Firm Growth and Efficiency in the Banking Industry:

A New Test of the Efficient Structure Hypothesis[†]

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Abstract

In this paper we propose a new test of the *efficient structure (ES) hypothesis*, which predicts that efficient firms come out ahead in competition and grow as a result. Our test has significant advantages over existing ones, because it is more direct, and can jointly test the so-called *quiet-life hypothesis*, which predicts that in a concentrated market firms do not minimize costs. We then apply this test to large banks in Japan. Consistent with the ES hypothesis, we find that more efficient banks become larger. We also find that market concentration reduces banks' efficiency, which supports the quiet-life hypothesis. These findings imply that there is an intriguing growth-efficiency dynamic throughout banks' life cycle, although our findings also suggest that the ES hypothesis dominates the quiet-life hypothesis in terms of economic impact.

Keywords: firm growth, cost efficiency, efficient structure hypothesis, quiet-life hypothesis

JEL classification codes: L11, G21

1. Introduction

In this paper we propose a new test of the effcient structure hypothesis, and apply the test to large banks in Japan. As proposed by Demsetz (1973), the *efficient structure hypothesis* (hereafter the ES hypothesis) predicts that under the pressure of market competition, efficient firms defeat the competition and grow, so that they become larger, obtain greater market share, and earn higher profits. Under this hypothesis, a market becomes more efficient as it becomes more concentrated, so anti-concentration measures cause unnecessary distortion in the economy. To test this hypothesis, empirical studies have examined the relation between proxies for firm efficiency and for market performance (see, for example, Weiss 1974, and Smirlock 1985, and Berger 1995).

In contrast to this approach, the test we propose in this paper focuses on a core and more fundamental feature of the ES hypothesis; i.e., the idea that *efficient firms defeat the competiton and grow*. The original hypothesis that Demsetz (1973) proposes is a composite hypothesis that predicts stages of causal relations from firm efficiency to firm growth, then to market structure, and finally to market performance. In each stage, however, the causality may or may not hold, and there might be alternative hypotheses that better explain the data. For example, although a small number of efficient firms might ultimately dominate the market, the market might become temporarily less concentrated if, for example, large inefficient firms lose market share. Thus, testing the reduced-form relation between efficiency and market performance is too rough to validate or invalidate the ES hypothesis as a whole.

Instead of testing the relation between firm efficiency and market performance, we propose to examine the causality from firm efficiency to firm growth, which is the key part of the ES hypothesis. To test this relation, we directly regress a measure of firm growth on a measure of firm efficiency. This is thus a more direct test of the ES hypothesis than existing tests, and this directness is one of the main contributions of this paper.

Although the effiicency-growth nexus is at the core of the ES hypothesis, our focus is necessarily limited in the sense that we do not examine the other parts of the hypothesis. However, our focus is wider than those in existing studies in another important respect. In our test, we propose also to take into account the determination of firm efficiency -- the key independent variable in the growth regression -- by simultaneously estimating an efficiency regression in which the efficiency measure is the dependent variable. The direct merit of this simultaneous estimation is an increase in the statistical efficiency of the estimation. However, it also allows us to test the so-called quiet-life hypothesis.

The *quiet-life hypothesis* suggests that in a concentrated market firms do not minimize costs because of insufficient managerial effort, lack of profit-maximizing behavior, wasteful expenditures to obtain and maintain monopoly power, and/or survival of inefficient managers (Berger and Hannan 1998). To test this hypothesis, we use our efficiency regression to examine whether firms in a more concentrated market are more inefficient. Simultaneous estimation of the growth and the efficiency regressions also allows us to take into account the possibility that the effects of the ES and the quiet-life hypotheses might co-exist. Thus, our approach yields economic as well as econometric advantages. This is another main contribution of our paper.[1]

Our contribution is not limited to the methodological side, however, because we actually apply our test to banks in Japan. From our empirical analysis, we find that more efficient banks have a higher likelihood of becoming larger. This finding supports the ES hypothesis. However, we also find that banks in more concentrated markets are more inefficient, which is consistent with the quiet-life hypothesis. On balance, our findings imply that efficiency allows firms to survive competition and to grow, but the resulting market concentration then erodes firm efficiency. This finding – that both the ES and the quiet-life hypotheses are both supported – is, to our knowledge, the first of its kind in the literature.

These findings raises another question: which effect is more dominant, the effect that efficient

[1] As explained below, our test has some other advantages over existing studies, e.g., a consideration for endogeneity.

firms grow, or that the resulting concentration deteriorates firm efficiency?. We find that the impact of the ES hypothesis dominates that of the quiet-life hypothesis. This implies that anti-concentration measures might increase inefficiency if they were applied to large banks in Japan.

The rest of the paper proceeds as follows. In the next section, we review related literature and explain our contribution. Section 3 explains our methodology. We apply the methodology to banks in Japan in section 4. The final section concludes.

2. Literature

2.1. Empirical studies on the efficient structure hypothesis

Earler studies consider the ES hypothesis as an alternative to the classical structure-conduct-performance (hereafter SCP) hypothesis. The SCP hypothesis predicts that a concentrated market engenders a low degree of competition, leading to market inefficiency, e.g., monopolistic pricing and excess (monopoly) profits. Similar to the ES hypothesis, the SCP hypothesis predicts a positive relation between concentration and profits, but the underlying mechanisms are completely different. Although the the SCP hypothesis implies the need for anti-concentration measures, such measures are highly distortinoary under the ES hypothesis.

Because the policy implications of these two hypotheses are contrary, earlier studies such as Weiss (1974) and Smirlock (1985) test the ES and the SCP hypotheses simultaneously by extending the traditional IO framework. The traditional framework examines the effect of market concentration (proxied by market Herfindahl, for example) on market performance (e.g., firm profit). To this framework, the earlier ES studies add market share as an additional independent variable, arguing that market share is a proxy for the relative efficiency of the firms. They then claim that the ES hypothesis is supported if the share has a positive effect on profit, but the SCP hypothesis is supported if market concentration has a positive effect.[2]

However, this approach suffers from serious drawbacks. First of all, it is unclear whether such findings indeed support the two hypotheses as the authors claim. Market shares, the squared sum of which is the Herfindahl index, also reflects market power of the firm, and so it might support the SCP hypothesis if market share has a positive impact on profit (Shepherd 1986).[3] Second, this approach suffers from an identification problem that is well-known for the classical test of the SCP

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[2] More recent studies along these lines include Evanoff and Fortier (1988), who take into account entry barriers; Tregenna (2009), who uses panel data from the pre-crisis period in the U.S.; Hsieh and Lee (2010), who allow the effect of market concentration to vary depending on the factors such as foreign or government bank ownership, law and regulation, corporate governance, economic development, and intra-industry competition; and Goddard et al. (2010) the main focus of which is profit convergence.

[3] Smirlock et al. (1984) disagree with the idea that market shares reflect market power, but this is mere speculation on their part. Smirlock (1985) additionally uses an interaction term between market concentration and market shares to separately identify the two hypotheses, but the reasoning behind this identification is again unclear.

hypothesis; i.e., we cannot identify a causal relationship by regressing a market performance variable on market structure variables (see e.g., Tirole 1988, p.1-2). Third, although these studies implicitly assume that the ES and the SCP hypotheses are alternatives, they might be compatible, at least in the short-run. Finally, as explained in the Introduction, examining the relation between market structure and market performance is too rough a test of the ES hypothesis.

The test that we propose in this paper does not suffer from these drawbacks. We directly test the effect of firm efficiency on firm growth, the core relationship of the ES hypothesis. In this test, we explicitly take into account the endogeneity of the variables, and allow for mutual compatibility of the ES hypothesis and the quiet-life hypothesis (which is closely related to the SCP hypothesis).

