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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.

Table 1
Importance of IT: Shares of Local Employment

	Total IT share (%)			IT share (%) excluding telecommunications		
Region	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).

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 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.

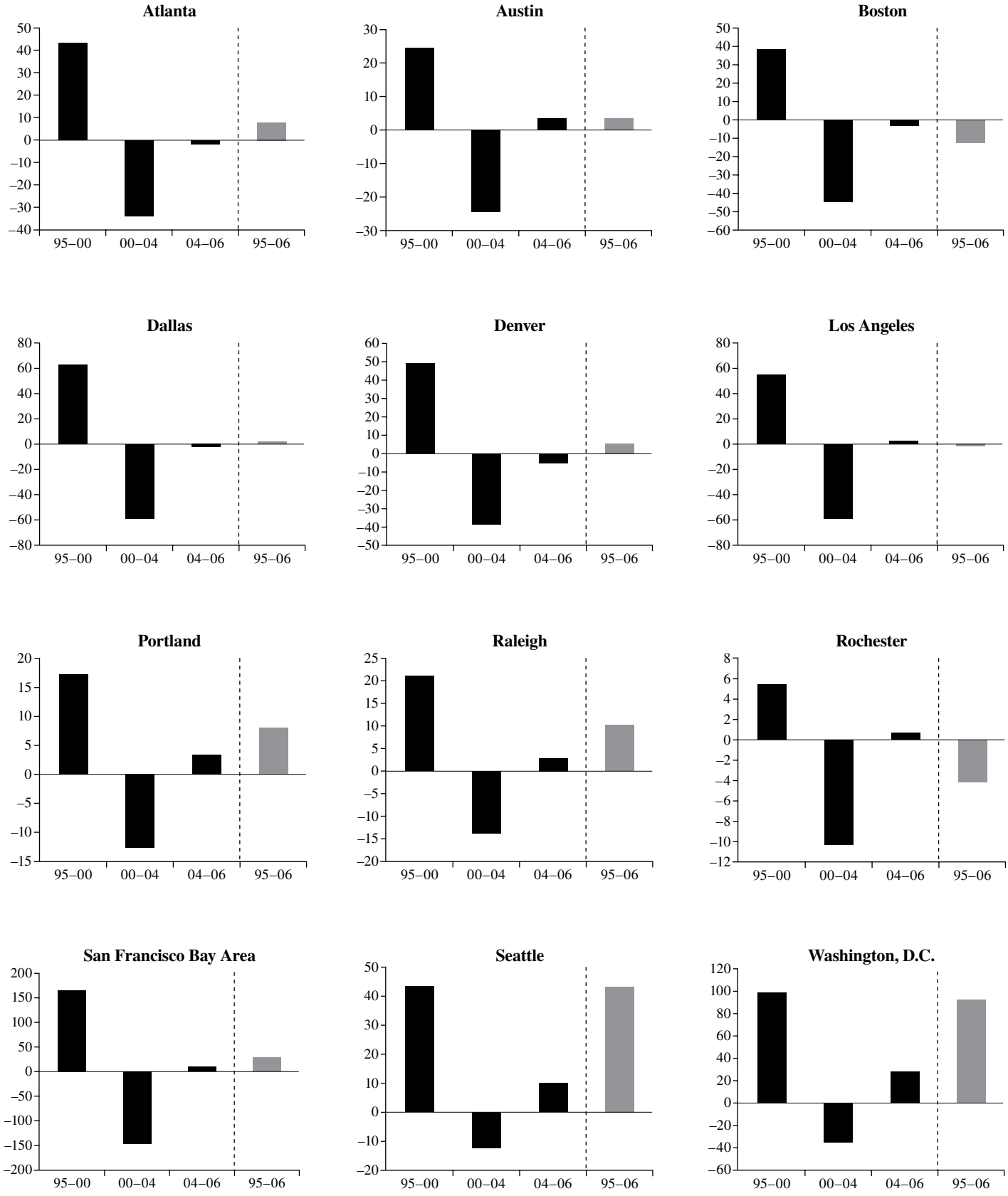
The performance during the recovery period was especially mixed. Atlanta, Boston, Dallas, and Denver continued to experience slight declines in IT employment, while Austin, Los Angeles, Raleigh, Rochester, and the San Francisco Bay Area made very slight increases, especially when compared to the gains 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 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-

FIGURE 2
IT EMPLOYMENT IN THE UNITED STATES

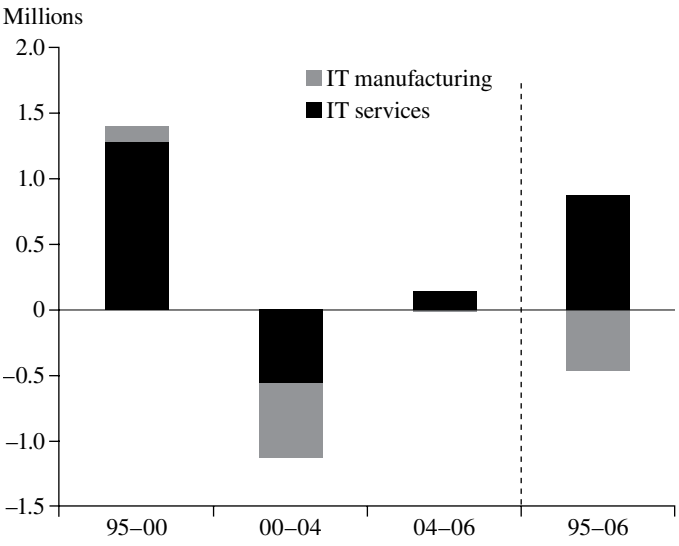


TABLE 2
PERFORMANCE OF IT SUBSECTORS

	Percent change in employment			
IT subsector	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).

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.

Table 3
Composition Shares of IT Employment

	IT services (%)			IT manufacturing (%)		
Region	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)

	IT services (%)			IT manufacturing (%)		
Region	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.

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.

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

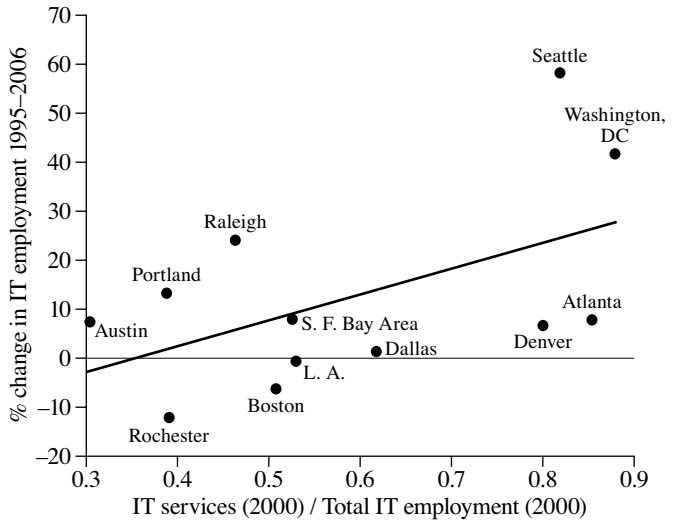
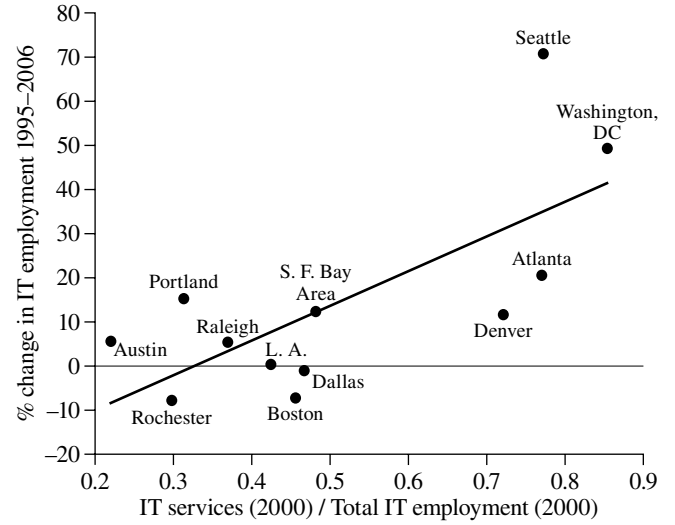


FIGURE 4
IT SHARE VS. CHANGE IN EMPLOYMENT
(EXCLUDING TELECOMMUNICATIONS)



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).

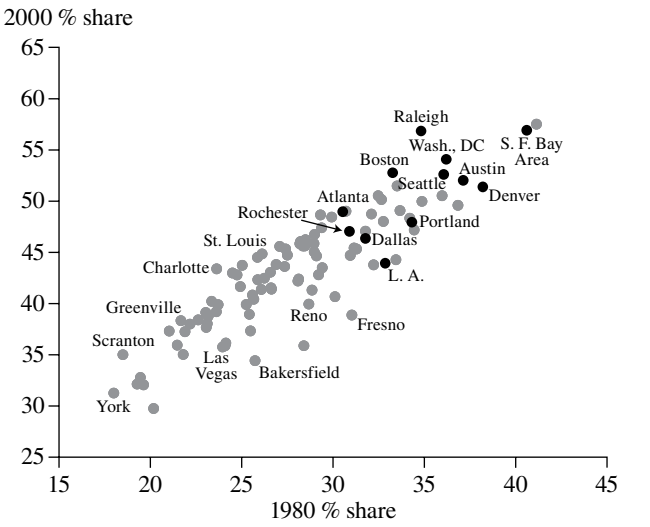
10. For example, the growth of IT production and employment in Oregon and other relatively low-cost states over the past decade has occurred in part because existing companies, such as Intel, have relocated production facilities from high-cost areas, such as Silicon Valley, while maintaining research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

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.

Appendix

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

	Local IT share (%)			Local IT share (%) ex. telecommunications		
Region	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).

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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

*The views in this paper are solely the responsibility of the authors and should not be interpreted as reflecting the views of the Federal Reserve Bank of San Francisco or the Board of Governors of the Federal Reserve System. We thank Phil Strahan for his comments on an earlier draft of this paper and Ryan Stever and William Hedberg for valuable research assistance.

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 **C**apital adequacy, **A**sset quality, **M**anagement, **E**arnings, **L**iquidity, and **S**ensitivity 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 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 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.

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 unobservable 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 cutpoints, 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.

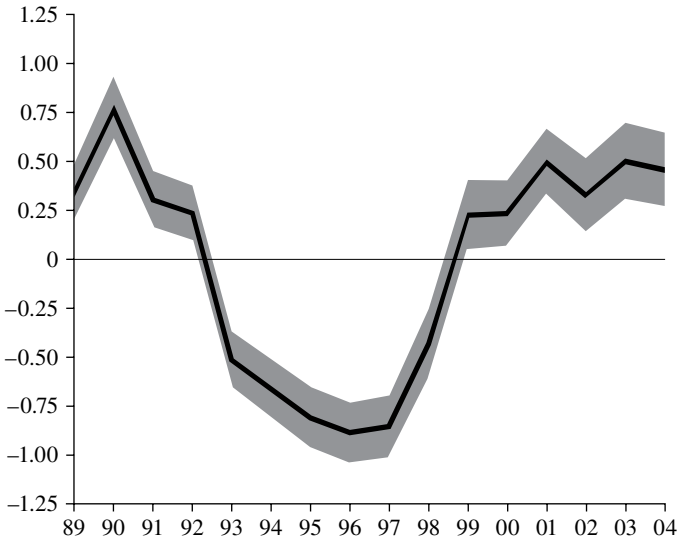
To proxy for the types of nonbank activities a BHC is engaged in—the "O" component of the BOPEC rating—we include as the fourth variable the ratio of a BHC's trading assets to its total assets. This includes nonbank activities which are conducted in banking or nonbanking subsidiaries.[5] The fifth variable 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_t 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 between 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.

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.

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

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.

TABLE 5
ORDERED LOGIT MODEL ESTIMATES

	Baseline regression: all BHCs		Indicator for public BHCs		Indicator for public BHCs with GDP growth	
	Coefficient	*p* value	Coefficient	*p* value	Coefficient	*p* 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	$\chi^2(24) = 2334.14$		$\chi^2(33) = 2488.95$		$\chi^2(34) = 2491.21$	
p values	0.000		0.000		0.000	
Pseudo R^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.

Table 6
Macroeconomic Variables

Variable	Coefficient	*p* 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.

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 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 institutions 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 emphazing 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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WP 2008-01

International Financial Remoteness and Macroeconomic Volatility

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Mark Spiegel, *FRB San Francisco*

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See p. 47 for the abstract of this paper.

WP 2008-02

Takeoffs

Joshua Aizenman, *University of California, Santa Cruz*
Mark Spiegel, *FRB San Francisco*

This paper identifies factors associated with takeoff—a sustained period of high growth following a period of stagnation. We examine a panel of 241 "stagnation episodes" from 146 countries; 54 percent of these episodes are followed by takeoffs. Countries that experience takeoffs average 2.3 percent annual growth following their stagnation episodes, while those that do not average 0 percent growth; 46 percent of the takeoffs are "sustained," i.e. lasting eight years or longer. Using probit estimation, we find that de jure trade openness is positively and significantly associated with takeoffs. A one standard deviation increase in de jure trade openness is associated with a 55 percent increase in the probability of a takeoff in our default specification. We also find evidence that capital account openness encourages takeoff responses, although this channel is less robust. Measures of de facto trade openness, as well as a variety of other potential conditioning variables, are found to be poor predictors of takeoffs. We also examine the determinants of nations achieving sustained takeoffs. While we fail to find a significant role for openness in determining whether or not takeoffs are sustained, we do find a role for output composition: Takeoffs in countries with more commodity-intensive output bundles are less likely to be sustained, while takeoffs in countries that are more service-intensive are more likely to be sustained. This suggests that adverse terms-of-trade shocks prevalent among commodity exports may play a role in ending long-term high growth episodes.

