by the omission of service quality could go either way. If, as concentration rises, firms find it easier to collude on price, they may be induced to compete more vigorously along non-price dimensions, providing more quality and better service to customers. In this event, our efficiency costs would overstate true social costs. However, it is just as possible that shirking on the part of managers in more concentrated markets (or any of the related reasons that efficiency is lower) may result in lower service quality as well as higher prices and costs in more concentrated markets, which would suggest that our efficiency costs may understate the true social losses.

The second qualification concerns the possibility that part of the loss in cost efficiency may be offset by a social gain from an increase in the inefficient managers' utility functions. Recall that there are at least four explanations for the observed efficiency losses associated with high market concentration that are difficult to identify individually -- 1) managers may shirk and put in less work effort; 2) managers may pursue other objectives that raise costs; 3) firms may expend resources obtaining and defending their market power positions; and 4) managers may be in jobs for which they do not have comparative advantages. If (1) or (2) is the underlying cause of the cost inefficiency, then the social value of the increased utility that managers receive from living a quiet life or from pursuing other non-profit-maximizing objectives should at least partially offset the efficiency costs associated with market concentration. On the other hand, if (3) or (4) is the cause of the inefficiency, then there may be no social offset, since resources used to obtain and defend market power advantages and costs from managerial incompetence that are hidden by market power may be deadweight social losses.

Thus, it is quite plausible that the efficiency costs measured here may overstate the true social costs associated with quiet life and related effects. However, by showing that the measured efficiency costs from market power substantially exceed the upwardly biased measures of the social losses from mispricing, we have demonstrated in our judgment that the efficiency costs associated with market power and concentration are potentially quite important and deserving of more study.

VIII. Conclusion

In this paper, we examine whether firms in more concentrated markets exhibit lower cost efficiency and how important these efficiency losses may be. The basic hypothesis tested is that the market power exercised by firms in concentrated markets provides a price "cushion" above the competitive level that allows firms to avoid the rigors of cost minimization without necessarily exiting the industry. The reduced pressures to minimize costs may result in lower cost efficiency for firms in concentrated markets through one or more of several mechanisms -- shirking by managers, the pursuit of objectives other than profit maximization, political or other activities to defend or gain market power, or simple incompetence that is obscured by the extra profits made available by the exercise of market power.

Our empirical application to a sample of over 5,000 U.S. banks suggests that market concentration does result in significantly lower cost efficiency. Extrapolating our results to the entire U.S. banking industry, we find that the operating efficiency costs associated with market concentration appear to be several times larger than -- perhaps 20 times larger than -- the social losses due to the noncompetitive pricing of bank outputs, as measured by the traditional "welfare triangle." The dominance of the efficiency costs over the social losses associated with mispricing are robust to a large number of changes in samples, assumptions, specifications, estimation techniques, and controls for alternative explanations. Our findings are also consistent with Scherer's (1970) educated guess that as much as 10% of costs are lost to concentration-related efficiency losses, which is near the top of our estimated range.

These results may have some general implications regarding antitrust policy, and some specific implications regarding regulation of the banking industry. If these results hold up under further scrutiny and corroboration by future research, they may suggest that antitrust and merger policy consider cost efficiency implications of impending mergers. While U.S. Justice Department guidelines currently allow consideration of potential cost efficiency gains from firm combinations, they do not explicitly consider the possibility for laxity in cost controls that might be a result of increases in market power.

In the banking industry in particular, the recent wave of horizontal mergers has often been justified by the participants and consultants as being based on cost savings from consolidations of back-office operations and branching networks. The fact that banking mergers among banks in overlapping markets has not generally been found to improve cost efficiency (see Berger and Humphrey 1992) could conceivably result from the efficiency costs of the higher concentration as measured here. That is, a reduction in market pressure to minimize costs may have offset the technical cost economies associated with the consolidations. Consideration of these efficiency costs in banking legislation and regulation may also be important because so many regulatory issues involve changes in the degree of competition or market contestability. Examples are policies relating to geographic barriers to entry, limits on the issuing of bank charters, and the powers of banks and nonbanks to enter each other's traditional lines of business.

