

Regional Growth and Resilience: Evidence from Urban IT Centers*

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After being emblematic of the U.S. economic surge in the late 1990s, urban areas that specialize in information technology (IT) products struggled in the aftermath of the IT spending bust, with most experiencing deeper and longer periods of economic decline than the nation as a whole. Seven years later, most have recovered, but only a few have regained the prominence of earlier years. In this paper, we consider the rise, the fall, and the recovery of urban IT centers and distinguish between the factors leading to temporary gains and those contributing to a more lasting growth path. Specifically, we examine the initial characteristics of the most prominent IT centers, linking these characteristics to a discussion of economic research concerning the sources of growth in urban industrial centers. We then follow these centers through the IT bust and subsequent economic recovery. The results indicate that, although each of our IT centers was hit hard by the IT bust beginning in 2000, the full impact of the decline and the subsequent pace of recovery varied considerably with the size, density, and composition of the local IT sector. The overall experience of the IT sector and the factors that ultimately seemed to separate those urban areas that succeeded from those that struggled suggest that inputs to the process such as education, research networks, and flexibility matter more than picking the right industry.

1. Introduction

The ability to attract and maintain industries that grow rapidly, produce positive spillovers for other businesses, and remain relatively resilient to global and national economic fluctuations that can have especially negative effects on less-diversified urban areas is the goal of many state and local policymakers. While the goal is clear, implementating it can be challenging, especially in a rapidly changing economic climate, where the process of selecting the right industry to link regional fortunes to can outlast the prominence of the industry itself.

During the 1990s, regional policymakers began focusing efforts on building a local information technology (IT) sector. One reason for this IT focus was that, for much of the 1990s, the IT sector was among the key drivers of the national economic expansion, helping to spur robust growth in output, productivity, and income. Between 1995 and 2000, for example, IT-producing businesses accounted for nearly

one-third of U.S. GDP growth and nearly two-thirds of the surge in productivity growth, despite accounting for less than 9 percent of total output at the start of the period.¹ Another reason is that the IT sector provides high-paying jobs. Although estimates vary, both by how IT is defined and by how wages are computed, one measure shows that the average IT job pays \$78,200 annually versus \$42,600 for the average job in the economy.² Finally, through the 1990s, it was expected that the IT sector would continue growing by producing a constant stream of new products and services, many of which would be produced domestically and shipped internationally.

However, as the IT bust in 2000 showed and many urban IT centers learned, the IT sector was not immune from the normal economic fluctuations that affect other industries. Indeed, over the last two decades, the IT sector has gone

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1. Data on the contributions of IT to GDP come from the Bureau of Economic Analysis (BEA) GDP releases. See Stiroh (2002) for analysis of the IT sector's contribution to productivity growth. Although the surge in productivity growth from 1995 to 2000 was dominated by IT-producing sectors, increases in productivity more generally were broad-based, with most sectors realizing productivity gains over the period.

2. Calculated in 2006 using the Bureau of Labor Statistics (BLS) Quarterly Census of Employment and Wages (QCEW); agriculture is removed from total employment for the "all jobs" calculation.

from being emblematic of U.S. economic prowess—growing about four times more quickly than the overall U.S. economy—to leading the 2001 recession, to struggling to return to a sustainable, albeit slower, rate of growth. These fluctuations in growth produced large swings in IT employment. For instance, during the boom period of 1995–2000, IT employment grew at an average annual rate of 5.0 percent, nearly twice the average annual growth in total nonfarm employment of 2.6 percent during the same period. Similarly, in the bust period of 2000–2004, IT employment fell at an average annual rate of –5.0 percent, roughly 10 times the rate of –0.5 percent for total nonfarm employment over the same period. Since 2004, IT employment nationally has expanded by about 1.2 percent per year, compared to the 5.0 percent rate of growth experienced during the boom period.

The considerable volatility experienced during these periods has prompted some key questions. For instance, how did individual regional IT centers fare during the boom, bust, and recovery periods? Why did some IT centers fare better than others? And what cities will be well positioned to take advantage of the next technology boom, whether it be in IT or some other field?

In this paper we partially address these questions by analyzing a sample of 12 urban IT centers during the IT “boom and bust” cycle from 1995 to 2004, and through the lukewarm recovery period from 2004 to 2006. We find that performance across these IT centers has been quite heterogeneous, with some centers showing significant signs of recovery, others showing small signs of recovery, and others continuing to contract. The centers with a larger focus in IT services, rather than IT manufacturing, appear to have performed better, mirroring the trends observed in IT manufacturing and IT services nationally. All of these IT centers, however, possess the ability to be at the forefront of the next technology boom because of their highly skilled labor forces. The overall experience of the IT sector and the factors that ultimately seemed to separate urban areas that succeeded from those that struggled suggest that inputs to the process such as education, research networks, and flexibility matter more than picking the right industry.

We begin in Section 2 by discussing our definition of IT and describing our sample of urban IT centers. In Section 3 we analyze the boom, bust, and recovery periods, examining the mixed performance across our IT centers. We then describe the national trends in IT, broken down into the subsectors of IT manufacturing and IT services in Section 4. This provides the background for discussing the relationship between employment gains, or losses, and a reliance on IT services versus manufacturing in Section 5. In Section 6 we discuss some of the underlying factors that help determine the formation and growth of urban IT centers, and in Section 7 we focus on one factor that especially unites all of the

IT centers, that they all possess highly educated labor forces. Section 8 concludes.

2. IT Centers: Definition and Sample

Before delving into our analysis of urban IT centers, it is important to define what is meant by information technology. Our broad definition of the IT sector is intended to capture the manufacture and service-based provision of advanced information technologies that rely on programming or other automated control mechanisms.³ On the manufacturing side, computers and communications equipment, and their primary building blocks—semiconductors and other advanced electronic machinery—form the core of this industry. IT manufacturing also includes the production of a variety of advanced measuring and testing equipment, such as photonics and electromedical and aeronautical devices, along with consumer electronics. The services side includes firms that provide wired and wireless communication technologies, along with deliverers of Internet and other computer programming, design, and management services, and research and engineering services. We use this broad definition wherever possible, although for much of what we study in this article, data constraints require that a narrower definition be applied.

Notably excluded from this definition are the biotechnology and pharmaceuticals industries (biotech). These sectors share some of the key characteristics of our IT industries, most notably a knowledge-intensive production process, as reflected in an advanced skill base and extensive research and development (R&D) outlays and patenting activity. However, these industries tend to play a much smaller role than IT industries in local economies, and the demand and innovation cycles in these industries are independent of those in IT; for example, the biotech and pharmaceutical industries did not share in the recent boom-and-bust cycle experienced by our more narrowly defined providers of IT goods and services. These features of biotech support its exclusion from an analysis of the shifting fortunes of IT centers.

With a definition of IT-producing industries in hand, we select a sample of urban areas where these industries play an important role. Geographically our definition of IT centers relies on the concept of metropolitan statistical areas (MSAs), as defined by the U.S. Office of Management and Budget and as used by federal statistical agencies. In general, MSAs consist of a core area containing a substantial population nucleus, together with adjacent communities that have a

3. The broad definition that we use is generally identical to the definition used by the American Electronics Association (see AEA 2003). It includes NAICS codes 33400, 333200, 333300, 511200, 51700, 518000, 541500, 541700, and 611400.

high degree of socioeconomic integration with that core. To identify our IT centers, we apply the broadest available MSA definition, which in several cases corresponds to combined MSAs that form a “consolidated” MSA, or CMSA. Each of these areas is tied together internally by economic factors, such as commuting patterns and business ties, that form a shared economic base.⁴

We choose our exact set of cities by comparing the importance of the IT sector in the local economy to the importance of the IT sector in the national economy. Starting with a sample of 16 MSAs known to have large IT sectors or high IT shares of local activity (American Electronics Association 2000), we measure the importance of IT to the local economy by the share of IT industries in total nonfarm employment in 1995, 2000, and 2006.⁵ We keep any MSAs that had a larger share than the United States in at least two of the three years.

The resulting list of 12 urban IT centers, shown in Table 1, is (in alphabetical order) Atlanta, Austin, Boston, Dallas, Denver, Los Angeles, Portland, Raleigh, Rochester, the San Francisco Bay Area, Seattle, and Washington, D.C. The four MSAs from the original 16 that are not included in our sample are Chicago, Minneapolis, New York, and Phoenix, each of which recorded shares of IT industries in total nonfarm employment below that of the United States in two or more years.

3. Performance of IT Centers

Figure 1 displays the employment performance of our IT centers across the time periods of the boom (1995–2000), the bust (2000–2004), and the recovery (2004–2006). The bars in each figure depict the level changes in employment during these periods, as well as the cumulative change in employment across all periods (1995–2006) for each IT center. The boom, bust, and recovery periods are shown in black, while the cumulative change is shown on the right in gray.

While all of the IT centers posted substantial gains in IT employment during the boom period, the bust varied greatly across IT centers; although all of the IT centers suffered declines in IT employment during the bust, some of the losses nearly or completely erased the gains made in the boom

TABLE 1
IMPORTANCE OF IT: SHARES OF LOCAL EMPLOYMENT

Region	Total IT share (%)			IT share (%) excluding telecommunications		
	1995	2000	2006	1995	2000	2006
Atlanta	6.5	7.6	5.5	3.9	4.8	3.7
Austin	11.8	13.1	8.6	10.7	11.7	7.7
Boston	9.3	9.8	7.9	8.5	8.9	7.1
Dallas	8.1	9.1	6.5	6.2	6.5	4.8
Denver	8.5	10.8	7.4	6.2	7.8	5.6
Los Angeles	5.5	5.8	4.5	4.6	4.7	3.7
Portland	7.6	8.4	7.1	6.8	7.5	6.5
Raleigh	9.5	11.4	8.7	8.6	9.7	7.7
Rochester	8.2	9.2	7.3	7.4	7.9	6.1
S.F. Bay Area	13.3	16.2	13.0	12.0	14.8	12.1
Seattle	6.1	8.1	7.8	4.7	6.5	6.5
Washington, D.C.	8.3	10.2	9.3	6.8	8.5	8.1
United States	4.9	5.6	4.5	3.9	4.4	3.7

Source: Authors' tabulations based on the U.S. BLS (QCEW).

period, while in others the losses were less pronounced. Austin, Boston, Los Angeles, and Rochester shed more IT jobs in the bust period than they gained during the boom period. In Atlanta, Dallas, Denver, Portland, and the San Francisco Bay Area, the decline in IT employment during the bust period came close to negating the increases during the boom. However, in Seattle, Washington, D.C., and Raleigh, the losses during the bust were not as considerable as those experienced in the other IT centers, and much of the gains in IT employment made during the boom period were retained.