WP 2008-03

Tax Competition among U.S. States: Racing to the Bottom or Riding on a Seesaw?

Robert Chirinko, *University of Illinois at Chicago*
Daniel Wilson, *FRB San Francisco*

This paper provides an empirical analysis of the determination of capital tax policy by U.S. states based on new panel data, a new econometric technique, and a new theoretical model. The analysis is undertaken with a panel data set covering all 48 contiguous states for the period 1969 to 2004 and is guided by the theory of strategic tax competition. The latter suggests that capital tax policy is a function of out-of-state tax policy, in-state and out-of-state economic conditions, and, perhaps most importantly, preferences for government services. Using the common correlated effects pooled estimator to account for cross-section dependence, and time lags to account for delayed responses, we estimate this reaction function for three state capital tax instruments: the investment tax credit rate, the corporate income tax rate, and the state's capital weight in its multistate income apportionment formula. We find the slope of the reaction function—i.e., the equilibrium response of in-state to out-of-state tax policy—is negative, contrary to many prior empirical results. We document that a positive slope is obtained when either aggregate time effects or time lags are omitted. We show that the positive slope found in misspecified models is the result of synchronous responses among states to common shocks rather than competitive responses to out-of-state tax policy. While striking given prior findings in the literature, these results are not surprising. The negative sign is fully consistent with qualitative and quantitative implications of the theoretical model developed in this paper. Rather than "racing to the bottom," our findings suggest that states are "riding on a seesaw."

WP 2008-04
A Black Swan in the Money Market

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See p. 49 for the abstract of this paper.

WP 2008-05
Learning, Expectations Formation, and the Pitfalls of Optimal Control Monetary Policy

Athanasios Orphanides, *Central Bank of Cyprus*
John C. Williams, *FRB San Francisco*

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See p. 49 for the abstract of this paper.

WP 2008-06
Capital–Labor Substitution and Equilibrium Indeterminacy

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Kevin J. Lansing, *FRB San Francisco*

Empirical evidence indicates that the elasticity of capital–labor substitution for the aggregate U.S. economy is below unity. In contrast, the existing indeterminacy literature has mostly restricted attention to a Cobb-Douglas production function which assumes a higher substitution elasticity than is implied by the data. This short paper examines the quantitative relationship between capital–labor substitution and the conditions needed for equilibrium indeterminacy (and belief-driven fluctuations) in a plausibly calibrated, one-sector growth model. We find that capital–labor substitution has little quantitative impact on the threshold degree of increasing returns for local indeterminacy. Our results suggest that the Cobb-Douglas specification is a satisfactory approximation for local indeterminacy analysis.

WP 2008-07
An Arbitrage-Free Generalized Nelson-Siegel Term Structure Model

Jens Christensen, *FRB San Francisco*
Francis X. Diebold, *University of Pennsylvania*
Glenn Rudebusch, *FRB San Francisco*

Forthcoming in *The Econometrics Journal*.
See p. 35 for the abstract of this paper.

WP 2008-08
Speculative Growth and Overreaction to Technology Shocks

Kevin J. Lansing, *FRB San Francisco*

This paper develops a stochastic endogenous growth model that exhibits "excess volatility" of equity prices because speculative agents overreact to observed technology shocks. When making forecasts about the future, speculative agents behave like rational agents with very low risk aversion. The speculative forecast rule alters the dynamics of the model in a way that tends to confirm the stronger technology response. For moderate levels of risk aversion, the forecast errors observed by the speculative agent are close to white noise, making it difficult for the agent to detect a misspecification of the forecast rule. In model simulations, I show that this type of behavior gives rise to intermittent asset price bubbles that coincide with improvements in technology, investment and consumption booms, and faster trend growth, reminiscent of the U.S. economy during the late 1920s and late 1990s. The model can also generate prolonged periods where the price–dividend ratio remains in the vicinity of the fundamental value. The welfare cost of speculation (relative to rational behavior) depends crucially on parameter values. Speculation can improve welfare if actual risk aversion is low and agents underinvest relative to the socially optimal level. But for higher levels of risk aversion, the welfare cost of speculation is large, typically exceeding 1 percent of per-period consumption.

WP 2008-09
Imperfect Knowledge and the Pitfalls of Optimal Control Monetary Policy

Athanasios Orphanides, *Central Bank of Cyprus*
John C. Williams, *FRB San Francisco*

Forthcoming in *Monetary Policy under Uncertainty and Learning*, eds. K. Schmidt-Hebbel and C. Walsh. *Series on Central Banking, Analysis, and Economic Policies*, Central Bank of Chile.
See p. 48 for the abstract of this paper.

WP 2008-10
Financial Globalization and Monetary Policy Discipline

Mark Spiegel, *FRB San Francisco*

Forthcoming in *IMF Staff Papers.*
See p. 45 for the abstract of this paper.

WP 2008-11
Monetary and Financial Integration in the EMU: Push or Pull?

Mark Spiegel, *FRB San Francisco*

Forthcoming in *Review of International Economics.*
See p. 46 for the abstract of this paper.

WP 2008-12
Climate Change and Asset Prices: Hedonic Estimates for North American Ski Resorts

Van Butsic, *University of Wisconsin*
Ellen Hanak, *Public Policy Institute of California*
Robert Valletta, *FRB San Francisco*

We use a hedonic framework to estimate and simulate the impact of global warming on real estate prices at North American ski resorts. To do so, we combine data on resort-area housing prices from two sources—data on average prices for U.S. Census tracts across a broad swath of the western United States and data on individual home sales for four markets in the western United States and Canada, each available over multiple decades—with detailed weather data and characteristics of ski resorts in those areas. Our OLS and fixed-effects models of changes in house prices with respect to medium-run changes in the share of snowfall in winter precipitation yield precise and consistent estimates of positive snowfall effects on housing values in both data sources. We use our estimates to simulate the impact of likely climate shifts on house prices in coming decades and find substantial variation across resort areas based on climatic characteristics such as longitude, elevation, and proximity to the Pacific Ocean. Resorts that are unfavorably located face likely large negative effects on home prices due to warming, unless adaptive measures are able to compensate for the deterioration of conditions in the ski industry.

WP 2008-13
Understanding Changes in Exchange Rate Pass-Through

Yelena Takhtamanova, *FRB San Francisco*

Recent research suggests that there has been a decline in the extent to which firms "pass through" changes in exchange rates to prices. Beyond providing further evidence in support of this claim, this paper proposes an explanation for the phenomenon. It then presents empirical evidence of a structural break during the 1990s in the relationship between the real exchange rate and CPI inflation for a set of 14 OECD countries. It is suggested that the recent reduction in the real exchange rate pass-through can be attributed in part to the low-inflation environment of the 1990s.

WP 2008-14
Do Banks Price Their Informational Monopoly?

Galina Hale, *FRB San Francisco*
João A.C. Santos, *FRB New York*

Forthcoming in *Journal of Financial Economics.*
See p. 38 for the abstract of this paper.

WP 2008-15
Sterilization, Monetary Policy, and Global Financial Integration

Joshua Aizenman, *University of California, Santa Cruz*
Reuven Glick, *FRB San Francisco*

Forthcoming in *Review of International Economics.*
See p. 36 for the abstract of this paper.

WP 2008-16
The Adjustment of Global External Balances: Does Partial Exchange Rate Pass-Through to Trade Prices Matter?

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Sylvain Leduc, *FRB San Francisco*
Nathan Sheets, *Federal Reserve Board of Governors*

This paper assesses whether partial exchange rate pass-through to trade prices has important implications for the prospective adjustment of global external imbalances. To address this question, we develop and estimate an open-economy DGE model in which pass-through is incomplete due to the presence of local currency pricing, distribution services, and a variable demand elasticity that leads to fluctuations in optimal markups. We find that the overall magnitude of trade adjustment is similar in a low and high pass-through world, with more adjustment in a low pass-through world occurring through a larger response of the exchange rate and terms of trade rather than real trade flows.

WP 2008-17
Loan Officers and Relationship Lending to SMEs

Hirofumi Uchida, *Wakayama University*
Gregory F. Udell, *Indiana University*
Nobuyoshi Yamori, *Nagoya University*

Previous research suggests that loan officers play a critical role in relationship lending by producing soft information about SMEs. For the first time, we empirically confirm this hypothesis We also examine whether the role of loan officers differs from small to large banks as predicted by Stein (2002). While we find that small banks produce more soft information, the capacity and manner in which loan officers produce soft information do not seem to differ between large and small banks. This suggests that, although large banks may produce more soft information, they likely tend to concentrate their resources on transactions lending.

WP 2008-18
Learning, Adaptive Expectations, and Technology Shocks

Kevin X.D. Huang, *Vanderbilt University*
Zheng Liu, *FRB San Francisco*
Tao Zha, *FRB Atlanta*

Forthcoming in *The Economic Journal*.
See p. 42 for the abstract of this paper.

WP 2008-19
Happiness, Unhappiness, and Suicide: An Empirical Assessment

Mary Daly, *FRB San Francisco*
Daniel Wilson, *FRB San Francisco*

Forthcoming in *Journal of the European Economic Association*.
See p. 35 for the abstract of this paper.

WP 2008-20
Who Drove the Boom in Euro-Denominated Bond Issues?

Galina Hale, *FRB San Francisco*
Mark Spiegel, *FRB San Francisco*

We make use of micro-level data for over 45,000 private bonds issued by over 5,000 firms from 22 countries in 1990–2006 to analyze the impact that the launch of the European Monetary Union had on the currency denomination of the bond issues. To our knowledge, ours is the first systematic analysis of issue at the micro level. The use of the micro data allows us to distinguish between the response to the advent of the euro by new and seasoned bond issuers and to condition on other issue characteristics. We find that the impact on new issuers is larger than on seasoned issuers and that most of the increase in the euro-denominated bond issuance was along the "extensive" margin. Insofar as new entrants to the bond market will define the overall currency composition in the long run, these results imply that aggregate studies might be underestimating the euro effect. We also find that, to a large extent, the increase in euro issuance was "at the expense" of U.S. dollar issuance, suggesting that the euro competes with the U.S. dollar as a currency of choice for international financial transactions.

WP 2008-21
Timeless Perspective Policymaking: When Is Discretion Superior?

Richard Dennis, *FRB San Francisco*

In this paper I show that discretionary policymaking can be superior to timeless perspective policymaking and identify model features that make this outcome more likely. Developing a measure of conditional loss that treats the auxiliary state variables that characterize the timeless perspective equilibrium appropriately, I use a New Keynesian dynamic stochastic general equilibrium model to show that discretion can dominate timeless perspective policymaking when the Phillips curve is relatively flat, due, perhaps, to firm-specific capital (or labor) and/or Kimball (1995) aggregation in combination with nominal price rigidity. These results suggest that studies applying the timeless perspective might also usefully compare its performance to discretion, paying careful attention to how policy performance is evaluated.

WP 2008-22
Asymmetric Expectation Effects of Regime Shifts in Monetary Policy

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Daniel F. Waggoner, *FRB Atlanta*
Tao Zha, *FRB Atlanta*

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See p. 43 for the abstract of this paper.

WP 2008-23
How Much of South Korea's Growth Miracle Can Be Explained by Trade Policy?

Michelle Connolly, *Duke University*
Kei-Mu Yi, *FRB Philadelphia*

South Korea's growth miracle has been well documented. A large set of institutional and policy reforms in the early 1960s is thought to have contributed to the country's extraordinary performance. In this paper, we assess the importance of one key set of policies, the trade policy reforms in Korea, as well as the concurrent General Agreement on Tariffs and Trade tariff reductions. We develop a model of neoclassical growth and trade that highlights two forces by which lower trade barriers can lead to increased per-worker GDP: comparative advantage and specialization, and capital accumulation. We calibrate the model and simulate the effects of three sets of tariff reductions that occurred between early 1962 and 1995. Our main finding is that the model can explain up to 32 percent of South Korea's catch-up to the G-7 countries in output per worker in the manufacturing sector. We find that the effects of the tariff reductions taken together are about twice as large as the sum of each reduction applied individually.

WP 2008-24
Inventories, Lumpy Trade, and Large Devaluations

George Alessandria, *FRB Philadelphia*
Joseph Kaboski, *Ohio State University*
Virgiliu Midrigan, *New York University*

Fixed transaction costs and delivery lags are important costs of international trade. These costs lead firms to import infrequently and hold substantially larger inventories of imported goods than domestic goods. Using multiple sources of data, we document these facts. We then show that a parsimoniously parameterized model economy with importers facing an (S, s)-type inventory management problem successfully accounts for these features of the data. Moreover, the model can account for import and import price dynamics in the aftermath of large devaluations. In particular, desired inventory adjustment in response to a sudden, large increase in the relative price of imported goods creates a short-term trade implosion, an immediate, temporary drop in the value and number of distinct varieties imported, as well as a slow increase in the retail price of imported goods. Our study of six current account reversals following large devaluation episodes in the last decade provide strong support for the model's predictions.