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Table 1

Variable Definitions and Sample Means for
Banks in the "Ownership" and "Full" Samples

<u>Symbol</u>	<u>Definition</u>	<u>"Ownership"</u> <u>Sample Means</u>	<u>"Full"</u> <u>Sample Means</u>
EFF	Efficiency measure, defined as the ratio of predicted costs of an efficient bank to that of bank i.	.658	.701
HERF	Herfindahl index of local market concentration.	.170	.224
INSIDE	The proportion of stock owned by board members and their relatives.	.149	
OUTBLOCK	The proportion of stock owned by outside owners with share blocks greater than 5%.	.071	
TTHREAT	Dummy variable indicating that state allows takeovers by other banking organizations.	.961	.844
POP	Population of the market in which each bank operates (in hundreds).	17,669	8,498
UNITB	Dummy variable indicating operation in a unit banking states.	.135	.295
LIMITB	Dummy variable indicating operation in a limited branching state.	.287	.448
WEST	Dummy variable indicating operation in the West (12th Federal Reserve District).	.139	.067
GP	Dummy variable indicating operation in the Great Plains (Districts 9, 10, 11).	.030	.162
NC	Dummy variable indicating operation in the North Central region (Districts 7, 8).	.209	.475
SOUTH	Dummy variable indicating operation in the South (Districts 5, 6).	.239	.152
SIZE2	Dummy variable indicating bank assets of between \$100 million and \$1 billion	.600	.193
SIZE3	Dummy variable indicating bank assets of between \$1 billion and \$10 billion.	.223	.032
SIZE4	Dummy variable indicating bank assets of greater than \$10 billion.	.073	.004

Note: The excluded dummy categories are statewide branching states (STATEB), Northeast location (NE, Federal Reserve Districts 1, 2, 3, 4), and assets less than \$100 million (SIZE1).

Table 2

The Relationship Between Bank Efficiency and Various
Explanatory Variables: "Ownership" Sample

Dep. Var:	OLS		2SLS	
	EFF	ln(EFF)	EFF	ln(EFF)
	(1)	(2)	(3)	(4)
CONSTANT	.71 (12.85)	-.69 (-7.90)	.71 (11.36)	-.61 (-5.69)
HERF	-.43** (-4.63)		-.41* (-2.02)	
ln(HERF)		-.12** (-5.51)		-.074* (-1.99)
INSIDE	-.012 (-.22)	-.025 (-.32)	-.011 (-.21)	-.010 (-.13)
OUTSIDE	-.14 (-1.70)	-.25* (-2.05)	-.15 (-1.64)	-.23 (-1.75)
TTHREAT	.057 (1.23)	.071 (1.06)	.056 (1.12)	.071 (1.04)
UNITB	-.023 (-.49)	-.029 (-.44)	-.018 (-.34)	.012 (.16)
LIMITB	.049* (1.98)	.10** (2.88)	.049 (1.92)	.093* (2.51)
WEST	-.049 (-1.70)	-.029 (-.68)	-.051 (-1.60)	-.054 (-1.16)
GP	-.038 (-.67)	-.070 (-.82)	-.041 (-.69)	-.079 (-.96)
NC	-.016 (-.43)	-.026 (-.49)	-.019 (-.45)	-.051 (-.92)
SOUTH	-.11** (-4.48)	-.14** (-3.95)	-.11** (-4.00)	-.17** (-4.17)
SIZE2	-.81E-3 (-.026)	-.016 (-.36)	-.0010 (-.032)	-.0075 (-.16)
SIZE3	.0059 (.17)	-.012 (-.25)	.0072 (.20)	.0016 (.031)
SIZE4	.017 (.39)	.015 (.24)	.019 (.42)	.035 (.52)
Adjusted R ²	.216	.258	.162	.182
No. of obs.	233	233	233	230

Note: t-statistics are in parentheses. The symbols * and ** denote significance at the 5 and 1 percent levels, respectively.

