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Abstract

This paper considers the aggregate performance of the banking industry, applying a modified and extended dynamic decomposition of bank return on equity. The aggregate performance of any industry depends on the underlying microeconomic dynamics within that industry . adjustments within banks, reallocations between banks, entry of new banks, and exit of existing banks. Bailey, Hulten, and Campbell (1992) and Haltiwanger (1997) develop dynamic decompositions of industry performance. We extend those analyses to derive an ideal decomposition that includes their decomposition as one component. We also extend the decomposition, consider geography, and implement decomposition on a state-by-state basis, linking that geographic decomposition back to the national level. We then consider how deregulation of geographic restrictions on bank activity affects the components of the state-level dynamic decomposition, controlling for competition and the state of the economy within each state and employing fixed- and random-effects estimation for a panel database across the fifty states and the District of Columbia from 1976 to 2000.

Journal of Economic Literature Classification: L1, G2

Keywords: aggregate fluctuations, dynamic decomposition, productivity

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An ‘Ideal’ Decomposition of Industry Dynamics: An Application to the Nationwide and State Level U.S. Banking Industry

1. Introduction

The U.S. banking industry provides fertile ground for cultivating research on industry dynamics under regulatory change.[1] The historical development of U.S. institutions, with the strong aversion to concentrations of power and with the significant regulation in the banking sector enacted in response to the Great Depression, generated an industry encompassing many more banks than the norm around the world. During the 1970s, financial innovations frequently circumvented existing regulation. Those innovations gradually eroded the effect of existing regulations, ultimately dismantling much of the regulatory superstructure erected during the Great Depression. Thus, the last two decades of the 20th century witnessed a chain of deregulatory actions that unlocked the regulatory handcuffs, enacted during the Great Depression. For example, the prohibition against intrastate and interstate banking slowly devolved, first with a series of relaxations of regulation on a state-by-state basis, then by growing state-level actions permitting interstate banking activity through multibank holding companies, and finally with the adoption of full interstate banking with the passage of the Interstate Banking and Branching Efficiency Act of 1994. In sum, the deregulation of geographic restrictions on banking activity at the state and national levels provides a most unusual real-world experiment on the effects of such deregulation on banking behavior and performance.[2]

We examine the performance of the banking industry, measured by the rate of return on

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[1] Kane (1996) provides an excellent historical account of the deregulatory movements in the U.S. banking sector.

[2] Existing work considers the effects of deregulation on various banking issues. For example, how did deregulation affect bank new charters, failures, and mergers (Amos, 1992; Cebula, 1994: Jeon and Miller, 2005a) and bank performance (Berger and Mester, 2003; Jayaratne and Strahan, 1997, 1998; Jeon and Miller, 2005b; Tirtirglu, Daniels, and Tirtirglu, 2005).

equity, at the national and state levels. Aggregate bank performance decomposes into effects due to adjustments within banks, reallocations between banks, entry of new banks, and exit of existing banks. We modify the decomposition of industry performance measures typically used in the existing literature (Bailey, Hulten, and Campbell, 1992; Haltiwanger 1997) and develop an "ideal" decomposition. In addition, we extend this new decomposition to consider geographic (regional) effects. That extension allows us to explore the effects, if any, of the deregulation of geographic restrictions on banking on the state-level decomposition of bank performance (return on equity). In that analysis, we control for competition and the state of the economy in each state, employing fixed- and random-effect regressions in the panel database across the fifty states and the District of Columbia from 1976 to 2000.

The dynamic decomposition of industry performance requires micro-level information on firms (banks) within an industry. The availability of micro-level (establishment-level) data for manufacturing industries spawned a series of such applied microeconomic research.[3] That research effort reveals more heterogeneity among firms and plants within the same industry than between industries. In sum, aggregate industry data hide important firm- and plant-level dynamics that collectively determine overall industry dynamics.

Bailey, Hulten, and Campbell (1992) provide an algebraic decomposition of an industry's total factor productivity (TFP) growth into three effects – "within," "between," and "net-entry" effects. The within effect measures the contribution of surviving firms toward TFP growth. The between (or reallocation) effect measures the contribution of changing market share of surviving firms toward TFP growth, while the net-entry effect measures the contribution of firms entry into and exit from the industry toward TFP growth. Haltiwanger (1997) extends Bailey, Hulten, and

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[3] McGuckin (1995) describes the Longitudinal Research Database (LRD) at the U.S. Bureau of the Census upon

Campbell (1992) and separates the effects of firm entrants into and exit from the industry. Moreover, he also divides the between effect into two components – the "share" and "covariance" effects. The share effect measures the contribution toward aggregate TFP growth of the changing share of firms while the covariance effect measures the contribution toward aggregate TFP growth of the changing share of firms times the changing TFP growth of firms.[4] Stiroh (1999), using U.S. banking data, further decomposes Haltiwanger's (1997) method by dividing banks into those that acquired other banks and those that did not.

Such decomposition methods share a common index-number issue – the base-year choice. Bailey, Hulten, and Campbell (1992), Haltiwanger (1997), and Stiroh (1999) choose the initial year as the base. Thus, the within effect measures the change in TFP growth at the firm level between the initial and final years weighted by the initial year's market share. Alternatively another decomposition exists of within, between (reallocation), entry, and exit effects when the final year provides the base. That is, the within effect weights the change in TFP growth between the initial and final years for each firm by the firm's industry share in the final year. Finally, an ideal dynamic decomposition combines these two dynamic decompositions into a simple average.[5] Thus, the weighting of the within, between (reallocation), entry, and exit effects all employ simple averages of the initial and final year weights. In addition, the ideal dynamic decomposition of the industry eliminates the covariance effect derived by Haltiwanger (1997).[6]

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which this research relies.

[4] As illustrated below, the covariance effect emerges as a consequence of the decomposition method. Our decomposition method causes the covariance effect to disappear.

[5] This discussion possesses an analogy to the price index literature. The Laspeyres (1871) price index uses the initial year, the Paasche (1974) price index uses the final year, and the Fisher (1922) ideal price index forms a geometric, rather than an arithmetic, average. Pigou (1920) also proposed the ideal price index.

[6] Griliches and Regev (1995) employ the ideal decomposition method in their study of firm productivity in Israeli industry. Scarpetta, Hemmings, Tressel, and Woo (2002) briefly describe the Griliches and Regev (1995) and Haltiwanger (1997) methods of decomposition, noting how they differ. We, however, link the differences to the

Finally, since the aggregate performance measure possesses more meaning on a regional basis, we extend our decomposition on a state-by-state basis.[7] That decomposition includes two components, where, on the one hand, the nation remains as the macro unit while individual states replace banks as the micro units to produce one component and, on the other hand, the states replace the nation as the macro unit while individual banks remain as the micro units to produce the other component.

This paper unfolds as follows. Section 2 discusses the existing dynamic decomposition and derives an alternative dynamic decomposition that when combined with the first decomposition yields the ideal dynamic decomposition. Section 3 illustrates the technique using the U.S. commercial banking industry. Section 4 extends the ideal dynamic decomposition to a state-by-state analysis. Section 5 considers how deregulation, state-level banking concentration, and the state of the state economy affect the components of the state-by-state dynamic decomposition. That analysis employs panel data estimation using the fixed- and random-effects regression techniques. Section 6 concludes.

2. Alternative Dynamic Decomposition[8]

Since we apply the ideal dynamic decomposition to the U.S. commercial banking industry, our derivation of the various dynamic decompositions employs industry return on equity (ROE). The ROE at time t (R_t) equals net income (NI_t) at time *t* divided by equity (E_t) at time *t*. That is,

$$R_t = NI_t / E_t, \tag{1}$$

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base-year weighting issue. Finally, after completing an earlier draft of our paper, Bartelsman, Haltiwanger, and Scarpetta (2004) most recently also note that the covariance term disappears for the ideal decomposition.

[7] The decomposition can also extend to the metropolitan statistical area (MSA) and non-MSA county levels of analysis. We do not make that extension, stopping short at the state level, since we consider the effect, if any, of banking and branching deregulation on bank performance. That is, banking and branching deregulation occurs at the state and national level and not the MSA or non-MSA country levels.

[8] Appendix A provides the details of the derivation.

where $NI_t = \sum_{i=1}^{n_t} NI_{i,t}$ and $E_t = \sum_{i=1}^{n_t} E_{i,t}$. Thus, after substitution and rearrangement, we get

$$R_t = \sum_{i=1}^{n_t} r_{i,t}\theta_{i,t} \ , \tag{2}$$

where $r_{i,t}$ equals the ratio of net income to equity for bank i in period t and $\theta_{i.t}$ equals the i-th bank's share of industry equity.

We want to decompose the change in industry return on equity into within, between, entry, and exit effects. Thus, the change in industry return on equity equals the following:

$$\Delta R_t = R_t - R_{t-1} = \sum_{i=1}^{n_t} r_{i,t}\theta_{i,t} - \sum_{i=1}^{n_{t-1}} r_{i,t-1}\theta_{i,t-1} \ . \tag{3}$$

Now, the number of banks in period *t* equals the number of banks in period *t-1* plus the number of bank entrants minus the number of bank exits. That is,

$$n_t = n_{t-1} + n_t^{enter} - n_{t-1}^{exit} \ . \tag{4}$$

Rearranging terms in equation (4) yields

$$n_t - n_t^{enter} = n_{t-1} - n_{t-1}^{exit} = n_t^{stay} \text{; or} \tag{5}$$

$$n_t = n_t^{stay} + n_t^{enter} \text{, and } n_{t-1} = n_t^{stay} + n_{t-1}^{exit} \ . \tag{6}$$

Note that $n_t^{stay} = n_{t-1}^{stay}$.[9] Thus, equation (3) adjusts as follows:

$$\Delta R_t = \sum_{i=1}^{n_t^{stay}} r_{i,t}\theta_{i,t} + \sum_{i=1}^{n_t^{enter}} r_{i,t}\theta_{i,t} - \sum_{i=1}^{n_t^{stay}} r_{i,t-1}\theta_{i,t-1} - \sum_{i=1}^{n_{t-1}^{exit}} r_{i,t-1}\theta_{i,t-1} \ . \tag{7}$$

Case 1: Existing Dynamic Decomposition

So far, we have separated the "stay" terms from the "entry" and "exit" terms. Now, we need to decompose the "stay" terms into within and between effects. Bailey, Hulten, and Campbell (1992) and Haltiwanger (1997) each weight the within effect with the individual firm's industry

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[9] Consider two time periods t and (t-1). We classify banks as staying, if the bank exists in both t and (t-1); entering, if the bank does not exist in (t-1) but does in t; and exiting, if the bank exists in (t-1) but not in t.

share of equity in the initial year. That is, we need to add and subtract $\sum_{i=1}^{n_t^{stay}} r_{i,t}\theta_{i,t-1}$ from the right-hand side of equation (7). After some manipulation, we get that

$$\Delta R_t = \sum_{i=1}^{n_t^{stay}} r_{i,t}\theta_{i,\Delta t} + \sum_{i=1}^{n_t^{stay}} r_{i,\Delta t}\theta_{i,t-1} + \sum_{i=1}^{n_t^{enter}} r_{i,t}\theta_{i,t} - \sum_{i=1}^{n_{t-1}^{exit}} r_{i,t-1}\theta_{i,t-1}\,, \qquad (8)$$

where $\theta_{i,\Delta t} = \theta_{i,t} - \theta_{i,t-1}$ and $r_{i,\Delta t} = r_{i,t} - r_{i,t-1}$.