WP 2008-25
When Bonds Matter: Home Bias in Goods and Assets

Nicolas Coeurdacier, *London Business School*
Pierre-Olivier Gourinchas,
University of California, Berkeley

Recent models of international equity portfolios exhibit two potential weaknesses: (1) The structure of equilibrium equity portfolios is determined by the correlation of equity returns with real exchange rates, yet empirically equities don't appear to be a good hedge against real exchange rate risk; and (2) Equity portfolios are highly sensitive to preference parameters. This paper solves both problems. It first shows that, in more general and realistic environments, the hedging of real exchange rate risks occurs through international bond holdings since relative bond returns are strongly correlated with real exchange rate fluctuations. Equilibrium equity positions are then optimally determined by the correlation of equity returns with the return on nonfinancial wealth, conditional on the bond returns. The model delivers equilibrium portfolios that are well-behaved as a function of the underlying preference parameters. We find reasonable empirical support for the theory for G-7 countries. We are able to explain short positions in domestic currency bonds for all G-7 countries, as well as significant levels of home equity bias for the United States, Japan, and Canada.

WP 2008-26
Current Account Dynamics and Monetary Policy

Andrea Ferrero, *FRB New York*
Mark Gertler, *New York University*
Lars Svensson, *Sveriges Riksbank*

We explore the implications of current account adjustment for monetary policy within a simple two-country stochastic general equilibrium model. Our framework nests the Obstfeld and Rogoff (2005) static model of exchange rate responsiveness to current account reversals. It extends this approach by endogenizing the dynamic adjustment path and by incorporating production and nominal price rigidities in order to study the role of monetary policy. We consider two different adjustment scenarios. The first is a "slow burn," where the adjustment of the current account deficit of the home country is smooth and slow. The second is a "fast burn," where, owing to a sudden shift in expectations of relative growth rates, there is a rapid reversal of the home country's current account. We examine several different monetary policy regimes under each of these scenarios. Our principal finding is that the behavior of the domestic variables (for instance, output and inflation) is quite sensitive to the monetary regime, while the behavior of the international variables (for instance, the current account and the real exchange rate) is less so. Among different policy rules, domestic inflation targeting achieves the best stabilization outcome of aggregate variables. This result is robust to the presence of imperfect pass-through on import prices, although in this case stabilization of consumer price inflation performs similarly well.

WP 2008-27
Why Do Foreigners Invest in the United States?

Kristin Forbes, *Massachusetts Institute of Technology*

Why are foreigners willing to invest almost $2 trillion per year in the United States? The answer affects whether the existing pattern of global imbalances can persist and whether

the United States can continue to finance its current account deficit without a major change in asset prices and returns. This paper tests various hypotheses and finds that standard portfolio allocation models and diversification motives are poor predictors of foreign holdings of U.S. liabilities. Instead, foreigners hold greater shares of their investment portfolios in the United States if they have less-developed financial markets. The magnitude of this effect decreases with income per capita. Countries with fewer capital controls and greater trade with the United States also invest more in U.S. equity and bond markets, and there is no evidence that foreigners invest in the United States based on diversification motives. The empirical results showing a primary role of financial market development in driving foreign purchases of U.S. portfolio liabilities supports recent theoretical work on global imbalances.

WP 2008-28

China's Exporters and Importers: Firms, Products, and Trade Partners

Kalina Manova, *Stanford University*
Zhiwei Zhang, *International Monetary Fund*

This paper provides a detailed overview of China's participation in international trade using newly available data on the universe of globally engaged Chinese firms over the 2003–2005 period. We document the distribution of trade flows and product- and trade-partner intensity across both exporting and importing firms and study the relationship between firms' intensive and extensive margins of trade. We also compare trade patterns across firms of different organizational structure, distinguishing between domestic private firms, domestic state-owned firms, foreign-owned firms, and joint ventures. We explore the variation in foreign ownership across sectors and find results consistent with recent theoretical and empirical work on the role of credit constraints and contractual imperfections in international trade and investment. Finally, we examine the rapid expansion of China's trade over the 2003–2005 period, and decompose it into its extensive and intensive margins. We also use monthly data and study the frequent churning and reallocation of trade flows across firms and across products and trade partners within firms.

WP 2008-29

Exporting Deflation? Chinese Exports and Japanese Prices

Christian Broda, *University of Chicago*
David Weinstein, *Columbia University*

Between 1992 and 2002, the Japanese Import Price Index (IPI) registered a decline of almost 9 percent and Japan entered a period of deflation. We show that much of the correlation between import prices and domestic prices was due to formula biases. Had the IPI been computed using a pure Laspeyres index like the CPI, the IPI would have hardly moved at all. A Laspeyres version of the IPI would have risen 1 percentage point per year faster than the official index. Second we show that Chinese prices did not behave differently from the prices of other importers. Although Chinese prices are substantially lower than the prices of other exporters, they do not exhibit a differential trend. However, we estimate that the typical price per unit quality of a Chinese exporter fell by half between 1992 and 2005. Thus the explosive growth in Chinese exports is attributable to growth in the quality of Chinese exports and the increase in new products being exported by China.

WP 2008-30

Do Nominal Rigidities Matter for the Transmission of Technology Shocks?

Zheng Liu, *FRB San Francisco*
Louis Phaneuf, *University of Quebec, Montreal*

A commonly held view is that nominal rigidities are important for the transmission of monetary policy shocks. We argue that they are also important for understanding the dynamic effects of technology shocks, especially on labor hours, wages, and prices. Based on a dynamic general equilibrium framework, our closed-form solutions reveal that a pure sticky-price model predicts correctly that hours decline following a positive technology shock but fails to generate the observed gradual rise in the real wage and the near-constance of the nominal wage; a pure sticky-wage model does well in generating slow adjustments in the nominal wage, but it does not generate plausible dynamics of hours and the real wage. A model with both types of nominal rigidities is more successful in replicating the empirical evidence about hours, wages, and prices. This finding is robust for a wide range of parameter values, including a relatively small Frisch elasticity of hours and a relatively high frequency of price reoptimization that are consistent with microeconomic evidence.

WP 2008-31

The Bond Premium in a DSGE Model with Long-Run Real and Nominal Risks

Glenn D. Rudebusch, *FRB San Francisco*
Eric T. Swanson, *FRB San Francisco*

The term premium on nominal long-term bonds in the standard dynamic stochastic general equilibrium (DSGE) model used in macroeconomics is far too small and stable relative to empirical measures obtained from the data—an example of the "bond premium puzzle." However, in models of endowment economies, researchers have been able to generate reasonable term premiums by assuming that investors have recursive Epstein-Zin preferences and face long-run economic risks. We show that introducing Epstein-Zin preferences into a canonical DSGE model can also produce a large and variable term premium without compromising the model's ability to fit key macroeconomic variables. Long-run real and nominal risks further improve the model's ability to fit the data with a lower level of household risk aversion.

WP 2008-32

Navigating the Trilemma: Capital Flows and Monetary Policy in China

Reuven Glick, *FRB San Francisco*
Michael Hutchinson, *University of California, Santa Cruz*

In recent years China has faced an increasing trilemma—how to pursue an independent domestic monetary policy and limit exchange rate flexibility, while at the same time facing large and growing international capital flows. This paper analyzes the impact of the trilemma on China's monetary policy as the country liberalizes its goods and financial markets and integrates with the world economy. It shows how China has sought to insulate its reserve money from the effects of balance-of-payments inflows by sterilizing through the issuance of central bank liabilities. However, we report empirical results indicating that sterilization dropped precipitously in 2006 in the face of the ongoing massive buildup of international reserves, leading to a surge in reserve money growth. We estimate a vector error correction model linking the surge in China's reserve money to broad money, real GDP, and the price level. We use this model to explore the inflationary implications of different policy scenarios. Under a scenario of continued rapid reserve money growth (consistent with limited sterilization of foreign exchange reserve accumulation) and strong economic growth, the model predicts a rapid increase in inflation. A model simulation using an extension of the framework that incorporates recent increases in bank reserve requirements also implies a rapid rise in inflation. By contrast, model simulations incorporating a sharp slowdown in economic growth lead to less inflation pressure even with a substantial buildup in international reserves.

WP 2008-33

Sovereign Wealth Funds: Stylized Facts about their Determinance and Governance

Joshua Aizenman, *University of California, Santa Cruz*
Reuven Glick, *FRB San Francisco*

This paper presents statistical analysis supporting stylized facts about sovereign wealth funds (SWFs). It discusses the forces leading to the growth of SWFs, including the role of fuel exports and ongoing current account surpluses, and large hoarding of international reserves. It analyzes the degree to which measures of SWF governance and transparency compare with national norms of behavior. We provide evidence that many countries with SWFs are characterized by effective governance but weak democratic institutions, as compared to other nonindustrial countries. We also present a model with which we compare the optimal degree of diversification abroad by a central bank versus that of an SWF. We show that if the central bank manages its foreign assets with the objective of reducing the probability of sudden stops, it will place a high weight on the downside risk of holding risky assets abroad and will tend to hold primarily safe foreign assets. In contrast, if the SWF, acting on behalf of the Treasury, maximizes the expected utility of a representative domestic agent, it will opt for relatively greater holding of more risky foreign assets. We discuss how the degree of a country's transparency may affect the size of the foreign asset base entrusted to a wealth fund's management, and show that, for relatively low levels of public foreign assets, assigning portfolio management independence to the central bank may be advantageous. However, for a large enough foreign asset base, the opportunity cost associated with the limited portfolio diversification of the central bank induces authorities to establish a wealth fund in pursuit of higher returns.

WP 2008-34

Inflation Expectations and Risk Premiums in an Arbitrage-Free Model of Nominal and Real Bond Yields

Jens Christensen, *FRB San Francisco*
Jose A. Lopez, *FRB San Francisco*
Glenn Rudebusch, *FRB San Francisco*

Differences between yields on comparable-maturity U.S. Treasury nominal and real debt, the so-called break-even inflation (BEI) rates, are widely used indicators of inflation expectations. However, better measures of inflation expectations could be obtained by subtracting inflation risk premiums from the BEI rates. We provide such decompositions using an estimated affine arbitrage-free model of the term structure that captures the pricing of both nominal and real Treasury securities. Our empirical results suggest that long-term inflation expectations have been well anchored over the past few years, and inflation risk premiums, although volatile, have been close to zero on average.

WP 2008-35

Consumption-Habits in a New Keynesian Business Cycle Model

Richard Dennis, *FRB San Francisco*

Consumption-habits have become an integral component in new Keynesian models. However, consumption-habits can be modeled in a host of different ways and this diversity is reflected in the literature. I examine whether different approaches to modeling consumption-habits have important implications for business cycle behavior. Using a standard new Keynesian business cycle model, I show that, to a first-order log-approximation, the consumption Euler equation associated with the additive functional form for habit formation encompasses the multiplicative function form. Empirically, I show that whether consumption-habits are internal or external has little effect on the model's business cycle characteristics.

Abstracts of Articles Accepted in Journals, Books, and Conference Volumes*

An Arbitrage-Free Generalized Nelson-Siegel Term Structure Model

Jens H.E. Christensen and **Glenn D. Rudebusch**, with Francis X. Diebold, *University of Pennsylvania*

Forthcoming in *The Econometrics Journal*.

The Svensson generalization of the popular Nelson-Siegel term structure model is widely used by practitioners and central banks. Unfortunately, like the original Nelson-Siegel specification, this generalization, in its dynamic form, does not enforce arbitrage-free consistency over time. Indeed, we show that the factor loadings of the Svensson generalization cannot be obtained in a standard finance arbitrage-free affine term structure representation. Therefore, we introduce a closely related generalized Nelson-Siegel model on which the no-arbitrage condition can be imposed. We estimate this new arbitrage-free generalized Nelson-Siegel model and demonstrate its tractability and good in-sample fit.

Happiness, Unhappiness, and Suicide: An Empirical Assessment

Mary C. Daly
Daniel J. Wilson

Forthcoming in *Journal of the European Economic Association*.

The use of subjective well-being (SWB) data for investigating the nature of individual preferences has increased tremendously in recent years. There has been much debate about the cross-sectional and time-series patterns found in these data, particularly with respect to the relationship between SWB and relative status. Part of this debate concerns how well SWB data measures true utility or preferences. In a recent paper, Daly, Wilson, and Johnson (2007) propose using data on suicide as a revealed preference (outcome-based) measure of well-being and find strong evidence that reference-group income negatively affects suicide risk. In this paper, we compare and contrast the empirical patterns of SWB and suicide data. We find that the two have very little in common in aggregate data (time series and cross-sectional), but have a strikingly strong relationship in terms of their determinants in individual-level, multivariate regressions. This latter result cross-validates suicide and SWB micro data as useful and complementary indicators of latent utility.

Robust Control with Commitment: A Modification to Hansen-Sargent

Richard Dennis

Published in *Journal of Economic Dynamics and Control* 32(7) (July 2008) pp. 2,061–2,084.

I examine the Hansen and Sargent (2003) formulation of the robust Stackelberg problem and show that their method of constructing the approximating equilibrium is generally invalid. I then turn to the Hansen and Sargent (2007) treatment, which, responding to the problems raised in this paper, changes subtly, but importantly, how the robust Stackelberg problem is formulated. In the context of Hansen and Sargent (2007), I prove, first, that their method for obtaining the approximating equilibrium is now equivalent to the one developed in this paper, and, second, that the worst-case specification errors are not subject to a time-consistency problem. In the context of the Erceg et al. (2000), sticky wage/sticky price model, I find that a robust central bank will fear primarily that the supply side of its approximating model is misspecified and that robustness affects importantly central bank promises about future policy.