Table 3

Estimations of the Relationship Between Bank Efficiency and Various
Explanatory Variables: "Full Sample"

Dep. Var:	OLS		2SLS	
	EFF	ln(EFF)	EFF	ln(EFF)
	(1)	(2)	(3)	(4)
CONSTANT	.70 (72.99)	-.44 (-31.05)	.78 (53.30)	-.50 (-27.39)
HERF	-.036** (-2.87)		-.36** (-7.80)	
ln(HERF)		-.031** (-7.42)		-.065** (-7.96)
TTHREAT	.025** (3.84)	.031** (3.32)	.017* (2.47)	.025** (2.65)
UNITB	.012 (1.47)	.020 (1.75)	-.0016 (-.18)	.0091 (.78)
LIMITB	.021** (3.32)	.047** (5.24)	.035** (5.02)	.057** (6.18)
WEST	-.099** (-10.57)	-.13** (-9.85)	-.090** (-8.98)	-.12** (-8.79)
GP	-.043** (-5.47)	-.049** (-4.38)	-.0052 (-.53)	-.030* (-2.49)
NC	.0040 (.54)	.0046 (.44)	-.0023 (-.29)	.0023 (.22)
SOUTH	-.084** (-11.88)	-.11** (-11.51)	-.072** (-9.31)	-.11** (-10.67)
SIZE2	-.013* (-2.59)	-.028** (-3.88)	-.035** (-5.66)	-.040** (-5.25)
SIZE3	-.016 (-1.40)	-.033* (-2.12)	-.044** (-3.52)	-.049** (-3.01)
SIZE4	-.0023 (-.08)	-.005 (-.15)	-.027 (-.87)	-.022 (-.55)
Adjusted R ²	.089	.107	.089	.108
No. of obs.	5263	5263	5222	5222

Note: See table 2.

Table 4

OLS Estimations of the Relationship Between Bank Efficiency
and Market Concentration Using the Step-Function Specification

Dep. Var:	"Ownership" Sample		"Full" Sample	
	EFF	ln(EFF)	EFF	ln(EFF)
	(1)	(2)	(3)	(4)
CONSTANT	.73 (13.53)	-.34 (-4.31)	.74 (72.94)	-.33 (-23.02)
HERF.1-.18	-.13** (-5.25)	-.18** (-5.03)	-.050** (-8.70)	-.068** (-8.30)
HERF.18-.25	-.13** (-4.46)	-.19** (-4.30)	-.059** (-8.90)	-.081** (-8.63)
HERF.25-.30	-.12** (-4.15)	-.18** (-4.15)	-.046** (-6.14)	-.063** (-5.93)
HERF>.30	-.17** (-5.04)	-.24** (-4.91)	-.048** (-7.41)	-.064** (-7.00)
INSIDE	-.030 (-.57)	-.040 (-.52)		
OUTSIDE	-.16 (-1.96)	-.25* (-2.04)		
TTHREAT	.048 (1.05)	.070 (1.05)	.016* (2.44)	.023* (2.49)
UNITB	.011 (.25)	.032 (.47)	.011 (1.43)	.027* (2.43)
LIMITB	.082** (3.21)	.14** (3.68)	.030** (4.62)	.054** (5.91)
WEST	-.0025 (-.08)	.0093 (.21)	-.082** (-8.68)	-.12** (-8.58)
GP	-.072 (-1.28)	-.097 (-1.17)	-.042** (-5.29)	-.058** (-5.18)
NC	-.042 (-1.16)	-.059 (-1.12)	-.001 (-.14)	.001 (-.08)
SOUTH	-.086** (-3.46)	-.13** (-3.53)	-.079** (-11.30)	-.11** (-11.48)
SIZE2	-.0036 (-.12)	-.010 (-.22)	-.019** (-3.76)	-.028** (-3.94)
SIZE3	.0008 (.02)	-.011 (-.23)	-.025* (-2.22)	-.035* (-2.24)
SIZE4	.018 (.04)	.008 (.12)	-.010 (-.36)	-.012 (-.30)
Adjusted R ²	.261	.268	.103	.112
No.of obs.	233	233	5263	5263

Note: See table 2.