To overcome some of the problems of the earlier studies, Berger and Hannan (1989) propose an alternative test, which investigates the price-concentration relationship. Berger and Hannan (1989) argure that although both the ES and the SCP hypothesis predict a positive relation between profits and market concentration, their implications are different with respect to the price-concentration nexus. The SCP hypothesis predicts that firms have more monopoly power in a concentrated market and set higher prices, while the ES hypothesis predicts that in a more concentrated market where efficient firms dominate, the market price is lower. Using data on U.S. deposit markets, Berger and Hannan (1989) find a lower interest rate (i.e., a higher price) in a more concentrated market -- a finding, they argue, which is consistent with the SCP hypothesis.

However, this test also suffers from serious drawbacks. First, the prediction of the ES hypothesis with respect to the price-concentration relationship is unclear. Although efficient firms might set a lower price in order to compete with their rivals, if superior competitive performance is unique to the efficient firms and unobtainable to others, efficient firms might set a *higher* price and enjoy more monopoly profits, at least in the short-run. Second, Berger and Hannan (1989) also consider the ES and the SCP hypotheses as being alternatives to each other, but the two hypotheses might be compatible, at least in the short-run.[4] In the test proposed in this paper, we do not focus on the price, and we do not consider the two hypotheses as mutually exclusive.

Berger (1995) proposes yet another (and, in our opinion, the best so far) approach to the ES hypothesis. He proposes to use a measure of cost efficiency as the main explanatory variable in a regression model of firm profitability. Although the use of firm profitability is problematic as indicated by Berger and Hannan (1989), Berger (1995) also proposes to run additional regressions where market concentration and market shares are a function of the cost efficiency measure. The

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[4] Another problem in Berger and Hannan (1989) is that the price regression ought to have independent variables to control for both supply and demand factors. Brewer and Jackson (2006) deal with this issue.

ES hypothesis is supported only if the efficiency measure has positive coefficients in all three of his regressions (i.e., on profitability, market concentration, and market share).[5]

This test of the ES hypothesis in Berger (1995) is more direct than the previous ones in that it uses a measure of firm efficiency as we do in this paper. Berger (1995)'s market share regression is also similar to our growth regression, although he does not directly examine firm growth. However, as explained above, the effects of efficiency on market concentration and profitability are unclear, and in fact, Berger (1995) does not find consistent results across the three regressions. In this paper, we focus on firm growth in order to test the most fundamental relation of the ES hypothesis. Also, Berger (1995) treats the efficiency measure as an exogenous variable, but it is more plausible to assume that an efficiency level is endogenously determined. We explicitly take this possibility into account with our efficiency regression. This also allows us to jointly test the ES and the quiet-life hypotheses in a manner that does not consider these to be mutually exclusive.[6]

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[5] Park and Weber (2006) apply this methodology to Korean banks. Al-Muharrami and Matthews (2009) consider four different approaches that include the tests of Berger and Hannan (1989) and of Berger (1995) as special cases.

[6] Note that to test the SCP hypothesis (or the "market power hypotheses" in the paper), Berger (1995) adds market concentration and market shares on the right-hand-side of the profitability regression. However, this approach is the same as earlier tests of the ES hypothesis such as Weiss (1974) and Smirlock (1985), and thus suffers from the drawbacks mentioned above.

2.2. Other related studies

Regarding the market structure-firm efficiency nexus that we examine with our efficiency regression, Berger and Hannan (1998) predict that market structure might negatively impact cost efficiency, because in a concentrated market firms do not minimize costs, due to insufficient managerial effort, lack of profit-maximization behavior, wasteful expenditures to obtain and maintain monopoly power, and/or survival of inefficient managers. They find support for this *quiet-life* hypothesis when they regress a measure of bank efficiency on a measure of market concentration (the Herfindahl index). However, different from our test, Berger and Hannan (1998) do not explicitly examine the ES hypothesis.[7]

More recent studies focus on the relationship between market power (not necessarily market structure) and firm efficiency, by employing elaborate methodologies using various market power measures (e.g., Maudos and de Guevara 2007, Turk Ariss 2010 , Schaeck and Chihak 2010, Färe et al. 2011, and Koetter et al. 2012). However, similar to Berger and Hannan (1998), these studies are only interested in the impact of market power on firm efficiency, and do not test the ES hypothesis as we do in this paper.

There are some other studies that are methodologically similar to ours. Jeon and Miller

[7] Note that Berger and Hannan (1998) recognize the possibility of reverse causality, and control for the endogeneity of the efficiency variable using instrumental variables.

(2005) investigates the co-existence of the market-power hypothesis and the ES hypothesis using a VAR model. However, they use a bivariate VAR model and only examine the relation between a market performance measure and a concentration measure. Casu and Girardone (2009) estimate a similar autoregressive model that is composed of competition variables (Lerner index) and efficiency variables (cost efficiency measures). However, the two regressions are separately estimated, with no control variables.

Finally, because we examine the effect of firm efficiency on firm growth, this paper is related to the literature on firm growth. Goddard et al. (2002) test the laws of proportionate effect, which are based on an idea of Gibrat (1931) that firms grow stochastically and so every industry sooner or later exhibits concentration.[8] However, it is hard to believe that firm growth is a purely stochastic phenomenon. It is more likely that growth is determined by some economic factors (which might themselves be stochastic). In our investigation of the ES hypothesis, we focus on firm efficiency as one such factor.

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[8] Goddard et al. (2004) extend this analysis and examine the simultaneous determination of firm growth and profitability.

3. Methodology

3.1. Growth regression to test the ES hypothesis

To test the core relationship of the ES hypothesis originally articulated by Demsetz (1973), we propose to directly investigate the effect of firm efficiency on firm growth. The main regression, the growth regression, takes the following form:

$$GROWTH_{i,t} = \gamma_0 + \gamma_1 EF_{i,t-1} + \gamma_2 X_{i,t} + \varepsilon_{i,t}, \qquad (1)$$

where the indices *i* and *t* respectively represent the firm and the time.

The dependent variable of this regression, $GROWTH_{i,t}$ is a proxy for firm growth. When we apply this test to banks in Japan in the next section, we use the amount and the growth of loans or assets as the firm growth proxy. The term $EF_{i,t-1}$ is the measure for firm efficiency. The above specification assumes that the effect of efficiency is realized with a one-year lag. A vector of independent variables $X_{i,t}$ consists of control variables such as economic conditions and/or firm heterogeneity. The final term $\varepsilon_{i,t}$ is an ordinary error term. To test the ES hypothesis, we examine whether the coefficient for $EF_{i,t-1}$ (i.e., γ_1) is positive and significant, because the hypothesis predicts that efficient firms grow.

There are several approaches to estimate $EF_{i,t-1}$. They are broadly classified into parametric and non-parametric approaches.[9] However, little consensus has been reached with respect to which is the best measure. The choice among different approaches also depends on the characteristics of the data used. As explained below, in our application of this test to banks in Japan, we adopt a parametric distribution-free approach that also takes into account time-varying fixed effects.

The original ES hypothesis predicts not only that efficient firms grow, but also that the growth of efficient firms makes the market more concentrated. As explained in the introduction, we do not focus on this growth-concentration nexus because, although the market might ultimately be concentrated with a small number of efficient firms in a steady state, the relationship between firm growth and market concentration is unclear before the steady state is reached. For example, as large inefficient firms lose market share, the market might become temporarily less concentrated. We do not focus on the effect on market performance either, because the effect of firm efficiency on market performance is also unclear.

[9] See for example, Schmidt (1985) and Bauer (1990). Berger and Humphrey (1997) survey methodologies used to estimate bank efficiency. Berger (2007) compares international evidence on bank efficiency.

3.2. Efficiency regression to test the quiet-life hypothesis

To increase the efficiency of our estimation, we run a regression with an efficiency measure on the left-hand side:

$$EF_{i,t} = \beta_0 + \beta_1 CONC_{t-1} + \beta_2 Z_{i,t} + \varpi_{i,t}, \qquad (2)$$

where, $Z_{i,t}$ is a vector of control variables, and $\varpi_{i,t}$ is an ordinary error term.

The main independent variable in this regression is $CONC_{t-1}$, a measure for market concentration such as the market Herfindahl or the three-firm concentration ratio. This variable allows us to test the quiet-life hypothesis, which predicts that there is a positive relationship between market concentration and firm *in*efficiency, because in a concentrated market firms do not minimize costs (Berger and Hannan 1998). In our test, a negative and significant coefficient for β_1 is consistent with this hypothesis.