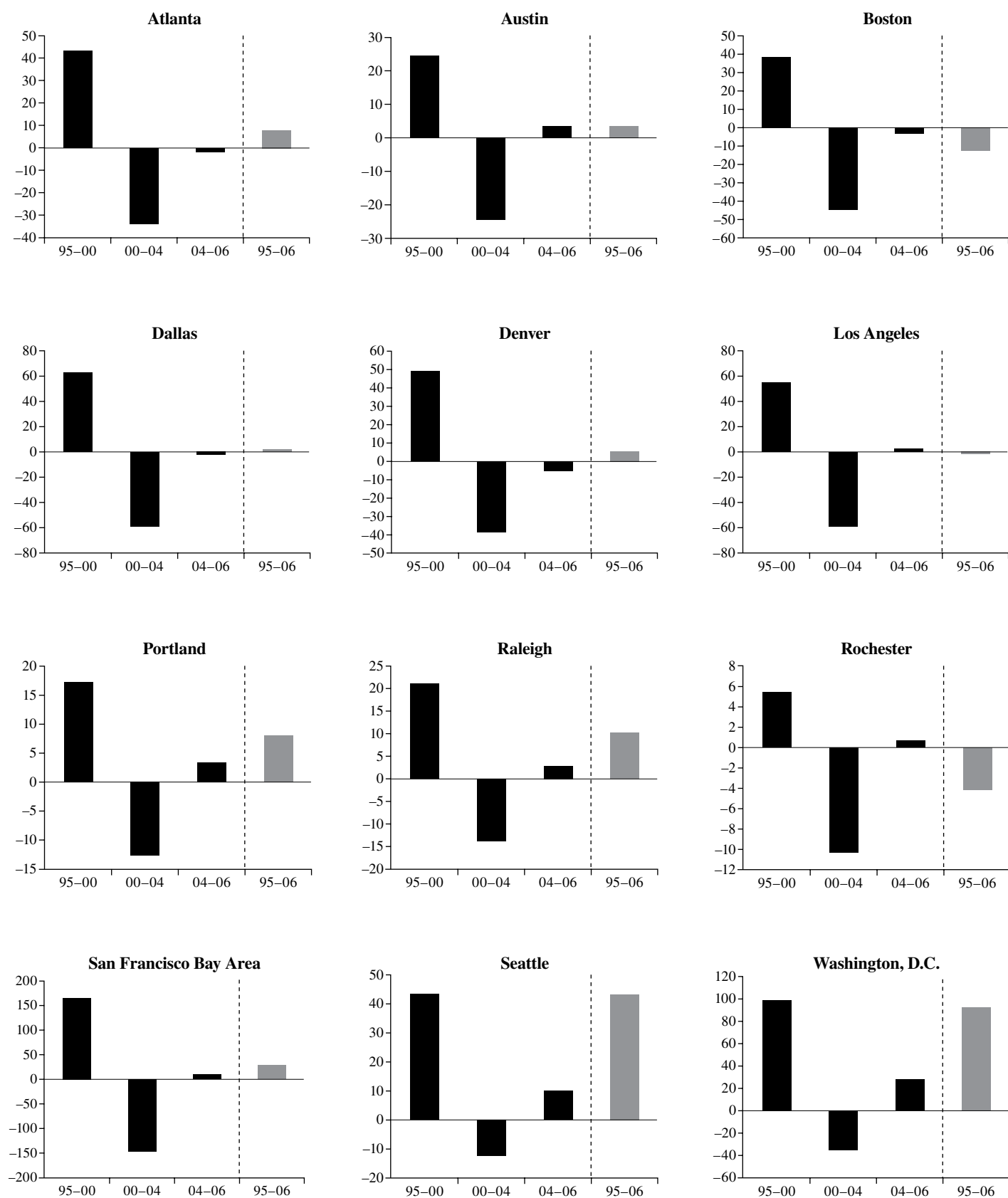
The performance during the recovery period was especially mixed. Atlanta, Boston, Dallas, and Denver continued to experience slight declines in IT employment, while Austin, Los Angeles, Raleigh, Rochester, and the San Francisco Bay Area made very slight increases, especially when compared to the gains and losses experienced during the boom and bust. Portland, Seattle, and Washington, D.C., fared the best during the latest period, experiencing slightly larger relative gains in IT jobs.

Overall, when we look across all time periods from 1995 to 2006, few IT centers made especially significant gains in IT employment. Seattle and Washington, D.C., posted the largest overall gains, retaining nearly all of the increases they experienced during the boom period. Portland and Raleigh fared comparably well also, overall maintaining roughly half of the gains they posted during the boom. However, Atlanta, Austin, Dallas, Denver, and the San Francisco Bay Area posted only slight overall gains, especially when compared to their meteoric increases during the boom. Moreover, Boston, Los Angeles, and Rochester suffered overall IT job losses between 1995 and 2006, owing to the significant

4. For example, as indicated later in this section, rather than focusing narrowly on “Silicon Valley,” which corresponds roughly to the San Jose MSA in California, we include the San Francisco and Oakland MSAs in our definition of the San Francisco Bay Area IT center. Although the San Jose MSA traditionally exhibits the highest IT density of any MSA nationwide, San Francisco and Oakland also are relatively dense centers of IT activity, and the connections between IT and related firms throughout the region are strong (similar to the “Route 128” region in and around Boston).

5. We also measured the contribution of local IT sectors to national IT activity, which we report in the appendix Table A1.

FIGURE 1
CHANGE IN TOTAL IT EMPLOYMENT (IN THOUSANDS)



number of IT jobs they shed during the bust and their lackluster performance during the recovery.

4. Performance of IT Services and Manufacturing

There are many reasons why the differences across IT centers occurred. One of the contributing factors could have been the relative focus IT centers placed on the major subsectors of IT, services and manufacturing. Before examining the IT services/manufacturing split across IT centers, we first turn our attention to the national trends during the boom, bust, and recovery periods. Figure 2 shows the level change in IT employment for the United States separated into IT manufacturing and services. The trends shown in Figure 2 indicate a substantial gap between IT manufacturing and services in regards to their gains in employment.

During the boom period the United States gained roughly 1.4 million jobs in IT industries. Of these gains in IT employment, 91.5 percent were made in IT services. This is because IT services grew much faster than IT manufacturing during this period, at an average annual rate of 8.2 percent compared with 1.2 percent, respectively), and because IT services make up a larger share of total IT employment in the United States. Conversely, during the bust, IT industries in the United States shed roughly 1.1 million jobs. Roughly 51 percent of this decline came from losses in IT manufacturing, despite the fact that it made up only 34.8 percent of total IT employment going into the bust in 2000.

IT manufacturing's weak performance in the boom and bust periods continued into the recovery period. Between 2004 and 2006, employment in IT manufacturing was basically stagnant, while IT services posted modest gains. Overall, between 1995 and 2006, IT services gained roughly 875,000 jobs, while IT manufacturing lost 462,000. This gap between IT manufacturing and IT services has considerable implications for our urban IT centers.

We delve deeper into the performance of IT manufacturing and IT services in Table 2. In this table we examine the percent change, during the same four periods as in Figure 2, for the major subsectors of IT manufacturing and IT services. During the boom period, almost every subsector of IT services outperformed the subsectors of IT manufacturing, with the sole exception of scientific R&D. The largest gains in this period were made in the computer systems design, software, and Internet service providers and web search industries. With the exceptions of semiconductors and computers and peripherals, the gains in IT manufacturing were much more subdued.

During the bust period there were sharp losses in all of the major subsectors of IT manufacturing, most notably for firms in the fields of communication equipment, audio and video, and semiconductors and electronics. Consistent with

FIGURE 2
IT EMPLOYMENT IN THE UNITED STATES

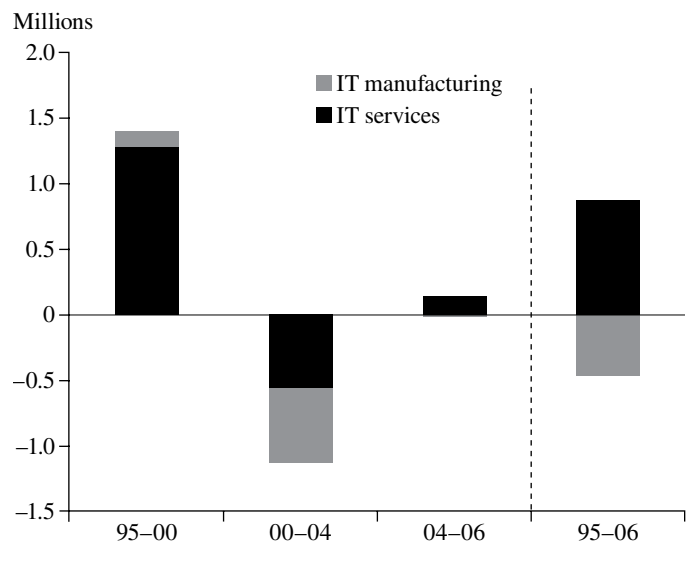


TABLE 2
PERFORMANCE OF IT SUBSECTORS

IT subsector	Percent change in employment			
	95-00	00-04	04-06	95-06
Manufacturing	6.8	-27.2	-0.9	-22.9
Computers/peripherals	10.4	-27.4	-6.6	-25.2
Communication equipment	1.0	-41.0	-1.3	-41.2
Audio/video	-5.2	-37.1	-5.0	-43.3
Semiconductor/electronics	20.1	-33.4	1.5	-18.7
Electronic instruments	-4.9	-10.2	1.4	-13.4
Magnetic media	0.6	-27.0	-14.0	-36.8
Services	48.1	-14.0	4.1	32.6
Software publishers	69.6	-11.3	3.3	55.4
Telecommunications	31.6	-19.0	-5.5	0.7
ISPs/web search portals	63.9	-25.3	0.7	23.3
Computer systems design	81.3	-12.9	11.7	76.4
Scientific R&D	12.7	5.4	10.1	30.7
Technical training	43.8	-13.5	-1.8	22.2

Source: Authors' tabulations based on the U.S. BLS (QCEW).

the dot-com crash, the largest declines in IT services were for Internet service providers, followed by telecommunications. Software publishers suffered the smallest percent declines, while providers of scientific R&D actually made gains during this period.

Gains in the recovery period were much more apparent for subsectors of IT services. Computer systems and design and scientific R&D posted substantial gains, while software publishers posted moderate gains and Internet service providers were fairly stagnant. Only the IT service subsectors of tele-

communications and technical training continued to experience job losses during the recovery period. Conversely, for IT manufacturing, only two subsectors recorded gains during the recovery period, semiconductors and electronics and electronic instruments.

When looking across all periods, every subsector of IT services, with the exception of telecommunications, made significant gains in employment. The most notable gains were made by computer systems design and software publishers. The results for IT manufacturing are a stark contrast. Every subsector of IT manufacturing posted considerable declines between 1995 and 2006, though manufacturers of semiconductors and electronics and electronic instruments fared somewhat better than the other subsectors.

5. Explaining the Variance in Performance

The discrepancy in performance between IT services and manufacturing can explain some of the variation in employment gains depicted in Figure 1 for our urban IT centers. In Table 3 we provide a look at the relative focus of our urban IT centers, and in Table 4 we refine our focus by excluding the outlier during the period, the telecommunications sector.⁶ The IT centers of Atlanta, Denver, Seattle, and Washington, D.C., all have a relative focus in IT services that is much larger than that of the nation. On the other hand, areas such as Austin, Boston, Portland, Raleigh, Rochester, and the San Francisco Bay Area are more heavily vested in IT manufacturing. Our results find that IT centers with a larger focus in IT services fared better, on average, than those with more of a focus in IT manufacturing.