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*The abstracts are arranged alphabetically by FRB San Francisco authors, whose names are in boldface.

Learning and Optimal Monetary Policy

Richard Dennis, with
Federico Ravenna,
University of California, Santa Cruz

Published in *Journal of Economic Dynamics and Control* 32(6) (June 2008) pp. 1,964–1,994.

To conduct policy efficiently, central banks must use available data to infer, or learn, the relevant structural relationships in the economy. However, because a central bank's policy affects economic outcomes, the chosen policy may help or hinder its efforts to learn. This paper examines whether real-time learning allows a central bank to learn the economy's underlying structure and studies the impact that learning has on the performance of optimal policies under a variety of learning environments. Our main results are as follows. First, when monetary policy is formulated as an optimal discretionary targeting rule, we find that the rational expectations equilibrium and the optimal policy are real-time learnable. This result is robust to a range of assumptions concerning private-sector learning behavior. Second, when policy is set with discretion, learning can lead to outcomes that are better than if the model parameters are known. Finally, if the private sector is learning, then unannounced changes to the policy regime, particularly changes to the inflation target, can raise policy loss considerably.

Sterilization, Monetary Policy, and Global Financial Integration

Reuven Glick, with
Joshua Aizenman,
University of California, Santa Cruz

Forthcoming in
Review of International Economics.

This paper investigates the changing pattern and efficacy of sterilization within emerging market countries as they liberalize markets and integrate with the world economy. We estimate the marginal propensity to sterilize foreign asset accumulation associated with net balance of payments inflows, across countries and over time. We find that the extent of sterilization of foreign reserve inflows has risen in recent years to varying degrees in Asia as well as in Latin America, consistent with greater concerns about the potential inflationary impact of reserve inflows. We also find that sterilization depends on the composition of balance of payments inflows.

Collateral Damage: Trade Disruption and the Economic Impact of War

Reuven Glick, with
Alan Taylor,
University of California, Davis

Forthcoming in
Review of Economics and Statistics.

Conventional wisdom in economic history suggests that conflict between countries can be enormously disruptive of economic activity, especially international trade. Yet nothing is known empirically about these effects in large samples. We study the effects of war on bilateral trade for almost all countries with available data extending back to 1870. Using the gravity model, we estimate the contemporaneous and lagged effects of wars on the trade of belligerent nations and neutrals, controlling for other determinants of trade. We find large and persistent impacts of wars on trade, and hence on national and global economic welfare. A rough accounting indicates that such costs might be of the same order of magnitude as the "direct" costs of war, such as lost human capital, as illustrated by case studies of World War I and World War II.

Sovereign Debt Crises and Credit to the Private Sector

Galina B. Hale, with
Carlos Arteta,
Federal Reserve Board of Governors

Published in *Journal of International Economics* 74(1) (January 2008) pp. 53–69.

We use micro-level data to analyze emerging markets' private sector access to international debt markets during sovereign debt crises. We find that these crises are systematically accompanied by a decline in foreign credit to domestic private firms, both during debt renegotiations and for over two years after restructuring agreements are reached. This decline is large, statistically significant, and robust. We find that this effect is concentrated in the nonfinancial sector and is different for firms in the exporting and in the non-exporting sectors. We also find that the magnitude of the effect depends on the type of debt restructuring agreement.

Are There Productivity Spillovers from Foreign Direct Investment in China?

Galina B. Hale, with
Cheryl Long, *Colgate University*

Forthcoming in *Pacific Economic Review.*

We review previous literature on productivity spillovers of foreign direct investment (FDI) in China and conduct our own analysis using a firm-level data set from a World Bank survey. We find that the evidence of FDI spillovers on the productivity of Chinese domestic firms is mixed, with many positive results largely due to aggregation bias or failure to control for endogeneity of FDI. Attempting over 6000 specifications which take into account forward and backward linkages, we fail to find evidence of systematic positive productivity spillovers from FDI in China.

The Decision to First Enter the Public Bond Market: The Role of Firm Reputation, Funding Choices, and Bank Relationships

Galina B. Hale, with
João Santos, *FRB New York*

Published in *Journal of Banking and Finance* 32(9) (September 2008) pp. 1,928–1,940.

This paper uses survival analysis to investigate the timing of a firm's decision to issue for the first time in the public bond market. We find that firms that are more creditworthy and have higher demand for external funds issue their first public bond earlier. We also find that issuing private bonds or taking out syndicated loans is associated with a faster entry to the public bond market. According to our results, the relationships that firms develop with investment banks in connection with their private bond issues and syndicated loans further speed up their entry to the public bond market. Finally, we find that a firm's reputation has a "U-shaped" effect on the timing of a firm's bond IPO. Consistent with Diamond's reputational theory, firms that establish a track record of high creditworthiness, as well as those that establish a track record of low creditworthiness, enter the public bond market earlier than firms with intermediate reputation.

Do Banks Price Their Informational Monopoly?

Galina B. Hale, with
João Santos, *FRB New York*

Forthcoming in
Journal of Financial Economics.

Modern corporate finance theory argues that, although bank monitoring is beneficial to borrowers, it also allows banks to use the information they gain through monitoring to "hold-up" borrowers for higher interest rates. In this paper, we seek empirical evidence for this information hold-up cost. Since new information about a firm's creditworthiness is revealed at the time of its first issue in the public bond market, it follows that after firms undertake their bond IPO, banks with an exploitable information advantage will be forced to adjust their loan interest rates downwards, particularly for firms that are revealed to be safe. We test this hypothesis by comparing banks' loan pricing policies before and after borrowers gain access to public bond markets. To isolate the information hold-up cost we further compare the change in the loan policies between borrowers that already had a credit rating at the time of their bond IPO and borrowers that get their first credit rating at that time. Our findings show that firms are able to borrow at lower interest rates after their bond IPO and that these savings are larger for safer firms. We also find that, among safe firms, those that get their first credit rating at the time of their bond IPO benefit from larger interest rate savings than those that already had a credit rating. These findings provide support for the hypothesis that banks price their informational monopoly. Finally, we find that while entering the public bond market may reduce these informational rents, it is also costly to firms because they have to pay higher underwriting costs on their IPO bond.

Lobbies and Technology Diffusion

Bart Hobijn, with
Diego Comin, *Harvard Business School*

Forthcoming in
Review of Economics and Statistics.

This paper explores whether lobbies slow down technology diffusion. To answer this question, we exploit the differential effect of various institutional attributes that should affect the costs of erecting barriers when the new technology has a technologically close predecessor but not otherwise. We implement this test in a unique data set compiled by us that covers the diffusion of 20 technologies for 23 countries over the past two centuries. We find that each of the relevant institutional variables that affect the costs of erecting barriers has a significantly larger effect on the diffusion of technologies with a competing predecessor technology than when no such technology exists. These effects are quantitatively important. Thus, we conclude that lobbies are an important barrier to technology adoption and to development.

A New Approach to Measuring Technology with an Application to the Shape of the Diffusion Curves

Bart Hobijn, with
Diego Comin, *Harvard Business School*
Emilie Rovito, *FRB New York*

Published in *Journal of Technology Transfer* 33(2) (April 2008) pp. 187–207.

This paper documents the sources and measures of the cross-country historical adoption technology (CHAT) data set that covers the diffusion of about 115 technologies in over 150 countries over the last 200 years. We use this comprehensive data set to explore the shape of the diffusion curves. Our main finding is that, once the intensive margin is measured, technologies do not diffuse in a logistic way.

Technology Usage Lags

Bart Hobijn, with
Diego Comin, *Harvard Business School*
Emilie Rovito, *FRB New York*

Published in *Journal of Economic Growth* 13(4) (December 2008) pp. 237–256.

We present evidence on the differences in the intensity with which 10 major technologies are used in 185 countries across the world. We do so by calculating how many years ago these technologies were used in the U.S. at the same intensity as they are used in the countries in our sample. We denote these time lags as technology usage lags and compare them with lags in real GDP per capita. We find that (i) technology usage lags are large, often comparable to lags in real GDP per capita, (ii) usage lags are highly correlated with lags in per-capita income, and (iii) usage lags are highly correlated across technologies. The productivity differentials between the state-of-the-art technologies that we consider and the ones they replace combined with the usage lags that we document lead us to infer that technology usage disparities might account for a large part of cross-country total factor productivity differentials.

Using Securities Market Information for Bank Supervisory Monitoring

John Krainer
Jose A. Lopez

Published in *International Journal of Central Banking* 4(1) (March 2008) pp. 125–164.

U.S. bank supervisors conduct comprehensive inspections of bank holding companies and assign them a supervisory rating, known as a BOPEC rating prior to 2005, meant to summarize their overall condition. We develop an empirical model of these BOPEC ratings that combines supervisory and securities market information. Securities market variables, such as stock returns and bond yield spreads, improve the model's in-sample fit. Debt market variables provide more information on supervisory ratings for banks closer to default, while equity market variables provide useful information on ratings for banks further from default. The out-of-sample accuracy of the model with securities market variables is little different from that of a model based on supervisory variables alone. However, the model with securities market information identifies additional ratings downgrades, which are of particular importance to bank supervisors who are concerned with systemic risk and contagion.

Asset Price Persistence and Real Estate Market Illiquidity: Evidence from Japanese Land Values

John Krainer and
Mark M. Spiegel, with
Nobuyoshi Yamori, *Nagoya University*

Forthcoming in *Real Estate Economics.*

We develop an overlapping generations model of the real estate market in which search frictions and a debt overhang combine to generate price persistence and illiquidity. Illiquidity stems from heterogeneity in agent real estate valuations. The variance of agent valuations determines how quickly prices adjust following a shock to fundamentals. We examine the predictions of the model by studying depreciation in Japanese land values subsequent to the 1990 stock market crash. Commercial land values fell much more quickly than residential land values. As we would posit that the variance of buyer valuations would be greater for residential real estate than for commercial real estate, this model matches the Japanese experience.

Time-Varying U.S. Inflation Dynamics and the New Keynesian Phillips Curve

Kevin J. Lansing

Forthcoming in
Review of Economic Dynamics.

This paper introduces a form of boundedly rational inflation expectations in the New Keynesian Phillips curve. The representative agent is assumed to behave as an econometrician, employing a time-series model for inflation that allows for both permanent and temporary shocks. The near-unity coefficient on expected inflation in the Phillips curve causes the agent's perception of a unit root in inflation to become close to self-fulfilling. In a "consistent expectations equilibrium," the value of the Kalman gain parameter in the agent's forecast rule is pinned down using the observed autocorrelation of inflation changes. The forecast errors observed by the agent are close to white noise, making it difficult for the agent to detect a misspecification of the forecast rule. I show that this simple model of inflation expectations can generate time-varying persistence and volatility that is broadly similar to that observed in long-run U.S. data. Model-based values for expected inflation track well with movements in survey-based measures of U.S. expected inflation. In numerical simulations, the model can generate pronounced low-frequency swings in the level of inflation that are driven solely by expectational feedback, not by changes in monetary policy.

High Exchange-Rate Volatility and Low Pass-Through

Sylvain Leduc, with
Giancarlo Corsetti,
European University Institute
Luca Dedola, *European Central Bank*

Forthcoming in
Journal of Monetary Economics.

Two specifications of an open-economy model are shown to generate high exchange-rate volatility and low exchange-rate pass-through (ERPT). In the model, price discrimination causes ERPT to be incomplete in both the short and the long run. In the short run, a small amount of nominal rigidities is enough to reduce ERPT sharply; still, exchange-rate depreciation worsens the terms of trade, consistent with the evidence. Possible biases from omitted variables and measurement error in the ERPT empirical literature (due to data limitations) are investigated using model-generated time series. Estimates of ERPT coefficients can be quite different from true parameters and are sensitive to the shocks driving the economies. Estimates can nonetheless detect key structural features of the models.

International Risk Sharing and the Transmission of Productivity Shocks

Sylvain Leduc, with
Giancarlo Corsetti,
European University Institute
Luca Dedola, *European Central Bank*

Published in *Review of Economic Studies*
75(2) (April 2008) pp. 443–473.

This paper shows that standard international business cycle models can be reconciled with the empirical evidence on the lack of consumption risk sharing. First, we show analytically that with incomplete asset markets productivity disturbances can have large uninsurable effects on wealth, depending on the value of the trade elasticity and shock persistence. Second, we investigate these findings quantitatively in a model calibrated to the U.S. economy. With the low trade elasticity estimated via a method of moments procedure, the consumption risk of productivity shocks is magnified by high terms of trade and real exchange rate (RER) volatility. Strong wealth effects in response to shocks raise the demand for domestic goods above supply, crowding out external demand and appreciating the terms of trade and the RER. Building upon the literature on incomplete markets, we then show that similar results are obtained when productivity shocks are nearly permanent, provided the trade elasticity is set equal to the high values consistent with micro-estimates. Under both approaches the model accounts for the low and negative correlation between the RER and relative (domestic to foreign) consumption in the data—the "Backus–Smith puzzle."

Optimal Monetary Policy and the Sources of Local-Currency Price Stability

Sylvain Leduc, with
Giancarlo Corsetti,
European University Institute
Luca Dedola, *European Central Bank*

Published in *International Dimensions of Monetary Policy*, eds. J. Gali and M. Gertler, Chicago: University of Chicago Press (2008).