The sum of individual bank's shares of equity over all banks in the industry in both periods *t* and *t-1* equals one. That is,

$$\sum_{i=1}^{n_t^{stay}} \theta_{i,t} + \sum_{i=1}^{n_t^{enter}} \theta_{i,t} = \sum_{i=1}^{n_t^{stay}} \theta_{i,t-1} + \sum_{i=1}^{n_{t-1}^{exit}} \theta_{i,t-1} = 1\text{; or} \qquad (9)$$

$$R_{t-1}\left[\sum_{i=1}^{n_t^{stay}} \theta_{i,t} + \sum_{i=1}^{n_t^{enter}} \theta_{i,t}\right] - R_{t-1}\left[\sum_{i=1}^{n_t^{stay}} \theta_{i,t-1} + \sum_{i=1}^{n_{t-1}^{exit}} \theta_{i,t-1}\right] = 0\,. \qquad (10)$$

Note that we could also use R_t rather than R_{t-1} in equation (10), leading to Case 1a. The standard decomposition in the literature, however, uses equation (10). The difference in decompositions reflects whether one compares the industry to where it started (R_{t-1}) or ended (R_t).

Finally, adding the left-hand side of equation (10), which equals zero, to equation (8) produces, after some algebraic manipulation, the following relation:

$$\Delta R_t = \underbrace{\sum_{i=1}^{n_t^{stay}} r_{i,\Delta t}\theta_{i,t-1}}_{\text{“within effect”}} + \underbrace{\sum_{i=1}^{n_t^{stay}} (r_{i,t} - R_{t-1})\theta_{i,\Delta t}}_{\text{“between effect”}} + \underbrace{\sum_{i=1}^{n_t^{enter}} (r_{i,t} - R_{t-1})\theta_{i,t}}_{\text{“entry effect”}}$$

$$- \underbrace{\sum_{i=1}^{n_{t-1}^{exit}} (r_{i,t-1} - R_{t-1})\theta_{i,t-1}}_{\text{“exit effect”}}\,. \qquad (11)$$

We evaluate the between, entry, and exit effects relative to the industry return on equity (R_{t-1}). For example, the between effect sums the differences between each bank's return on equity and the industry's return on equity multiplied by that bank's change in equity share. In this case, we evaluate the bank's return on equity in period t and the industry's return on equity in period (t-1). Because of the timing difference, Haltiwanger (1997) decomposes the between (reallocation) effect into a “share” effect and a “covariance” effect by adding and subtracting $r_{i,t-1}$ within the term $(r_{i,t} - R_{t-1})$ contained in the between effect summation.[10] That is, we get

$$\underset{\text{“between effect”}}{\sum_{i=1}^{n_t^{stay}} (r_{i,t} - R_{t-1})\theta_{i,\Delta t}} = \underset{\text{“covariance effect”}}{\sum_{i=1}^{n_t^{stay}} r_{i,\Delta t}\theta_{i,\Delta t}} + \underset{\text{“share effect”}}{\sum_{i=1}^{n_t^{stay}} (r_{i,t-1} - R_{t-1})\theta_{i,\Delta t}} \ . \tag{12}$$

The covariance effect combines elements of both within and between (reallocation) effects. The covariance effect emerges as an artifact of the discrete nature of the decomposition method and possesses a “second-order-small” effect. If, however, we compare the industry to where its return on equity ended (R_t), then the covariance term does not emerge. Our ideal decomposition also mitigates this problem, as the covariance effect disappears.

Case 2: Alternative Dynamic Decomposition

Now, decompose the change in industry return on equity by weighting the within effect by period-t individual bank’s share of industry equity. That is, we need to add and subtract $\sum_{i=1}^{n_t^{stay}} r_{i,t-1}\theta_{i,t}$ to equation (7). Then follow the same procedures used in the first dynamic decomposition where the industry return on equity in period t (R_t) replaces the industry return on equity in period t-1 (R_{t-1}) in equation (10). After necessary manipulations, the final form equals:

$$\Delta R_t = \underset{\text{“within effect”}}{\sum_{i=1}^{n_t^{stay}} r_{i,\Delta t}\,\theta_{i,t}} + \underset{\text{“between effect”}}{\sum_{i=1}^{n_t^{stay}} (r_{i,t-1} - R_t)\theta_{i,\Delta t}} + \underset{\text{“entry effect”}}{\sum_{i=1}^{n_t^{enter}} (r_{i,t} - R_t)\theta_{i,t}}$$

$$- \underset{\text{“exit effect”}}{\sum_{i=1}^{n_{t-1}^{exit}} (r_{i,t-1} - R_t)\theta_{i,t-1}} \ . \tag{13}$$

Now, we further decompose the between (reallocation) effect by adding and subtracting $r_{i,t}$ inside the term $(r_{i,t-1} - R_t)$ contained in the between summation and generate the following result:

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[10] Stiroh (1999) further decomposes the within, share, and covariance effects into effects for banks that acquire

$$\underbrace{\sum_{i=1}^{n_t^{stay}} (r_{i,t-1} - R_t)\theta_{i,\Delta t}}_{\text{“between effect”}} = \underbrace{-\sum_{i=1}^{n_t^{stay}} r_{i,\Delta t}\theta_{i,\Delta t}}_{\text{-“covariance effect”}} + \underbrace{\sum_{i=1}^{n_t^{stay}} (r_{i,t} - R_t)\theta_{i,\Delta t}}_{\text{“share effect”}} \qquad (14)$$

In *Case 1*, the between effect decomposes into a share effect evaluated in period (t-1) plus the covariance effect. Now, in *Case 2*, the between effect decomposes into a share effect evaluated in period t minus the covariance effect. Similar to *Case 1*, an alternative dynamic decomposition (*Case 2a*) uses the original equation (10). Now, the dynamic decomposition equals equation (13) where R_{t-1} replaces R_t everywhere. And again, no covariance term emerges from this dynamic decomposition. The ideal dynamic decomposition (*Case 3*) simply averages *Case-1* and *Case-2*. Thus, the between effect in the ideal decomposition equals the average of the share effects evaluated in periods t and (t-1) and the covariance effects cancel.

Case 3: *Ideal Dynamic Decomposition*

The ideal dynamic decomposition averages *Case 1* and *Case 2* (*Cases 1a* and *2a*) as follows:

$$\Delta R_t = \underbrace{\sum_{i=1}^{n_t^{stay}} r_{i,\Delta t}\bar{\theta}_i}_{\text{“within effect”}} + \underbrace{\sum_{i=1}^{n_t^{stay}} (\bar{r}_i - \bar{R})\theta_{i,\Delta t}}_{\text{“between effect”}} + \underbrace{\sum_{i=1}^{n_t^{enter}} (r_{i,t} - \bar{R})\theta_{i,t}}_{\text{“entry effect”}}$$

$$\underbrace{-\sum_{i=1}^{n_{t-1}^{exit}} (r_{i,t-1} - \bar{R})\theta_{i,t-1}}_{\text{“exit effect”}} . \qquad (15)$$

where $\bar{\theta}_i = (\theta_{i,t} + \theta_{i,t-1})/2$,

$\bar{r}_i = (r_{i,t} + r_{i,t-1})/2$, and

$\bar{R} = (R_t + R_{t-1})/2$.

In sum, the ideal dynamic decomposition includes four effects. The within effect equals the summation of each bank’s change in return on equity weighted by its average share of industry equity between period *t* and *t-1*. The between (reallocation) effect equals the summation

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other banks and banks that do not.

of the difference between each bank's return on equity and the average industry return on equity between periods *t* and *t-1* times the change in that bank's share of industry equity. The entry effect equals the summation of the difference between each entry bank's return on equity in period *t* and the average industry return on equity between periods *t* and *t-1* times the entry bank's share of industry equity in period *t*. Finally, the exit effect equals the summation of the difference between each exit bank's return on equity in period *t-1* and the average industry return on equity between periods *t* and *t-1* times the exit bank's share of industry equity in period *t-1*.

Schumpeter (1950) coined the phrase "creative destruction" to describe his view of the capitalism, evolving through a dynamic process of mergers, entry, and exit of firms spurred by innovation and technical change. Bartelsman, Haltiwanger, and Scarpetta (2004) associate the reallocation (between), entry and exit effects of productivity change with creative destruction, which they call restructuring, reallocation and creative destruction. The banking industry operates, however, under regulation, since instability in the banking system can cause a banking crisis and recession, or worse. The public must maintain its confidence in the soundness of the banking industry. A process of creative destruction in the banking industry, if too large, may undermine the public's confidence. Thus, since stability proves the hallmark of a sound banking practice, we anticipate that the within effect should dominate movements in aggregate bank performance.

3. Commercial Bank Return on Equity: Nationwide Decomposition

To illustrate the ideal dynamic decomposition, we employ Call Report data for all commercial banks in the U.S. from 1976 to 2000.[11] To calculate the dynamic decomposition between two years, say 1999 and 2000, we need to identify and separate entrants (banks that entered the

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[11] The data for our analysis come from the Federal Reserve Bank of Chicago web site, which is located at

industry), exits (banks that exited the industry), and stays (banks that stayed in the industry). To do so, we matched bank ID numbers in the database. If a bank ID number exists in both 1999 and 2000, then the bank stays in the industry. If a bank ID number exists in 1999, but not in 2000, then the bank exits. If a bank ID number exists in 2000, but not in 1999, then the bank enters.

Table 1 provides the dynamic decomposition of aggregate return on equity for all commercial banks in the U.S. between 1976 and 2000. Several observations emerge. First, on a year-to-year basis, the within effect explains the change in return on equity. The correlations between the within, between, entry, and exit effects and the change in return on equity equal 0.92, -0.12, 0.02, and –0.30, respectively. Further, simple ordinary least squares regressions of the change in return on equity onto the within, between, entry, and exit effects only produce a significant regression for the within effect.[12] The within effect, however, does not contribute much to the cumulative, long-run change in return on equity, as we show below. The years 1992 and 1993 reflect an important turning point in our analysis. The strength of the linkage between the within effect and the change in return on equity grows for the sample from 1976 to 1992, but it diminishes for 1993 to 2000.[13]

Cyclical movements of bank performance on a year-to-year basis reflect movements in the within effect. Cyclical movements in bank performance rely largely on the fortune of individual banks, on average. The trend movements of bank performance, however, reflect

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http://www.chicagofed.org/economic_research_and_data/commercial_bank_data.cfm.

[12] The significant regression generates an intercept of 0.00, not significantly different from zero at the 1-percent level, and a slope coefficient of 0.83, which is significantly less than one at the 5-, but not the 10-, percent level.

[13] The simple correlations alter to 0.99 and 0.90 for the 1976 to 1992 and 1993 to 2000 periods. In addition, the slope coefficients for the simple linear regressions change to 0.97 and 0.50 for the same two sub-periods, where 0.97 is not significantly different from 1.

movements in the between effect. Now, trend movements in bank performance rely on shifts in market share from low to high performance banks.

Second, the between (reallocation) effect contributes positively to increasing the industry return on equity in 19 out of the 24 years in our sample. As noted above, the 1992 and 1993 years emerge as an important turning point. In addition, between 1980 and 1992, the between (reallocation) effect increases industry return on equity for 13 consecutive years. From 1993 to 2000, the contribution of the between (reallocation) effect provides a much-less consistent story, 4 positive and 4 negative years. Prior to 1992, mergers and acquisitions exhibit more intrastate activity; after 1992, interstate merger and acquisitions become a larger part of the overall story. Moreover, interstate mergers and acquisitions generally involve much bigger banks. Our findings, therefore, suggest that intrastate mergers and acquisitions contributed more to improved industry performance than does interstate mergers and acquisitions. Jayaratne and Strahan (1998) and Tirtirglu, Daniels, and Tirtirglu (2005) make similar observations.