We *simultaneously* estimate the regressions (1) and (2). From an econometric viewpoint, this yields the benefit of increasing the efficiency of our estimation. In addition, the simultaneous estimation also gives us important economic insight. The mechanisms of the ES hypothesis and the quiet-life hypothesis might work simultaneously, at least in the short-run. Our approach allows for the two hypotheses to be supported at the same time, which is the case when we find γ_1 to be positive and β_1 to be negative. Furthermore, if we find support for the two hypotheses, we can infer the relative strength of the effects of the two hypotheses by comparing the economic significance of the coefficient estimates.

4. Application to Japanese banks

4.1. Data

In this section, we apply the methodology proposed in the previous section to banks in Japan from the 1974-2005 period (fiscal years).[10] Unless otherwise specified, the data used are from banks' financial statements (unconsolidated base) compiled in the Nikkei NEEDS Company (Bank) Data File CD-ROM (Nikkei Media Marketing, Inc.).

Banks in Japan are classified into several types.[11] We chose to examine city banks and long-term credit banks that operate in a single nationwide market.[12] We excluded trust banks because they are not ordinary banks, in that they provide trust services. We excluded other smaller banks because they all operate regionally, mainly targeting small- or medium-sized enterprises in the region, and so their markets are segmented from those in our sample.[13]

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[10] Fiscal years in Japan start in April and end in the following March. The duration of the sample period shortens in some analysis when we use lagged variables.

[11] See Uchida and Udell (2010) for more information about different types of banks in Japan.

[12] City banks are the largest banks and have nationwide branch networks, and long-term credit banks are those legally designated to focus on long-term banking. There used to be three long-term credit banks in Japan, but all of them changed their status to ordinary banks by 2004.

[13] Ishikawa and Tsutsui (2013) report evidence consistent with this market segmentation.

The banking industry in Japan has experienced a wave of drastic consolidation since the late 1990s, and in this period many banks in our sample merged with each other and changed their names. Banks grow when a merger takes place, because the new bank is larger in size than each of its predecessors. However, our focus is on growth due to efficiency, and not on growth due to consolidation. Thus, when new banks emerge due to consolidation, we treat the new banks and their predecessors as different entities. As a result, we have 26 banks in our sample.[14]

4.2. Specification of the main regressions

This subsection explains how we specify the two regressions explained in section 3. The descriptive statistics for the variables used below are shown in Table 1.

<<Insert Table 1 about here>>

4.2.1. Growth regression

To test the ES hypothesis, we use two alternative specifications for equation (1) (growth

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[14] The 26 banks are: Industrial Bank of Japan, Long-Term Credit Bank of Japan, Nippon Credit Bank, Shinsei Bank, Aozora Bank, Daiichi Kangyo Bank, Mizuho Bank, Mitsui Bank, Sakura Bank, Fuji Bank, Mizuho Corporate Bank, Mitsubishi Bank, Tokyo Mitubishi Bank, Kyowa Bank, Asahi Bank, Sanwa Bank, UFJ Bank, Sumitomo Bank, Sumitomo Mitsui Banking Corporation, Daiwa Bank, Resona Bank, Tokai Bank, Hokkaido Takushoku Bank, Taiyo Kobe Bank, Bank of Tokyo, and Saitama Bank. Bank of Tokyo Mitsubishi UFJ is excluded because we have only one observation for them in our sample period.

regression):

$$\ln L_{i,t} = \gamma_0 + \gamma_1 \cdot EF_{i,t-1} + \gamma_2 \cdot \ln GDP_t + \gamma_3 \cdot rc_t + \gamma_4 \cdot CR_{i,t} + \gamma_5 \cdot INFL_t + \varpi_{i,t}^L, \qquad (3)$$

or

$$\Delta \ln L_{i,t} = \gamma_0 + \gamma_1 \cdot EF_{i,t-1} + \gamma_2 \cdot \Delta \ln GDP_t + \gamma_3 \cdot \Delta rc_t + \gamma_4 \cdot \Delta CR_{i,t} + \gamma_5 \cdot \Delta INFL_t + \varpi_{i,t}^L. \; (3')$$

The variable $L_{i,t}$ is the amount of loans outstanding (in real terms). We focus on bank growth in the lending market, because loans are one of the key products of a bank.[15] The key independent variable is $EF_{i,t-1}$, a measure of banks' cost efficiency. Equations (3) and (3') are alternatives that differ in terms of how they measure bank growth. Equation (3) is a level regression that focuses on the effect of $EF_{i,t-1}$ on the level of $L_{i,t}$. Equation (3') is a difference regression that focuses on the change (difference) in $L_{i,t}$ from the previous period. In either version, the ES hypothesis is supported if we find that γ_1 is positive. Note that the difference regression controls for time-invariant bank fixed effects.

To estimate the efficiency measure $EF_{i,t-1}$, we follow an approach using time-varying bank fixed effects (see e.g., Schmidt and Sickels 1984 and Schmidt 1985 for this approach). First, we estimate a cost function that includes time-varying bank fixed effects. More specifically, we include terms such as $a_i(\tau_t *) \equiv a_i + a_{iT} \cdot \tau_t * + a_{iTT} \cdot (\tau_t *)^2 + a_{iTTT} \cdot (\tau_t *)^3$ in a cost function, where

[15] In a robustness check in subsection 4.4, we focus on growth in bank assets.

a_i is a constant that is unique to bank *i* (indicating bank fixed effects), and $\tau_t *$ is time trend.[16] We then obtain a cost *in*efficiency measure as the difference between respective estimates of $a_i(\tau_t *)$ and the minimum of them in each year. Finally, we obtain our measure of cost efficiency by reversing the sign of the inefficiency measure and taking the exponential. More details of our derivation for the cost efficiency measure can be found in the Appendix of Homma et al. (2012), but two notable advantages of our approach are worth mentioning here: First, we use a parametric distribution-free approach, which is more flexible than stochastic-frontier approaches. Second, our efficiency measure is flexible in the sense that it is time-varying.[17]

Turning to other explanatory variables, we control for loan supply and loan demand, because our dependent variable is the amount of loans. We use GDP_t, real GDP, as a measure of demand. For supply variables, we use rc_t, the call rate, which is an interest rate for the most representative interbank market in Japan, and $CR_{i,t}$, the capital-asset ratio. Due to data availability, rc_t is the interest rate for secured overnight lending before 1985, and for unsecured overnight lending after 1985. Also, $CR_{i,t}$ is the Basel capital ratio if available, and is 1 – leverage if otherwise. Finally,

[16] This is the approach of Cornwell et al. (1990), but our measure is more flexible than theirs because they do not use the cubic term.

[17] When we estimate the time-invariant efficiency measure by the OLS regression with time-invariant bank fixed effects, we find that the estimates are on average smaller than those for the time-variant fixed effects used below. This implies that time-invariant estimation underestimates the efficiency measures.

we use $INFL_t$, the inflation rate defined as the rate of change of the GDP deflator. This variable might capture a demand as well as a supply factor. Sources of these data are the SNA from the Cabinet Office and the Financial and Economic Statistics Monthly from the Bank of Japan. In equation (3'), we take the first differences of these variables.