These results can be seen in Figure 3, a scatterplot of our IT centers depicting the relationship between an IT center's relative focus and the percent change in IT employment these centers experienced. We plot IT services' share of total IT employment in 2000 and the percent change in IT employment between 1995 and 2006. The fitted regression line is upward-sloping through the points, implying a positive relationship between the share of IT services and gains in employment. Similar results are shown in Figure 4, which excludes the telecommunications industry.

Indeed, IT centers with a broad focus in IT services performed better than those with a primary focus in IT manufacturing. In fact, all centers with a share of IT services greater than the nation's in 2000 experienced net employment gains in the overall IT sector between 1995 and 2006.

6. We provide separate results excluding telecommunications because, while the telecommunications industry is a large user of IT, it is not an IT producer. Consequently, the swings in the telecommunications industry (shown in Table 2) were largely driven by forces that were independent of the forces that affected the IT-producing sectors.

TABLE 3
COMPOSITION SHARES OF IT EMPLOYMENT

Region	IT services (%)			IT manufacturing (%)		
	1995	2000	2006	1995	2000	2006
Atlanta	80.3	85.5	88.1	19.7	14.5	11.9
Austin	17.6	30.4	37.0	82.4	69.6	63.0
Boston	39.8	50.8	60.3	60.2	49.2	39.7
Dallas	51.2	61.8	66.0	48.8	38.2	34.0
Denver	74.6	80.1	81.5	25.4	19.9	18.5
Los Angeles	43.4	53.0	54.4	56.6	47.0	45.6
Portland	37.7	38.8	38.7	62.3	61.2	61.3
Raleigh	38.7	46.3	52.7	61.3	53.7	47.3
Rochester	25.8	39.1	42.2	74.2	60.9	57.8
S.F. Bay Area	41.0	52.6	57.5	59.0	47.4	42.5
Seattle	77.6	81.9	85.6	22.4	18.1	14.4
Washington, D.C.	83.2	88.0	90.4	16.8	12.0	9.6
United States	57.3	65.2	69.8	42.7	34.8	30.2

Source: Authors' tabulations based on the U.S. BLS (QCEW).

TABLE 4
COMPOSITION SHARES OF IT EMPLOYMENT
(EXCLUDING TELECOMMUNICATIONS)

Region	IT services (%)			IT manufacturing (%)		
	1995	2000	2006	1995	2000	2006
Atlanta	67.3	77.1	82.4	32.7	22.9	17.6
Austin	8.9	22.0	29.2	91.1	78.0	70.8
Boston	33.8	45.6	55.9	66.2	54.4	44.1
Dallas	36.3	46.7	54.6	63.7	53.3	45.4
Denver	64.8	72.2	75.5	35.2	27.8	24.5
Los Angeles	31.5	42.5	45.3	68.5	57.5	54.7
Portland	30.9	31.3	33.1	69.1	68.7	66.9
Raleigh	32.0	37.0	46.8	68.0	63.0	53.2
Rochester	17.1	29.8	31.4	82.9	70.2	68.6
S.F. Bay Area	34.2	48.2	54.5	65.8	51.8	45.5
Seattle	71.0	77.3	82.7	29.0	22.7	17.3
Washington, D.C.	79.5	85.5	89.0	20.5	14.5	11.0
United States	46.2	56.0	62.7	53.8	44.0	37.3

Source: Authors' tabulations based on the U.S. BLS (QCEW).

Seattle and Washington, D.C., which have some of the highest shares in IT services at 82 and 88 percent, respectively, experienced the largest percent gains in employment. Conversely, performance in IT centers with a large focus in IT manufacturing was much more mixed.⁷ Some, such as San Francisco and Raleigh, did post modest gains in IT employment, while others, such as Rochester and Boston, reported overall losses in IT employment.

7. A large focus in IT manufacturing is defined as those urban IT centers that have a larger share of IT manufacturing employment in total IT than the United States. See Table 3.

FIGURE 3
IT SHARE VS. CHANGE IN EMPLOYMENT

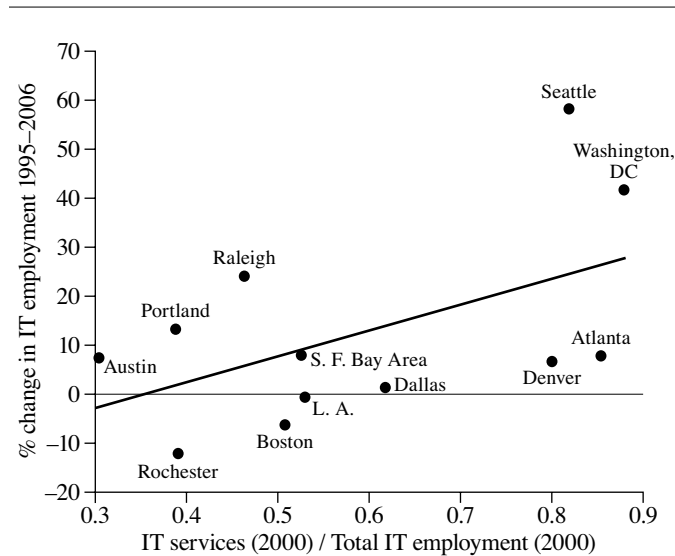
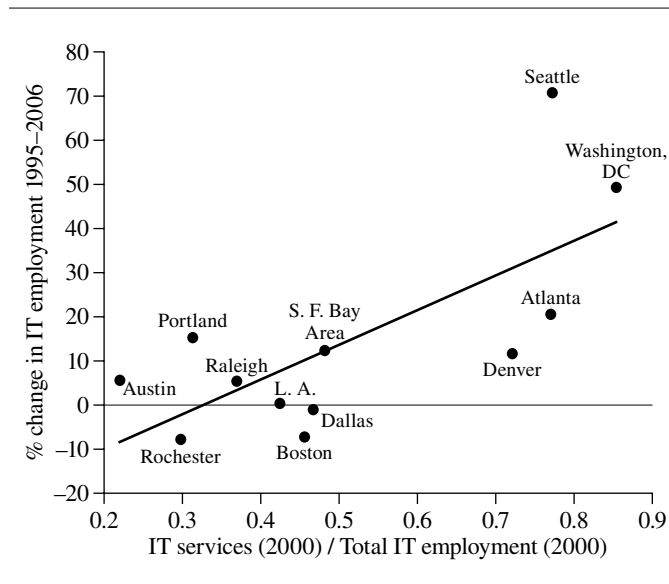


FIGURE 4
IT SHARE VS. CHANGE IN EMPLOYMENT
(EXCLUDING TELECOMMUNICATIONS)



These results bring out an important point, that the composition of the IT sector played a key role in determining the patterns of gains and losses in urban IT centers during these periods. Unfortunately, the detail in Table 2 for the nation is not generally available at the MSA level. However, where details are available, they provide some insights into the performance of individual MSAs. For instance, software-heavy Seattle and computer system design-intensive Washington, D.C., had the largest percent gains in IT employment, which is consistent with the national trends in these sectors. In fact,

the percent gain Seattle made in software employment between 1995 and 2006 was roughly three times the percent gain in software employment made nationally over the same period. In contrast, Boston, with its large focus in computer and peripheral and semiconductor manufacturing, posted overall percent declines in IT employment. Similarly, semiconductor-focused Austin recorded somewhat weak percent gains in IT employment.

An interesting case is the San Francisco Bay Area. In 1995, roughly 60 percent of Bay Area IT jobs were in manufacturing, while, at the national level, IT manufacturing jobs constituted about 43 percent of total IT employment. By 2006, however, the Bay Area IT sector had made strong gains in the IT service subsectors of Internet service providers and web search portal and computer systems design. As such, despite the downshift in IT manufacturing jobs, the Bay Area was still able to make overall gains in IT employment between 1995 and 2006.

6. The Determinants of Regional Resilience

So far we have described where the IT sector has been concentrated and how the performance of IT centers has varied over time. Overall, we showed that IT centers that specialize more in IT services than in IT manufacturing fared better, on average, over the past decade, but that centers that were able to adjust to changes in demand, like the San Francisco Bay Area, were able to continue growing. In this section, then, we discuss what underlying factors determine the formation of urban IT clusters and their growth. We begin with a review of earlier work on the topic and conclude with more recent research examining the role of education in the development of urban growth centers.

On the formation of specialized industry clusters, the work of Ellison and Glaeser (1997, 1999) is especially instructive. They note that Silicon Valley-style concentrations of industries can arise through two broad features of urban economies. The first is the presence of location-specific cost advantages—i.e., differences in input costs due to climate and geography, access to raw materials, and available supplies of different categories of labor. Although most inputs into the IT production process—financial capital, specialized machinery, raw materials, etc.—are unlikely to exhibit substantial price variation across geographic areas, variation in the availability and relative price of skilled labor (such as college-educated workers) may represent one important source of cost variation for IT producers.

An additional mechanism for the development of specialized IT centers is the presence of beneficial knowledge spillovers among firms within the same industry and geographic area. To the extent that these “agglomeration economies” exist and contribute to local economic specialization, they cre-

ate the potential for “increasing returns” in production, or increased productivity in the locally concentrated industry as output increases. The tendency for initial industry leaders, such as Silicon Valley, to maintain or expand their innovative and productive edge over time is consistent with increasing returns in local IT centers. Moreover, this process of increasing returns through knowledge spillovers is likely to function most effectively in markets with an abundant supply of highly skilled labor, which suggests a potentially positive interaction between location-specific cost advantages and knowledge spillovers in determining IT industry growth.

Saxenian (1994) has identified some of the key features of agglomeration economies in Silicon Valley’s IT sector, including knowledge transmission through employee mobility (often entrepreneurial), supportive and activist financial institutions (see Hellman and Puri (2002) for evidence on the role of venture capitalists), and the presence of knowledge centers such as research universities and institutes (see Audretsch and Feldman (1996) regarding the importance of knowledge spillovers from these sources). More general evidence, which systematically models growth performance across cities, also supports the importance of knowledge spillovers in urban IT centers. Beardsell and Henderson (1999) find strong evidence of positive spillovers at the local level in an analysis restricted to the computer industry. Moreover, Audretsch and Feldman (1996) find that industries in which knowledge spillovers are more prevalent have the greatest propensity to exhibit innovative clusters at the local level.