Third, the entry effect contributes negatively to industry return on equity in each and every year. That is, entrants to the banking industry, on average, experience a return on equity below the average return on equity in the market. Thus, entry lowers industry return on equity, which is not a surprise. DeYoung and Hasan (1998) and DeYoung (1999) note that bank entrants generally are small banks that require several years before they experience a return on equity comparable to the industry average, assuming that they survive.

Fourth, the exit effect improves industry return on equity between each pair of years, except one, 1999 to 2000. That is, exits from the banking industry, on average, experience a return on equity below the industry average. That finding is also not a surprise. For example, Stiroh and Strahan (1999) argue that after deregulation, exiting banks merged into banks that were better run, more profitable banks, on average. Our results suggest that this outcome was not only true, on average, after deregulation, but also true before deregulation. Finally, only between 1999 and 2000 were exiting banks, on average, more profitable than the industry average.[14]

Finally, the dynamic decomposition that covers the 1976 to 2000 period merely reflects the summation of the year-by-year effects. That is, the change in industry return on equity equals 0.0487. And the aggregate within, between (reallocation), entry, and exit effects total –0.0072, 0.0451, -0.0459, and –0.0566, respectively.[15] Thus, the aggregate change in industry return on equity reflects the positive contributions of the between and exit effects.[16] Moreover, the entry effect largely offsets the exit effect, while the within effect, although negative, is small. Thus, the aggregate increase in the industry return on equity falls just above the aggregate positive contribution of the between effect. Note that the within effect proves important in understanding year-to-year, short-run changes in return on equity, but unimportant in understanding cumulative, long-run changes, where the between effect becomes the important player.

The persistent positive between effect, especially between 1980 and 1992, provides the most unexpected result. Some analysts would question the examination of cumulative changes, arguing that bank profitability (return on equity) cannot exhibit a trend because competitive pressure forces equilibrium at a normal rate of return. Indeed, the within effect supports such a competitive story. That is, on a year-to-year basis, the within effect explains most of the movement in return on equity. The between effect, nevertheless, exhibits strong (positive)

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[14] Stiroh and Strahan (2003) go further, concluding that the relative profitability of exiting banks improves after deregulation. Our results imply that if more above-average return-on-equity banks exit after deregulation, then enough below-average return-on-equity banks exit to keep the aggregate exit effect negative. The reverse holds only for the 1999 to 2000 exits.

[15] The average effects equal –0.0003, 0.0019, -0.0019, and –0.0024, respectively, over the 25-year period.

[16] Note that the exit effect, while negative, contributes positively to the change in industry return on equity, since it enters the dynamic decomposition with a negative sign.

persistence that, although generally small in magnitude, accumulates to a sizeable value.[17]

The positive persistence of the between effect implies a process of consolidation in the U.S. banking industry, or creative destruction, that associates with rising profitability. That is, the conventional wisdom argues that the emergence of interstate banking and branching generated a significant increase in mergers and acquisitions (Rhoades 2000, and Jeon and Miller 2003). And a positive between effect emerges, where those banks with an above average return on equity increase their equity share. One view of the consolidation process in the banking industry suggests that it is by and large a positive event -- banks became more efficient (Jayaratne and Strahan, 1997, 1998; and Tirtirglu, Daniels, and Tirtirglu, 2005) and better-run (more profitable) banks increased their market share (Stiroh and Strahan, 2003). Another view notes that recent merger activity increased measures of industry concentration and profitability, where concentration temporally leads profitability (Jeon and Miller 2005b). Both stories imply a positive cumulative between effect, which we observe.[18]

In sum, the cumulative long-run process reveals significant creative destruction within the U.S. banking industry. Short-run movements, however, exhibit negligible creative destruction. That is, our earlier conjecture that the banking industry should not experience creative destruction proves accurate for the short run, but inaccurate for the long run.

4. Dynamic Decomposition with Geographic Aggregation

Our discussion so far considers how to decompose some industry measure of performance based on the contributions to that performance of individual firms, in our example commercial banks.

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[17] We ignore for the moment the exit and entry effects, since they provide expected outcomes that largely offset each other.

[18] A third view argues that initial innovators in new and better bank services earn excess profits in the short run. Competitive pressures eliminate these excess earnings in the longer run. But, continued new innovations extends the time of excess returns (Berger and Mester, 2003). This view also supports a positive between effect.

The regulation of banking in the U.S. provides some interest in data aggregated to the state, rather than to the national, level. In fact, although not used in this study, the Federal Deposit Insurance Corporation makes much state-level data available on their web site (http://www2.fdic.gov/hsob/index.asp). That is, banking raises the possibility of examining the performance of the industry at the state level. Such considerations lead to two extensions of our decomposition analysis – (i) decompose national performance measures using the state, rather than the individual bank, as the micro unit of analysis; and (ii) decompose state-level performance measures using the individual bank as the micro unit of analysis.

National Decomposition: State as the Micro Unit[19]

We start, once again, with equation (1). That is,

$$R_t = NI_t / E_t \,. \tag{1}$$

We index net income and equity across states and banks. Thus, $\sum_{s=1}^{S}\sum_{i=1}^{n_s} NI_{i,s,t}$ and $\sum_{s=1}^{S}\sum_{i=1}^{n_s} E_{i,s,t}$, where $NI_{i,s,t}$ and $E_{i,s,t}$ equal net income and equity for bank i in state s and period t, S (=51) equals the number of states (and the District of Columbia), and n_s equals the number of banks in state s.

Thus, substituting and rearranging yields the following:

$$R_t = \sum_{s=1}^{S} \theta_{s,t} \sum_{i=1}^{n_s} r_{i,s,t}\theta_{i,s,t} \ , \tag{16}$$

where $r_{i,s,t}$ equals the ratio of net income to equity for bank i in state s and period t and $\theta_{i.s,t}$ equals the i-th bank's share of industry equity in state s and period t. Now, the second

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[19] Appendix B provides the complete derivation. This national-to-state-level decomposition possesses potential applications to decomposing national macroeconomic data, for example, the unemployment rate.

summation in equation (16) equals the return on equity in state s. That is, we have that

$$R_{s,t} = \sum_{i=1}^{n_s} r_{i,s,t}\theta_{i,s,t} \text{ ; or} \tag{17}$$

$$R_t = \sum_{s=1}^{S} \theta_{s,t} R_{s,t} \ . \tag{18}$$

Following the same steps to decompose the change in the return on equity at the national level, but now using state aggregates as the micro units, we can easily derive the following relationship:

$$\Delta R_t = \underbrace{\sum_{s=1}^{S} \bar{\theta}_s R_{s,\Delta t}}_{\text{"within effect"}} + \underbrace{\sum_{s=1}^{S} \theta_{s,\Delta t}\left[\bar{R}_s - \bar{R}\right]}_{\text{"between effect"}}, \tag{19}$$

where $\bar{\theta}_s = (\theta_{s,t} + \theta_{s,t-1})/2$,

$\bar{R}_s = (R_{s,t} + R_{s,t-1})/2$, and

$\bar{R} = (R_t + R_{t-1})/2$.

No entry or exit effects exist in the decomposition, since states do not enter or exit. The entry and exit effects in the national decomposition will appear in the decomposition of the state-level change in return on equity $R_{s,\Delta t}$ that we discuss in the next sub-section. Also, note that equation (19) reports the ideal dynamic decomposition (case 3) that averages case-1 and case-2 decompositions. And in the process, the covariance term reported by other authors disappears.

Table 1 also reports the decomposition in equation (19) for the 1976 to 2000 sample period. Several observations stand out. First, once again, the within effect dominates the between effect on a year-by-year basis, even more strongly in this case. The sign of the within effect matches the sign of the change in the return on equity each year, except between 1993 and 1994 when the change in return on equity essentially equals zero. In addition, the within effect equals 114 percent of the change in return on equity, on average, excluding 1994. The correlations between the within and between effects and the change in return on equity equal 0.997 and –0.04. Simple ordinary least squares regressions of the change in return on equity onto, in turn, the within and between effects only yields a significant regression for the within effect.[20]

Second, while the summation of the individual within effects and the change in return on equity equal 0.0239 and 0.0487, respectively, the year-by-year values exceed zero only 9 and 10 times out of the 24 yearly observations. That is, the sum of the positive numbers must exceed the sum of the negative numbers in absolute value to generate an overall positive outcome.

Finally, the between effect exceeds zero in 20 out of 24 years. Moreover, although the between effect generally equals a smaller fraction of the change in the return on equity than the within effect, its accumulated value over the 24 years matches the within effect in magnitude. On average, the within and between effects contributes about half of the cumulative, long-run change in return on equity. In other words, the within effect exhibits persistence, unlike the results for the decomposition with individual banks as the micro unit.

Unlike the nationwide decomposition, the within effect now contributes about half of the cumulative change in return on equity with the between effect contributing the other half. Using the state as the individual unit, however, merges the within, between, exit, and entry effects that occur within each state. Thus, the persistence that we find for the state-level within effect probably reflects the aggregation of the persistence in the between, entry, and exit effects for individual banks within a state. The next section considers the decomposition of each state's return on equity. Nonetheless, even though the year-to-year cyclical link between the within

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[20] That regression produces a constant of 0.00, which is not significantly different from zero at the 1-percent level,

effect and the return on equity is so strong (i.e., correlation of 0.997), the within effect only explains one-half of the long-run change in return on equity. That is, market-share shifts from low- to high-performance banks explain much of the trend movements in bank performance.

Once again, some analysts will object to cumulative effects because the competitive nature of the banking market will drive the return on equity to normal levels. The persistent between effect belies that argument. Moreover, the between effect calculated with the state as the micro unit isolates the accumulation of the between effect to two sub-periods – 1986 to 1990 and 1994 to 2000. The former generates just in excess of 40 percent of the total accumulation over the 1976 to 2000 sample (i.e., 0.100 out of 0.248). The latter generates another 40 percent (0.102 out of 0.248). The first sub-period corresponds to the peak in the bank failures handled by the FDIC during the 1980s while the second sub-period corresponds to the most recent legislation that authorized interstate banking activity and the significant expansion of interstate merger activity. The positive between effect implies that during these two periods of bank consolidation, or creative destruction, the states with above average return on equity experienced a rising equity share.

State-Level Decomposition: Bank as the Micro Unit

This section decomposes the change in return on equity at the state level, $R_{s,\Delta t}$. The process of deriving the decomposition follows the same outline that we employ in Section 2, except that the return on equity at the state level replaces the return on equity for the nation. We report here only the ideal dynamic decomposition (case 3) that averages case-1 and case-2 dynamic decompositions. After the required manipulations, we come to the following decomposition:

$$R_{s,\Delta t} = \sum_{i=1}^{n_{s,t}^{stay}} r_{i,s,\Delta t}\bar{\theta}_{i,s} + \sum_{i=1}^{n_{s,t}^{stay}} (\bar{r}_{i,s} - \bar{R}_s)\theta_{i,s,\Delta t} + \sum_{i=1}^{n_{s,t}^{enter}} (r_{i,s,t} - \bar{R}_s)\theta_{i,s,t}$$

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and a slope coefficient of 0.99, which is not significantly different from one at the 1-percent level.

$$\text{“within effect”} \qquad \text{“between effect”} \qquad \text{“entry effect”}$$

$$-\underbrace{\sum_{i=1}^{n_{s,t-1}^{exit}}(r_{i,s,t-1}-\bar{R}_s)\theta_{i,s,t-1}}_{\text{“exit effect”}}\,. \tag{20}$$

where $\bar{\theta}_{i,s} = (\theta_{i,s,t} + \theta_{i,s,t-1})/2$,

$\bar{r}_{i,s} = (r_{i,s,t} + r_{i,s,t-1})/2$, and

$\bar{R}_s = (R_{s,t} + R_{s,t-1})/2$.