4.2.2. Efficiency regression

Turning to equation (2), the efficiency regression to test the quiet-life hypothesis, we use the following two alternative specifications:

$$EF_{i,t} = \beta_1 \cdot HI_{t-1} + \beta_2 \cdot D_{SMLBANK} + \beta_3 \cdot D_{MEDBANK} + \beta_4 \cdot D_{LARBANK} + \beta_5 \cdot D_{HUGBANK}$$

$$+ \beta_6 \cdot D_{MERGER} + \beta_7 \cdot D_{LTCB} + \beta_8 \cdot D_{FHC} + \beta_9 \cdot AGE_i$$

$$+ \beta_{10} \cdot LA_{i,t} + \beta_{11} \cdot DA_{i,t} + \beta_{12} \cdot SDROA_i + \varpi^U_{i,t}. \qquad (4)$$

or

$$\Delta EF_{i,t} = \beta_1 \cdot HI_{t-1} + \beta_2 \cdot D_{SMLBANK} + \beta_3 \cdot D_{MEDBANK} + \beta_4 \cdot D_{LARBANK} + \beta_5 \cdot D_{HUGBANK}$$

$$+ \beta_6 \cdot D_{MERGER} + \beta_7 \cdot D_{LTCB} + \beta_8 \cdot D_{FHC} + \beta_9 \cdot AGE_i + \beta_{10} \cdot \Delta LA_{i,t} + \beta_{11} \cdot \Delta DA_{i,t}$$

$$+ \beta_{12} \cdot SDROA_i + \varpi^U_{i,t}. \qquad (4')$$

In these equations, the dependent variable is the measure of cost efficiency $EF_{i,t}$ (or its one-year difference). The key independent variable is HI_{t-1}, the market Herfindahl (representing market concentration), calculated using each bank's nominal amount of loans outstanding. Equation (4) (the level regression) focuses on the effect of HI_{t-1} on the level of efficiency, and equation (4') (the difference regression) focuses on its effect on the change in the efficiency level. These equations are simultaneously estimated with equation (3) or (3'), respectively. Either in equation (4) or (4'), the quiet-life hypothesis predicts a negative coefficient for β_1.

For control variables, we use several bank-specific characteristics. Dummy variables $D_{SMLBANK}$, $D_{MEDBANK}$, $D_{LARBANK}$, and $D_{HUGBANK}$ respectively indicate that the relevant bank is a small, medium-sized, large, or huge bank. The cut-offs for these size categories are 15 trillion yen, 40 trillion yen, and 65 trillion yen in nominal assets. We use all four dummies, and do not include an intercept in equation (4) or (4').

A dummy variable D_{MERGER} takes a value of unity if the relevant bank has ever experienced a merger before the relevant year. This variable captures the effect that consolidation increases cost efficiency. A dummy variable D_{LTCB} takes a value of unity if the relevant bank is a long-term credit bank. Another dummy variable D_{FHC} indicates that the bank is affiliated with a financial holding company. Firm age is represented by AGE_i.

We also include some financial variables. Two financial ratios are used to capture the difference in efficiency levels due to banks' varying dependence on traditional deposit-to-loan business models: $LA_{i,t}$ is the ratio of total loans to total assets, and $DA_{i,t}$ is the ratio of total deposits to total assets. To control for bank risk, we use $SDROA_i$, the standard deviation of ROA over the sample period.

4.2.3. Additional specification and estimation method

In addition to the baseline specifications explained above, we estimate the equations by allowing for different impacts of the key independent variables for different time periods. Specifically, we add interaction terms between our key independent variables (i.e., $EF_{i,t-1}$ in equation (3) or (3') and HI_{t-1} in equation (4) or (4')) and three dummy variables, D^{7689}, D^{9000} and D^{0105}, which respectively take the value of unity for the periods 1976-89, 1990-2000, and 2001-2005. The first period corresponds to the period when deregulation measures were taken, and includes the famous "Japanese bubble" occurred. The second period corresponds to the post-bubble period, which saw a serious economic slump and financial crisis. The third period is a period of recovery from that slump.

For each specification, we simultaneously estimate the growth and the efficiency regressions by Generalized Method of Moments (GMM). In doing so, we deal with many potential problems in the estimation. First, we explicitly control for heterosckedascity of the error terms. Second, we correct for serial correlation when it is found. This is of particular importance because our panel data have large T (time period).

We also take into account possible endogeneity of some variables by using different instrumental variables for each equation. Although either of our two dependent variables enter in the other equation as an independent variable, we cannot completely rule out the possibility that some other independent variables are endogenous variables due to reverse causality.[18] As instruments, we use the individual bank dummies for both equations, $\ln GDP_{t-1}$, rc_t, $CR_{i,t-1}$, $INFL_t$, $EF_{i,t-1}$, (or $EF_{i,t-1} \cdot D^{7689}$, $EF_{i,t-1} \cdot D^{9000}$, and $EF_{i,t-1} \cdot D^{0105}$ when these interaction terms are used) for the growth regression, and HI_{t-1}, $D_{SMLBANK}$, $D_{MEDBANK}$, $D_{LARBANK}$, D_{MARGER}, D_{FHC}, $LA_{i,t-1}$, $DA_{i,t-1}$ (or $HI_{t-1} \cdot D^{7689}$, $HI_{t-1} \cdot D^{9000}$, and $HI_{t-1} \cdot D^{0105}$) for the efficiency regression.

Note that in dealing with this endogeneity problem, our approach has methodological advantages over the ordinary ones. Ordinary approaches are based on the estimation of a stochastic frontier cost function, and thus the inefficiency term follows a specific distribution. In this case, it is extremely difficult to cope with the endogeneity problem, because the overall likelihood function is difficult to derive. For example, one needs to specify the generating process

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[18] Such variables include, for example, $\ln GDP_t$ and $CR_{i,t}$ in equation (3), $\Delta \ln GDP_t$ and $\Delta CR_{i,t}$ in equation (3'), $LA_{i,t}$ and $DA_{i,t}$ in equation (4), and $LA_{i,t}$ and $DA_{i,t}$ in equation (4').

of the endogenous variables as well as a joint distribution of the inefficiency term and other error terms.

4.3. Results

4.3.1. Level regressions

The estimation results are shown in Table 2. In this table, panel (A) reports the results for the simultaneous estimation of the level equations (3) and (4). In each panel, column (i) shows the results for the baseline regression, and column (ii) shows those when we interact the key independent variables with the three period dummies D^{7689}, D^{9000} and D^{0105}. The test statistic for the overidentification restriction is far from significant (the p-value is 0.58). Therefore, we cannot reject the null hypothesis of overidentification. This means that the likelihood that there is an error in the specification of the two equations is small.

<<Insert Table 2 about here>>

The coefficients of interest are those for $EF_{i,t-1}$ (in each subperiod) in the growth regression, and for HI_{t-1} (in each subperiod) in the efficiency regression. From column (i) of panel (A), we see that the coefficient on $EF_{i,t-1}$ is positive and significant. This means that efficient banks become larger. This finding lends support to the ES hypothesis. As for the quiet-life hypothesis, we find that the coefficient for HI_{t-1} is negative and significant. This finding means that banks in a more concentrated market become more inefficient, which is consistent with the quiet-life hypothesis.

Turning to column (ii), we find that the effect of $EF_{i,t-1}$ on bank growth is always positive and significant even when we divide the sample period. The impact is the largest in the middle of the three sub-periods, and the smallest in the 2001-2005 period. In the efficiency regression, the hypothesis is supported in the 1990-2000 and the 2001-2005 periods, since HI_{t-1} has a negative coefficient for $EF_{i,t-1}$ in these periods. We also find that the coefficient is the largest in the 1990s-2000 period, so the deterioration of efficiency due to market concentration is the highest in the 1990s. The sign of the point estimate is opposite in the 1976-1989 period, but is statistically insignificant.

4.3.2. Difference regressions

The results for the difference regression are shown in panel (B) of Table 2. They are on balance similar to, and consistent with, those in panel (A). In column (i) where we report the results for equation (3') and (4'), the ES hypothesis is supported, since the coefficient for $EF_{i,t-1}$ is positive and statistically significant. The coefficient for HI_{t-1} in the efficiency regression is again negative and significant, so the quiet-life hypothesis is also supported. In column (ii) where we allow for different impacts of the main independent variables in the three sub-periods, we find that the main results are qualitatively unchanged. The only difference between panel (A) and panel (B) is that the coefficient for $HI_{t-1} \cdot D^{7689}$ is now negative and significant.