Table 5
Efficiency Costs of Market Power by Herfindahl Level

Continuous Function OLS

		Ownership Sample			Full Sample		
		Total EFFCOST	EFFCOST/OC	EFFCOST/TA	Total EFFCOST	EFFCOST/OC	EFFCOST/TA
<i>Herfindahl</i>	<i>Number</i>						
$H < .10$	1383	0.0	0.0000	.0000	0.0	0.0000	.0000
$.10 \leq H < .18$	3670	1,290.7	0.0407	.0014	342.6	0.0108	.0004
$.18 \leq H < .25$	2973	1,878.8	0.0824	.0027	504.9	0.0221	.0007
$.25 \leq H < .30$	1430	547.5	0.1104	.0034	148.8	0.0300	.0009
$H \geq .30$	2817	769.3	0.1465	.0044	212.5	0.0405	.0012
<i>Total</i>	12273	4,486.3	0.0465	.0015	1,208.7	0.0125	.0004

Continuous Function 2SLS

		Ownership Sample			Full Sample		
		Total EFFCOST	EFFCOST/OC	EFFCOST/TA	Total EFFCOST	EFFCOST/OC	EFFCOST/TA
<i>Herfindahl</i>	<i>Number</i>						
$H < .10$	1383	0.0	0.0000	.0000	0.0	0.0000	.0000
$.10 \leq H < .18$	3670	826.0	0.0261	.0009	725.3	0.0229	.0008
$.18 \leq H < .25$	2973	1,209.6	0.0530	.0017	1,063.6	0.0466	.0015
$.25 \leq H < .30$	1430	354.4	0.0714	.0022	312.0	0.0629	.0019
$H \geq .30$	2817	502.0	0.0956	.0029	442.7	0.0843	.0025
<i>Total</i>	12273	2,892.1	0.0300	.0010	2,543.6	0.0264	.0009

Step Function OLS

		Ownership Sample			Full Sample		
		Total EFFCOST	EFFCOST/OC	EFFCOST/TA	Total EFFCOST	EFFCOST/OC	EFFCOST/TA
<i>Herfindahl</i>	<i>Number</i>						
$H < .10$	1383	0.0	0.0000	.0000	0.0	0.0000	.0000
$.10 \leq H < .18$	3670	5,260.2	0.1660	.0056	2,082.7	0.0657	.0022
$.18 \leq H < .25$	2973	3,866.2	0.1695	.0055	1,767.6	0.0775	.0025
$.25 \leq H < .30$	1430	808.2	0.1629	.0050	302.1	0.0609	.0019
$H \geq .30$	2817	1,127.6	0.2148	.0064	324.1	0.0617	.0018
<i>Total</i>	12273	11,062.2	0.1146	.0037	4,476.5	0.0464	.0015

* All dollar values in \$millions

Table 6
Efficiency Costs of Market Power by Size Class

Continuous Function OLS

		Ownership Sample			Full Sample		
		Total EFFCOST	EFFCOST/OC	EFFCOST/TA	Total EFFCOST	EFFCOST/OC	EFFCOST/TA
<i>Size Class</i>	<i>Number</i>						
$TA < 25M$	3695	176.3	0.0840	.0031	48.1	0.0229	.0008
$25M \leq TA < 50M$	3237	302.3	0.0803	.0026	82.7	0.0219	.0007
$50M \leq TA < 100M$	2666	427.7	0.0747	.0023	116.5	0.0203	.0006
$100M \leq TA < 1B$	2337	1,056.3	0.0596	.0019	285.1	0.0161	.0005
$1B \leq TA < 10B$	299	1,651.7	0.0534	.0018	443.6	0.0143	.0005
$TA \geq 10B$	39	871.3	0.0240	.0008	232.7	0.0064	.0002
<i>Total</i>	12273	4,486.3	0.0465	.0015	1,208.7	0.0125	.0004