Table 2 reports the summations and averages of the decompositions over the 24-year period for each state.[21] Several items deserve notice. First, the entry effect falls below zero, on average, in every state except Minnesota. That is, on average, over the whole 24-year sample period, Minnesota experienced bank entrants that earned a return on equity that exceeded the average of all banks in Minnesota when those banks entered. New banks typically exhibit small size and generally low performance for the first few years. Thus, Minnesota bucked that trend.

Second, the exit effect falls below zero, on average, in 41 of the 51 states. The 10 exceptions – Arkansas, District of Columbia, Georgia, Iowa, Idaho, Indiana, Michigan, Missouri, South Carolina, and West Virginia – each experienced, on average, bank exits with a higher return on equity than the average of all banks in the state when those banks exited. Typically when banks exit, some other bank acquires that bank's assets and liabilities. That is, the exit associates with a take-over or merger. A take-over or merger where the exiting bank exhibits higher than average performance generates a positive exit effect.

With the exception of Idaho, those states come from the South or the Mid-West. In addition, and more importantly, with the exception of Arkansas, Georgia, Iowa, and South

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[21] The year-by-year results for all states are available from the authors on request.

Carolina, these states also experienced a substantial (i.e., more tan 39 percent) average decrease in the number of banks over the 1976 to 2000 time frame. Moreover, with the exception of Arkansas, Georgia, Iowa, Missouri, and South Carolina, each experienced a substantial (i.e., more than 6.25) average increase in branches per bank.[22] In sum, those states exhibited a more intensive consolidation, or creative destruction, on average. That is, the extent of the consolidation process necessitated the exit of more than just weak-performance banks. To investigate that conjecture more systematically, the next section considers panel-data estimation of the components of the decomposition that includes deregulation and state economic performance variables.

Third, the average within effect exceeds the average between effect over all states and time. That finding reverses the finding at the national level where the between effect exceeded the within effect, on average. How is this possible? Note that the within and between effects exhibit the identical effect in magnitude for the dynamic decomposition of the national return on equity where the state is micro unit of analysis. Thus, the shifting of assets between banks achieves more importance at the national level because of more uneven growth of assets between states than between banks within a given state.

Fourth, the within effect exceeds zero for 37 of the 51 states. A negative within effect implies that banks' performance deteriorate, on average. The 14 states with a negative within effect include Alaska, Connecticut, Massachusetts, Maine, Minnesota, Montana, Nebraska, New Jersey, New York, Oklahoma, Pennsylvania, Texas, Vermont, and Washington.

Many of those states fall in the North East region. Other states come from the energy states. Thus, the recessions experienced by those states may provide some common ground. But,

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[22] Viewed another way, those ten states went from 3 unit-banking states, 4 limited-branching states and 3 statewide-

that observation does not cover all 14 states. As noted before, the next section examines such conjectures more systematically, using panel-data regressions of the components of the decomposition.

Finally, the between effect exceeds zero in 39 of the 51 states. A negative between effect implies that assets shifted from higher- to lower-performance banks in a state. The 12 states with a negative between effect include Arizona, the District of Columbia, Georgia, Hawaii, Idaho, Illinois, Maryland, Maine, Mississippi, Oregon, South Dakota, and Utah.

The geographic pattern of those states defies a logical explanation. And we do not find other easy answers. We do note that half of these states – Arizona, the District of Columbia, Idaho, Maine, Oregon, and Utah – introduced nationwide multibank holding company acquisitions without reciprocity before the 1994 legislation that extended the legislation to all states. The panel-data analysis of the next section addresses the issues more systematically.

Close inspection of Table 2 reveals potential anomalous findings for the within and between effects – especially Alaska and Arizona, and possibly Hawaii. The within and between effects each possess large values with opposite signs. Examination of the year-by-year, state-by-state information yields the following explanation. In all three instances, a dramatic drop in equity occurs for one bank in each state between two years – 1985 to 1986 in Alaska, 1998 to 1999 in Arizona, and 1994 to 1995 in Hawaii – but no similar decline in income, expenses, and thus net income. Thus, the return on equity shoots up in magnitude for one bank in one year in each of those three states -- -12,717.3 percent in Alaska in 1986, 5,720.7 percent in Arizona in 1999, and 1,630.6 percent in Hawaii in 1995. The resultant contribution to the aggregate within and between effects exceeds 90 percent in each case. In addition, the banks in question exit the

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branching states in 1976 to 4 limited-branching states and 6 statewide-branching states in 2000.

industry the following year in Alaska and Arizona, but not in Hawaii. The bank in Hawaii does not exit in 1996. It still operates with lower equity but now also experiences lower income, expenses, and net income. The contribution to the within and between effects in Hawaii in 1996 when both net income and equity experience much lower levels no longer possesses a large effect, because the weighting factor now averages much smaller weights in 1995 and 1996.[23]

5. Explaining State-by-State Dynamic Decomposition

Differences in bank performance across states may reflect differences in bank concentration, differences in the regulatory environment, and differences in the state of the economy. Moreover, those state-by-state differences may affect the individual components of the dynamic decomposition differently – the within, between, entry, and exit effects. We explore such differences through the application of panel data fixed- and random-effects regression estimates.

We calculate the decomposition on a state-by-state basis, computing the within, between, entry and exit effects for each state over the 1976 to 2000 period in this paper. We collect other variables to capture concentration, regulatory, and economic effects. We measure concentration in banking (*hhi*) with the Hirschman-Herfindahl index in each state.[24] Several variables capture the regulatory stance of states with respect to mergers and acquisitions. One, the ratio of branches to banks (*brn_bn*) measures the effective regulatory stance in the state with respect to

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[23] Hadi (1992, 1994) develops methods for determining multiple outliers in multivariate data. Applying that methodology to our data set for the within and between effects identifies five additional outliers where the within and between effects experience nearly equal magnitudes greater than 0.2 and opposite signs – Massachusetts between 1990 and 1991, Texas between 1987 and 1988, Indiana between 1982 and 1983, and 1983 and 1984, and Missouri between 1982 and 1983 in order of importance according to Hadi’s procedure.

[24] Issues of endogeneity of the concentration measure exist. The Hirschman-Herfindahl index reflects the cumulative effect of entry and exit as well as the relative growth of existing banks. Our decomposition of state-level return on equity examines the effects of entry, exit, and the growth of existing banks. That is, the churning of banks ultimately affects the concentration measure. Jeon and Miller (2005b) find, however, that the Hirschman-Herfindahl index Granger-causes the return on equity, not vise versa. Nonetheless, readers need to exercise care in interpreting our findings.

branching.[25] In addition, three dummy variables specify the regulatory stance in each state vis-à-vis bank mergers through multibank holding companies. A state could allow out-of-state bank holding companies to acquire banks within its borders with or without conditions (reciprocity). For example, some states allow bank holding companies from other states to acquire a bank within its borders only for the set of states that also allow bank holding companies from this state to acquire banks within their borders. All such regulations became abrogated with the passage of the Interstate Banking and Branching efficiency Act of 1994, which permitted bank holding company operations on a national basis without geographic restrictions. The first dummy variable (*regid*) is one if a state possesses regional reciprocity, zero otherwise; the second (*nation*) is one if a state possesses national reciprocity, zero otherwise; and the third (*non*) is one if a state possesses national non-reciprocity, zero otherwise.[26] Finally, state-level economic information includes the unemployment rate (*unem*).

Table 3 reports the results of the panel-data fixed- and random-effects estimation.[27] Note that the fixed- and random-effect techniques control for state-specific variables that do not change over time (e.g., geographic location and size). Moreover, we perform the Hausman specification test to select the fixed- or random-effects model. The dependent variables include the within, between, entry, and exit effects. For the within-effect regression, the random-effects-model proves the superior choice while for the between-, entry-, and exit-effect regressions, the

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[25] Many studies include dummy variables for unit, limited, and statewide branching regulation. Kaparakis, Miller, and Noulas (1994) use the ratio of branches to banks to categorize states into these three categories. We use the actual ratio of branches to banks to capture the branching regulatory effect.

[26] Amel (1993) provides the initial specification for the three dummy variables. Daniels and Tirtirglu (1998) updated Amel's specification through 1995. We extend the dummy variables to 2000, where national non-reciprocity was legislated to become effective in September 1995 as noted in the text.

[27] Table 3 reports the fixed- and random-effects regressions that exclude all observations with both the within and between effects greater than 0.2 in absolute value. The findings generally do not differ qualitatively from those that do not exclude those outlier observations. Those results are available on request.

fixed-effects model dominates.

Several observations deserve notice. First, the within effect significantly responds to the state of the economy and to bank concentration, but not to the regulatory variables. If the state economy improves (i.e., experiences lower unemployment) or exhibits higher concentration, then the within effect increases, suggesting that the performance of each bank, on average, improves. The concentration effect proves significant only at the 10-percent level. In other words, states with higher banking concentration and good economies support the growth in return on equity within each bank, on average.

Second, the between effect rises with state-level concentration and falls in those states that permit interstate bank holding company acquisitions. In other words, a more concentrated state banking market that does not face external competition associates with shifts in assets, on average, from lower to higher return on equity banks. That is, the importance of the between (reallocation) effect increases with less competition, whereby more highly concentrated states experience a higher between effect and states that allow more competition from interstate bank holding company acquisitions exhibit a lower between effect.[28]

Third, the entry and exit effects significantly respond to higher concentration. The more concentrated a state is, the higher the entry effect is and the lower the exit effect is. That is, in more concentrated states, banks that enter tend to perform better and banks that exit tend to perform worse than banks that enter and exit in less concentrated states.[29] In other words, more competitive state banking markets experience more entry and exit of banks, since the threshold

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[28] Jeon and Miller (2005b) provide a more detailed analysis of the concentration and bank performance relationship, concluding that changes in concentration Granger cause bank performance over this period, rather than the reverse.

[29] These findings generally conform to those of Stiroh and Strahan (2003), albeit with a different methodology.

hurdle for entry and exit lies below that hurdle for less-competitive state banking markets.

Fourth, states with a high ratio of branches to banks (i.e., relatively more-permissive state branching regulation), on average, experience a larger exit effect. That means that those banks that do exit will exhibit higher performance. Conversely, states that permitted bank holding company operations within its borders see, on average, lower entry and exit effects, implying that those banks that do enter and exit exhibit lower performance.

Fifth, a higher unemployment rate associates with a lower exit effect at the 10-percent level, weakly suggesting that states with higher unemployment rates experience the exit of banks with poorer performance than in states with a lower unemployment rate.