We also find that the control variables generally have the anticipated impacts on the dependent variables, and that these effects are statistically significant. The amount of loans ($\ln L_{i,t}$ or $\Delta \ln L_{i,t}$) is larger when loan demand is larger (larger GDP), or when loan supply is larger (a smaller interbank lending rate or a higher capital ratio (panel (A) only)). Banks are more efficient when they are large (but not huge), probably due to economies of scale. Post-merger banks are more efficient, probably because the merger enables them to cut costs; long-term credit banks are more efficient, probably because they are less dependent on deposit funding; and banks affiliated with a financial holding company are less efficient, probably because of their complex and hierarchical organizational structure. We also find that younger banks and less risky banks are more efficient, and banks with a higher loan to asset ratio or deposit to asset ratio are more efficient.

4.3.3. Simultaneous versus separate estimation

In theory, the simultaneous estimation of the growth and the efficiency regressions increases the efficiency of the estimation. To check whether this is indeed the case, we ran the two regressions separately and compared the results with the ones above. What we expected was that the findings above would be qualitatively the same in terms of the signs and the magnitudes of the estimated parameters for important variables, but that the *t*-values for the parameters would be larger in absolute values for the joint estimation than for the separate estimations.

<<Insert Table 3 about here>>

Table 3 reports the results for the separate estimations for the growth and the efficiency regressions by GMM. We find that the expectations above generally hold, especially for the difference regressions in panel (B). The results for the coefficients of the key variables in panel (B) are qualitatively similar to those in Table 2, and have smaller *t*-values. However, there are some exceptions in the case of the level regressions (panel (A)). Inconsistent with the above expectations, the coefficients for $EF_{i,t-1}$ in the growth regressions with and without the interaction terms are negative and/or statistically significant, and some coefficients for HI_{t-1} in the efficiency regression with the interaction terms are positive and statistically significant.

However, we also find that the null hypothesis of the test for overidentification is rejected for the growth regression in panel (A). This means that in the case of separate estmation of the level regressions, the growth regression suffers from mis-specification. On balance, the results from the simultaneous estimation are more believable, because, as we have already seen above, it does not suffer from serious miss-specification, and therefore the parameter estimates are consistent.

4.3.4. Economic implication

On balance, our findings support both the ES and the quiet-life hypotheses. These findings are robust to alternative measures of bank growth (i.e., levels or differences). Note that as discussed above, the two hypotheses are not mutually exclusive in theory, at least in the short run. However, existing empirical studies did not allow for this possibility. This paper is therefore the first study to find evidence supporting both hypotheses at once.

Our findings are intriguing from an economic point of view. The finding for the ES hypothesis implies that efficient banks grow more. However, if the banking market becomes more concentrated due to the growth of such (efficient) banks, the finding for the quiet-life hypothesis then implies that the banks lose efficiency. As they become inefficient, they then lose the size they had previously gained (the ES hypothesis). In this manner, our findings seem to imply the existence of an interesting cyclical dynamic of banks growth and decline, due to the interaction between growth and efficiency.

To further pursue this possibility, we calculate the economic impact of the two hypotheses. For the ES hypothesis, when we focus on the results for the baseline specification in Table 2 (column (i) of panel A,), the point estimate for the coefficient for $EF_{i,t-1}$ in the growth regression is 1.643. This indicates that for an average bank, an increase in the cost efficiency measure by one standard deviation (0.150) leads to an increase in $\ln L_{i,t}$ by 0.246, which is equivalent to a 1.279-fold increase in $L_{i,t}$. The impact is therefore economically significant.

The economic significance of the impact of the quiet-life hypothesis can be calculated similarly. As shown in the same column in Table 2, the point estimate for the coefficient for HI_{t-1} in the efficiency regression is -0.684. Because the standard deviation of the Herfindahl index for the 30-year period (1976-2005, N=30) is 0.074, an increase in the index by one standard deviation leads to a decrease in $EF_{i,t}$ by 0.050. Because the standard deviation of $EF_{i,t}$ is 0.150, we can conclude that the economic impact of the quiet-life hypothesis is less significant than that of the ES hypothesis. Although this comparison depends on different assumptions, it suggests that the economic impact of the ES hypothesis dominates that of the quiet-life hypothesis. Note that this finding has an important policy implication. It implies that anti-concentration measures might *increase* inefficiency in the economy.

4.4. Robustness check

4.4.1. Alternative measure for bank growth

In this subsection, we check the robustness of our findings using yet another measure of bank growth. Instead of focusing on bank growth in terms of loan size, we now focus on growth in terms of asset size. For this check, we estimate the same equations ((3) and (4) or (3') and (4')) but replace $L_{i,t}$ with $A_{i,t}$, the size of banks' assets.

<<Insert Table 4 about here>>

Table 4 shows the results when we focus on asset growth. Again, panels (A) and (B) respectively report the results for the level regressions (equations (3) and (4)) and for the difference regressions (equations (3') and (4')), and in each panel columns (i) and (ii) are respectively for the specification without and with the interaction terms between our key independent variables and the period dummies.

We can see that the results for the ES and the quiet-life hypotheses are robust to this alternative specification. Compared with Table 2, the coefficients for the main independent variables ($EF_{i,t-1}$ and HI_{t-1}) have the same signs and comparable significance levels, the only exception being the effect of $EF_{i,t-1}$ on asset growth during the 1990s. On balance, irrespective of whether we measure bank growth by loan size or by asset size, both the ES hypothesis and the quiet-life hypothesis are supported. This reinforces our conclusions from the previous section.

4.4.2. Effect of bank consolidation

Although our findings thus far are consistent with the ES and the quiet-life hypotheses, we cannot rule out the possibility that these findings are derived from a different mechanism.[19] Because there has been significant consolidation among our sample banks, we assign different identification to banks before and after mergers. This very approach might create the relationships we find among our main variables, even if the ES and the quiet-life hypotheses did not hold.

Suppose, for example, that two banks merged and improved their cost efficiency. Suppose also that there are other banks whose efficiency did not change before and after this merger event.

[19] This is a possibility that helpfully suggested by an anonymous referee.

Under our approach, if the efficiency of the merged bank significantly improved, efficiency of the other banks deteriorates because our efficiency measure is a *relative* measure defined vis-à-vis the most efficient bank in the same year. At the same time, industry concentration would also increases due to the merger. Taken together, such mergers might give rise to a negative correlation between market concentration and the average efficiency of sample banks.

In our estimation, this concern might be mitigated to some extent, because we use one-year lags of the main independent variables, and so the findings are not caused by the above mechanism insofar as it operates only in the same year. Also, in the efficiency regression, we directly control for the effect of efficiency improvement after mergers using the merger dummy, D_{MERGER}.

However, we cannot yet completely rule out the possibility that the effect of consolidation drives our findings to some degree. Thus, to take into account this concern more seriously, we check the change in the efficiency levels of the banks that experienced mergers. More specifically, we check (1) whether the most efficient bank in each year is a bank that has just experienced a merger, and (2) if so, whether the efficiency of the bank improved in a significant manner after the merger. The above concern is significant if the answers to these questions are both yes.

Regarding the first question, we find that out of our 31 sample fiscal-years, there are only three years in which the bank that had just experienced a merger is the most efficient bank: (i) Sakura

Bank in FY 1991, (ii) Asahi Bank in FY1992, and (iii) Mizuho Corporate Bank in FY2003. There were five other merger events in our sample, but in these cases, post-merger banks were not the most efficient banks.[20] This means that the concern above is not likely the main driver of our findings.

To answer question (2) for the three most-efficient banks that did merge in our sample, we also compare the levels of their cost efficiency before and after the mergers. By definition, the efficiency measure takes the value of 1.0 for the year's most efficient bank. The levels of the measures of the predecessors of the three banks are (i) 0.80 (Mitsui Bank) and 0.95 (Taiyo Kobe Bank), (ii) 0.97 (Kyowa Bank) and 1.00 (Saitama Bank), and (iii) 0.56 (Industrial Bank of Japan), 0.79 (Daiichi Kanogyo Bank), and 0.83 (Fuji Bank). Compared with the standard deviation of the efficiency measure, which is 0.15 (see Table 1), those improvements are not very large. On balance, these findings imply that the efficiency improvement after mergers is not the primary driver of our main findings, and lend supports to our interpretation that the ES and the quiet-life hypotheses drive the findings.