We analyze the policy trade-offs generated by local currency price stability of imports in economies where upstream producers strategically interact with downstream firms selling the final goods to consumers. We study the effects of staggered price setting at the downstream level on the optimal price (and markup) chosen by upstream producers and show that downstream price movements affect the desired markup of upstream producers, magnifying their price response to shocks. We revisit the international dimensions of optimal monetary policy, unveiling an argument in favor of consumer price stability as the main prescription for monetary policy. Since stable consumer prices feed back into a low volatility of markups among upstream producers, this contains inefficient deviations from the law of one price at the border. However, efficient stabilization of different CPI components will not generally result in perfect stabilization of headline inflation. National policies optimally respond to the same shocks in a similar way, thus containing volatility of the terms of trade, but not necessarily of the real exchange rate. The latter will be more volatile, among other things, the larger the home bias in expenditure and the content of local inputs in consumer goods.

Productivity, External Balance, and Exchange Rates: Evidence on the Transmission Mechanism among G-7 Countries

Sylvain Leduc, with
Giancarlo Corsetti,
European University Institute
Luca Dedola, *European Central Bank*

Published in *NBER International Seminar on Macroeconomics 2006,* Cambridge, MA: MIT Press Book (2008) pp. 117–194.

This paper investigates the international transmission of productivity shocks in a sample of five G-7 countries. For each country, using long-run restrictions, we identify shocks that permanently increase domestic labor productivity in manufacturing (our measure of tradables) relative to an aggregate of other industrial countries including the rest of the G-7. We find that, consistent with standard theory, these shocks raise relative consumption, deteriorate net exports, and raise the relative price of nontradables—in full accord with the Harrod-Balassa-Samuelson hypothesis. Moreover, the deterioration of the external account is fairly persistent, especially for the U.S. The response of the real exchange rate and (our proxy for) the terms of trade differs across countries: while both relative prices depreciate in Italy and the U.K. (smaller and more open economies), they appreciate in the U.S. and Japan (the largest and least open economies in our sample); results are, however, inconclusive for Germany. These findings question a common view in the literature, that a country's terms of trade fall when its output grows, thus providing a mechanism to contain differences in national wealth when productivity levels do not converge. They enhance our understanding of important episodes such as the strong real appreciation of the dollar as the U.S. productivity growth accelerated in the second half of the 1990s. They also provide an empirical contribution to the current debate on the adjustment of the U.S. current account position. Contrary to widespread presumptions, productivity growth in the U.S. tradable sector does not necessarily improve the U.S. trade deficit nor deteriorate the U.S. terms of trade, at least in the short and medium run.

Investment-Specific Technological Change, Skill Accumulation, and Wage Inequality

Zheng Liu, with
Hui He, *University of Hawaii*

Published in *Review of Economic Dynamics* 11(2) (April 2008) pp. 314–334.

Wage inequality between education groups in the United States has increased substantially since the early 1980s. The relative number of college-educated workers has also increased dramatically in the postwar period. This paper presents a unified framework where the dynamics of both skill accumulation and wage inequality arise as an equilibrium outcome driven by measured investment-specific technological change. Working through equipment-skill complementarity and endogenous skill accumulation, the model does well in capturing the steady growth in the relative quantity of skilled labor during the postwar period and the substantial rise in wage inequality after the early 1980s. Based on the calibrated model, we examine the quantitative effects of some hypothetical tax-policy reforms on skill accumulation, wage inequality, and welfare.

Learning, Adaptive Expectations, and Technology Shocks

Zheng Liu, with
Kevin X.D. Huang, *Vanderbilt University*
Tao Zha, *FRB Atlanta*

Forthcoming in *The Economic Journal*.

This study explores the macroeconomic implications of adaptive expectations in a standard growth model. We show that the self-confirming equilibrium under adaptive expectations is the same as the steady-state rational expectations equilibrium for all admissible parameter values, but that dynamics around the steady state are substantially different between the two equilibria. The differences are driven mainly by the dampened wealth effect and the strengthened intertemporal substitution effect, not by escapes emphasized by Williams (2003). Consequently, adaptive expectations can be an important source of frictions that amplify and propagate technology shocks and seem promising for generating plausible labor market dynamics.

Gains from International Monetary Policy Coordination: Does It Pay to Be Different?

Zheng Liu, with
Evi Pappa,
Universitat Autònoma de Barcelona

Published in *Journal of Economic Dynamics and Control* 32(7) (July 2008) pp. 2,085–2,117.

In a two-country world where each country has a traded and a nontraded sector and each sector has sticky prices, optimal independent policy in general cannot replicate the natural-rate allocations. There are potential welfare gains from coordination since the planner under a cooperating regime internalizes a terms-of-trade externality that independent policymakers overlook. If the countries have symmetric trading structures, however, the gains from coordination are quantitatively small. With asymmetric trading structures, the gains can be sizable since, in addition to internalizing the terms-of-trade externality, the planner optimally engineers a terms-of-trade bias that favors the country with a larger traded sector.

Asymmetric Expectation Effects of Regime Shifts in Monetary Policy

Zheng Liu, with
Daniel Waggoner, *FRB Atlanta*
Tao Zha, *FRB Atlanta*

Forthcoming in
Review of Economic Dynamics.

This paper addresses two substantive issues: (1) Does the magnitude of the expectation effect of regime switching in monetary policy depend on a particular policy regime? (2) Under which regime is the expectation effect quantitatively important? Using two canonical dynamic stochastic general equilibrium models, we show that there exists asymmetry in the expectation effect across regimes. The expectation effect under the dovish policy regime is quantitatively more important than that under the hawkish regime. These results suggest that the possibility of regime shifts in monetary policy can have important effects on rational agents' expectation formation and on equilibrium dynamics. They offer a theoretical explanation for the empirical possibility that a policy shift from the dovish regime to the hawkish regime may not be the main source of substantial reductions in the volatilities of inflation and output.

Empirical Analysis of the Average Asset Correlation for Real Estate Investment Trusts

Jose A. Lopez

Forthcoming in *Quantitative Finance.*

The credit risk capital requirements within the current Basel II Accord are based on the asymptotic single risk factor (ASRF) approach. The asset correlation parameter, defined as an obligor's sensitivity to the ASRF, is a key driver within this approach, and its average values for different types of obligors are to be set by regulators. Specifically, for commercial real estate (CRE) lending, the average asset correlations are to be determined using formulas for either income-producing real estate or high-volatility commercial real estate. In this paper, the value of this parameter was empirically examined using portfolios of U.S. publicly traded real estate investment trusts as a proxy for CRE lending more generally. CRE lending as a whole was found to have the same calibrated average asset correlation as corporate lending, providing support for the recent U.S. regulatory decision to treat these two lending categories similarly for regulatory capital purposes. However, the calibrated values for CRE categories, such as multifamily residential or office lending, varied in important ways. The comparison of calibrated and regulatory values of the average asset correlations for these categories suggests that the current regulatory formulas generate parameter values that may be too high in most cases.

EAD Calibration for Corporate Credit Lines

Jose A. Lopez, with
Gabriel Jimenez, *Bank of Spain*
Jesus Saurina, *Bank of Spain*

Forthcoming in *Journal of Risk Management in Financial Institutions.*

Managing the credit risk inherent to a corporate credit line is similar to that of a term loan, but with one key difference. For both instruments, the bank should know the borrower's probability of default and the facility's loss given default. However, since a credit line allows the borrowers to draw down the committed funds according to their own needs, the bank must also have a measure of the line's exposure at default (EAD). In fact, EAD is one of the key parameters used for regulatory capital calculations within the Basel II framework. Yet, relatively few empirical studies of EAD for corporate credit lines have been published, mainly due to a lack of data. A primary goal of this article is to provide calibrated values for use in EAD calculations for corporate credit lines. Our study is based on the Spanish credit register, which provides a census of all corporate lending within Spain over the last 20 years. The length and breadth of this data set allows us to provide the most comprehensive overview of corporate credit line use and EAD calculations to date. Our analysis shows that defaulting firms have significantly higher credit line usage rates and EAD values up to five years prior to their actual default. Furthermore, we find that there are important variations in EAD values due to credit line size, collateralization, and maturity. While our results are derived from data for a single country, they should provide useful benchmarks for further academic, business, and policy research into this underdeveloped area of credit risk management.

Empirical Analysis of Corporate Credit Lines

Jose A. Lopez, with
Gabriel Jimenez, *Bank of Spain*
Jesus Saurina, *Bank of Spain*

Forthcoming in
Review of Financial Studies.

Since bank credit lines are a major source of corporate funding, we examine the determinants of their usage with a comprehensive database of Spanish corporate credit lines. A line's default status is a key factor driving its usage, which increases as firm financial conditions worsen. Firms with prior defaults access their credit lines less, suggesting that bank monitoring influences firms' usage decisions. Line usage has an aging effect that causes it to decrease by roughly 10 percent per year of its life. Lender characteristics, such as the length of a firm's banking relationships, as well as macroeconomic conditions affect usage decisions.

Examining the Bond Premium Puzzle with a DSGE Model

Glenn D. Rudebusch
Eric T. Swanson

Published in *Journal of Monetary Economics* 55, Supplement 1 (October 2008) pp. S111–S126.

The basic inability of standard theoretical models to generate a sufficiently large and variable nominal bond risk premium has been termed the "bond premium puzzle." We show that the term premium on long-term bonds in the canonical dynamic stochastic general equilibrium (DSGE) model used in macroeconomics is far too small and stable relative to the data. We find that introducing long-memory habits in consumption as well as labor market frictions can help fit the term premium, but only by seriously distorting the DSGE model's ability to fit other macroeconomic variables, such as the real wage; therefore, the bond premium puzzle remains.

Revealing the Secrets of the Temple: The Value of Publishing Central Bank Interest Rate Projections

Glenn D. Rudebusch
John C. Williams

Published in *Asset Prices and Monetary Policy*, ed. J.Y. Campbell. Chicago: University of Chicago Press (2008) pp. 247–284.

The modern view of monetary policy stresses its role in shaping the entire yield curve of interest rates in order to achieve various macroeconomic objectives. A crucial element of this process involves guiding financial market expectations of future central bank actions. Recently, a few central banks have started to explicitly signal their future policy intentions to the public, and two of these banks have even begun publishing their internal interest rate projections. We examine the macroeconomic effects of direct revelation of a central bank's expectations about the future path of the policy rate. We show that, in an economy where private agents have imperfect information about the determination of monetary policy, central bank communication of interest rate projections can help shape financial market expectations and may improve macroeconomic performance.

A Macro-Finance Model of the Term Structure, Monetary Policy, and the Economy

Glenn D. Rudebusch, with Tao Wu, *FRB Dallas*

Published in *The Economic Journal* 118(530) (July 2008) pp. 906–926.

This article develops and estimates a macro-finance model that combines a canonical affine no-arbitrage finance specification of the term structure of interest rates with standard macroeconomic aggregate relationships for output and inflation. Based on this combination of yield curve and macroeconomic structure and data, we obtain several interesting results: (1) the latent term structure factors from no-arbitrage finance models appear to have important macroeconomic and monetary policy underpinnings, (2) there is no evidence of a slow partial adjustment of the policy interest rate by the central bank, and (3) both forward-looking and backward-looking elements play roles in macroeconomic dynamics.

Financial Globalization and Monetary Policy Discipline

Mark M. Spiegel

Forthcoming in *IMF Staff Papers.*

The literature appears to have reached a consensus that financial globalization has had a "disciplining effect" on monetary policy, as it has reduced the returns from—and hence the temptation for—using monetary policy to stabilize output. As a result, monetary policy over recent years has placed more emphasis on stabilizing inflation, resulting in reduced inflation and greater output stability. However, this consensus has not been accompanied by convincing empirical evidence that such a relationship exists. One reason is likely to be that de facto measures of financial globalization are endogenous, and that instruments for financial globalization are elusive. In this paper, I introduce a new instrument, financial remoteness, as a plausibly exogenous instrument for financial openness. I examine the relationship between financial globalization and median inflation levels over an 11-year cross section from 1994 through 2004, as well as a panel of 5-year median inflation levels between 1980 and 2004. The results confirm a negative relationship between median inflation and financial globalization in the base specification, but this relationship is sensitive to the inclusion of conditioning variables or country fixed effects, precluding any strong inferences.

Monetary and Financial Integration: Evidence from the EMU

Mark M. Spiegel

Forthcoming in *Journal of the Japanese and International Economies.*

This paper examines the impact of European Monetary Union (EMU) accession on bilateral Portuguese international borrowing patterns. Using a difference-in-differences methodology, I demonstrate that Portugal's accession to the EMU was accompanied by a change in its borrowing pattern in favor of borrowing from its EMU partner nations. This extends the evidence in the literature that overall international borrowing is facilitated by the creation of a monetary union and raises the issue of financial diversion. The results are shown to survive a wide variety of robustness checks and are corroborated by preliminary evidence concerning Greece's accession to EMU in 2001.

Monetary and Financial Integration in the EMU: Push or Pull?

Mark M. Spiegel

Forthcoming in *Review of International Economics.*

A number of studies have recently noted that monetary integration in the European Monetary Union (EMU) has been accompanied by increased financial integration. This paper examines the channels through which monetary union increased financial integration, using international panel data on bilateral international commercial bank claims from 1998–2006. I decompose the relative increase in bilateral commercial bank claims among union members following monetary integration into three possible channels: a "borrower effect," as a country's EMU membership may leave its borrowers more creditworthy in the eyes of foreign lenders; a "creditor effect," as membership in a monetary union may increase the attractiveness of a nation's commercial banks as intermediaries, perhaps through increased scale economies enjoyed by commercial banks themselves or through an improved regulatory environment after the advent of monetary union; and a "pairwise effect," as joint membership in a monetary union increases the quality of intermediation between borrowers and creditors when both are in the same union. This pairwise effect could be attributed to mitigated currency risk stemming from monetary integration, but may also indicate that monetary union integration increases borrowing capacity. I decompose the data into a series of difference-in-differences specifications to isolate these three channels and find that the pairwise effect is the primary source of increased financial integration. This result is robust to a number of sensitivity exercises used to address concerns frequently associated with difference-in-differences specifications, such as serial correlation and issues associated with the timing of the intervention.