Continuous Function 2SLS

		Ownership Sample			Full Sample		
		Total EFFCOST	EFFCOST/OC	EFFCOST/TA	Total EFFCOST	EFFCOST/OC	EFFCOST/TA
<i>Size Class</i>	<i>Number</i>						
$TA < 25M$	3695	114.4	0.0545	.0020	100.8	0.0480	.0017
$25M \leq TA < 50M$	3237	196.5	0.0521	.0017	173.1	0.0459	.0015
$50M \leq TA < 100M$	2666	277.2	0.0484	.0015	244.1	0.0426	.0013
$100M \leq TA < 1B$	2337	681.5	0.0385	.0012	599.5	0.0338	.0011
$1B \leq TA < 10B$	299	1,063.1	0.0344	.0011	934.7	0.0302	.0010
$TA \geq 10B$	39	559.3	0.0154	.0005	491.5	0.0136	.0004
<i>Total</i>	12273	2,892.1	0.0300	.0010	2,543.6	0.0264	.0009

Step Function OLS

		Ownership Sample			Full Sample		
		Total EFFCOST	EFFCOST/OC	EFFCOST/TA	Total EFFCOST	EFFCOST/OC	EFFCOST/TA
<i>Size Class</i>	<i>Number</i>						
$TA < 25M$	3695	346.8	0.1653	.0060	129.2	0.0616	.0022
$25M \leq TA < 50M$	3237	597.4	0.1583	.0051	222.3	0.0589	.0019
$50M \leq TA < 100M$	2666	867.1	0.1515	.0047	327.0	0.0571	.0018
$100M \leq TA < 1B$	2337	2,449.0	0.1382	.0044	978.5	0.0552	.0018
$1B \leq TA < 10B$	299	4,201.7	0.1358	.0045	1,746.9	0.0565	.0019
$TA \geq 10B$	39	2,600.2	0.0717	.0023	1,072.5	0.0296	.0009
<i>Total</i>	12273	11,062.2	0.1146	.0037	4,476.5	0.0464	.0015

* All dollar values in \$millions

Table 7
Welfare Triangle Losses From Market Power
 "Liberal" Data Set

		$\tau = .05$								
		$\epsilon = 1$			$\epsilon = 2$			$\epsilon = 3$		
		Total Loss	Loss/OC	Loss/TA	Total Loss	Loss/OC	Loss/TA	Total Loss	Loss/OC	Loss/TA
<i>Herfindahl</i>	<i>Number</i>									
$H < .10$	1383	0.0	0.0000	0.0000	0.0	0.0000	0.0000	0.0	0.0000	0.0000
$.10 \leq H < .18$	3670	5.3	0.0001	0.0000	10.7	0.0002	0.0000	16.0	0.0003	0.0000
$.18 \leq H < .25$	2973	18.0	0.0004	0.0000	36.1	0.0008	0.0001	54.1	0.0012	0.0001
$.25 \leq H < .30$	1430	11.1	0.0009	0.0001	22.3	0.0018	0.0001	33.4	0.0028	0.0002
$H \geq .30$	2817	15.8	0.0013	0.0001	31.6	0.0025	0.0002	47.4	0.0038	0.0003
Total	12273	50.3	0.0003	0.0000	100.6	0.0006	0.0000	150.9	0.0009	0.0001
<i>Size Class</i>	<i>Number</i>									
$TA < 25M$	3695	2.4	0.0006	0.0000	4.8	0.0012	0.0001	7.3	0.0018	0.0001
$25M \leq TA < 50M$	3237	4.7	0.0006	0.0000	9.5	0.0011	0.0001	14.2	0.0017	0.0001
$50M \leq TA < 100M$	2666	7.2	0.0005	0.0000	14.3	0.0010	0.0001	21.5	0.0016	0.0001
$100M \leq TA < 1B$	2337	14.4	0.0003	0.0000	28.7	0.0007	0.0001	43.1	0.0010	0.0001
$1B \leq TA < 10B$	299	16.6	0.0003	0.0000	33.2	0.0005	0.0000	49.9	0.0008	0.0001
$TA \geq 10B$	39	5.0	0.0001	0.0000	10.0	0.0002	0.0000	15.0	0.0003	0.0000
Total	12273	50.3	0.0003	0.0000	100.6	0.0006	0.0000	150.9	0.0009	0.0001