What magnitudes can we associate with those significant effects? That is, are the effects important in a practical way? Table 4 reports the means, standard deviations, minimum values, and maximum values for all the variables used in the regression analysis. The following observations emerge. The Hirschman-Herfindahl coefficients each possess important magnitudes. For a 1,000 unit change in the Hirschman-Herfindahl index (about one-standard deviation of its sample movement), the coefficient implies a change in the within, between, entry, and exit effects equal to around 66-, 200-, 200-, and 200-percent, respectively, of one standard deviation of the sample movements. In sum, increasing concentration in a state improves the average performance in that state through the within, between, entry, and exit effects. A 2 percent increase in the unemployment rate (about one-standard deviation of its sample movement), generates about a 60-percent of a one-standard deviation reduction in within effect and about an 80-percent of a one-standard deviation reduction in the exit effect. Similarly, an increase in branches per bank of 7 (about one-standard deviation of its sample movement) produces about a 400-percent of a one-standard deviation increase in the exit effect. And for each of the significant interstate bank holding company acquisition dummy variables, the introduction of such interstate activity always produces a change in the between, entry, and exit effects that exceeds at least a one-standard deviation movement in the respective effect. In sum, the coefficients represent important magnitudes relative to movements in the within, between, entry, and exit effects.

What do these findings tell us? The cyclical movement in bank performance (i.e., the within effect) responds to the state of the economy with lower unemployment generating a larger within effect, as expected. The regulatory changes in intrastate and interstate banking and branching activity do not affect the cyclical movement in bank performance, but affect its trend movements. For a given level of concentration (i.e., Hirschman-Herfindahl index), increasing intrastate and interstate banking and branching opportunities generally decreases bank performance, but usually at the ten-percent level of significance. More concentration in the state banking market, holding intrastate and interstate banking and branching opportunities constant, however, leads to higher bank performance (return on equity), where the concentration effect proves significant at the one-percent level in each case save the within equation.[30] In sum, regulatory change associates with creative destruction in the U.S. banking industry.

6. Conclusion

The deregulation of the U.S. banking industry over the past quarter century affected bank operations and performance in important ways. We consider the dynamic decomposition of the return on equity aggregated first to the national level and then to the state level. Further, we consider the effects of deregulation of geographic restrictions as well as banking concentration

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[30] As noted above, Jeon and Miller (2005b) provide a more detailed analysis of the concentration and bank performance relationship, concluding that changes in concentration Granger cause bank performance over this period. Stiroh and Strahan (2003) argue that improvements in bank performance associate with higher market

and the state of the economy on a state-by-state basis on bank operations.

We apply our ideal dynamic decomposition to the return on equity in the commercial banking industry between 1976 and 2000 where the microeconomic unit is the bank.[31] We find that the between and exit effects contributed positively and strongly to the banking industry's trend return on equity. The entry effect also contributed negatively and strongly to the industry's trend return on equity. But the within effect, although negative, did not contribute much to the long-run change in industry return on equity. Interestingly, although the within effect does not contribute to the cumulative, long-run change in return on equity over the sample period, the within effect dominates the between, entry, and exit effects on a year-to-year basis. In sum, the within effect dominates the cyclical movements in bank performance, but the trend movement in bank performance reflects the between effect. That is, the growing market share of high-performance banks at the expense of low-performance banks explains the trend movement in bank performance over our sample period.[32] That is, the trend movement in industry performance reflects a process of creative destruction.

Next, we apply the ideal dynamic decomposition to the return on equity in the commercial-banking industry where the microeconomic unit is the state. Now, the entry and exit effects lose any practical meaning. Here, the within and between effects exhibit some interesting patterns. As for the national decomposition, the within effect, once again, dominates the between effect in its contribution to the change in state return on equity on a year-by-year basis. The between effect, although seemingly insignificant each year, produces a significant effect on the

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shares, but they do not consider causality issues, assuming that bank performance leads market share changes.

[31] Unlike manufacturing industry micro data, we do not have information at the branch level that would correspond to the plant level for manufacturing firms.

[32] Stiroh and Strahan (2003), using a different methodology, reach a similar conclusion.

change in return on equity over the long run, reaching parity with the within effect over the entire 25-year sample period. Those findings prove consistent with the results for the national decomposition, except that the within effect still explains one-half of the trend movement in bank performance. But, the aggregation of data to the state level forces the individual bank between, entry, and exit effects into the within effect at the state level of aggregation.

Then, we apply the ideal dynamic decomposition on a state-by-state basis where the microeconomic unit is the bank. Here, the cumulative, long-run within effect in each state dominates the between effect. That is, the between effect possesses more clout, on average, between banks in different states than between banks in the same state.

We employ our state-by-state decompositions to perform panel-data fixed- and random-effects regressions of the components of the decomposition onto bank concentration, bank regulation, and state economic variables. The state of the economy and bank concentration affect the cyclical component of bank performance (within effect) while bank concentration as well as intrastate and interstate banking and branching deregulation affect the trend movements in bank performance (between, entry, and exit effects). That is, deregulation affects the process of creative destruction within the U.S. banking industry.

Lower unemployment and higher bank concentration within a state boosts the within effect, on average. That is, a good economy with a concentrated banking market raises the return on equity in a state. At the same time, high bank concentration and the absence of interstate competition boosts the between effect, on average, whereby assets move from low to high return-on-equity banks. Finally, high bank concentration associates with entry of banks with higher return on equity and exit of banks with lower return on equity, on average.

Combining the effects in the prior paragraph suggests a positive linkage between bank profitability and bank concentration, a well-documented fact in the literature. The conventional wisdom suggests that the consolidation within the U.S. banking industry showers benefits on consumers of banks services, arguing that banks became more efficient (Jayaratne and Strahan, 1997, 1998). This efficient structure view stipulates that more efficient banks become more profitable, which leads to increased concentration (Berger 1995).[33] The market power view, on the other hands, suggests that improved profitability follows from increased concentration (Jeon and Miller 2005b).

In sum, the bank consolidation process produced increased average bank performance in each state through all avenues – within, between, entry, and exit effects. Interestingly, the movement to interstate acquisitions through multibank holding companies caused a reduction in average bank performance in each state through the between and entry effects, but an increase in performance through the exit effect.

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[33] Berger and Mester (2003) argue that initial innovators in bank services capture excess profits in the short run but that a process of continued innovation sustains that excess profitability beyond the short run.

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Table 1: Dynamic Decomposition of U.S. Banking Industry: 1976-2000

YEAR	WITHIN	BETWEEN	ENTRY	EXIT	ΔROE	ST_WTHN	ST_BTWN
1976-1977	0.0101	0.0010	-0.0006	-0.0004	0.0108	0.0108	0.0000
1977-1978	0.0231	0.0013	-0.0011	-0.0006	0.0239	0.0235	0.0005
1978-1979	-0.0704	-0.0008	-0.0008	-0.0003	-0.0717	-0.0716	0.0000
1979-1980	-0.0147	0.0043	-0.0006	-0.0002	-0.0107	-0.0117	0.0010
1980-1981	-0.0227	0.0053	-0.0014	-0.0020	-0.0168	-0.0182	0.0014
1981-1982	-0.0298	0.0114	-0.0012	-0.0029	-0.0167	-0.0177	0.0010
1982-1983	-0.0075	0.0019	-0.0011	-0.0020	-0.0048	-0.0054	0.0006
1983-1984	0.0738	0.0064	-0.0016	-0.0047	0.0832	0.0830	0.0002
1984-1985	0.0150	0.0013	-0.0014	-0.0004	0.0152	0.0148	0.0004
1985-1986	-0.0226	0.0123	-0.0015	-0.0111	-0.0007	-0.0006	-0.0001
1986-1987	0.0164	0.0046	-0.0014	-0.0019	0.0215	0.0184	0.0032
1987-1988	-0.0008	0.0149	-0.0022	-0.0027	0.0145	0.0118	0.0027
1988-1989	0.0029	0.0019	-0.0120	-0.0023	-0.0049	-0.0066	0.0016
1989-1990	-0.0158	0.0023	-0.0020	-0.0007	-0.0149	-0.0174	0.0025
1990-1991	-0.0218	0.0177	-0.0003	-0.0017	-0.0027	-0.0026	-0.0001
1991-1992	0.0156	0.0017	-0.0006	-0.0010	0.0178	0.0179	0.0000
1992-1993	-0.0066	-0.0022	-0.0010	-0.0028	-0.0070	-0.0057	-0.0013
1993-1994	-0.0038	0.0013	-0.0003	-0.0029	0.0000	-0.0012	0.0012
1994-1995	0.0003	-0.0041	-0.0011	-0.0010	-0.0039	-0.0048	0.0009
1995-1996	0.0024	0.0010	-0.0093	-0.0029	-0.0030	-0.0100	0.0070
1996-1997	0.0046	0.0028	-0.0005	-0.0082	0.0151	0.0188	-0.0037
1997-1998	-0.0150	-0.0019	-0.0009	-0.0001	-0.0176	-0.0179	0.0003
1998-1999	0.0720	-0.0435	-0.0017	-0.0047	0.0315	0.0294	0.0021
1999-2000	-0.0119	0.0043	-0.0012	0.0007	-0.0095	-0.0131	0.0036
SUM	-0.0072	0.0451	-0.0459	-0.0566	0.0487	0.0239	0.0248
AVE	-0.0003	0.0019	-0.0019	-0.0024	0.0020	0.0010	0.0010

Note: The change in return on equity between any two years (e.g., ΔROE between 1999 and 2000 equals –0.0095 = 0.2599 – 0.2694) equals the sum of the WITHIN, BETWEEN, and ENTRY effects minus the EXIT effect (e.g., -0.0119 + 0.0043 – 0.0012 – 0.0007 = -0.0095). It also equals the sum of the state within (ST_WTHN) and state between (ST_BTWN) effects.

Table 2: State-by-State Dynamic Decomposition of U.S. Banking Industry: 1976-2000