Moderate Inflation and the Deflation-Depression Link

Mark M. Spiegel, with Jess Benhabib, *New York University*

Forthcoming in *Journal of Money, Credit, and Banking.*

In a recent paper, Atkeson and Kehoe (2004) demonstrated the lack of a robust empirical relationship between inflation and growth for a cross-section of countries with 19th and 20th century data, concluding that the historical evidence only provides weak support for the contention that deflation episodes are harmful to economic growth. In this paper, we revisit this relationship by allowing for inflation and growth to have a nonlinear specification dependent on inflation levels. In particular, we allow for the possibility that high inflation is negatively correlated with growth, while a positive relationship exists over the range of negative to moderate inflation. Our results confirm a positive relationship between inflation and growth at moderate inflation levels, and support the contention that the relationship between inflation and growth is nonlinear over the entire sample range.

Economic Spillovers from International Environmental Cooperation

Mark M. Spiegel, with
Andrew Rose,
University of California, Berkeley

Published in VOXEU.org.

Prospects for international environmental cooperation often seem dim, as agreement must hew to the lowest common denominator. This column identifies economic gains from environmental commitments via reputational spillovers and their impact on capital flows. The evidence suggests that nations have more to gain from cooperation than they may realize.

International Financial Remoteness and Macroeconomic Volatility

Mark M. Spiegel, with
Andrew Rose,
University of California, Berkeley

Forthcoming in
Journal of Development Economics.

This paper shows that proximity to major international financial centers seems to reduce business cycle volatility. In particular, we show that countries that are further from major locations of international financial activity systematically experience more volatile growth rates in both output and consumption, even after accounting for domestic financial depth, political institutions, and other controls. Our results are relatively robust in the sense that more financially remote countries are more volatile, though the results are not always statistically significant. The comparative strength of this finding is in contrast to the more ambiguous evidence found in the literature.

Non-Economic Engagement and International Exchange: The Case of Environmental Treaties

Mark M. Spiegel, with
Andrew Rose,
University of California, Berkeley

Forthcoming in *Journal of Money, Credit, and Banking.*

We examine the role of non-economic partnerships in promoting international economic exchange. Since far-sighted countries are more willing to join costly international partnerships such as environmental treaties, environmental engagement tends to encourage international lending. Countries with such non-economic partnerships also find it easier to engage in economic exchanges since they face the possibility that debt default might also spill over to hinder their non-economic relationships. We present a theoretical model of these ideas, and then verify their empirical importance using a bilateral cross-section of data on international crossholdings of assets and environmental treaties. Our results support the notion that international environmental cooperation facilitates economic exchange.

Futures Prices as Risk-Adjusted Forecasts of Monetary Policy

Eric T. Swanson, with
Monika Piazzesi, *Stanford University*

Published in *Journal of Monetary Economics* 55(4) (May 2008) pp. 677–691.

Many researchers have used federal funds futures rates as measures of financial markets' expectations of future monetary policy. However, to the extent that federal funds futures reflect risk premia, these measures require some adjustment. In this paper, we document that excess returns on federal funds futures have been positive on average and strongly countercyclical. In particular, excess returns are surprisingly well predicted by macroeconomic indicators such as employment growth and financial business-cycle indicators such as Treasury yield spreads and corporate bond spreads. Excess returns on eurodollar futures display similar patterns. We document that simply ignoring these risk premia significantly biases forecasts of the future path of monetary policy. We also show that risk premia matter for some futures-based measures of monetary policy shocks used in the literature.

Welfare-Maximizing Monetary Policy under Parameter Uncertainty

John C. Williams, with
Rochelle Edge, *Federal Reserve Board*
Thomas Laubach, *Federal Reserve Board*

Forthcoming in
Journal of Applied Econometrics.

This paper examines welfare-maximizing monetary policy in an estimated micro-founded general equilibrium model of the U.S. economy where the policymaker faces uncertainty about model parameters. Uncertainty about parameters describing preferences and technology implies uncertainty about the model's dynamics, utility-based welfare criterion, and the "natural" rates of output and interest that would prevail absent nominal rigidities. We estimate the degree of uncertainty regarding natural rates due to parameter uncertainty. We find that optimal Taylor rules under parameter uncertainty respond less to the output gap and more to price inflation than would be optimal absent parameter uncertainty. We also show that policy rules that focus solely on stabilizing wages and prices yield welfare outcomes very close to the first-best.

Imperfect Knowledge and the Pitfalls of Optimal Control

John C. Williams, with
Athanasios Orphanides,
Central Bank of Cyprus

Forthcoming in *Monetary Policy under Uncertainty and Learning*,
eds. K. Schmidt-Hebbel and C. Walsh.
Series on Central Banking, Analysis, and Economic Policies, Central Bank of Chile.

This paper examines the robustness characteristics of optimal control policies derived under the assumption of rational expectations to alternative models of expectations formation and uncertainty about the natural rates of interest and unemployment. We assume that agents have imperfect knowledge about the precise structure of the economy and form expectations using a forecasting model that they continuously update based on incoming data. We also allow for central bank uncertainty regarding the natural rates of interest and unemployment. We find that the optimal control policy derived under the assumption of perfect knowledge about the structure of the economy can perform poorly when knowledge is imperfect. These problems are exacerbated by natural rate uncertainty, even when the central bank's estimates of natural rates are efficient. We show that the optimal control approach can be made more robust to the presence of imperfect knowledge by de-emphasizing the stabilization of real economic activity and interest rates relative to inflation in the central bank loss function. That is, robustness to the presence of imperfect knowledge about the economy provides an incentive to employ a "conservative" central banker. We then examine two types of simple monetary policy rules from the literature that have been found to be robust to model misspecification in other contexts. We find that these policies are robust to the alternative models of learning that we study and natural rate uncertainty. We also find that they outperform the optimal control policy and generally perform as well as the robust optimal control policy that places less weight on stabilizing economic activity and interest rates.

Learning, Expectations Formation, and the Pitfalls of Optimal Control Monetary Policy

John C. Williams, with Athanasios Orphanides, *Central Bank of Cyprus*

Published in *Journal of Monetary Economics* 55, Supplement 1 (October 2008) pp. S80–S96.

The optimal control approach to monetary policy has garnered increased attention in recent years. Optimal control policies, however, are designed for the specific features of a particular model and therefore may not be robust to model misspecification. One important source of potential misspecification is how agents form expectations. Specifically, whether they know the complete structure of the model as assumed in rational expectations or learn using a forecasting model that they update based on incoming data. Simulations of an estimated model of the U.S. economy show that the optimal control policy derived under the assumption of rational expectations can perform poorly when agents learn. The optimal control approach can be made more robust to learning by deemphasizing the stabilization of real economic activity and interest rates relative to inflation in the central bank loss function. That is, robustness to learning provides an incentive to employ a "conservative" central banker. In contrast to optimal control policies, two types of simple monetary policy rules from the literature that have been found to be robust to model misspecification in other contexts are shown to be robust to learning.

A Black Swan in the Money Market

John C. Williams, with John Taylor, *Stanford University*

Published in *American Economic Journal: Macroeconomics* 1(1) (January 2009) pp. 58–83.

The recent financial crisis saw a dramatic and persistent jump in interest rate spreads between overnight federal funds and longer-term interbank loans. The Federal Reserve took several actions to reduce these spreads, including the creation of the Term Auction Facility (TAF). The effectiveness of these policies depends on the cause of the increased spreads such as counterparty risk, liquidity, or other factors. Using a no-arbitrage pricing framework and various measures of risk, we find robust evidence that increased counterparty risk contributed to the rise in spreads, but we do not find robust evidence that the TAF had a significant effect on spreads.

Investment Behavior of U.S. Firms over Heterogeneous Capital Goods: A Snapshot

Daniel J. Wilson

Published in *Review of Income and Wealth* 54(2) (June 2008) pp. 269–278.

Recent research has indicated that investment in certain capital types, such as computers, has fostered accelerated productivity growth and enabled a fundamental reorganization of the workplace. However, remarkably little is known about the composition of investment at the micro level. This short paper takes an important first step in filling this knowledge gap by looking at the newly available micro data from the 1998 Annual Capital Expenditure Survey (ACES), a sample of roughly 30,000 firms drawn from the private, nonfarm economy. The paper establishes a number of stylized facts. Among other things, I find that in contrast to aggregate data the typical firm tends to concentrate its capital expenditures in a very limited number of capital types, though which types are chosen varies greatly from firm to firm. In addition, computers account for a significantly larger share of firms' incremental investment than they do of lumpy investment.

State Investment Tax Incentives: A Zero-Sum Game?

Daniel J. Wilson, with
Robert Chirinko, *Emory University*

Published in
Journal of Public Economics 92(12)
(December 2008) pp. 2,362–2,384.

Over the past four decades, state investment tax incentives have proliferated. This emergence of state investment tax credits (ITC) and other investment tax incentives raises two important questions: (1) Are these tax incentives effective in achieving their stated objective, to increase investment within the state?; (2) To the extent these incentives raise investment within the state, how much of this increase is due to investment drawn away from other states? To begin to answer these questions, we construct a detailed panel data set for 48 states for 20-plus years. The data set contains series on output and capital, their relative prices, and establishment counts. The effects of tax variables on capital formation and establishments are measured by the Jorgensonian user cost of capital that depends in a nonlinear manner on federal and state tax variables. Cross-jurisdictional differences in state investment tax credits and state corporate tax rates entering the user cost, combined with a panel that is long in the time dimension, are key to identifying the effectiveness of state investment incentives. Two models are estimated. The capital demand model is motivated by the first-order condition for a profit-maximizing firm and relates at the state level the capital/output ratio to the relative user cost of capital. The twin-counties model exploits both the spatial breaks ("discontinuities") in tax policy at state borders and our panel data set to relate at the county level the relative user cost to the location of manufacturing establishments. Using the capital demand model, we find that own-state capital formation is substantially increased by tax-induced reductions in the own-state price of capital and, more interestingly, substantially decreased by tax-induced reductions in the price of capital in competitive states. Similarly, using our twin-counties model, we find that county manufacturing establishment counts around state borders are higher on the side of the border with the lower price of capital, but the difference is economically small, suggesting that establishments are much less mobile than overall capital. Extensions of the capital demand model also reveal that state capital tax policy appears to be a zero-sum game among the states in that an equiproportionate increase in own-state and competitive-states user costs tends to have no effect on own-state capital formation.

Conferences

Monetary Policy and Asset Markets

2008 Annual Pacific Basin Conference

Applied Micro Summer Conference

Symposium: Research on the Effects of Fiscal Stimulus

Symposium: The Outlook for Future Productivity Growth

The San Francisco Fed's Research Department organized three conferences and two symposiums in 2008.

The Department's annual macroeconomic conference, "Monetary Policy and Asset Markets," addressed the role of asset markets in the economy and their importance for the conduct and implementation of monetary policy, a particularly pertinent topic, given the ongoing developments in U.S. financial markets. Papers focused on five areas: extracting information on policy changes from the interest rate term structure; examining the extent to which subjective expectations may explain certain asset price puzzles; quantifying the factors that drive residential investment and housing sector spillovers to the broader economy; studying how investors' need to learn about an asset's risk and return characteristics can generate recurrent bubbles and crashes; and analyzing whether shocks to expectations in currency markets create a role for a central bank stabilizing its exchange rate.

The 2008 Annual Pacific Basin Conference sponsored by the Bank's Center for Pacific Basin Studies (CPBS) brought together papers on a variety of international topics, including trade and growth in Asia, global current account imbalances, and international investment patterns.

The Department sponsored a summer conference focused on various applied microeconomic topics, including analyses of the impacts of government programs and insights into the behavior of businesses; all the papers shared a common approach of applying detailed microeconomic data to understand behavior and to distinguish causation from correlation.

The Bank's Center for the Study of Innovation and Productivity (CSIP) sponsored two symposiums. The first, "Research on the Effects of Fiscal Stimulus," featured four of the foremost economic experts on fiscal policy, who spoke about countercyclical fiscal policy and the likely impact of the Economic Stimulus Act of 2008. The papers in the second symposium, "The Outlook for Future Productivity Growth," varied in their methodologies but came to somewhat similar conclusions, that productivity is poised to grow at about 2 percent over the next several years, a pace similar to the postwar average but below the rapid growth rates achieved from the mid-1990s through the mid-2000s.

These conferences bring professional economists from the Federal Reserve System and from research institutions together with policymakers from the United States and abroad. Many of the papers presented are "works in progress" and therefore represent the latest research on policy-related issues.

Attendance at all of the conferences is by invitation only. In addition, the papers are chosen from submissions by a select group of noted researchers.