		$\tau = .10$								
		$\epsilon = 1$			$\epsilon = 2$			$\epsilon = 3$		
		Total Loss	Loss/OC	Loss/TA	Total Loss	Loss/OC	Loss/TA	Total Loss	Loss/OC	Loss/TA
<i>Herfindahl</i>	<i>Number</i>									
$H < .10$	1383	0.0	0.0000	0.0000	0.0	0.0000	0.0000	0.0	0.0000	0.0000
$.10 \leq H < .18$	3670	21.3	0.0003	0.0000	42.7	0.0007	0.0000	64.0	0.0010	0.0001
$.18 \leq H < .25$	2973	72.1	0.0015	0.0001	144.2	0.0031	0.0002	216.3	0.0046	0.0003
$.25 \leq H < .30$	1430	44.6	0.0037	0.0003	89.2	0.0074	0.0006	133.7	0.0111	0.0008
$H \geq .30$	2817	63.2	0.0050	0.0004	126.5	0.0100	0.0007	189.7	0.0150	0.0011
Total	12273	201.2	0.0011	0.0001	402.5	0.0023	0.0001	603.7	0.0034	0.0002
<i>Size Class</i>	<i>Number</i>									
$TA < 25M$	3695	9.7	0.0023	0.0002	19.4	0.0047	0.0003	29.0	0.0070	0.0005
$25M \leq TA < 50M$	3237	19.0	0.0022	0.0002	37.9	0.0045	0.0003	56.9	0.0067	0.0005
$50M \leq TA < 100M$	2666	28.6	0.0021	0.0002	57.3	0.0042	0.0003	85.9	0.0063	0.0005
$100M \leq TA < 1B$	2337	57.5	0.0014	0.0001	114.9	0.0028	0.0002	172.4	0.0042	0.0003
$1B \leq TA < 10B$	299	66.5	0.0011	0.0001	133.0	0.0022	0.0001	199.5	0.0032	0.0002
$TA \geq 10B$	39	20.0	0.0004	0.0000	40.1	0.0009	0.0000	60.1	0.0013	0.0001
Total	12273	201.2	0.0011	0.0001	402.5	0.0023	0.0001	603.7	0.0034	0.0002