Strictly speaking, Ellison and Glaeser’s arguments regarding the sources of localized growth refer to the degree of geographic concentration of total U.S. output in a sector, hence the overall size (rather than density) of local IT sectors in our setting. However, the benefits of agglomeration economies are likely to be most pronounced when production is locally dense (that is, constitutes a large share of output), since the benefits of knowledge spillovers may be diluted when the IT sector must compete more vigorously with other sectors for scarce knowledge resources. Thus, it is likely that specialization is important for IT sector growth, in the sense that an urban area must achieve a high density of IT activities as a share of overall economic activity in order to realize the benefits of agglomeration.⁸

Interestingly, other research finds that industrial diversity, rather than specialization, plays a key role in urban innovation and growth (see Feldman and Audretsch 1999, Duranton and Puga 2001).⁹ This is not necessarily inconsistent

with the role of IT specialization, however, as it may also be true that diversity *within* the IT sector supports innovation. In particular, Duranton and Puga (2001) emphasize that innovative activities are most common and effective in diversified production environments, in which firms searching for the best products and processes benefit from a wide range of possibilities. The process of knowledge spillovers in the IT industry, achieved through employee mobility and related factors, functions as a critical delivery mechanism for realizing the benefits of diversified product environments. Duranton and Puga also note that it is common for firms to start up in diversified cities and then move to more specialized production locales; this is consistent with the tendency for IT firms to have headquarters in IT centers but to locate production facilities in lower-cost locations increasingly over time.¹⁰ Moreover, by ensuring a wide range of production processes and of products, a diverse local IT sector may possess the advantage of enhanced flexibility in response to changing conditions in IT markets; these may include changes in patterns of demand, changing domestic and overseas cost conditions, and other broad changes that affect the demand and supply for IT products and services.

To summarize this previous research, it appears that urban areas that have a large IT sector and that have a relatively high density of IT activities may have two key advantages over other areas in regard to IT innovation and production. First, high IT density enables a region to capitalize on local increasing returns to IT innovation and production, thereby reducing costs and enhancing productivity within their IT sector. This is especially true when highly skilled labor is in abundant supply. In addition, having a large local IT sector increases the likelihood of diversity *within* the IT sector, since growth constraints related to market size are likely to be less binding when the product array is relatively broad. In addition to providing flexibility to respond to changing IT industry demand and cost conditions, diversity within the IT sector may provide an impetus for IT innovative activities by allowing firms to access a wide range of product and process options. As such, a combination of size and density in the IT sector may be optimal and go a long way towards explaining the continuity of an industry leader such as Silicon Valley.

7. The Role of Education in Regional Resilience

The previous section described theories about why IT sectors developed where they did and what factors gave certain areas

8. Ciccone and Hall (1996) provide persuasive evidence that the density of overall economic activity in local economies, rather than their size, is a key determinant of economic growth.

9. The importance of industrial diversity for urban growth is an idea often traced back to Jacobs (1969).

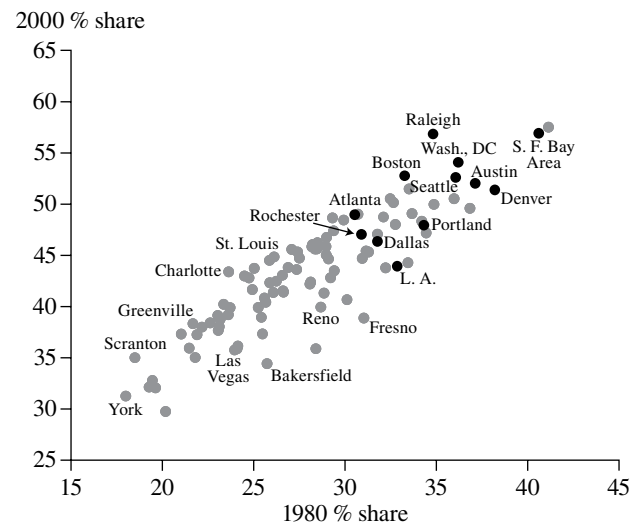
10. For example, the growth of IT production and employment in Oregon and other relatively low-cost states over the past decade has occurred in part because existing companies, such as Intel, have relocated production facilities from high-cost areas, such as Silicon Valley, while maintaining research and management facilities in their cities of origin.

an advantage. However, great uncertainty surrounds which IT centers will be positioned to do well in the future, especially in terms of which cities will continue to prosper as IT centers and which cities will be home to future information/knowledge-based industries. Although numerous factors influence where certain industries prosper (including local government tax policies, proximity to suppliers and customers, et cetera), in this section we explore the potential importance of the education of the local labor force.¹¹

As shown in Doms and Lewis (2006) and Beaudry, Doms, and Lewis (2006), cities vary tremendously in their educational attainment. One measure that is commonly used to compare average education levels is a concept called the “college-equivalent share.” The college-equivalent share measures the fraction of the full-time workforce that has at least four years of college plus one-half times the share of the workforce with at least some college.¹² Figure 5 shows the college equivalent share for 100 of the largest CMSAs in 1980 and 2000.¹³ These cities include the 12 IT centers previously described, shown with solid markers. There are several items to note. First, cities vary tremendously in the education of their labor forces; the San Francisco Bay Area had a college equivalent share of 57 percent in 2000 compared to 31 percent for York, Pennsylvania. A second striking feature is the persistence in the college-equivalent share over time; the correlation between the college-equivalent share in 1980 and 2000 for the cities shown in Figure 5 is 89 percent. A third feature of note is that IT centers tend to be in highly educated cities. In fact, the 12 IT centers we study averaged a college-equivalent share of 51 percent compared to 42 percent for the non-IT centers.¹⁴

There are many reasons why IT centers arose where they did, including historical legacies, local tax policies, and so forth. One of those reasons is likely to be the quality of the local labor force. That is, it may not be surprising that the IT centers prospered in highly educated areas, especially since the IT industry employs a relatively highly educated labor force. Using our measure of education, IT industries

FIGURE 5
COLLEGE EQUIVALENT SHARE OF WORKFORCE



Note: 100 largest CMSAs plotted. Black dots show 12 IT centers from our sample.

tend to have highly educated workforces, with an average college-equivalent share of 61 percent compared to an average college-equivalent share of 47 percent for the entire U.S. workforce.¹⁵

One reason why cities can vary in their educational attainment arises from the industry and occupational structure of a city. For instance, a city with a large IT presence will have more highly educated workforces than cities with lower skill industries and jobs. However, the industry and occupational differences account for only a small fraction of the distribution observed in Figure 5.

If that is so, then the question arises: Why are some cities more educated than others? There are likely many factors, so being able to say why one city is more educated than another is difficult. It is easier to say that education is correlated with a factor, such as having a large arts community or being close to an ocean, than to say that a factor “causes” a local labor force to be more highly educated.

With that caveat in mind, Moretti (2004) finds that one important factor influencing why some cities are more educated than others is the presence of colleges and universities. These schools can raise the education of the local labor force for several reasons. First, having an abundance of higher education opportunities nearby increases the likelihood that the local population will take advantage of higher school-

11. Years of education is often used as a measure of the quality of the workforce because other measures of skill simply are not available over time and across cities. Although years of education is not a perfect measure of the quality of a local labor force, it is likely to be positively correlated with the quality of the labor force. For instance, cities that possess many college graduates are also likely to possess more entrepreneurs.

12. This is just one measure of education. However, the statements and results cited in this section are robust to a wide variety of definitions.

13. We choose to show years in which the decennial population census was conducted because detailed education and employment information is available for a large sample of cities in those years.

14. Tying the results here to the previous section, IT centers with higher education tended to have better employment performance than less-educated IT centers.

15. This statistic is based on the 2000 decennial census for full-time workers. The highly educated nature of the IT labor force is apparent using other measures of education, such as average years of education, proportion of the workforce with more than a college degree, and so on.

ing. Second, after graduation, students may be inclined to stay near where they went to school. Finally, being near colleges and universities may be appealing to college graduates for the amenities provided. Whatever the reasons, it has been repeatedly found that cities with a relative abundance of colleges and universities may also have relatively highly educated workforces.¹⁶

Looking ahead, a natural question to ask is, Which cities will become the loci of the next knowledge-intensive industries? As stated, there are many reasons why one industry may be clumped in one area and not another. However, having highly educated workforces will likely be an important factor.

8. Summary

This paper partially addresses the question of how various IT centers fared during the boom, bust, and lukewarm recovery period. We find that performance across these IT centers has been quite heterogeneous, with some centers showing significant signs of recovery, others showing small signs of recovery, and others continuing to contract. The IT centers with a larger focus on IT services, rather than manufacturing, appear to have performed better, mirroring the trends observed in IT manufacturing and IT services nationally. All of these IT centers, however, possess the ability to be at the forefront of the next technology boom because of their highly skilled labor forces. Regarding the original question raised in our paper, the results indicate that the more lasting contributors to regional growth and resilience are related to factors such as the education and skill level of the workforce, the diversity of the product base, innovative capacity, and ability to respond to changing conditions such as the recent rise in IT imports and overseas production.

Appendix

TABLE A1
CONTRIBUTION OF LOCAL IT EMPLOYMENT
TO NATIONAL IT EMPLOYMENT (PERCENT SHARES)

Region	Local IT share (%)			Local IT share (%) ex. telecommunications		
	1995	2000	2006	1995	2000	2006
Atlanta	2.2	2.4	2.1	1.6	1.9	1.8
Austin	1.0	1.1	1.0	1.1	1.3	1.1
Boston	4.2	3.9	3.6	4.9	4.4	4.1
Dallas	3.3	3.6	3.1	3.2	3.3	2.9
Denver	1.8	2.2	1.8	1.7	2.0	1.7
Los Angeles	6.0	5.5	5.5	6.2	5.7	5.6
Portland	1.3	1.3	1.4	1.5	1.4	1.5
Raleigh	0.9	1.0	1.0	1.0	1.1	1.1
Rochester	0.7	0.7	0.6	0.8	0.7	0.6
S.F. Bay Area	7.4	8.4	7.3	8.3	9.7	8.4
Seattle	1.6	2.0	2.3	1.6	2.0	2.4
Washington, D.C.	4.7	5.2	6.1	4.9	5.5	6.6

Source: Authors' tabulations based on the U.S. BLS (QCEW).

16. An appealing approach of Moretti (2004), also used by Doms and Lewis (2006), is examining cities with land grant colleges. Land grant colleges were mostly established in the late 1800s and were not located in particularly highly educated areas. Therefore, the subsequent high education levels of land grant college cities are more likely to be due to the presence of the college.

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Do Supervisory Rating Standards Change Over Time?*

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Supervisory BOPEC ratings were assigned to bank holding companies (BHCs) during the years 1987 to 2004 as a summary of their overall performance and level of supervisory concern. In this article, we examine the stability of the BOPEC ratings assigned over that period. We model supervisory ratings using balance sheet variables, and our analysis suggests that BOPEC rating standards varied over time. Supervisors seem to have applied more stringent rating standards from 1989 to 1992, a period marked by a recession and a large degree of distress in the banking sector. Rating standards then eased during the economic recovery from 1993 to 1998, before showing increasing signs of toughness again from 1999 through 2004. Based on our estimated model parameters, we find that, in some cases, up to 25 percent of the BHCs that were assigned a BOPEC rating in a “tough” year would have been given a better rating in an “easy” year. The reasons for the observed variation in supervisory standards could be changes in supervisory behavior, but they are also surely related to the substantial changes that occurred within the U.S. banking system over this 17-year period.