In this section are the conference agendas as well as summaries of the conferences that appeared in our *FRBSF Economic Letter.*

Monetary Policy and Asset Markets

Federal Reserve Bank of San Francisco
February 22, 2008

Sponsored by the Federal Reserve Bank of San Francisco

Papers presented at this conference can be found on the website
http://www.frbsf.org/economics/conferences/0802/

Keynote Speech: The Costs and Benefits of Deviating from the Systematic Component of Monetary Policy

John Taylor, *Stanford University*

Monetary Policy Shifts and the Term Structure

Andrew Ang, *Columbia Business School*
Jean Boivin, *Institute of Applied Economics, Montreal*
Sen Dong, *Lehman Brothers*

Discussants: Giorgio Primiceri, *Northwestern University*
Kenneth D. West, *University of Wisconsin*

Housing Market Spillovers: Evidence from an Estimated DSGE Model

Matteo Iacoviello, *Boston College*
Stefano Neri, *Bank of Italy*

Discussants: Tommaso Monacelli, *Università Bocconi*
Jonas Fisher, *FRB Chicago*

Expectations, Real Exchange Rates, and Monetary Policy

Michael B. Devereux, *University of British Columbia*
Charles Engel, *University of Wisconsin*

Discussants: Jon Faust, *Johns Hopkins University*
Michael Woodford, *Columbia University*

Learning about Risk and Return: A Simple Model of Bubbles and Crashes

William Branch, *University of California, Irvine*
George Evans, *University of Oregon*

Discussants: Ken Kasa, *Simon Fraser University*
Bruce Preston, *Columbia University*

Bond Positions, Expectations, and the Yield Curve

Monika Piazzesi, *FRB Minneapolis and University of Chicago*
Martin Schneider, *FRB Minneapolis and NYU*

Discussants: Pierre-Olivier Gourinchas, *University of California, Berkeley*
Jonathan Wright, *Federal Reserve Board of Governors*

2008 Annual Pacific Basin Conference

Federal Reserve Bank of San Francisco
September 19–20, 2008

Sponsored by the Center for Pacific Basin Studies,
Federal Reserve Bank of San Francisco

Papers presented at this conference can be found on the website
http://www.frbsf.org/economics/conferences/0809/agenda.pdf

Keynote Speech: Commodity Speculation and Emerging Markets

Michael Dooley, *University of California, Santa Cruz*

Exporting Deflation? Chinese Exports and Japanese Prices

David Weinstein, *Columbia University*
Christian Broda, *University of Chicago*

Discussants: Yu-Chin Chen,
Sam Kortum, *University of Chicago*

Why Do Foreigners Invest in the United States?

Kristin Forbes, Massachusetts Institute of Technology

Discussants: Henning Bohn, *University of California, Santa Barbara*
Vincenzo Quadrini, *University of Southern California*

Current Account Dynamics and Monetary Policy

Andrea Ferrero, *FRB New York*
Mark Gertler, *New York University*
Lars Svensson, *Central Bank of Sweden*

Discussants: Paul Bergin, *University of California, Davis*
Maury Obstfeld, *University of California, Berkeley*

Inventories, Lumpy Trade, and Large Devaluations

George Alessandria, *FRB Philadelphia*
Joseph Kaboski, *Ohio State University*
Virgiliu Midrigan, *New York University*

Discussants: Ariel Burstein, *University of California, Los Angeles*
Thomas Chaney, *University of Chicago*

How Much of South Korea's Growth Miracle Can Be Explained by Trade Policy?

Michelle Connolly, *Duke University*
Kei-Mu Yi, *FRB Philadelphia*

Discussants: Katheryn Russ, *University of California, Davis*
Jian Wang, *FRB Dallas*

China's Exporters and Importers: Firms, Products, and Trade Partners

Kalina Manova, *Stanford University*
Zhiwei Zhang, *International Monetary Fund*

Discussants: Ippei Fujiwara, *Bank of Japan*
John Schindler, *U.S. Department of the Treasury*

When Bonds Matter: Home Bias in Goods and Assets

Nicolas Coeurdacier, *London Business School*
Pierre-Olivier Gourinchas, *University of California, Berkeley*

Discussants: Paolo Pesenti, *FRB New York*
Jonathan Heathcote, *FRB Minneapolis*

Applied Micro Summer Conference

Federal Reserve Bank of San Francisco
June 25–27, 2008

Sponsored by Federal Reserve Bank of San Francisco

Papers presented at this conference can be found on the website
http://www.frbsf.org/economics/conferences/0806/

Can Subgroup-Specific Mean Treatment Effects Explain Heterogeneity in Welfare Reform Effects? Evidence from Connecticut's Jobs First Experiment

Marianne Bitler, *University of California, Irvine*
Jonah Gelbach, *University of Arizona*
Hilary Hoynes, *University of California, Davis*

Salience and Taxation: Theory and Evidence

Raj Chetty, *University of California, Berkeley*
Adam Looney, *Federal Reserve Board of Governors*
Kory Kroft, *University of California, Berkeley*

Trade Induced Technical Change? The Impact of Chinese Imports on Technology and Employment

Nicholas Bloom, *Stanford University*
Mirko Draca, *London School of Economics*
John Van Reenen, *London School of Economics*

The Return to Capital for Small Retailers in Kenya: Evidence from Inventories

Michael Kremer, *Harvard University*
Jean Lee, *Harvard University*
Jonathan Robinson, *University of California, Santa Cruz*

The Impact of the Food Stamp Program on Infant Outcomes

Douglas Almond, *Columbia University*
Hilary Hoynes, *University of California, Davis*
Diane Whitmore Schanzenbach, *University of Chicago*

The Effect of Education on Adult Mortality and Health: Evidence from the United Kingdom

Damon Clark, *University of Florida*
Heather Royer, *Case Western Reserve*

Symposium: Research on the Effects of Fiscal Stimulus

Federal Reserve Bank of San Francisco
May 9, 2008

Sponsored by the Center for the Study of Innovation and Productivity, Federal Reserve Bank of San Francisco

Some papers presented at this symposium can be found on the website http://www.frbsf.org/csip/research/symposium200805.pdf

Perspectives on Fiscal Stimulus — Michael Boskin, *Stanford University and Hoover Institution*

Economic Stimulus: Lessons from 2001–2004 and Prospects for 2008 — Matthew Shapiro, *University of Michigan*

Consumer Spending and the 2001 Tax Rebates — Nicholas Souleles, *University of Pennsylvania, Wharton*

How Much Should We Rely on Fiscal Stimulus? — Alan Auerbach, *University of California, Berkeley*

Symposium: The Outlook for Future Productivity Growth

Federal Reserve Bank of San Francisco
November 14, 2008

Sponsored by the Center for the Study of Innovation and Productivity, Federal Reserve Bank of San Francisco

Some papers presented at this symposium can be found on the website http://www.frbsf.org/csip/research/symposium200811.pdf

Keynote Speech: Computer Mediated Transactions

Hal Varian, *Google and University of California, Berkeley*

Projecting World Economic Growth: The Contribution of Information Technology

Dale Jorgenson, *Harvard University*

Explaining a Productive Decade: An Update

Stephen Oliner, *Federal Reserve Board of Governors*

The Slowest Potential Output Growth in U.S. History: Measurement and Interpretation

Robert Gordon, *Northwestern University*

What Do We Know and Not Know about Potential Output?

John Fernald, *FRB San Francisco*

Panel Discussion: Productivity Growth in Real Time

John C. Williams, *FRB San Francisco*
Daniel Sichel, *Federal Reserve Board of Governors*
Peter McGoldrick, *European Central Bank*
Robert Gordon, *Northwestern University*
Dale Jorgenson, *Harvard University*

Monetary Policy and Asset Markets: Conference Summary

Reprinted from FRBSF Economic Letter *2008-21, July 11, 2008.*

This *Economic Letter* summarizes the papers presented at a conference on "Monetary Policy and Asset Markets" held at the Federal Reserve Bank of San Francisco on February 22, 2008.

At this year's conference, academic researchers and policymakers gathered to discuss five research papers that address the role of asset markets in the economy and their importance for the conduct and implementation of monetary policy, a particularly pertinent topic, given the ongoing developments in U.S. financial markets. Among other things, asset markets provide a source for financing investment and consumption, they facilitate diversification of risk, and they represent an important source of information on expectations about future price movements and about future monetary policy actions.

One of the papers focused on extracting information on policy changes from the interest rate term structure and on whether investors value those policy changes or view them as an additional source of risk to be hedged. Another paper examined the extent to which subjective expectations may explain certain asset price puzzles. A third paper looked at the housing sector, quantifying the factors that drive residential investment and the extent to which housing sector developments can spill over to the broader economy. A fourth paper studied asset price bubbles, showing how investors' need to learn about an asset's risk and return characteristics can generate recurrent bubbles and crashes. A fifth paper analyzed whether shocks to expectations in currency markets create a role for a central bank stabilizing its exchange rate.

Monetary policy shifts and the term structure

Much empirical evidence suggests that monetary policy in the U.S. has changed in important ways over the postwar period. One prominent example of such a change is the tighter monetary policy that followed Paul Volcker's appointment to Chairman of the Federal Reserve, which is widely accepted to have lowered inflation during the early 1980s. Evidence also suggests that a change in monetary policy may have played an important role in the lower inflation and output volatility that the economy has experienced since the mid-1980s. Of course, in addition to affecting aggregates like output and inflation, changes in monetary policy affect asset prices and the term structure of interest rates. In fact, since short-term and long-term interest rates are connected by investor behavior, the interest rate term structure might usefully provide valuable information on the nature and importance of monetary policy changes.

To harness this information from the term structure, Ang, Boivin, and Dong estimate a monetary policy rule for the U.S. together with a model of the interest rate term structure. Their approach allows them to determine more accurately the policy changes that have taken place over the past 50 years and to quantify how these policy changes have affected the risk premium associated with holding long-term nominal bonds. Importantly, if investors dislike the risk associated with policy changes, then they will demand greater compensation to hold long-term bonds, implying a higher risk premium.

The authors find that monetary policy has indeed changed in important ways that are consistent with previous studies. For example, they find that the Federal Reserve responded to inflation shocks more aggressively during the 1980s and 1990s than it did during the 1970s. Interestingly, they also find that investors are generally willing to pay—rather than be paid—to be exposed to monetary policy changes, implying that investors value the policy changes that have occurred.

Learning about risk and return: Bubbles and crashes

Many believe that prices for assets like stocks can depart in important ways from the fundamental factors, such as profits, that should determine their value. These departures from fundamentals can be prolonged and lead to increases and falls in asset prices that are popularly referred to as bubbles and crashes. For example, the run-ups in stock prices that ended abruptly in 1987 and 2000 are each consistent with bubbles that drove prices above their fundamentals and that then crashed. Researchers studying asset price bubbles often associate them with periods when investors appear willing to accept lower compensation for holding risk, with the crash then occurring once investors become more cautious and demand greater compensation for risk.

Although theories of risk-neutral "rational" investors can generate asset price bubbles, they have difficulty explaining their subsequent crashes, often attributing them to forces that

are external to the theory. In contrast, Branch and Evans analyze asset price behavior from the perspective of investors who must learn and who are risk-averse. Specifically, in their model, investors must use historical data on an asset's price to estimate the return and, critically, the risk associated with holding that asset. Using a theory of empirical learning that assumes investors favor recent over older data, these authors show that occasional shocks to fundamentals may cause investors to lower their estimate of risk and raise their estimate of return, causing stock prices to rise above fundamentals. They show that, as stock prices increase, so too do investor estimates of perceived riskiness, until demand for stocks collapses and the bubble crashes.

Expectations, real exchange rates, and monetary policy

The role that exchange rates play in the conduct of monetary policy is a key issue, especially for small open economies for which the tradable goods sector is often large. Policy-induced movements in interest rates, for instance, can change the external value of the currency, which, if prices of some goods are sticky, can alter how a country allocates its expenditure between domestically produced and imported goods. This mechanism provides an additional channel through which a central bank can stimulate or damp aggregate demand. Although the exchange rate's role as a channel through which monetary policy can operate is clear, it is less clear whether central banks should respond to exchange rate movements or actively seek to damp fluctuations in the currency.

Devereux and Engel argue that a case can be made for a central bank responding to and stabilizing the exchange rate. They argue that the relative price of any two nondurable goods should ideally be unaffected by perceptions of future fundamentals. For instance, even though one might expect a technological innovation to make one good relatively cheaper to produce tomorrow, leading to the expectation that its relative price will be lower tomorrow, ideally this expectation should not change its relative price today. But since exchange rates move primarily in response to news that alters expectations about the future, when nominal prices are sticky, news shocks can create relative price changes that are undesirable. As a consequence, Devereux and Engel suggest that a monetary policy that can offset, or mitigate, the effects of news shocks emanating through the exchange rate can potentially raise welfare.

Housing market spillovers

Many of the central issues and concerns facing the economy today are related to the housing sector. Over the past seven or eight years, residential investment first surged at a faster rate than usual and then collapsed as demand for housing first faltered and then crashed. While some believe that the low interest rates that followed the collapse of the "dot-com" bubble may have helped spur the housing sector, implying that the housing sector responds passively to macroeconomic developments, it is also possible that the housing sector could be an increasingly important driver of the business cycle.

To help understand the role of the housing sector in the business cycle, Iacoviello and Neri develop a model that explicitly introduces a housing sector, which governs the production of new homes, and a market for loans, secured against house values, into an otherwise quite standard New Keynesian business cycle model. They examine the nature of the shocks hitting the housing sector and analyze whether any spillovers from housing sector developments to the wider economy are big. Estimating their model on U.S. data over the period 1965:Q1–2006:Q4, they find that shocks to housing supply and demand each explain roughly 25 percent of the cyclical volatility of residential investment while monetary factors explain about 20 percent. They also find that it was faster technological progress in the nonhousing sector that drove up house prices during the 1970s, but that the recent boom and bust in residential investment growth "was driven in non-negligible part by monetary factors." With respect to housing sector spillovers, for the period following the reforms to the mortgage market that occurred in the 1980s, they find that fluctuations emanating from the housing sector have accounted for about 12 percent of the variation in consumption growth.