* All dollar values in \$millions

Table 8
Welfare Triangle Losses From Market Power
"Ultra-Liberal" Data Set

		$\tau = .05$								
		$\epsilon = 1$			$\epsilon = 2$			$\epsilon = 3$		
		Total Loss	Loss/OC	Loss/TA	Total Loss	Loss/OC	Loss/TA	Total Loss	Loss/OC	Loss/TA
<i>Herfindahl</i>	<i>Number</i>									
$H < .10$	1383	0.0	0.0000	0.0000	0.0	0.0000	0.0000	0.0	0.0000	0.0000
$.10 \leq H < .18$	3670	6.0	0.0001	0.0000	12.0	0.0002	0.0000	18.0	0.0003	0.0000
$.18 \leq H < .25$	2973	20.5	0.0004	0.0000	41.1	0.0008	0.0001	61.6	0.0012	0.0001
$.25 \leq H < .30$	1430	12.3	0.0009	0.0001	24.6	0.0018	0.0002	37.0	0.0028	0.0002
$H \geq .30$	2817	17.8	0.0013	0.0001	35.5	0.0025	0.0002	53.3	0.0038	0.0003
<i>Total</i>	12273	56.6	0.0003	0.0000	113.2	0.0006	0.0000	169.9	0.0008	0.0001
<i>Size Class</i>	<i>Number</i>									
$TA < 25M$	3695	2.5	0.0006	0.0000	5.0	0.0012	0.0001	7.4	0.0017	0.0001
$25M \leq TA < 50M$	3237	5.2	0.0006	0.0000	10.4	0.0011	0.0001	15.6	0.0017	0.0001
$50M \leq TA < 100M$	2666	7.9	0.0005	0.0000	15.9	0.0010	0.0001	23.8	0.0016	0.0001
$100M \leq TA < 1B$	2337	16.1	0.0003	0.0000	32.1	0.0007	0.0001	48.2	0.0010	0.0001
$1B \leq TA < 10B$	299	19.0	0.0003	0.0000	38.0	0.0005	0.0000	56.9	0.0008	0.0001
$TA \geq 10B$	39	6.0	0.0001	0.0000	11.9	0.0002	0.0000	17.9	0.0003	0.0000
<i>Total</i>	12273	56.6	0.0003	0.0000	113.2	0.0006	0.0000	169.9	0.0008	0.0001

		$\tau = .10$								
		$\epsilon = 1$			$\epsilon = 2$			$\epsilon = 3$		
		Total Loss	Loss/OC	Loss/TA	Total Loss	Loss/OC	Loss/TA	Total Loss	Loss/OC	Loss/TA
<i>Herfindahl</i>	<i>Number</i>									
$H < .10$	1383	0.0	0.0000	0.0000	0.0	0.0000	0.0000	0.0	0.0000	0.0000
$.10 \leq H < .18$	3670	24.0	0.0003	0.0000	47.9	0.0007	0.0001	71.9	0.0010	0.0001
$.18 \leq H < .25$	2973	82.2	0.0015	0.0001	164.3	0.0031	0.0002	246.5	0.0046	0.0004
$.25 \leq H < .30$	1430	49.3	0.0037	0.0003	98.6	0.0074	0.0006	147.9	0.0111	0.0009
$H \geq .30$	2817	71.1	0.0050	0.0004	142.2	0.0100	0.0008	213.2	0.0150	0.0012
<i>Total</i>	12273	226.5	0.0011	0.0001	453.0	0.0022	0.0002	679.5	0.0034	0.0002
<i>Size Class</i>	<i>Number</i>									
$TA < 25M$	3695	9.9	0.0023	0.0002	19.8	0.0047	0.0003	29.7	0.0070	0.0005
$25M \leq TA < 50M$	3237	20.8	0.0022	0.0002	41.6	0.0045	0.0004	62.4	0.0067	0.0005
$50M \leq TA < 100M$	2666	31.8	0.0021	0.0002	63.6	0.0042	0.0003	95.3	0.0062	0.0005
$100M \leq TA < 1B$	2337	64.2	0.0014	0.0001	128.5	0.0027	0.0002	192.7	0.0041	0.0003
$1B \leq TA < 10B$	299	75.9	0.0011	0.0001	151.8	0.0021	0.0002	227.7	0.0032	0.0002
$TA \geq 10B$	39	23.8	0.0004	0.0000	47.7	0.0009	0.0000	71.5	0.0013	0.0001
<i>Total</i>	12273	226.5	0.0011	0.0001	453.0	0.0022	0.0002	679.5	0.0034	0.0002

* All dollar values in \$millions