1. Introduction

Bank supervisors engage in extensive monitoring of banking organizations in order to conduct effective supervision, enforce regulations, and guard against systemic risk. In the United States, several financial regulatory agencies supervise commercial banks and related depository institutions, but the Federal Reserve System is the primary regulator of bank holding companies (BHCs) and, after the Gramm-Leach-Bliley Act of 1999, of financial holding companies. The supervisory monitoring of BHCs is primarily conducted using both on-site and off-site inspections. In particular, on-site supervisory visits produce a detailed picture of a BHC’s financial condition and risk profile. The frequency of inspections is determined according to a BHC’s size and its level of supervisory concern.¹

From 1987 through 2004, BHCs received a numerical rating called a composite BOPEC rating at the end of these on-

site visits.² The BOPEC acronym stands for five key areas of supervisory concern: the condition of the BHC’s **B**ank subsidiaries, **O**ther nonbank subsidiaries, **P**arent company, **E**arnings, and **C**apital adequacy. BHCs with the best performance are assigned a BOPEC rating of one, while those with the worst performance are given a BOPEC rating of five. A rating of one or two indicates that the BHC is not considered to be of supervisory concern. Note that BOPEC ratings, as well as all other inspection materials, are highly confidential and are never made publicly available.

Like bond ratings given by the private rating agencies, BOPEC ratings are deemed absolute ratings and, thus, should be comparable over time. However, given the changes in the banking sector over the past several decades and the large changes in the competitive environment in which banks operate, it is natural to question whether the standards used to assign supervisory ratings have also changed. In an important study of corporate bond ratings, Blume, Lo, and MacKinlay

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1. For a detailed explanation of how inspection frequency is determined, see sections 5000.0.2-4 of the Bank Holding Supervision Manual issued by the Division of Banking Supervision and Regulation at the Board of Governors of the Federal Reserve System (www.federalreserve.gov/BoardDocs/SupManual).

2. Starting in 2005, the Federal Reserve’s BHC supervisory rating system was changed from a method of historical analysis of BHC financial conditions to a forward-looking assessment of risk management and financial factors. The new rating system is known as the RFI/C(D) rating system. Each inspected BHC is assigned a “C” composite rating, which is based on an evaluation of its managerial and financial condition as well as the future potential risk of its subsidiary depository institutions. The other main components of the rating system are **R**isk management, **F**inancial condition, and potential **I**mpact of the parent company and nondepository subsidiaries on the subsidiary depository institutions.

(BLM, 1998) found that bond rating standards became more stringent over the period from 1978 to 1995. While subsequent studies, such as Jorion, Shi, and Zhang (2009), have raised some questions about this result, the general conclusion that rating standards move over time has been widely accepted. With regard to supervisory ratings, Berger, Kyle, and Scalise (BKS, 2001) directly address this question with respect to the CAMELS ratings assigned after bank examinations. They found that bank examiners were “tougher” in assigning ratings during the years 1989 through 1992 and less so from 1993 to 1998.

In this study, we examine the related question of whether the supervisory standards used to assign BOPEC ratings have changed over the period from 1987 to 2004. Using the econometric model proposed by BLM (1998), we look at whether a BHC that was assigned a given rating at a given point in time might have received a different rating at another point in time, holding constant the financial characteristics of the BHC. In this regard, we estimate an ordered logit model in which the dependent variable is the BOPEC rating. The regressors are supervisory variables that should have explanatory power in predicting BHC health; see Krainer and Lopez (2003, 2004, 2008) for further discussion. In addition, we include indicator variables for the year in which the BOPEC rating was assigned in order to track potential changes in supervisory standards over time. In this model, if rating standards change through time, the estimated intercepts should be statistically different from the benchmark year.

Our empirical results show that the yearly intercepts do vary significantly, suggesting that BOPEC rating standards did change over time. We find that supervisory standards were “tough” from 1989 to 1992, a period that corresponds with a recession and a “credit crunch,” “easy” from 1993 to 1998, and “tough” again from 1999 through 2004. These results for BHCs align quite well with the bank-level results reported by BKS (2001). Our results are robust to including various cyclical measures of macroeconomic conditions, such as GDP growth and stock market returns, in the model.

We also find that the changes in rating standards had an impact on BOPEC rating assignments. As per BLM (1998), we use our estimated annual intercepts to gauge the magnitude of the differing standards by examining the degree to which ratings assigned in a given year would change if they had been assigned in another year. We find that about 15 percent of the BOPEC ratings assigned during the relatively “easy” years of 1993 to 1998 would have been given worse (i.e., higher) ratings in other years. Similarly, roughly 15 percent of BOPEC ratings assigned in the “tough” years of our sample would have received better (i.e., lower) BOPEC ratings during the “easy” years.

The underlying reasons for these changes range from possible examiner forbearance due to economic and political

concerns, as is argued by Rosen (2003), to the significant changes in the banking system’s structure and regulation, as detailed by Furlong and Kwan (2006). Our empirical results cannot directly address the underlying reasons for this pattern of supervisory behavior, but the size and timing of our implied changes in BOPEC rating standards can provide guidance for future research.

The paper is structured as follows. In Section 2, we provide a brief survey of the academic literature on supervisory rating standards. In Section 3, we discuss our data set and ordered logit model. In Section 4, we empirically analyze patterns in rating standards, and Section 5 concludes.

2. Literature Review

The stability of rating standards was first examined within an econometric framework by BLM (1998) for Standard and Poor’s (S&P) corporate bonds. Using bond ratings over the period from 1978 through 1995, they estimated an ordered logit model that incorporated several control variables, such as total leverage and market value, as well as indicator variables (i.e., time dummies) for the ratings’ assignment years. They found that the pattern of estimated coefficients on the indicator variables was downward sloping, indicating worsening ratings, in a statistically significant way. Their empirical results support the hypothesis that rating standards became more stringent over this period. The authors note that their results are conditional only on the firm characteristics included in their model. While they conducted a series of robustness tests to verify their results, it is possible that the changing intercept values were just compensating for an omitted variable or time variation in the coefficients on the explanatory variables.

In a follow-up study, Jorion et al. (2009) found much less support for this conclusion when they extended the analysis to the period from 1985 to 2002 and to encompass speculative-grade bonds. They found that these bonds did not exhibit the downward trend in their intercept variables. In addition to some further technical results, they argued that the omitted variable that could account for BLM’s main result was the informativeness of accounting data. Based on indirect measures of the quality of accounting data for credit risk analysis and earnings management, they showed that the trend in the investment-grade intercept can be significantly reduced.

Turning to supervisory ratings, the most relevant study is BKS (2001), who examined changes in bank-level supervisory ratings, known as CAMELS ratings.³ They also used an

3. As with BOPEC ratings, CAMELS ratings are assigned after bank examinations and are not made public. The CAMELS acronym refers to six key areas of supervisory concern: the bank’s Capital adequacy, Asset quality, Management, Earnings, Liquidity, and Sensitivity to risk.

ordered logit model with time-varying intercepts for their analysis, but they allowed the intercepts to vary only across time periods. Their results suggest that supervisors assigned tougher ratings during the credit crunch period from 1989 to 1992 and easier ratings during the expansion period of 1993 to 1998. They also found that these changes in supervisory rating standards led to changes in bank lending patterns. However, they determined that the observed changes in bank lending can be only partially explained by changes in supervisory rating standards.⁴ This latter result is consistent with Peek and Rosengren (1997) who found that tougher supervisory enforcement of capital requirements led to a sharp decline in bank lending in New England during the 1990–1991 recession, and with Curry, Fissel, and Ramirez (2006) who found that business lending at the state level was sensitive to CAMELS rating changes over the period from 1985 to 1993. Our study differs from the BKS study in two key ways: we use supervisory BOPEC ratings of bank holding companies instead of supervisory CAMELS ratings of banks, and we use annual indicator variables instead of regime indicators.

3. Sample, Model, and Estimation Results

3.1. The BOPEC Sample

The core database for our analysis is the supervisory BOPEC ratings assigned over the period from the first quarter of 1988 to the fourth quarter of 2004. We analyze only BOPEC ratings assigned after an on-site, full-scope inspection. This reflects the concern that limited and targeted inspections produce a less comprehensive supervisory information set than is produced in a full inspection. Our sample of BOPEC ratings is further refined to include only inspections of top-tier BHCs with identifiable lead banks, since they are typically the legal entity within the banking group that has the highest level of responsibility; for example, it is the top-tier entity that issues publicly traded equity. We also require each BHC to have at least four quarters of supervisory data and at least one prior BOPEC rating. This effectively removes de novo BHCs and new BHCs arising from mergers from the sample. Finally, four quarters of supervisory data are required to calculate certain explanatory variables for the model described later.

The assets of the BHCs inspected in our sample are summarized in Table 1. The full sample contains 7,045 BOPEC ratings for 2,077 different BHCs. There were slightly more

TABLE 1
ASSET SIZE OF BHCs IN THE BOPEC SAMPLE

	1988–1995	1996–2004	1988–2004
Total inspections	4,119	2,926	7,045
Asset size:			
Assets < \$1b	3,123	1,699	4,822
\$1b < assets < \$100b	981	1,177	2,158
Assets > \$100b	15	50	65
Inspections of publicly traded BHCs	1,610	1,593	3,203
Asset size:			
Assets < \$1b	690	535	1,225
\$1b < assets < \$100b	905	1,008	1,913
Assets > \$100b	15	50	65

Note: A BHC is defined in our data set as a top-tier BHC with an identifiable lead bank and four quarters of available supervisory reporting data.

inspections in the first half of the sample period than in the second half; this trend reflects both the gradual consolidation taking place over the period and the relatively benign environment for banks towards the end of the sample, which tends to slow down the frequency for each bank's periodic inspections. As shown in the table, an important difference between the private and publicly traded BHCs in our sample is size: Public BHCs are generally larger than private BHCs, with a greater percentage having total assets ranging between \$1 billion and \$100 billion. The table also shows that almost 70 percent of the total inspections in the sample are of relatively small institutions with less than \$1 billion in total assets.

Table 2 presents the distribution of BOPEC ratings assigned in each year for all BHCs and for publicly traded BHCs. Note that there are very few BOPEC 5 ratings in the sample, since both supervisors and bankers take actions to try to prevent this outcome. Clearly, for each year and in total, the majority of the ratings fall in the upper two categories, which indicates that a BHC's financial condition and risk profile are of little supervisory concern. For the full 17-year period, the total percentage of ratings in these top two categories is 80 percent. Although the distribution fluctuates over the sample, the annual percentage of ratings in the top two categories for the full sample never falls below the 60 percent observed in 1991. From that point, the percentage of BOPEC assignments in the top two categories increases steadily, reaching 96 percent of assignments in 1998. From there through 2004, the percentage fluctuates between 87 and 93 percent.