[20] The five cases are: Bank of Tokyo Mitsubishi in FY1997, UFJ Bank in FY 2001, Mitsui Sumitomo Bank in FY2002, Resona Bank in FY2003, and Mizuho Bank in FY 2003.

5. Conclusion

This paper proposes a new test of the efficient structure (ES) hypothesis. This test has many advantages over those in existing studies, because it directly examines the relationship between firm efficiency and firm growth, and simultaneously tests the quiet-life hypothesis.

Applying this test to data on large banks in Japan, we consistently find that more efficient banks tend to become larger, which is consistent with the efficient structure hypothesis. We also find that market concentration erodes banks' cost efficiency, which is consistent with the quiet-life hypothesis. These findings imply that banks undergo an intriguing life-cycle dynamic: Banks grow rapidly as they become more efficient, but the resulting market concentration assures a "quiet life" for banks, which makes them lose efficiency and shrink. That said, we also find that the economic impact of the quiet-life hypothesis is less significant than that of the ES hypothesis, implying that anti-concentration measures might increase inefficiency in the economy.

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Table 1 Descriptive statistics for simultaneous estimation

Variables		Definition	Source	# of obs.	Mean	Std Dev	Minimum	Maximum
Efficiency Hypothesis regression	$y_{L,i,t}$	Real loans outstanding = loans outstanding / GDP deflator (million yen)	(a), (b)	384	16,039,100	10,597,000	2,559,613	56,489,700
	$EF_{i,t-1}$	Cost effiicency measure	Our calculation (see Appendix)	384	0.772	0.150	0.424	1.000
	GDP_t	Real GDP	(b)	384	392,717	88,959	247,834	548,249
	rc_t	Call rate (interbank rate) (collateralized rate before 1986 and uncollateralized rate afterwards)	(c)	384	0.029	0.014	0.007	0.127
	CR_t	Regulatory capital ratio (if unavailable, capital/assets)	(a)	384	0.035	0.029	0.007	0.142
	$INFL_t$	Inflation rate (the rate of change in GDP deflator)	(b)	384	0.017	0.024	-0.03	0.078
Quiet-life Hypothesis regression	HI_{t-1}	Hirfindahl index (market concentration measure)	(a)	384	0.087	0.04	0.071	0.424
	$D_{SMLBANK}$	Small bank dummy (= 1 if total assets < 15 trillion yen)	(a)	384	0.346	0.476	(NA)	(NA)
	$D_{MEDBANK}$	Medium bank dummy (= 1 if 15 trillion yen =< total assets < 40 trillion yen)	(a)	384	0.391	0.489	(NA)	(NA)
	$D_{LARBANK}$	Large bank dummy (= 1 if 40 trillion yen =< total assets < 65 trillion yen)	(a)	384	0.224	0.417	(NA)	(NA)
	$D_{HUGBANK}$	Huge bank dummy (= 1 if total assets >= 65 trillion yen)	(a)	384	0.039	0.194	(NA)	(NA)
	D_{MERGER}	Merger dummy (= 1 if the bank experienced a merger)	Hand collected (different sources)	384	0.094	0.292	(NA)	(NA)
	D_{LTCB}	LTCB dummy (= 1 if the bank is a long-term credit bank)	Hand collected (different sources)	384	0.201	0.401	(NA)	(NA)
	D_{FHC}	Holding company dummy (= 1 if the bank is affiliated with a financial holding company)	Hand collected (different sources)	384	0.057	0.233	(NA)	(NA)
	AGE_i	Bank age	Hand collected (different sources)	384	65.479	28.111	3.083	104.833
	$LA_{i,t}$	Loans/assets	(a)	384	0.568	0.072	0.330	0.732
	$DA_{i,t}$	Deposits/assets	(a)	384	0.581	0.197	0.132	0.794
	$SDROA_i$	Standard deviation of ROA (ROA= (total interest income - total interest expenses - ordinary costs)/assets)	(a)	384	0.002	0.001	0.000	0.003

Data sources: (a) Nikkei NEEDS CD-ROM, (b) SNA of the Cabinet Office, (c) Financial and economic statistics monthly of the Bank of Japan.

Table 2. Estimation results for the growth and the efficiency regressions

This table shows the results for the GMM estimation of the growth and the efficiency regressions. The dependent variable in the growth regression is banks' loan level $\ln L_{i,t}$ (in Panel (A)) or loan growth $\Delta \ln L_{i,t}$ (in Panel (B)). The main independent variable is the bank efficiency measure $EF_{i,t\text{-}1}$ (in column (i)) or its interactions with period dummies (in column (ii)). The dependent variable in the efficiency regression is the bank efficiency measure $EF_{i,t}$ and the main independendt variable is the measure for market concentration (Hirfindahl index) $HI_{i,t\text{-}1}$ (in column (i)) or its interactions with period dummies (in column (ii)). For more detailed definitions of these and other variables, see Section 4.2. ***, **, and * respectively represent that the estimated coefficient is significant at a 1%, 5%, and 10% level.

(A) Dependent variable: $\ln L_{i,t}$ for the growth regression and $EF_{i,t}$ for the efficiency regression

	Independent variable	(i) Baseline regression Estimate	t-statistic		(ii) With period dummies Estimate	t-statistic	
Growth regression	(intercept)	-9.3568	-4.9937	***	-9.7267	-5.0949	***
	$EF_{i,t\text{-}1}$	1.6429	26.7299	***	NA		
	$EF_{i,t\text{-}1}*D^{7689}$	NA			1.4803	22.8522	***
	$EF_{i,t\text{-}1}*D^{9000}$	NA			1.7363	26.4944	***
	$EF_{i,t\text{-}1}*D^{0105}$	NA			1.3702	27.6018	***
	$\ln GDP_t$	1.9358	13.4672	***	1.9622	13.3719	***
	rc_t	-29.1109	-42.2625	***	-26.3154	-36.3041	***
	$CR_{i,t}$	10.6659	22.0355	***	10.6968	22.6059	***
	$INFL_t$	1.0935	0.8749		2.3538	2.0566	**
Efficiency regression	$HI_{i,t\text{-}1}$	-0.6842	-6.5825	***	NA		
	$HI_{i,t\text{-}1}*D^{7689}$	NA			0.1529	0.4262	
	$HI_{i,t\text{-}1}*D^{9000}$	NA			-1.4574	-4.5602	***
	$HI_{i,t\text{-}1}*D^{0105}$	NA			-0.4329	-3.6786	***
	$D_{SMLBANK}$	0.2272	7.3620	***	0.1331	3.2526	***
	$D_{MEDBANK}$	0.2671	9.3913	***	0.2165	5.5281	***
	$D_{LARBANK}$	0.4209	14.8058	***	0.3913	9.9878	***
	$D_{HUGBANK}$	0.2215	7.0374	***	0.2074	4.7401	***
	D_{MERGER}	0.0548	4.5290	***	0.0500	3.0520	***
	D_{LTCB}	0.2235	9.0928	***	0.1283	4.8876	***
	D_{FHC}	-0.0566	-4.8623	***	-0.0875	-4.5692	***
	AGE_t	-0.0002	-1.6451	*	-0.0002	-1.0930	
	$LA_{i,t}$	0.3701	6.8200	***	0.7255	9.1481	***
	$DA_{i,t}$	0.6696	16.4805	***	0.4426	8.8203	***
	$SDROA_i$	-55.5862	-8.7794	***	-59.6685	-10.7600	***
R^2		0.4148 (Growth regression) 0.5191 (Efficiency regression)			0.4639 (Growth regression) 0.4928 (Efficiency regression)		
Obs.		384			384		
Order of MA for the error term		10			10		
Test for overidentification [P value]		44.3696 [0.582]			44.2691 [0.586]		
Value function		0.1155			0.1153		

(B) Dependent variable: $\Delta\ln L_{i,t}$ for the growth regression and $\Delta EF_{i,t}$ for the efficiency regression