	SUMMATION				AVERAGE			
	WITHIN	BETWEEN	ENTRY	EXIT	WITHIN	BETWEEN	ENTRY	EXIT
Alabama	0.0559	0.0572	-0.0198	-0.0229	0.0023	0.0024	-0.0008	-0.0010
Alaska	-4.2136	3.7726	-0.0088	-0.2701	-0.1756	0.1572	-0.0004	-0.0113
Arizona	5.8222	-5.4452	-0.1142	-0.0504	0.2426	-0.2269	-0.0048	-0.0021
Arkansas	0.0606	0.0140	-0.0160	0.0246	0.0025	0.0006	-0.0007	0.0010
California	0.0041	0.0468	-0.0413	-0.0429	0.0002	0.0019	-0.0017	-0.0018
Colorado	0.0667	0.0392	-0.0515	-0.0630	0.0028	0.0016	-0.0021	-0.0026
Connecticut	-0.4477	0.1084	-0.0701	-0.0554	-0.0187	0.0045	-0.0029	-0.0023
Delaware	0.0702	0.0461	-0.2844	-0.2737	0.0029	0.0019	-0.0119	-0.0114
D. Columbia	0.0678	-0.0143	-0.0339	0.0490	0.0028	-0.0006	-0.0014	0.0020
Florida	0.1292	0.0407	-0.0954	-0.0430	0.0054	0.0017	-0.0040	-0.0018
Georgia	0.2546	-0.0342	-0.0409	0.0044	0.0106	-0.0014	-0.0017	0.0002
Hawaii	0.7731	-0.6665	-0.0108	-0.0242	0.0322	-0.0278	-0.0004	-0.0010
Idaho	0.1027	-0.0313	-0.0693	0.0189	0.0043	-0.0013	-0.0029	0.0008
Illinois	0.0657	-0.0338	-0.0223	-0.0245	0.0027	-0.0014	-0.0009	-0.0010
Indiana	0.0127	0.0346	-0.0113	0.0049	0.0005	0.0014	-0.0005	0.0002
Iowa	0.0096	0.0234	-0.0102	0.0082	0.0004	0.0010	-0.0004	0.0003
Kansas	0.0320	0.0504	-0.0150	-0.0094	0.0013	0.0021	-0.0006	-0.0004
Kentucky	0.0224	0.0337	-0.0185	-0.0211	0.0009	0.0014	-0.0008	-0.0009
Louisiana	0.0343	0.0789	-0.0209	-0.0010	0.0014	0.0033	-0.0009	-0.0000
Maine	-0.2481	-0.0014	-0.0574	-0.0633	-0.0103	-0.0001	-0.0024	-0.0026
Maryland	0.0252	-0.0096	-0.0288	-0.0473	0.0010	-0.0004	-0.0012	-0.0020
Massachusetts	-0.3362	0.3453	-0.0929	-0.0848	-0.0140	0.0144	-0.0039	-0.0035
Michigan	0.1562	0.0061	-0.0206	0.0013	0.0065	0.0003	-0.0009	0.0001
Minnesota	-0.0862	0.1166	0.0024	-0.0440	-0.0036	0.0049	0.0001	-0.0018
Mississippi	0.2238	-0.1712	-0.0151	-0.0197	0.0093	-0.0071	-0.0006	-0.0008
Missouri	0.0896	0.0258	-0.0098	0.0271	0.0037	0.0011	-0.0004	0.0011
Montana	-0.0055	0.0578	-0.0231	-0.0267	-0.0002	0.0024	-0.0010	-0.0011
Nebraska	-0.0345	0.0172	-0.0113	-0.0740	-0.0014	0.0007	-0.0005	-0.0031
Nevada	0.4834	0.0048	-0.1115	-0.0694	0.0201	0.0002	-0.0046	-0.0029
New Hampshire	0.1259	0.2036	-0.1058	-0.2689	0.0052	0.0085	-0.0044	-0.0112
New Jersey	-0.0128	0.0020	-0.0484	-0.0257	-0.0005	0.0001	-0.0020	-0.0011
New Mexico	0.0450	0.0323	-0.0516	-0.0027	0.0019	0.0013	-0.0022	-0.0001
New York	-0.1960	0.0834	-0.0493	-0.0619	-0.0082	0.0035	-0.0021	-0.0026
North Carolina	0.1023	0.0079	-0.0398	-0.0290	0.0043	0.0003	-0.0017	-0.0012
North Dakota	0.0293	0.0660	-0.0100	-0.0071	0.0012	0.0027	-0.0004	-0.0003
Ohio	0.1611	0.0050	-0.0212	-0.0290	0.0067	0.0002	-0.0009	-0.0012
Oklahoma	-0.0714	0.1067	-0.0243	-0.0378	-0.0030	0.0044	-0.0010	-0.0016
Oregon	0.2020	-0.0964	-0.1225	-0.0280	0.0084	-0.0040	-0.0051	-0.0012
Pennsylvania	-0.0457	0.0637	-0.0333	-0.0495	-0.0019	0.0027	-0.0014	-0.0021
Rhode Island	0.0963	0.0403	-0.0688	-0.0098	0.0040	0.0017	-0.0029	-0.0004
South Carolina	0.1947	0.0107	-0.0494	0.0544	0.0081	0.0004	-0.0021	0.0023

Table 2: State-by-State Dynamic Decomposition of U.S. Banking Industry: 1976-2000 (continued)

	SUMMATION				AVERAGE			
	WITHIN	**BETWEEN**	**ENTRY**	**EXIT**	**WITHIN**	**BETWEEN**	**ENTRY**	**EXIT**
South Dakota	0.6880	-0.0942	-0.1084	-0.0615	0.0287	-0.0039	-0.0045	-0.0026
Tennessee	0.0387	0.0746	-0.0306	-0.0545	0.0016	0.0031	-0.0013	-0.0023
Texas	-0.4211	0.4444	-0.0351	-0.0953	-0.0175	0.0185	-0.0015	-0.0040
Utah	0.3434	-0.1206	-0.0873	-0.0248	0.0143	-0.0050	-0.0036	-0.0010
Vermont	-0.2834	0.1131	-0.0273	-0.0854	-0.0118	0.0047	-0.0011	-0.0036
Virginia	0.1873	0.1197	-0.0431	-0.1027	0.0078	0.0050	-0.0018	-0.0043
Washington	-0.1120	0.0577	-0.0176	-0.0059	-0.0047	0.0024	-0.0007	-0.0002
West Virginia	0.0292	0.0570	-0.0221	0.0240	0.0012	0.0024	-0.0009	0.0010
Wisconsin	0.0274	0.0132	-0.0206	-0.0189	0.0011	0.0006	-0.0009	-0.0008
Wyoming	0.0062	0.0611	-0.0412	-0.1120	0.0003	0.0025	-0.0017	-0.0047
AVERAGE	0.0848	-0.0047	-0.0467	-0.0436	0.0035	-0.0002	-0.0019	-0.0018
ST. DEV.	1.0372	0.9474	0.0468	0.0680	0.0432	0.0395	0.0020	0.0028

Note: The SUMMATION equals the sum across all years for a given state while the AVERAGE equals the SUMMATION divided by 24.

Table 3: Panel Fixed- and Random-Effects Regressions of Decomposition Components

	Variable	Within Effect		Between Effect		Entry Effect		Exit Effect	
		Coef.	**t-stat**	**Coef.**	**t-stat**	**Coef.**	**t-stat**	**Coef.**	**t-stat**
Fixed-Effects Model (FE)	***hhi***	-0.0011	-0.34	0.0033*	2.88	0.0015*	2.98	-0.0021*	-2.89
	bch_bn	0.0011	1.60	-0.0000	-0.14	-0.0001	-0.94	0.0006*	4.06
	regid	0.0047	0.98	-0.0028†	-1.65	-0.0012†	-1.65	-0.0014	-1.26
	non	-0.0054	-1.07	-0.0041**	-2.33	-0.0014†	-1.77	-0.0035*	-3.13
	nation	-0.0060	-1.13	-0.0025	-1.30	-0.0001	-0.1	-0.0006	-0.46
	unem	-0.0021**	-2.09	0.0003	0.81	0.0002	1.51	-0.0004†	-1.71
Random-Effects Model (RE)	***hhi***	0.0033†	1.79	0.0001	0.17	0.0003	0.87	-0.0010**	-2.02
	bch_bn	-0.0002	-0.61	-0.0001	-0.56	-0.0001	-1.53	0.0002**	2.32
	regid	0.0064	1.48	-0.0029†	-1.91	-0.0009	-1.31	-0.0004	-0.36
	non	-0.0012	-0.3	-0.0033**	-2.36	-0.0010	-1.54	-0.0019**	-2.07
	nation	-0.0028	-0.59	-0.0025	-1.49	-0.0003	-0.33	0.0004	0.32
	unem	-0.0015**	-2.03	-0.0000	-0.09	0.0002†	1.82	-0.0002	-0.88
	constant	0.0086	1.49	0.0034	1.66	-0.0026*	-2.63	-0.0005	-0.33
Hausman Test	**χ^2(6)**	6.87		13.90		12.80		24.98	
	p-value	0.3330		0.0308		0.0463		0.0003	
	Decision	RE		FE		FE		FE	

Note: The dependent variables are the within, between, entry, and exit effects. The independent variables include Hirschman-Herfindahl index (*hhi*) based on bank assets, the average number of branches per bank (*bch_bn*), three dummy variables for interstate banking activity [the first dummy variable (*regid*) is one if a state possesses regional reciprocity, zero otherwise; the second (*nation*) is one if a state possesses national reciprocity, zero otherwise; and the third (*non*) is one is a state possesses national non-reciprocity, zero otherwise], and the state unemployment rate (*unem*). The Hausman test chooses between the random-effect model, the null-hypothesis, and the fixed-effect model. The coefficient estimate appears in the first column followed by its t-statistic in the next. The coefficients of hhi are multiplied by 1,000.

* means significantly different from zero at the 1-percent level.
** means significantly different from zero at the 5-percent level
† means significantly different from zero at the 10-percent level.

Table 4: Summary Statistics on Data in Regressions

Variable	Number of Observations	Mean	Standard Deviation	Minimum	Maximum
Within Effect	1216	0.0019	0.0496	-0.4153	0.4594
Between Effect	1216	0.0012	0.0176	-0.2283	0.2198
Entry Effect	1216	-0.0020	0.0079	-0.1723	0.0585
Exit Effect	1216	-0.0018	0.0115	-0.2173	0.0690
hhi	1216	1025	969	63	8247
bch_bn	1216	7.6580	6.8272	0.0256	38.6607
regid	1216	0.1604	0.3671	0.0000	1.0000
non	1216	0.2977	0.4574	0.0000	1.0000
nation	1216	0.1168	0.3213	0.0000	1.0000
unem	1216	6.1325	2.1121	2.2000	18.0000

Appendix A: Ideal Nationwide Dynamic Decomposition

<u>DERIVATION OF PROPOSITION</u>:

We can rewrite the change in return on equity as follows:

$$\begin{aligned}
\Delta R_t &= R_t - R_{t-1} \\
&= \sum_{i=1}^{n_t} r_{i,t}\theta_{i,t} - \sum_{i=1}^{n_{t-1}} r_{i,t-1}\theta_{i,t-1} \\
&= \sum_{i=1}^{n_t^{stay}+n_t^{entry}} r_{i,t}\theta_{i,t} - \sum_{i=1}^{n_t^{stay}+n_{t-1}^{exit}} r_{i,t-1}\theta_{i,t-1} \\
&= \sum_{i=1}^{n_t^{stay}} r_{i,t}\theta_{i,t} + \sum_{i=1}^{n_t^{entry}} r_{i,t}\theta_{i,t} - \sum_{i=1}^{n_t^{stay}} r_{i,t-1}\theta_{i,t-1} - \sum_{i=1}^{n_{t-1}^{exit}} r_{i,t-1}\theta_{i,t-1} \qquad (A1)
\end{aligned}$$

<u>Decomposition 1</u>: [Use period (t-1) as the base period.]