Our sample contains 3,203 BOPEC rating assignments for publicly traded BHCs, which represents a little over 40 percent of the full sample. These ratings correspond to 660 unique institutions, which implies a slightly higher ratio of BOPEC ratings per BHC than for the full sample, i.e., 3.39

4. Bizer (1993) did a study similar to that of BKS, although smaller in scope. He found that supervisors were harder on banks during the credit crunch than on banks in one comparison quarter, 1988:Q4. Other previous studies are similar to the Bizer study in that they are smaller in scope or depth than the BKS study.

TABLE 2
BOPEC RATINGS IN SAMPLE

	BOPEC rating						Percent of total, according to BOPEC rating				
	1	2	3	4	5	Total	1	2	3	4	5
A. All BHCs											
1988	86	224	82	39	3	434	19.8	51.6	18.9	9.0	0.7
1989	91	256	116	51	6	520	17.5	49.2	22.3	9.8	1.2
1990	61	201	76	40	20	398	15.3	50.5	19.1	10.1	5.0
1991	75	251	132	70	16	544	13.8	46.1	24.3	12.9	2.9
1992	88	316	131	91	27	653	13.5	48.4	20.1	13.9	4.1
1993	137	317	92	51	8	605	22.6	52.4	15.2	8.4	1.3
1994	166	264	40	22	6	498	33.3	53.0	8.0	4.4	1.2
1995	178	241	30	16	2	467	38.1	51.6	6.4	3.4	0.4
1996	231	248	20	3	1	503	45.9	49.3	4.0	0.6	0.2
1997	214	210	15	1	0	440	48.6	47.7	3.4	0.2	0.0
1998	145	128	16	3	1	293	49.5	43.7	5.5	1.0	0.3
1999	116	150	20	4	0	290	40.0	51.7	6.9	1.4	0.0
2000	129	189	38	6	0	362	35.6	52.2	10.5	1.7	0.0
2001	89	209	36	6	2	342	26.0	61.1	10.5	1.8	0.6
2002	74	134	23	3	0	234	31.6	57.3	9.8	1.3	0.0
2003	60	143	14	3	0	220	27.3	65.0	6.4	1.4	0.0
2004	75	148	15	3	1	242	31.0	61.2	6.2	1.2	0.4
Total	2,015	3,629	896	412	93	7,045	28.6	51.5	12.7	5.8	1.3
B. Publicly traded BHCs											
1988	56	96	23	14	2	191	29.3	50.3	12.0	7.3	1.0
1989	43	102	24	8	2	179	24.0	57.0	13.4	4.5	1.1
1990	23	74	23	8	4	132	17.4	56.1	17.4	6.1	3.0
1991	28	86	54	27	5	200	14.0	43.0	27.0	13.5	2.5
1992	43	92	41	48	10	234	18.4	39.3	17.5	20.5	4.3
1993	57	112	37	24	2	232	24.6	48.3	15.9	10.3	0.9
1994	80	124	17	6	3	230	34.8	53.9	7.4	2.6	1.3
1995	76	118	14	3	1	212	35.8	55.7	6.6	1.4	0.5
1996	102	112	7	1	0	222	45.9	50.5	3.2	0.5	0.0
1997	90	92	1	1	0	184	48.9	50.0	0.5	0.5	0.0
1998	88	81	7	2	0	178	49.4	45.5	3.9	1.1	0.0
1999	77	91	7	2	0	177	43.5	51.4	4.0	1.1	0.0
2000	75	88	13	3	0	179	41.9	49.2	7.3	1.7	0.0
2001	60	109	15	3	0	187	32.1	58.3	8.0	1.6	0.0
2002	53	90	14	0	0	157	33.8	57.3	8.9	0.0	0.0
2003	41	105	8	0	0	154	26.6	68.2	5.2	0.0	0.0
2004	43	104	7	1	0	155	27.7	67.1	4.5	0.6	0.0
Total	1,035	1,676	312	151	29	3,203	32.3	52.3	9.7	4.7	0.9

for the full sample and 4.85 for the publicly traded sample. However, the ratings distribution for publicly traded BHCs is quite similar to that for the full sample.

Table 3 presents the patterns of changes in the BOPEC ratings in our sample. The most frequent outcome is no change in BOPEC rating, accounting for about 63 percent of the full sample and ranging from 39 percent to 79 percent of the annual totals. The ratio of BOPEC upgrades relative to downgrades fluctuates over the sample in a way that corresponds with our measure of time-varying standards. There are two

periods of relative weakness for the banks. First, more downgrades occurred than upgrades in the period from 1988 through 1992, a period coinciding with a banking crisis and, later, an economy-wide recession. From 1993 through 1998, upgrades greatly outnumbered downgrades, and the percentage showing no change in BOPEC ratings rose from 58 percent to 75 percent. The second period of weakness occurred from 1999 through 2004, where downgrades again outnumbered upgrades, although by a lesser margin, and the percentage showing no change in BOPEC ratings remained

TABLE 3
BOPEC RATING CHANGES IN SAMPLE

	Change in BOPEC rating				Percent of total		
	Upgrade	No change	Downgrade	Total	Upgrade	No change	Downgrade
A. All BHCs							
1988	96	170	168	434	22.1	39.2	38.7
1989	84	301	135	520	16.2	57.9	26.0
1990	62	227	109	398	15.6	57.0	27.4
1991	70	295	179	544	12.9	54.2	32.9
1992	130	360	163	653	19.9	55.1	25.0
1993	187	349	69	605	30.9	57.7	11.4
1994	137	312	49	498	27.5	62.7	9.8
1995	139	285	43	467	29.8	61.0	9.2
1996	123	341	39	503	24.5	67.8	7.8
1997	101	299	40	440	23.0	68.0	9.1
1998	38	222	33	293	13.0	75.8	11.3
1999	25	226	39	290	8.6	77.9	13.4
2000	41	267	54	362	11.3	73.8	14.9
2001	30	241	71	342	8.8	70.5	20.8
2002	34	164	36	234	14.5	70.1	15.4
2003	21	174	25	220	9.5	79.1	11.4
2004	30	177	35	242	12.4	73.1	14.5
Total	1,348	4,410	1,287	7,045	19.1	62.6	18.3
B. Publicly traded BHCs							
1988	45	90	56	191	23.6	47.1	29.3
1989	25	127	27	179	14.0	70.9	15.1
1990	10	85	37	132	7.6	64.4	28.0
1991	19	113	68	200	9.5	56.5	34.0
1992	44	136	54	234	18.8	58.1	23.1
1993	68	141	23	232	29.3	60.8	9.9
1994	58	154	18	230	25.2	67.0	7.8
1995	53	136	23	212	25.0	64.2	10.8
1996	40	170	12	222	18.0	76.6	5.4
1997	32	137	15	184	17.4	74.5	8.2
1998	19	142	17	178	10.7	79.8	9.6
1999	14	139	24	177	7.9	78.5	13.6
2000	16	143	20	179	8.9	79.9	11.2
2001	12	153	22	187	6.4	81.8	11.8
2002	28	107	22	157	17.8	68.2	14.0
2003	10	130	14	154	6.5	84.4	9.1
2004	13	121	21	155	8.4	78.1	13.5
Total	506	2,224	473	3,203	15.8	69.4	14.8

at a high level, ranging from 70 percent to 79 percent. The data for publicly traded BHCs is similar with respect to the BOPEC no change category.

3.2. Model

Our previous work on modeling and forecasting BOPEC ratings has used a standard ordered logit model, as per the BLM and BKS studies. This model assumes that the BOPEC rating assigned to BHC i in quarter t , denoted BP_{it}^* , is an unob-

servable continuous variable based on supervisory variables available at the end of year $t-1$. The rating is modeled as

$$BP_{it}^* = \alpha + (\beta + \gamma I_{Eit-1})x_{it-2} + \varepsilon_{it},$$

where x_{it-2} is a $(k \times 1)$ vector of explanatory variables unique to BHC i from two quarters prior (i.e., the soonest possible as per Gunther and Moore (2000)) to the BOPEC assignment, and the indicator variable I_{Eit-1} identifies BHCs with publicly traded equity at year-end prior to the BOPEC assignment. The interaction terms allow us to control for possible differ-

ences between BHCs without public equity and those with public equity. The error term ε_{it} has a standard logistic distribution. While we do not have a panel structure to our data because inspections do not take place at a set frequency, we do have repeat observations of the same entity over time. To control for this possible dependence in the error term, we adjust the standard errors in the results sections by clustering on entity.

Since BP_{it}^* is unobserved, we can only model the observable BOPEC rating $BP_{it} \in \{1, 2, 3, 4, 5\}$. Thus, in addition to the parameter vector (α, β, γ) and the parameters in the variance-covariance matrix, we must also estimate four cut-points, denoted n_j , such that

$$\begin{aligned} BP_{it} &= 1 \text{ if } BP_{it}^* \in (-\infty, n_1], \\ &= 2 \text{ if } BP_{it}^* \in (n_1, n_2], \\ &= 3 \text{ if } BP_{it}^* \in (n_2, n_3], \\ &= 4 \text{ if } BP_{it}^* \in (n_3, n_4], \\ &= 5 \text{ if } BP_{it}^* \in (n_4, \infty). \end{aligned}$$

The density function for an assigned BOPEC rating is constructed by defining Y_{ijt} as an indicator variable equal to one if rating j is assigned to BHC i at time t . Since the ratings are ordered, the probability that BHC i is assigned BOPEC rating j is calculated as the difference between the cumulative probability of receiving rating j and the cumulative probability of receiving rating $j-1$,

$$\Pr(Y_{ijt} = 1) = \Lambda[n_j - (BP_{it}^* - \varepsilon_{it})] - \Lambda[n_{j-1} - (BP_{it}^* - \varepsilon_{it})]$$

where $\Lambda(x)$ is the cumulative logistic function. In an estimation sample with N ratings, the likelihood function is

$$L(\theta) = \prod_{i=1}^N \prod_{j=1}^5 \Pr(Y_{ijt} = 1)^{Y_{ijt}}.$$

We want to examine whether rating standards have changed over the sample period. As in BLM and BKS, we address this question by replacing the constant intercept term with a time-varying one, denoted as α_t , within our model:

$$BP_{it}^* = \alpha_t + (\beta + \gamma I_{Et-1})x_{it-2} + \varepsilon_{it}.$$

Note that this specification implies that time-varying standards reflect time variation in supervisory ratings that we are not able to account for using our BHC-specific explanatory variables, x_{it} . As noted by BLM, this may be due to actual changes in BOPEC rating standards or to an omitted variable with dynamic characteristics that are proxied for by α_t .

The choice of which supervisory variables to include in x_{it-2} is challenging. No simple behavioral models exist of how supervisors assign BOPEC ratings. Based on prior work by Krainer and Lopez (2003, 2004, 2008), we select eight explanatory variables that are reasonable proxies for the five components of the BOPEC rating; see Table 4 for summary statistics.