	Independent variable	(i) Baseline regression Estimate	t-statistic		(ii) With period dummies Estimate	t-statistic	
Growth regression	(intercept)	-0.0716	-4.3809	***	-0.0610	-2.9994	***
	$EF_{i,t\text{-}1}$	0.0741	4.1062	***	NA		
	$EF_{i,t\text{-}1}*D^{7689}$	NA			0.1144	6.3861	***
	$EF_{i,t\text{-}1}*D^{9000}$	NA			0.0461	2.4200	**
	$EF_{i,t\text{-}1}*D^{0105}$	NA			0.0541	2.0677	**
	$\Delta\ln GDP_t$	1.9404	6.1116	***	1.2298	4.1799	***
	Δrc_t	0.2540	0.3687		-0.8406	-1.6572	*
	$\Delta CR_{i,t}$	-1.6677	-2.4387	**	-0.2083	-0.5230	
	$\Delta INFL_t$	-0.0498	-0.3195		-0.0990	-0.9283	
Efficiency regression	$HI_{i,t\text{-}1}$	-0.9472	-19.8616	***	NA		
	$HI_{i,t\text{-}1}*D^{7689}$	NA			-2.2824	-11.6058	***
	$HI_{i,t\text{-}1}*D^{9000}$	NA			-1.8475	-12.3069	***
	$HI_{i,t\text{-}1}*D^{0105}$	NA			-1.1408	-29.4724	***
	$D_{SMLBANK}$	0.0919	8.5882	***	0.1809	11.9026	***
	$D_{MEDBANK}$	0.0969	9.5025	***	0.1784	11.7840	***
	$D_{LARBANK}$	0.1050	8.7632	***	0.1694	11.2464	***
	$D_{HUGBANK}$	0.1079	8.4225	***	0.1687	12.3409	***
	D_{MERGER}	0.0096	1.4041		0.0157	3.0676	***
	D_{LTCB}	0.0036	0.5060		-0.0001	-0.0182	
	D_{FHC}	0.0387	5.5857	***	0.0112	1.5361	
	AGE_t	-0.0001	-1.0165		0.00004	0.6584	
	$\Delta LA_{i,t}$	-0.0919	-0.6092		-0.4502	-3.7898	***
	$\Delta DA_{i,t}$	0.7781	6.0029	***	0.2123	1.9406	*
	$SDROA_i$	-9.2732	-2.2257	**	-8.5338	-3.2575	***
R^2		0.2728 (Growth regression) 0.3545 (Efficiency regression)			0.4690 (Growth regression) 0.4420 (Efficiency regression)		
Obs.		384			384		
Order of MA for the error term		3			5		
Test for overidentification [P value]		45.1245 [0.551]			49.5029 [0.374]		
Value function		0.1175			0.1289		

Table 3. Separate estimation results for the growth and the efficiency regressions

This table shows the results for the separate GMM estimation of the growth and the efficiency regressions. The dependent variable in the growth regression is banks' loan level $\ln L_{i,t}$ (in Panel (A)) or loan growth $\Delta \ln L_{i,t}$ (in Panel (B)). The main independent variable is the bank efficiency measure $EF_{i,t\text{-}1}$ (in column (i)) or its interactions with period dummies (in column (ii)). The dependent variable in the efficiency regression is the bank efficiency measure $EF_{i,t}$ and the main independent variable is the measure for market concentration (Hirfindahl index) $HI_{i,t\text{-}1}$ (in column (i)) or its interactions with period dummies (in column (ii)). For more detailed definitions of these and other variables, see Section 4.2. ***, **, and * respectively represent that the estimated coefficient is significant at a 1%, 5%, and 10% level.

(A) Dependent variable: $\ln L_{i,t}$ for the growth regression and $EF_{i,t}$ for the efficiency regression

	Independent variable	(i) Baseline regression Estimate	t-statistic		(ii) With period dummies Estimate	t-statistic	
Growth regression	(intercept)	-14.3526	-6.9085	***	-6.8037	-1.6724	*
	$EF_{i,t\text{-}1}$	-0.1538	-0.9075		NA		
	$EF_{i,t\text{-}1}*D^{7689}$	NA			-0.3177	-1.8215	*
	$EF_{i,t\text{-}1}*D^{9000}$	NA			0.0677	0.4486	
	$EF_{i,t\text{-}1}*D^{0105}$	NA			-0.4320	-2.8236	***
	$\ln GDP_t$	2.4322	15.1727	***	1.8485	5.9070	***
	rc_t	-27.3955	-13.1923	***	-26.7881	-66.1332	***
	$CR_{i,t}$	8.3746	7.6323	***	9.1100	9.3322	***
	$INFL_t$	3.2961	2.6649	***	1.2774	0.9980	
Efficiency regression	$HI_{i,t\text{-}1}$	-0.5053	-5.9720	***	NA		
	$HI_{i,t\text{-}1}*D^{7689}$	NA			1.3379	3.0825	***
	$HI_{i,t\text{-}1}*D^{9000}$	NA			0.5613	1.6477	*
	$HI_{i,t\text{-}1}*D^{0105}$	NA			-0.1587	-1.6429	*
	$D_{SMLBANK}$	0.1562	1.5670		-0.0590	-0.4916	
	$D_{MEDBANK}$	0.1524	1.5380		-0.0527	-0.4471	
	$D_{LARBANK}$	0.2491	2.5798	***	0.0519	0.4487	
	$D_{HUGBANK}$	0.0271	0.2714		-0.1820	-1.5172	
	D_{MERGER}	0.0186	0.7975		0.0217	0.8687	
	D_{LTCB}	0.1616	3.0005	***	0.1706	3.0055	***
	D_{FHC}	-0.0013	-0.1024		0.0366	1.9345	*
	AGE_t	-0.0008	-2.5343	**	-0.0008	-2.5106	**
	$LA_{i,t}$	0.4991	7.0158	***	0.5907	6.0412	***
	$DA_{i,t}$	0.7286	6.5241	***	0.7732	6.4561	***
	$SDROA_i$	-29.3664	-2.2950	**	-22.5850	-1.7175	*
Adjusted R^2		0.5311 (Growth reg.) 0.6336 (Efficiency reg.)			0.5559 (Growth reg.) 0.6434 (Efficiency reg.)		
Obs.		384 (Growth reg.) 384 (Efficiency reg.)			384 (Growth reg.) 384 (Efficiency reg.)		
Order of MA for the error term		10 (Growth reg.) 10 (Efficiency reg.)			10 (Growth reg.) 10 (Efficiency reg.)		
Test for overidentification [P value]		41.0963 [0.022] (Growth reg.) 26.3184 [0.238] (Efficiency reg.)			36.0426 [0.071] (Growth reg.) 27.5612 [0.191] (Efficiency reg.)		
Value function		0.1070 (Growth reg.) 0.0685 (Efficiency reg.)			0.0939 (Growth reg.) 0.0718 (Efficiency reg.)		

(B) Dependent variable: $\Delta \ln L_{i,t}$ for the growth regression and $\Delta EF_{i,t}$ for the efficiency regression