Adding the term $\sum_{i=1}^{n_t^{stay}} r_{i,t}\theta_{i,t-1} - \sum_{i=1}^{n_t^{stay}} r_{i,t}\theta_{i,t-1}$, which equals zero, to the right hand side of (A1) produces the following:

$$\begin{aligned}
\Delta R_t &= \sum_{i=1}^{n_t^{stay}} r_{i,t}\theta_{i,t} + \sum_{i=1}^{n_t^{entry}} r_{i,t}\theta_{i,t} - \sum_{i=1}^{n_t^{stay}} r_{i,t-1}\theta_{i,t-1} - \sum_{i=1}^{n_{t-1}^{exit}} r_{i,t-1}\theta_{i,t-1} + [\sum_{i=1}^{n_t^{stay}} r_{i,t}\theta_{i,t-1} - \sum_{i=1}^{n_t^{stay}} r_{i,t}\theta_{i,t-1}] \\
&= [\sum_{i=1}^{n_t^{stay}} r_{i,t}\theta_{i,t} - \sum_{i=1}^{n_t^{stay}} r_{i,t}\theta_{i,t-1}] + [\sum_{i=1}^{n_t^{stay}} r_{i,t}\theta_{i,t-1} - \sum_{i=1}^{n_t^{stay}} r_{i,t-1}\theta_{i,t-1}] + \sum_{i=1}^{n_t^{entry}} r_{i,t}\theta_{i,t} - \sum_{i=1}^{n_{t-1}^{exit}} r_{i,t-1}\theta_{i,t-1} \\
&= \sum_{i=1}^{n_t^{stay}} r_{i,t}(\theta_{i,t} - \theta_{i,t-1}) + \sum_{i=1}^{n_t^{stay}} (r_{i,t} - r_{i,t-1})\theta_{i,t-1} + \sum_{i=1}^{n_t^{entry}} r_{i,t}\theta_{i,t} - \sum_{i=1}^{n_{t-1}^{exit}} r_{i,t-1}\theta_{i,t-1} \\
&= \sum_{i=1}^{n_t^{stay}} r_{i,t}\theta_{i,\Delta t} + \sum_{i=1}^{n_t^{stay}} r_{i,\Delta t}\theta_{i,t-1} + \sum_{i=1}^{n_t^{entry}} r_{i,t}\theta_{i,t} - \sum_{i=1}^{n_{t-1}^{exit}} r_{i,t-1}\theta_{i,t-1}
\end{aligned}$$

Note that $\sum_{i=1}^{n_t} \theta_{i,t} = 1$ and $\sum_{i=1}^{n_{t-1}} \theta_{i,t-1} = 1$. Thus, we have that

$$\sum_{i=1}^{n_t^{stay}} \theta_{i,t} + \sum_{i=1}^{n_t^{entry}} \theta_{i,t} = 1 \text{ and } \sum_{i=1}^{n_t^{stay}} \theta_{i,t-1} + \sum_{i=1}^{n_{t-1}^{exit}} \theta_{i,t-1} = 1 \qquad (A2)$$

Therefore, we have that

$$\begin{aligned}
\Delta R_t &= \sum_{i=1}^{n_t^{stay}} r_{i,t}\theta_{i,\Delta t} + \sum_{i=1}^{n_t^{stay}} r_{i,t}\theta_{i,t} + \sum_{i=1}^{n_t^{entry}} r_{i,\Delta t}\theta_{i,t-1} - \sum_{i=1}^{n_{t-1}^{exit}} r_{i,t-1}\theta_{i,t-1} \\
&\quad - R_{t-1}[\sum_{i=1}^{n_t^{stay}} \theta_{i,t} + \sum_{i=1}^{n_t^{entry}} \theta_{i,t}] + R_{t-1}[\sum_{i=1}^{n_t^{stay}} \theta_{i,t-1} + \sum_{i=1}^{n_{t-1}^{entry}} \theta_{i,t-1}] \\
&= \sum_{i=1}^{n_t^{stay}} r_{i,t}\theta_{i,\Delta t} + \sum_{i=1}^{n_t^{stay}} r_{i,\Delta t}\theta_{i,t-1} - R_{t-1}\sum_{i=1}^{n_t^{stay}} \theta_{i,t} + R_{t-1}\sum_{i=1}^{n_t^{stay}} \theta_{i,t-1} \\
&\quad + [\sum_{i=1}^{n_t^{entry}} r_{i,t}\theta_{i,t} - R_{t-1}\sum_{i=1}^{n_t^{entry}} \theta_{i,t}] - [\sum_{i=1}^{n_{t-1}^{exit}} r_{i,t-1}\theta_{i,t-1} - R_{t-1}\sum_{i=1}^{n_{t-1}^{exit}} \theta_{i,t-1}] \\
&= \sum_{i=1}^{n_t^{stay}} r_{i,t}\theta_{i,\Delta t} + \sum_{i=1}^{n_t^{stay}} r_{i,\Delta t}\theta_{i,t-1} - \sum_{i=1}^{n_t^{stay}} R_{t-1}(\theta_{i,t} - \theta_{i,t-1}) + [\sum_{i=1}^{n_t^{entry}} (r_{i,t} - R_{t-1})\theta_{i,t}] - [\sum_{i=1}^{n_{t-1}^{exit}} (r_{i,t-1} - R_{t-1})\theta_{i,t-1}] \\
&= \sum_{i=1}^{n_t^{stay}} r_{i,t}\theta_{i,\Delta t} + \sum_{i=1}^{n_t^{stay}} r_{i,\Delta t}\theta_{i,t-1} - \sum_{i=1}^{n_t^{stay}} R_{t-1}\theta_{i,\Delta t} + \sum_{i=1}^{n_t^{entry}} (r_{i,t} - R_{t-1})\theta_{i,t} - \sum_{i=1}^{n_{t-1}^{exit}} (r_{i,t-1} - R_{t-1})\theta_{i,t-1} \\
&= \sum_{i=1}^{n_t^{stay}} (r_{i,t} - R_{t-1)}\theta_{i,\Delta t} + \sum_{i=1}^{n_t^{stay}} r_{i,\Delta t}\theta_{i,t-1} + \sum_{i=1}^{n_t^{entry}} (r_{i,t} - R_{t-1})\theta_{i,t} - \sum_{i=1}^{n_{t-1}^{exit}} (r_{i,t-1} - R_{t-1})\theta_{i,t-1} \qquad (A3)
\end{aligned}$$

<u>Decomposition 2</u>: [Use period (t) as the base period.]

Adding the term $\sum_{i=1}^{n_t^{stay}} r_{i,t-1}\theta_{i,t} - \sum_{i=1}^{n_t^{stay}} r_{i,t-1}\theta_{i,t}$, which equals zero, to the right hand side of (A1) produces the following:

$$\begin{aligned}
\Delta R_t &= \sum_{i=1}^{n_t^{stay}} r_{i,t}\theta_{i,t} + \sum_{i=1}^{n_t^{entry}} r_{i,t}\theta_{i,t} - \sum_{i=1}^{n_t^{stay}} r_{i,t-1}\theta_{i,t-1} - \sum_{i=1}^{n_{t-1}^{exit}} r_{i,t-1}\theta_{i,t-1} + [\sum_{i=1}^{n_t^{stay}} r_{i,t-1}\theta_{i,t} - \sum_{i=1}^{n_t^{stay}} r_{i,t-1}\theta_{i,t}] \\
&= [\sum_{i=1}^{n_t^{stay}} r_{i,t}\theta_{i,t} - \sum_{i=1}^{n_t^{stay}} r_{i,t-1}\theta_{i,t}] + [\sum_{i=1}^{n_t^{stay}} r_{i,t-1}\theta_{i,t} - \sum_{i=1}^{n_t^{stay}} r_{i,t-1}\theta_{i,t-1}] + \sum_{i=1}^{n_t^{entry}} r_{i,t}\theta_{i,t} - \sum_{i=1}^{n_{t-1}^{exit}} r_{i,t-1}\theta_{i,t-1} \\
&= \sum_{i=1}^{n_t^{stay}} (r_{i,t} - r_{i,t-1})\theta_{i,t} + \sum_{i=1}^{n_t^{stay}} r_{i,t-1}(\theta_{i,t} - \theta_{i,t-1}) + \sum_{i=1}^{n_t^{entry}} r_{i,t}\theta_{i,t} - \sum_{i=1}^{n_{t-1}^{exit}} r_{i,t-1}\theta_{i,t-1} \\
&= \sum_{i=1}^{n_t^{stay}} r_{i,\Delta t}\theta_{i,t} + \sum_{i=1}^{n_t^{stay}} r_{i,t-1}\theta_{i,\Delta t} + \sum_{i=1}^{n_t^{entry}} r_{i,t}\theta_{i,t} - \sum_{i=1}^{n_{t-1}^{exit}} r_{i,t-1}\theta_{i,t-1}
\end{aligned}$$

With (A2), we have that

$$
\begin{aligned}
\Delta R_t &= \sum_{i=1}^{n_t^{stay}} r_{i,\Delta t}\theta_{i,t} + \sum_{i=1}^{n_t^{stay}} r_{i,t-1}\theta_{i,\Delta t} + \sum_{i=1}^{n_t^{entry}} r_{i,t}\theta_{i,t} - \sum_{i=1}^{n_{t-1}^{exit}} r_{i,t-1}\theta_{i,t-1} \\
&\quad - R_t[\sum_{i=1}^{n_t^{stay}} \theta_{i,t} + \sum_{i=1}^{n_t^{entry}} \theta_{i,t}] + R_t[\sum_{i=1}^{n_t^{stay}} \theta_{i,t-1} + \sum_{i=1}^{n_t^{entry}} \theta_{i,t-1}] \\
&= \sum_{i=1}^{n_t^{stay}} r_{i,\Delta t}\theta_{i,t} + \sum_{i=1}^{n_t^{stay}} r_{i,t-1}\theta_{i,\Delta t} - R_t \sum_{i=1}^{n_t^{stay}} \theta_{i,t} + R_t \sum_{i=1}^{n_t^{stay}} \theta_{i,t-1} \\
&\quad + [\sum_{i=1}^{n_t^{entry}} r_{i,t}\theta_{i,t} - R_t \sum_{i=1}^{n_t^{entry}} \theta_{i,t}] - [\sum_{i=1}^{n_{t-1}^{exit}} r_{i,t-1}\theta_{i,t-1} - R_t \sum_{i=1}^{n_{t-1}^{exit}} \theta_{i,t-1}] \\
&= \sum_{i=1}^{n_t^{stay}} r_{i,\Delta t}\theta_{i,t} + \sum_{i=1}^{n_t^{stay}} r_{i,t-1}\theta_{i,\Delta t} - \sum_{i=1}^{n_t^{stay}} R_t(\theta_{i,t} - \theta_{i,t-1}) + [\sum_{i=1}^{n_t^{entry}} (r_{i,t} - R_t)\theta_{i,t}] - [\sum_{i=1}^{n_{t-1}^{exit}} (r_{i,t-1} - R_t)\theta_{i,t-1}] \\
&= \sum_{i=1}^{n_t^{stay}} r_{i,\Delta t}\theta_{i,t} + \sum_{i=1}^{n_t^{stay}} r_{i,t-1}\theta_{i,\Delta t} - \sum_{i=1}^{n_t^{stay}} R_t\theta_{i,\Delta t} + \sum_{i=1}^{n_t^{entry}} (r_{i,t} - R_t)\theta_{i,t} - \sum_{i=1}^{n_{t-1}^{exit}} (r_{i,t-1} - R_t)\theta_{i,t-1} \\
&= \sum_{i=1}^{n_t^{stay}} r_{i,\Delta t}\theta_{i,t} + \sum_{i=1}^{n_t^{stay}} (r_{i,t-1} - R_t)\theta_{i,\Delta t} + \sum_{i=1}^{n_t^{entry}} (r_{i,t} - R_t)\theta_{i,t} - \sum_{i=1}^{n_{t-1}^{exit}} (r_{i,t-1} - R_t)\theta_{i,t-1} \qquad (A4)
\end{aligned}
$$

<u>Decomposition 3</u> [Determine the ideal dynamic decomposition.]