The first variable is the natural log of total BHC assets, which is our control variable for firm size. The next three variables are used to capture the supervisory concerns regarding the BHC's bank subsidiaries, as summarized in the "B" component of the rating. The second variable is the ra-

TABLE 4
SUMMARY STATISTICS FOR EXPLANATORY VARIABLES

	Mean	Standard deviation	25th percentile	Median	75th percentile
A. All BHCs					
Assets (in billions)	\$7.56	\$40.10	\$0.21	\$0.46	\$2.11
Nonperforming loans / assets (%)	1.81	1.80	0.82	1.34	2.23
Allowances for loan losses / assets (%)	1.05	0.68	0.72	0.91	1.18
Trading Assets / assets (%)	0.39	2.62	0.00	0.00	0.00
Double leverage (%)	82.02	32.81	58.66	87.28	99.82
Return on average assets (ROAA) (%)	0.82	1.18	0.63	0.98	1.24
Equity capital (%)	7.87	2.41	6.35	7.68	9.20
B. Publicly traded BHCs					
Assets (in billions)	\$16.10	\$58.30	\$0.74	\$2.29	\$9.23
Nonperforming loans / assets (%)	1.75	1.82	0.83	1.29	2.03
Allowances for loan losses / assets (%)	1.13	0.61	0.78	0.97	1.27
Trading assets / assets (%)	0.78	3.74	0.00	0.00	0.00
Double leverage (%)	74.10	30.33	49.30	78.48	97.06
Return on average assets (ROAA) (%)	0.89	1.22	0.75	1.03	1.26
Equity capital (%)	7.96	1.97	6.71	7.79	9.04
Beta	0.4632	0.4524	0.1450	0.4248	0.7153
Asset volatility	0.0486	0.0515	0.0255	0.0391	0.0559

tio of the BHC's nonperforming loans to its total assets. This "problem loans" variable proxies for the health and performance of the BHC's loans that are not making their scheduled payments. The third variable is the ratio of the BHC's allowances (or provisions) for losses on loans and leases to its total loans, another proxy for the health and performance of the BHC's lending portfolio.

To proxy for the types of nonbank activities a BHC is engaged in—the "O" component of the BOPEC rating—we include as the fourth variable the ratio of a BHC's trading assets to its total assets. This includes nonbank activities which are conducted in banking or nonbanking subsidiaries.⁵ The fifth variable is the so-called "double leverage" ratio between the BHC and its lead bank, which is the ratio of the lead bank's equity capital to that of the parent's equity capital. This variable provides a measure of the soundness of the parent BHC, indicating the extent to which the parent's equity capital can be used to buffer against damage to the lead bank's equity capital. We use this variable as a proxy for the condition of the parent BHC as summarized in the "P" component of the BOPEC rating. The sixth variable is the BHC's return on average assets (ROAA), defined as the ratio of the four-quarter average of the BHC's net income to the four-quarter average of its assets. This variable is used to proxy for the "E" component of the BOPEC rating.⁶ The seventh variable is the BHC's ratio of equity capital to its total assets. This variable is used to proxy for the "C" component of the BOPEC rating. Finally, as a means to capture possible persistence in supervisory ratings, we include the lagged BOPEC rating as the eighth variable.

Given the model above, we made the model's β parameters constant through time, but we allow the intercept terms α_i to vary over time. We exclude the indicator variable for 1988, which means that each of the annual intercept estimates reflects how standards differ when compared to the 1988 base year. We then test for equality of estimated intercepts across different years, which translates to a test of equality of rating standards.

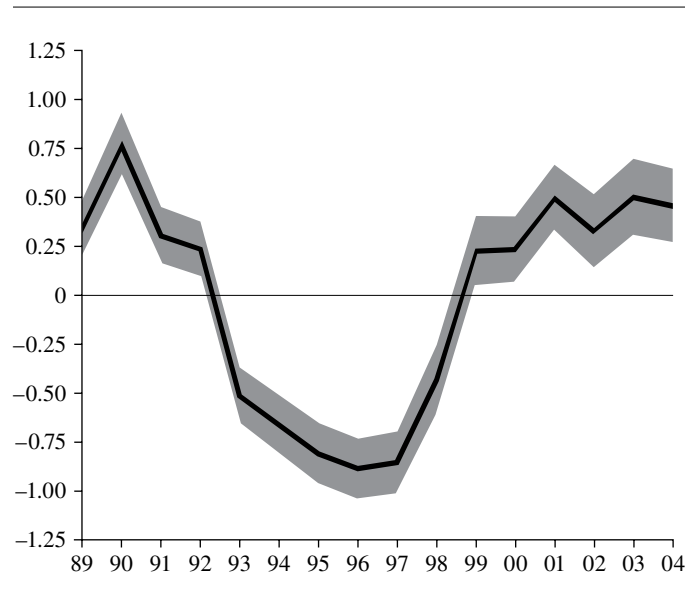
3.3. Empirical Results

In the first two columns of Table 5, we present the results of our base model estimation, where we make no distinction be-

5. Note that the trading assets variable as currently reported first became available in the first quarter of 1995. Before then, we proxy for BHC trading assets using the sum of the self-reported replacement cost of interest rate and foreign exchange derivative contracts.

6. A variety of capital measures have been used in previous studies, such as Evanoff and Wall (2000) and Estrella, Park, and Peristiani (2000). We choose a simple measure to facilitate comparison over the entire 17-year period.

FIGURE 1
BOPEC RATING TRENDS COMPARED TO 1988



Note: Positive values indicate more stringent supervisory rating standards compared to 1988; negative values indicate more lenient supervisory rating standards compared to 1988. The gray band indicates standard error bands.

tween publicly traded and private BHCs. The estimated coefficients on the control variables generally have the expected signs and tend to be statistically significant at the conventional levels. The coefficient on total assets is negative, suggesting that large banks tend to have better supervisory ratings. In general, more capital relative to assets and higher ROAA are associated with better ratings. Higher levels of nonperforming loan ratios and allowances for loan loss reserves are associated with worse ratings. The trading assets and double leverage variables fail to be statistically significant.

The main variables of interest here are the estimated coefficients on the time indicators, which are graphed in Figure 1 along with a standard error band. As we noted earlier, these coefficients are meant to reflect general supervisory concerns about BHCs that are not captured in the BHC-specific control variables. A positive coefficient on one of these time indicators implies that, relative to the base year of 1988, ratings were larger in magnitude (i.e., worse ratings) in that year. That is, controlling for observable variation, BHCs were rated more stringently in that year. In contrast, a negative coefficient implies that ratings were lower in magnitude (i.e., better ratings) and that BHCs were rated more leniently in that year.

The observed indicator pattern suggests that ratings were relatively stringent from 1989 through 1992. Starting in 1993 and through 1998, the estimated year coefficients are significantly negative. The coefficients return to positive values

TABLE 5
ORDERED LOGIT MODEL ESTIMATES

	Baseline regression: all BHCs		Indicator for public BHCs		Indicator for public BHCs with GDP growth	
	Coefficient	<i>p</i> value	Coefficient	<i>p</i> value	Coefficient	<i>p</i> value
Year dummies						
1989	0.34*	0.02	0.32*	0.02	0.33*	0.02
1990	0.78*	0.00	0.76*	0.00	0.78*	0.00
1991	0.31*	0.04	0.31*	0.05	0.35*	0.04
1992	0.24	0.12	0.25	0.10	0.25	0.10
1993	0.51*	0.00	−0.52*	0.00	−0.50*	0.00
1994	−0.67*	0.00	−0.68*	0.00	−0.69*	0.00
1995	−0.81*	0.00	−0.82*	0.00	−0.81*	0.00
1996	−0.89*	0.00	−0.92*	0.00	−0.92*	0.00
1997	−0.86*	0.00	−0.91*	0.00	−0.92*	0.00
1998	−0.43*	0.01	−0.52*	0.00	−0.52*	0.00
1999	0.23	0.16	0.15	0.37	0.15	0.38
2000	0.24	0.16	0.16	0.35	0.17	0.33
2001	0.50*	0.00	0.40*	0.01	0.43*	0.01
2002	0.33	0.08	0.21	0.28	0.22	0.25
2003	0.50*	0.00	0.36*	0.05	0.36*	0.05
2004	0.46*	0.02	0.22	0.28	0.23	0.27
ROAA	−98.27	0.00	−92.59	0.00	−92.62	0.00
Equity capital	−21.34	0.00	−25.89	0.00	−25.90	0.00
Allowance for losses	33.25	0.12	59.00	0.02	58.94	0.02
Assets	−0.13	0.00	−0.06	0.35	−0.06	0.35
Trading assets	0.94	0.50	2.91	0.21	2.92	0.21
Problem loans	53.00	0.00	57.20	0.00	57.21	0.00
Double leverage	−0.05	0.65	−0.03	0.85	−0.02	0.86
Publicly traded	—	—	−0.80	0.44	−0.80	0.44
Lag BOPEC	2.16	0.00	2.00	0.00	2.00	0.00
Interaction terms ^a						
ROAA	—	—	−27.37	0.22	−27.41	0.22
Equity capital	—	—	12.10	0.00	12.11	0.00
Allowance for losses	—	—	−68.52	0.02	−68.47	0.02
Assets	—	—	−0.01	0.94	0.00	0.94
Trading assets	—	—	−2.57	0.35	−2.59	0.34
Problem loans	—	—	−10.89	0.30	−10.91	0.30
Double leverage	—	—	0.06	0.76	0.06	0.77
Lag BOPEC	—	—	0.44	0.00	0.44	0.00
GDP growth	—	—	—	—	3.63	0.58
Number of observations	7,045		7,045		7,045	
Wald chi-squared statistics	$\chi^2(24) = 2334.14$		$\chi^2(33) = 2488.95$		$\chi^2(34) = 2491.21$	
<i>p</i> values	0.000		0.000		0.000	
Pseudo <i>R</i> ²	0.465		0.470		0.4702	

a. The interaction terms are the product of the indicator variable for public BHCs and the variables listed below.

*Statistically significant at the 5-percent level.

from 1999 through 2004. Note that changes in the estimates of the time indicators approximate changes in overall economic activity and the health of the banking sector.

We conduct a robustness test by examining whether this time pattern was due to different rating standards for public BHCs and report the results in the third and fourth columns

of Table 5. We do so by interacting the control variables with an indicator for publicly traded BHCs. The BHC-specific variables all have the same signs and incidence of statistical significance as in the first estimation. In addition, few of the interaction terms are statistically significant. Thus, despite the differences between the typically larger public BHCs

and smaller private BHCs, our results suggest that supervisory ratings for both groups are determined in a similar manner. Most importantly for our analysis, the addition of the interaction terms has little impact on the observed indicator pattern.

As noted earlier, an alternative interpretation of the results could be that the pattern observed in our estimated intercept terms indicates the existence of some omitted variable that is having an effect on the determination of supervisory ratings. To address this concern, we augment our model by including macroeconomic variables in the specification. The variables we use include stock market variables such as the one-year change in S&P 500 index and a measure of the equity premium (the earnings–price ratio less the real 10-year Treasury yield), a measure of the speculative-grade bond spread, and average GDP growth rates leading up to the inspection. The last two columns in Table 5 present the results when the average GDP growth rate in the four quarters prior to the inspection is used as the macroeconomic variable. Note that the GDP coefficient is not statistically significant, and the other coefficient estimates barely change. The same result is seen with the other macroeconomic variables, except for the equity premium, as shown in Table 6. These results suggest that the changes in supervisory sentiment that our indicator variables capture occur at a lower frequency than the fluctuations in our proxies for macroeconomic conditions. The exception of the equity premium may be because of its slower-moving dynamics compared to the other variables.