	Independent variable	(i) Baseline regression Estimate	t-statistic		(ii) With period dummies Estimate	t-statistic	
Growth regression	(intercept)	-0.0577	-3.2177	***	-0.0652	-2.8095	***
	$EF_{i,t\text{-}1}$	0.0564	2.9072	***	NA		
	$EF_{i,t\text{-}1}*D^{7689}$	NA			0.1016	5.3263	***
	$EF_{i,t\text{-}1}*D^{9000}$	NA			0.0404	1.8945	*
	$EF_{i,t\text{-}1}*D^{0105}$	NA			0.0445	1.5457	
	$\Delta \ln GDP_t$	1.9046	5.7189	***	1.6005	4.7206	***
	Δrc_t	0.0485	0.0594		-1.6316	-2.0931	**
	$\Delta CR_{i,t}$	-1.2069	-1.6419		0.6651	1.0802	
	$\Delta INFL_t$	0.0613	0.3782		0.0612	0.4863	
Efficiency regression	$HI_{i,t\text{-}1}$	-0.9375	-13.4537	***	NA		
	$HI_{i,t\text{-}1}*D^{7689}$	NA			-2.3411	-8.0039	***
	$HI_{i,t\text{-}1}*D^{9000}$	NA			-1.9275	-8.6050	***
	$HI_{i,t\text{-}1}*D^{0105}$	NA			-1.1525	-16.2888	***
	$D_{SMLBANK}$	0.1108	8.4130	***	0.1963	8.1017	***
	$D_{MEDBANK}$	0.1113	8.8538	***	0.1929	7.9878	***
	$D_{LARBANK}$	0.1168	8.0724	***	0.1925	7.7650	***
	$D_{HUGBANK}$	0.1190	6.3114	***	0.1853	8.1704	***
	D_{MERGER}	0.0027	0.3636		0.0092	1.3228	
	D_{LTCB}	0.0110	1.3309		0.0017	0.2225	
	D_{FHC}	0.0350	2.9982	***	-0.0002	-0.0189	
	AGE_t	-0.0002	-2.5744	***	-0.00006	-0.7767	
	$\Delta LA_{i,t}$	-0.0976	-0.6270		-0.4187	-2.4708	**
	$\Delta DA_{i,t}$	0.5802	3.3399	***	0.1986	1.3454	
	$SDROA_i$	-15.4088	-3.1260	***	-10.7552	-2.2722	**
Adjusted R^2		0.2826 (Growth reg.) 0.3791 (Efficiency reg.)			0.4392 (Growth reg.) 0.4401 (Efficiency reg.)		
Obs.		384 (Growth reg.) 384 (Efficiency reg.)			384 (Growth reg.) 384 (Efficiency reg.)		
Order of MA for the error term		3 (Growth reg.) 3 (Efficiency reg.)			5 (Growth reg.) 5 (Efficiency reg.)		
Test for overidentification [P value]		21.1923 [0.682] (Growth reg.) 29.7675 [0.124] (Efficiency reg.)			28.9610 [0.266] (Growth reg.) 30.4253 [0.108] (Efficiency reg.)		
Value function		0.0552 (Growth reg.) 0.0775 (Efficiency reg.)			0.0754 (Growth reg.) 0.0792 (Efficiency reg.)		

Table 4. Robustness check: Asset growth

This table shows the results for the GMM estimation of the growth and the efficiency regressions. The specifications are the same as those in Table 2, except that the dependent variable in the growth regression is banks' asset level ln$A_{i,t}$ (in Panel (A)) or asset growth Δln$A_{i,t}$ (in Panel (B)). ***, **, and * respectively represent that the estimated coefficient is significant at the 1%, 5%, or 10% level.

(A) Dependent variable: ln $A_{i,t}$ for the growth regression and $EF_{i,t}$ for the efficiency regression

		(i) Baseline regression			(ii) With period dummies		
		Estimate	t-statistic		Estimate	t-statistic	
Growth regression	(intercept)	-7.5958	-4.0937	***	-8.4228	-3.9375	***
	$EF_{i,t-1}$	1.3579	22.0450	***	NA		
	$EF_{i,t-1}*D^{7689}$	NA			1.2955	15.3250	***
	$EF_{i,t-1}*D^{9000}$	NA			1.4232	20.9330	***
	$EF_{i,t-1}*D^{0105}$	NA			1.1889	19.3441	***
	lnGDP_t	1.8625	13.1084	***	1.9217	11.7809	***
	rc_t	-30.0980	-74.4652	***	-28.0184	-53.5050	***
	$CR_{i,t}$	11.2982	28.0618	***	11.6685	29.9260	***
	$INFL_t$	1.4611	1.1724		2.5429	2.1276	**
Efficiency regression	$HI_{i,t-1}$	-0.6066	-6.6838	***	NA		
	$HI_{i,t-1}*D^{7689}$	NA			0.0796	0.1961	
	$HI_{i,t-1}*D^{9000}$	NA			-1.2618	-3.7576	***
	$HI_{i,t-1}*D^{0105}$	NA			-0.3186	-2.5015	**
	$D_{SMLBANK}$	0.3705	9.8781	***	0.3029	5.7440	***
	$D_{MEDBANK}$	0.4145	11.4563	***	0.3821	7.6686	***
	$D_{LARBANK}$	0.5626	16.5634	***	0.5471	11.5179	***
	$D_{HUGBANK}$	0.3628	9.9574	***	0.3544	7.0592	***
	D_{MERGER}	0.0521	3.8112	***	0.0344	2.2622	**
	D_{LTCB}	0.1862	6.4472	***	0.0769	2.6175	***
	D_{FHC}	-0.0862	-6.1316	***	-0.1115	-5.7451	***
	AGE_t	-0.0004	-2.2245	**	-0.0004	-2.2711	**
	$LA_{i,t}$	0.1682	3.3809	***	0.5268	6.4990	***
	$DA_{i,t}$	0.6189	13.9704	***	0.3808	7.0306	***
	$SDROA_i$	-47.1487	-7.3962	***	-54.6401	-8.9812	***
R^2		0.3907 (Growth reg.)			0.4102 (Growth reg.)		
		0.5083 (Efficiency reg.)			0.4949 (Efficiency reg.)		
Obs.		384			384		
Order of MA for the error term		10			10		
Test for overidentification		45.0666			44.873		
[P value]		[0.553]			[0.561]		
Value function		0.1174			0.1169		

(B) Dependent variable: Δln $A_{i,t}$ for the growth regression and $\Delta EF_{i,t}$ for the efficiency regression

		(i) Baseline regression			(ii) With period dummies		
		Estimate	t-statistic		Estimate	t-statistic	
Growth regression	(intercept)	-0.0711	-6.3981	***	-0.1075	-4.4869	***
	$EF_{i,t-1}$	0.0415	4.0365	***	NA		
	$EF_{i,t-1}*D^{7689}$	NA			0.0885	5.4116	***
	$EF_{i,t-1}*D^{9000}$	NA			0.0282	1.5050	
	$EF_{i,t-1}*D^{0105}$	NA			0.0966	4.1645	***
	ΔlnGDP_t	2.7817	7.6949	***	3.1306	5.4440	***
	Δrc_t	-3.4835	-4.0774	***	-6.8801	-5.5926	***
	$\Delta CR_{i,t}$	0.5773	0.6405		4.3528	5.0199	***
	$\Delta INFL_t$	0.1226	0.6490		0.1278	0.7298	
Efficiency regression	$HI_{i,t-1}$	-0.9702	-21.2590	***	NA		
	$HI_{i,t-1}*D^{7689}$	NA			-2.4582	-10.5871	***
	$HI_{i,t-1}*D^{9000}$	NA			-1.9796	-11.2853	***
	$HI_{i,t-1}*D^{0105}$	NA			-1.1917	-24.7775	***
	$D_{SMLBANK}$	0.0897	9.5884	***	0.1806	9.8701	***
	$D_{MEDBANK}$	0.0953	10.3644	***	0.1838	10.1481	***
	$D_{LARBANK}$	0.1036	9.5136	***	0.1821	9.8694	***
	$D_{HUGBANK}$	0.0995	7.9288	***	0.1804	10.0970	***
	D_{MERGER}	0.0132	2.1420	**	0.0125	2.3936	**
	D_{LTCB}	0.0017	0.2762		-0.0085	-1.4141	
	D_{FHC}	0.0454	6.6030	***	0.0002	0.0165	
	AGE_t	-0.00003	-0.4502		0.0001	1.2258	
	$\Delta LA_{i,t}$	-0.1102	-0.7683		-0.6206	-3.9290	***
	$\Delta DA_{i,t}$	0.7620	6.5925	***	0.3872	2.9075	***
	$SDROA_i$	-8.2640	-2.3280	**	-3.7070	-1.0905	
R^2		0.2472 (Growth reg.)			0.2207 (Growth reg.)		
		0.3559 (Efficiency reg.)			0.4140 (Efficiency reg.)		
Obs.		384			384		
Order of MA for the error term		3			5		
Test for overidentification		42.0602			41.8537		
[P value]		[0.677]			[0.685]		
Value function		0.1095			0.1090		