Add the previous two decompositions together, (A3) plus (A4). Thus,

$$
\begin{aligned}
2\Delta R_t &= \sum_{i=1}^{n_t^{stay}} r_{i,\Delta t}\theta_{i,t} + \sum_{i=1}^{n_t^{stay}} (r_{i,t-1} - R_t)\theta_{i,\Delta t} + \sum_{i=1}^{n_t^{entry}} (r_{i,t} - R_t)\theta_{i,t} - \sum_{i=1}^{n_{t-1}^{exit}} (r_{i,t-1} - R_t)\theta_{i,t-1} \\
&\quad + \sum_{i=1}^{n_t^{stay}} (r_{i,t} - R_{t-1})\theta_{i,\Delta t} + \sum_{i=1}^{n_t^{stay}} r_{i,\Delta t}\theta_{i,t-1} + \sum_{i=1}^{n_t^{entry}} (r_{i,t} - R_{t-1})\theta_{i,t} - \sum_{i=1}^{n_{t-1}^{exit}} (r_{i,t-1} - R_{t-1})\theta_{i,t-1} \\
&= \sum_{i=1}^{n_t^{stay}} r_{i,\Delta t}(\theta_{i,t} + \theta_{i,t-1}) + \sum_{i=1}^{n_t^{stay}} (r_{i,t-1} - R_t + r_{i,t} - R_{t-1})\theta_{i,\Delta t} \\
&\quad + \sum_{i=1}^{n_t^{entry}} (r_{i,t} - R_t + r_{i,t} - R_{t-1})\theta_{i,t} - \sum_{i=1}^{n_{t-1}^{exit}} (r_{i,t-1} - R_t + r_{i,t-1} - R_{t-1})\theta_{i,t-1} \\
\Delta R_t &= \sum_{i=1}^{n_t^{stay}} r_{i,\Delta t}\overline{\theta_i} + \sum_{i=1}^{n_t^{stay}} \left[\overline{r_i} - \overline{R}\right]\theta_{i,\Delta t} + \sum_{i=1}^{n_t^{entry}} \left[r_{i,t} - \overline{R}\right]\theta_{i,t} - \sum_{i=1}^{n_{t-1}^{exit}} \left[r_{i,t-1} - \overline{R}\right]\theta_{i,t-1} \qquad Q.E.D.
\end{aligned}
$$

where $\bar{\theta}_i = (\theta_{i,t} + \theta_{i,t-1})/2$,

$\bar{r}_i = (r_{i,t} + r_{i,t-1})/2$, and

$\bar{R} = (R_t + R_{t-1})/2$.

Appendix B: Ideal State-Level Dynamic Decomposition

Since our illustration uses the U.S. commercial banking industry, our derivation of the various dynamic decompositions employs industry return on equity (R). The return on equity at time t (R_t) equals net income (NI_t) at time t divided by equity (E_t) at time t. That is,

$$
\begin{aligned}
R_t &= \frac{NI_t}{E_t} \\
&= \frac{\sum_{s=1}^{S}\sum_{i=1}^{n_s} NI_{i,s,t}}{\sum_{s=1}^{S}\sum_{i=1}^{n_s} E_{i,s,t}} \\
&= \sum_{s=1}^{S}\left[\frac{\sum_{i=1}^{n_s} NI_{i,s,t}}{\sum_{s=1}^{S}\sum_{i=1}^{n_s} E_{i,s,t}}\right] \\
&= \sum_{s=1}^{S}\left[\frac{\sum_{i=1}^{n_s} NI_{i,s,t}}{\sum_{i=1}^{n_s} E_{i,s,t}}\,\frac{\sum_{i=1}^{n_s} E_{i,s,t}}{\sum_{s=1}^{S}\sum_{i=1}^{n_s} E_{i,s,t}}\right] \\
&= \sum_{s=1}^{S}\left[\sum_{i=1}^{n_s}\left(\frac{NI_{i,s,t}}{E_{i,s,t}}\,\frac{E_{i,s,t}}{\sum_{i=1}^{n_s} E_{i,s,t}}\right)\frac{\sum_{i=1}^{n_s} E_{i,s,t}}{\sum_{s=1}^{S}\sum_{i=1}^{n_s} E_{i,s,t}}\right] \\
&= \sum_{s=1}^{S}\left[\sum_{i=1}^{n_s}\left(r_{i,s,t}\theta_{i,s,t}\right)\theta_{s,t}\right] \\
&= \sum_{s=1}^{S}\theta_{s,t}\sum_{i=1}^{n_s} r_{i,s,t}\theta_{i,s,t}
\end{aligned}
$$

or

$$R_t = \sum_{s=1}^{S}\theta_{s,t}R_{s,t} \ ,$$

where $R_{s,t} = \sum_{i=1}^{n_s} r_{i,s,t}\theta_{i,s,t}$.

Thus, we can calculate, using period (t-1) as the base period, that

$$\begin{aligned}
\Delta R_t &= R_t - R_{t-1} \\
&= \sum_{s=1}^{S}\theta_{s,t}R_{s,t} - \sum_{s=1}^{S}\theta_{s,t-1}R_{s,t-1} \\
&= \sum_{s=1}^{S}\theta_{s,t}R_{s,t} - \sum_{s=1}^{S}\theta_{s,t-1}R_{s,t-1} + \sum_{s=1}^{S}\theta_{s,t-1}R_{s,t} - \sum_{s=1}^{S}\theta_{s,t-1}R_{s,t} + R_t - R_t \\
&= \sum_{s=1}^{S}\theta_{s,t}R_{s,t} - \sum_{s=1}^{S}\theta_{s,t-1}R_{s,t-1} + \sum_{s=1}^{S}\theta_{s,t-1}R_{s,t} - \sum_{s=1}^{S}\theta_{s,t-1}R_{s,t} + R_t\sum_{s=1}^{S}\theta_{s,t-1} - R_t\sum_{s=1}^{S}\theta_{s,t} \\
&= \sum_{s=1}^{S}\theta_{s,t}R_{s,t} - R_t\sum_{s=1}^{S}\theta_{s,t} - \sum_{s=1}^{S}\theta_{s,t-1}R_{s,t-1} + \sum_{s=1}^{S}\theta_{s,t-1}R_{s,t} - \sum_{s=1}^{S}\theta_{s,t-1}R_{s,t} + R_t\sum_{s=1}^{S}\theta_{s,t-1} \\
&= \sum_{s=1}^{S}\theta_{s,t}\left(R_{s,t} - R_t\right) + \sum_{s=1}^{S}\theta_{s,t-1}\left(R_{s,t} - R_{s,t-1}\right) - \sum_{s=1}^{S}\theta_{s,t-1}\left(R_{s,t} - R_t\right) \\
&= \sum_{s=1}^{S}\theta_{s,\Delta t}\left(R_{s,t} - R_t\right) + \sum_{s=1}^{S}\theta_{s,t-1}R_{s,\Delta t}
\end{aligned}$$

In that derivation, we used the fact that $\sum_{s=1}^{S}\theta_{s,t-1} = \sum_{s=1}^{S}\theta_{s,t} = 1$. Now, we can recalculate, using period t as the base period, as follows:

$$\begin{aligned}
\Delta R_t &= R_t - R_{t-1} \\
&= \sum_{s=1}^{S}\theta_{s,t}R_{s,t} - \sum_{s=1}^{S}\theta_{s,t-1}R_{s,t-1} \\
&= \sum_{s=1}^{S}\theta_{s,t}R_{s,t} - \sum_{s=1}^{S}\theta_{s,t-1}R_{s,t-1} + \sum_{s=1}^{S}\theta_{s,t}R_{s,t-1} - \sum_{s=1}^{S}\theta_{s,t}R_{s,t-1} + R_{t-1} - R_{t-1} \\
&= \sum_{s=1}^{S}\theta_{s,t}R_{s,t} - \sum_{s=1}^{S}\theta_{s,t-1}R_{s,t-1} + \sum_{s=1}^{S}\theta_{s,t}R_{s,t-1} - \sum_{s=1}^{S}\theta_{s,t}R_{s,t-1} + R_{t-1}\sum_{s=1}^{S}\theta_{s,t-1} - R_{t-1}\sum_{s=1}^{S}\theta_{s,t} \\
&= \sum_{s=1}^{S}\theta_{s,t}R_{s,t} - \sum_{s=1}^{S}\theta_{s,t}R_{s,t-1} - \sum_{s=1}^{S}\theta_{s,t-1}R_{s,t-1} + R_{t-1}\sum_{s=1}^{S}\theta_{s,t-1} + \sum_{s=1}^{S}\theta_{s,t}R_{s,t-1} - R_{t-1}\sum_{s=1}^{S}\theta_{s,t} \\
&= \sum_{s=1}^{S}\theta_{s,t}\left(R_{s,t} - R_{s,t-1}\right) - \sum_{s=1}^{S}\theta_{s,t-1}\left(R_{s,t-1} - R_{t-1}\right) + \sum_{s=1}^{S}\theta_{s,t}\left(R_{s,t-1} - R_{t-1}\right) \\
&= \sum_{s=1}^{S}\theta_{s,t}\left(R_{s,t} - R_{s,t-1}\right) + \sum_{s=1}^{S}\left(\theta_{s,t} - \theta_{s,t-1}\right)\left(R_{s,t-1} - R_{t-1}\right) \\
&= \sum_{s=1}^{S}\theta_{s,t}R_{s,\Delta t} + \sum_{s=1}^{S}\theta_{s,\Delta t}\left(R_{s,t-1} - R_{t-1}\right)
\end{aligned}$$

Adding those two results together gives the following relationship:

$$
\begin{aligned}
2\Delta R_t &= \sum_{s=1}^{S}\left(\theta_{s,t}+\theta_{s,t-1}\right)R_{s,\Delta t}+\sum_{s=1}^{S}\theta_{s,\Delta t}\left[\left(R_{s,t}+R_{s,t-1}\right)-\left(R_t+R_{t-1}\right)\right]\\
\Delta R_t &= \sum_{s=1}^{S}\left(\frac{\theta_{s,t}+\theta_{s,t-1}}{2}\right)R_{s,\Delta t}+\sum_{s=1}^{S}\theta_{s,\Delta t}\left[\left(\frac{R_{s,t}+R_{s,t-1}}{2}\right)-\left(\frac{R_t+R_{t-1}}{2}\right)\right]\\
\Delta R_t &= \underbrace{\sum_{s=1}^{S}\bar{\theta}_s R_{s,\Delta t}}_{\text{"within effect"}}\quad+\underbrace{\sum_{s=1}^{S}\theta_{s,\Delta t}\left[\bar{R}_s-\bar{R}\right]}_{\text{"between effect"}}
\end{aligned}
$$

The ideal dynamic decomposition of nationwide effects includes two state effects, the within effect and the between (reallocation) effect. Furthermore, we can decompose each $R_{s,\Delta t}$ as we do for the national data (see Appendix A)

$$
R_{s,\Delta t}=\underbrace{\sum_{i=1}^{n_{s,t}^{stay}} r_{i,s,\Delta t}\,\bar{\theta}_{i,s}}_{\text{“within effect”}}+\underbrace{\sum_{i=1}^{n_{s,t}^{stay}}(\bar{r}_{i,s}-\bar{R}_s)\theta_{i,s,\Delta t}}_{\text{“between effect”}}+\underbrace{\sum_{i=1}^{n_{s,t}^{enter}}(r_{i,s,t}-\bar{R}_s)\theta_{i,s,t}}_{\text{“entry effect”}}
$$

$$
\underbrace{-\sum_{i=1}^{n_{s,t}^{exit}}(r_{i,s,t-1}-\bar{R}_s)\theta_{i,s,t-1}}_{\text{“exit effect”}}\,.
$$

where $\bar{\theta}_{i,s}=(\theta_{i,s,t}+\theta_{i,s,t-1})/2$,

$\bar{r}_{i,s}=(r_{i,s,t}+r_{i,s,t-1})/2$, and

$\bar{R}_s=(R_{s,t}+R_{s,t-1})/2$.