4. Implications of Our Findings

In this section, we discuss the implications of our observed indicator pattern. First, we gauge the economic impact of the estimated coefficients by conducting counterfactual exercises, as per BLM (1998). Second, we discuss possible explanations for the observed pattern in the indicator variables, ranging from supervisory forbearance to larger changes in the banking system over this period.

4.1. Counterfactual Exercise

To assess the magnitude of these empirical standard changes, we follow the methodology used by both BLM and BKS. In this approach, we use the parameter estimates from our BOPEC model to determine what the supervisory rating assigned in year t would have been using the supervisor rating standards for year $t+s$. In notational terms, for a given BOPEC rating assignment in, say, 1992, we determined the fitted value of its control variables with the estimated β and γ parameters; i.e., $\widehat{A} = (\widehat{\beta} + \widehat{\gamma}I_{Eit-1})x_{it-2}$. However, instead of adding $\widehat{\alpha}_{1992}$ to that value to determine the model's fitted value for the BOPEC rating, we use the supervisory standard

TABLE 6
MACROECONOMIC VARIABLES

Variable	Coefficient	<i>p</i> values
High-yield bond less 10-year Treasury	0.059	0.190
10-year Treasury less 3-month Treasury	0.002	0.974
S&P equity premium less 10-year Treasury	−0.101	0.033
One-quarter GDP growth	3.632	0.579
Four-quarter average GDP growth	22.111	0.228
S&P 500 Index yearly returns	0.302	0.396

Note: We obtain results by including each variable individually in the ordered logit model that created Table 5.

from, say, 1998 as summarized by $\widehat{\alpha}_{1998}$. The resulting sum of $\widehat{\alpha}_{1998} + \widehat{A}_{it}$ generates the model's counterfactual rating for BHC i if it were inspected in 1998 instead of 1992. In essence, we fix the BHC characteristics and vary the supervisory standards as measured by annual α_t parameters.

Table 7 presents these results. The column in the center of the table lists the base year for which we examine BOPEC ratings compared to rating standards from alternative years. The measure of comparison displayed in the other columns is the net percentage of assigned ratings that were changed, which is the sum of the percentage of BOPEC ratings upgraded (positive numbers) and downgraded (negative numbers). For example, for base year 1998, the value of +4.8 percent for three years earlier implies that 1998 BOPEC ratings would have been assigned better values, on net, using 1995 rating standards. In contrast, for base year 1995, the value of −10.9 percent for three years later suggests that 1995 BOPEC ratings would have been assigned worse values, on net, using 1998 rating standards.

As shown earlier in Figure 1, three distinct periods are suggested by our estimated indicator pattern: 1989 through 1992 was a period of relatively tougher supervisory rating standards; 1993 through 1998 exhibited looser rating standards; and 1998 through 2004 returned to relatively tighter standards. This pattern is mirrored in Table 6, particularly in the ratings assigned from 1993 to 1998. For the imputed ratings, both backward and forward from these years, the average of net changes in BOPEC ratings are relatively large negative numbers, on the order of 15 percent being downgraded. These suggested changes in BOPEC ratings correspond to about 70 additional downgrades per year during this period, which would more than double the number of downgrades observed. Similarly, BOPEC ratings assigned before and after this period would receive higher ratings using the looser standards of the middle time period, on the order of 15 percent being upgraded. In summary, the counterfactual exercise suggests that the changes in standards had a meaningful impact on supervisory outcomes.

TABLE 7
COUNTERFACTUAL ANALYSIS BASED ON THE BASELINE MODEL (PERCENT CHANGE)

-15 years	-10 years	-5 years	-3 years	Base year	+3 years	+5 years	+10 years	+15 years
				1989	3.3	18.1	3.3	0.6
				1990	22.1	24.9	13.3	
				1991	21.3	25.9	-3.1	
			-1.4	1992	20.4	21.0	-1.2	
			-23.5	1993	3.5	-3.0	-18.3	
		-16.5	-16.5	1994	-1.2	-14.9	-18.7	
		-28.7	-18.8	1995	-10.9	-18.8		
		-18.9	-13.3	1996	-17.5	-20.7		
		-15.2	-8.9	1997	-15.2	-16.1		
		1.0	4.8	1998	-6.8	-6.8		
	5.5	14.8	16.9	1999	5.5	2.8		
	-3.9	16.0	16.0	2000	3.6			
	9.1	24.0	18.7	2001	5.6			
	3.8	17.1	3.8	2002				
	14.5	13.2	5.0	2003				
3.7	15.7	5.0	1.7	2004				

Note: Potential percent change in base year BOPEC rating compared to other sample BOPEC ratings.

4.2. Possible Explanations

As mentioned earlier, the BLM methodology used here can detect changes in supervisory rating standards conditional on the explanatory variables used in the analysis. Thus, in addition to possible changes in supervisory behavior, we must consider other factors outside of our model that could be driving the observed indicator pattern.

Furlong and Kwan (2006) provide a useful survey of banking behavior over this period. In that paper, the authors detailed the substantial increase in bank charter values since the early 1990s. They showed that the median charter value (i.e., the ratio of market-based equity to book-value equity) for public BHCs from 1990 through 1998 for all BHC size categories rose sharply. From 1999 to 2003, these ratios declined for all public BHC categories, but in particular for the largest BHCs. Loosely speaking, their analysis matches our observed indicator pattern, and their discussion of the factors driving franchise value should inform our analysis of possible changes in supervisory standards. In particular, we discuss regulatory changes, consolidation mainly through mergers, state-level deregulation and increases in efficiency as argued by Jayaratne and Strahan (1996), and changes in the levels of bank equity capital.

Turning first to regulatory changes, the bank regulatory environment changed substantially over the period from 1988 through 2004, most importantly with the passage of the Federal Deposit Insurance Corporation Improvement Act (FDICIA) in 1991. The primary goals of the legislation were to assure the least-cost resolution of insured depository insti-

tutions that were sufficiently near insolvency and to improve bank supervision. FDICIA had two key features to ensure that these goals were reached: early closure of failing institutions and early supervisory intervention in undercapitalized banks, known as prompt corrective action (PCA), that became more stringent as bank capital declined. The change in legislation and in supervisory practices should provide some of the explanation for our observed indicator pattern with regard to supervisory BHC ratings. For example, Aggarwal and Jacques (2001) found, using data from 1992 through 1996, that FDICIA led to increased bank capital ratios without offsetting increases in credit risk. This outcome is consistent with better supervisory rating outcomes during that period.

Another important caveat to our hypothesized change in supervisory rating standards is presented by Peek and Rosengren (1997). They argued that the period just before the implementation of PCA was not more lenient in terms of supervisory actions. They found that formal regulatory actions during this period occurred well before banks became undercapitalized according to the PCA capital thresholds. They also found that supervisory restrictions on bank behavior, such as cease-and-desist orders and written agreements, tended to be more comprehensive than those required by PCA. The authors suggest that any improvement in supervisory intervention was more likely caused by the FDICIA requirements for more frequent examinations than by the PCA legislation and implementation. As shown in Tables 2 and 3, the number of BOPEC assignments increased in 1991 and 1992, but the relative frequency of BOPEC changes in those

years shifted only slightly towards more downgrades. Starting in 1994, the number of BOPEC assignments begins to decrease, but the more important shift was an increase in the percentage of BOPEC no-change assignments.

Rosen (2003) raised a different regulatory concern. He noted that a relatively large number of banks changed their charter and thus changed their primary supervisors during the 1990s. For example, in 1993, 124 banks (or just over 1 percent of all banks) changed their primary supervisors. The author's results suggest that banks were more likely to change their supervisory agency when they were also changing their portfolio composition. How these changes are related to our suggested changes in supervisory standards is not clear, but such changes could influence standards through competition among supervisory agencies or through actually different views on similar banks.

The U.S. banking system also experienced a significant amount of bank consolidation during this time period, owing both to failures and resolutions in the late 1980s and early 1990s and to mergers, especially starting in the mid-1990s. The increased consolidation could have led to changes in supervisory practices and standards, as the nature of the largest BHCs was changing. For example, supervisory practices shifted from emphasizing the quality of the loan portfolio to the quality of bank risk management systems, as exhibited in the introduction of the "S" component of the CAMELS ratings in 1997.

Deregulation at the state level was a further driver of bank consolidation. In particular, the Riegle-Neal Interstate Banking and Branching Efficiency Act of 1994 permitted interstate bank mergers starting in 1997, but that process had started several years before (see Jayaratne and Strahan 1998). The improvements in bank performance and the demise of less-efficient banking organizations subsequent to interstate banking deregulation could have contributed to the observed indicator pattern as supervisory concerns shifted in response.

Finally, as described in Flannery and Rangan (2006), bank capital ratios increased during this period. Furlong and Kwan (2006) showed that, for their three size categories of public BHCs, book-value capital ratios began rising sharply in the early 1990s before stabilizing in the late 1990s. This increase

was caused by several factors, such as increased regulatory emphasis on capital requirements arising from the 1988 Basel Accord. Furlong and Kwan (2006) attributed this increase partly to increased BHC charter values owing to the reasons we discussed earlier; see Furlong (1992) for some measures of this magnitude. As we have argued, the increased capital ratios may have altered supervisory standards, at least for awhile, and contributed to the "easier" standards from 1993 to 1998.

5. Conclusion

As part of their supervisory efforts, the U.S. banking supervisory agencies assign ratings to institutions at the end of an examination. In this paper, we examine the BOPEC ratings assigned by Federal Reserve examiners to bank holding companies from 1987 to 2004. In particular, we examine whether those standards fluctuated over time using the econometric framework proposed by Blume, Lo, and MacKinlay (1998).

Our analysis suggests that supervisory standards did change over this period. We find that supervisory standards were tough from 1989 to 1992, a period that corresponds with the credit crunch period; eased from 1993 to 1998; and were tough again from 1999 through 2004. These results align quite well with the bank-level results reported by Berger, Kyle, and Scalise (2001). We also find that the changes in rating standards had an impact on BOPEC rating assignments. That is, we find that about 15 percent of the BOPEC ratings assigned during the relatively easy years from 1993 to 1998 would have been given worse (i.e., higher) ratings in other years. Similarly, roughly 15 percent of BOPEC ratings assigned in the tough years of our sample would have received better (i.e., lower) BOPEC ratings during the easy years.

The underlying reasons for these changes range from examiner forbearance due to economic and political concerns, as argued by Rosen (2003), to the significant changes in the banking system's structure and regulation, as detailed by Furlong and Kwan (2006). Our empirical results cannot directly address the underlying reasons for this pattern or supervisory behavior, but the size and timing of our implied changes in BOPEC rating standards can help provide guidance for future research.

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