Bond positions, expectations, and the yield curve

Standard asset pricing models suggest that an asset's price should depend on its expected return and on how those returns are expected to covary with consumption. For a given expected return, an asset that is expected to provide a higher return in situations when consumption is low provides a form of insurance that households value and are prepared to pay a premium for. This consumption-based approach to valuing assets has given rise to a number of important asset pricing puzzles, including the famous equity premium puzzle that describes the apparent excess return to holding stocks. These asset price puzzles challenge our understanding of how assets, such as bonds, should be valued.

One key assumption in this literature is that expectations are formed rationally, which is to say that the people forming expectations about returns, etc., get things right on average and do not make systematic forecasting errors. It is possible, however, that expectations are not rational. In that case, what appear to be asset pricing puzzles may instead simply reflect the subjective beliefs of investors rather than a fundamental failure of asset pricing theory.

To investigate the importance of subjective expectations for asset prices, Piazzesi and Schneider study evidence on expected returns from the Blue Chip and Goldsmith-Nagan surveys. Analyzing these surveys, they find systematic differences between subjective and objective interest rate expectations, differences that have material implications for bond prices and the excess return to holding bonds. Moreover, they find survey-based expected excess returns to be smaller and less countercyclical than other measures of expected excess returns. Building a statistical model that explains jointly interest rates and inflation and investors' subjective beliefs about these variables, Piazzesi and Schneider are able to explain why subjective risk premia are significantly less volatile than objective risk premia.

Richard Dennis
Senior Economist

Conference papers

Conference papers are available at
http://www.frbsf.org/economics/conferences/0802/index.html

Ang, Andrew, Jean Boivin, and Sen Dong. 2008. "Monetary Policy Shifts and the Term Structure." University of Columbia, manuscript.

Branch, William, and George Evans. 2008. "Learning about Risk and Return: A Simple Model of Bubbles and Crashes." University of Oregon Working Paper 2008-1.

Devereux, Michael, and Charles Engel. 2008. "Expectation, Real Exchange Rates, and Monetary Policy." University of Wisconsin, manuscript.

Iacoviello, Matteo, and Stefano Neri. 2008. "Housing Market Spillovers: Evidence from an Estimated DSGE Model." Boston College Working Paper 659.

Piazzesi, Monika, and Martin Schneider. 2008. "Bond Positions, Expectations, and the Yield Curve." University of Chicago, manuscript.

2008 Annual Pacific Basin Conference: Summary

Reprinted from FRBSF Economic Letter *2009-10, March 13, 2009.*

This *Economic Letter* summarizes the papers presented at the 2008 Annual Pacific Basin conference held September 19–20, 2008, at the Federal Reserve Bank of San Francisco under the sponsorship of the Bank's Center for Pacific Basin Studies.

This year's Pacific Basin conference brought together papers on a variety of international topics, including trade and growth in Asia, global current account imbalances, and international investment patterns.

Trade and growth in Asia

Traditional trade theory holds that firms are more likely to engage in international trade when they have advantages of greater productivity and/or lower costs. Newer work suggests that credit availability and contract concerns, such as intellectual property rights, are also important factors in determining patterns of trade. Manova and Zhang make use of newly available data on globally active Chinese firms to assess the role of these factors. They find that most of China's trade is conducted by a few firms, with the top 1 percent responsible for 50 to 60 percent of exports and imports. Foreign-owned firms account for roughly 50 percent of China's trade and are substantially more likely to export and import than privately held domestic firms. This may be because affiliates of foreign multinationals frequently import intermediate products for further processing, final assembly, and re-exporting.

Manova and Zhang also find evidence that foreign-owned and state-owned firms account for relatively more of Chinese exports and imports in industries in which access to financing is important. This is consistent with a credit-constraints view of international trade, which holds that a firm's ability to obtain financing affects its ability to export and import. Foreign ownership can offer cheaper financing by providing access to the financial resources of the parent company. State ownership facilitates financing from local state-owned banks. These advantages enhance the ability of foreign- and state-owned firms to trade relative to more credit-constrained firms.

In addition, Manova and Zhang find that the share of Chinese exports and imports held by the affiliates of foreign multinationals is relatively higher in sectors that are more intensive in research and development (R&D). By comparison, both private and state-owned domestic firms are substantially more active in sectors with low R&D intensity. This suggests that firms engaged in developing and producing more technologically sophisticated products prefer to integrate production across borders through foreign branches and subsidiaries, rather than outsourcing to unaffiliated firms.

China's overall trade growth has been accompanied by a dramatic change in the pattern of its bilateral trade with Japan and the United States. In 1992, Japan imported three times as much from the United States as from China. By 2005, China had become Japan's largest trading partner, with Japan importing twice as much from China as it was from the United States. Over the same period, Japanese import prices generally fell, leading some analysts to suggest that Chinese imports contributed to Japan's persistent deflation.

Weinstein and Broda assess the impact of imported Chinese goods on Japanese prices from 1992 to 2005. They first show that the methodology used to compute official Japanese import prices overstates how much overall import prices declined over the period. They find no evidence that China had a strong deflationary impact on reported Japanese import prices, either directly through lower rates of inflation for existing imported Chinese products, or through competitive pressure on other exporters to Japan. They detect no difference in the price trend of Chinese goods compared with other imported goods.

However, Weinstein and Broda link Japan's expanded imports from China to significant increases in the quality of goods. They estimate that when prices are adjusted for quality (price per unit quality), the typical price of Chinese exports fell by half between 1992 and 2005. Thus, they attribute the growth in Japanese imports from China to the increasing quality and variety of Chinese goods.

South Korea's real per capita GDP growth averaged almost 7 percent annually between 1961 and 1995. A key feature of this "miracle" was an enormous increase in Korea's international trade, particularly in manufactured goods. Over this period, Korea's merchandise exports as a share of GDP rose from 2 percent to more than 30 percent, while the share of manufactured goods in exports rose from 35 percent to over 90 percent.

Connolly and Yi assess the importance of trade-policy reforms in explaining Korea's growth miracle. They point out that in the early 1960s Korea eliminated tariffs on imported inputs and capital equipment used to produce goods for export. In addition, beginning in the 1970s and continuing for the next two decades, Korea engaged in a broad, gradual reduction of tariff rates.

Connolly and Yi formulate a structural model of growth and trade that highlights several channels through which trade liberalization can increase per capita income. First, bilateral tariff reduction may engender specialization and greater productivity growth. Second, tariff exemptions for investment goods increase imports of such goods and spur capital accumulation. They find that tariff reductions can explain up to one-third of South Korea's catch-up to industrial countries in output per worker.

International trade

Fixed transaction costs and delivery lags represent important frictions to international trade. Alessandria, Kaboski, and Midrigan document that these costs lead firms to limit the frequency with which they place import orders and to hold substantially larger inventories of imported goods than domestic goods. They argue that this behavior helps explain the short-run responses of trade flows and pricing to unanticipated terms-of-trade shocks experienced in recent years by developing economies.

Specifically, Alessandria, Kaboski, and Midrigan formulate a model of importers facing uncertain demand, order lags, and fixed costs of importing, They show that a sudden devaluation that increases the relative price of imported goods at the wholesale level leads to an immediate, though temporary, drop in the quantity of imported goods as well as higher than desired inventory holdings. Consequently, importers find it desirable to limit increases in retail prices of imported goods so they can draw down their inventories. The model provides a novel explanation for the slow adjustment of retail prices observed during devaluation episodes.

Global imbalances and investment

Many economists argue that the large U.S. current account deficit, driven in great part by an enormous excess of imports into the United States over exports, is unsustainable and necessarily must shrink. Correcting the current account imbalance would require a falling dollar to expand U.S. exports and curb imports. Ferrero, Gertler, and Svensson explore what would be the best monetary policy during a period when the current account deficit was contracting.

The authors construct a simple two-country model. They recognize that monetary policy by itself may not be able to do much to facilitate adjustment, since current account imbalances largely reflect real factors such as differences in savings and investment among trading nations. They consider two adjustment scenarios—one in which the home country's current account adjustment is smooth and slow, and the second, in which the home country's current account deficit is rapidly reversed.

Ferrero, Gertler, and Svensson find that, under the slow-adjustment scenario, alternative approaches to monetary policy have only modestly different effects on the domestic economy. In contrast, when adjustment takes place rapidly, domestic output and inflation are very sensitive to monetary policy. They conclude that the best economic outcome occurs when monetary authorities target a specified inflation rate. The authors argue that monetary policy targeting a fixed exchange rate is not desirable because holding the nominal exchange rate steady places all the burden of adjustment on domestic prices. In such a case, while the nominal exchange rate is fixed, it is necessary to lower domestic prices substantially relative to foreign prices in order to make domestic goods more attractive to foreigners so that exports expand and the current account deficit declines. To make general domestic prices lower, monetary policymakers would be forced to raise interest rates at the cost of lower domestic output.

Global investment

The last 20 years have witnessed an unprecedented increase in cross-border financial transactions. Theory suggests these capital flows should be motivated in part by investor desire to diversify risks globally. Standard international portfolio models hold that domestic investors should direct a share of their wealth abroad proportionate to the financial size of foreign markets, typically measured by relative stock market capitalization. However, empirical evidence suggests that investors have a bias for equities and bonds from their home markets and a strong reluctance to "go abroad" as much as the standard model indicates they should.

More recent models suggest that a home equity bias may arise when domestic stock investments provide a good hedge against exchange rate risk. Theoretically, the hedge would be effective if domestic stock market returns were to rise when the domestic currency appreciated. In that case, domestic residents holding domestic stocks would receive more income just as domestic goods become more expensive for foreigners, causing external demand for those goods to fall. The extra equity income hedges the lower profits of domestic exporters stemming from the loss of earnings on sales to foreigners. However, the empirical correlation between equity returns and the real exchange rate is too low to explain the observed equity home bias.

Coeurdacier and Gourinchas explain equity home bias by introducing bonds into an international portfolio model. In this model, the hedging of real exchange rate risks primarily occurs through international bond holdings rather than equities, because relative bond returns are strongly correlated with real exchange rate fluctuations. Since bonds can hedge real exchange rates very well, equities are not needed to protect against exchange rate risk. Equilibrium equity positions

are determined instead by the correlation of returns on equity with returns from other nonfinancial forms of wealth. Their model explains the significant levels of home equity bias in the United States, Japan, and Canada.

The ability of the United States to run persistent current account deficits has been in part sustained by U.S. success in attracting foreign capital inflows. Why are foreigners willing to invest so much in the United States, especially given low returns relative to comparable investments in other countries and widespread expectations of continued dollar depreciation?

Forbes finds that standard portfolio allocation models and diversification motives are poor predictors of foreign holdings of U.S. liabilities. Foreigners do not invest more in either U.S. equity or debt markets if returns in their own markets are less correlated with the United States, providing little support for a diversification motive for foreign investment. Instead, foreigners hold greater shares of their investment portfolios in the United States if they have less-developed financial markets. This supports the view that U.S. financial markets provide services to countries lacking deep or efficient markets. In addition, countries with fewer capital controls and greater trade with the United States also invest more in U.S. equity and bond markets, suggesting that trade relationships foster international investment flows.

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Conference papers

Conference papers are available in pdf format at
http://www.frbsf.org/economics/conferences/0809/agenda.pdf

Alessandria, George, Joseph Kaboski, and Virgiliu Midrigan. "Inventories, Lumpy Trade, and Large Devaluations."

Coeurdacier, Nicolas, and Pierre-Olivier Gourinchas. "When Bonds Matter: Home Bias in Goods and Assets."

Connolly, Michelle, and Kei-Mu Yi. "How Much of South Korea's Growth Miracle Can Be Explained by Trade Policy?"

Ferrero, Andrea, Mark Gertler, and Lars Svensson. "Current Account Dynamics and Monetary Policy."

Forbes, Kristin. "Why Do Foreigners Invest in the United States?"

Manova, Kalina, and Zhiwei Zhang. "China's Exporters and Importers: Firms, Products, and Trade Partners."

Weinstein, David, and Christian Broda. "Exporting Deflation? Chinese Exports and Japanese Prices."

Applied Micro Summer Conference: Summary

Reprinted from "Summer Reading: New Research in Applied Microeconomics," FRBSF Economic Letter *2008-27, September 5, 2008.*

This *Economic Letter* summarizes several papers presented at the Federal Reserve Bank of San Francisco's Applied Microeconomics Summer Conference, held June 25–27, 2008.

This year's conference included papers on a number of topics, including analyses of the impacts of government programs and insights into the behavior of businesses. All the papers shared a common approach of applying detailed, microeconomic data to understand behavior and to distinguish causation from correlation.

Assessing the impacts of public policy

One of the primary focuses of applied microeconomic research is analyzing the effects of government programs, sometimes called program evaluation. This year's conference contained several papers of this type; one examined the effects of changes in public assistance programs on labor market outcomes, another examined consumer responses to how taxes are posted, and a third explored the impact of the Food Stamp Program on health outcomes.

Very few microeconomists conduct independent randomized trials to analyze behavioral responses. However, microeconomists frequently use randomized trials conducted by states or the federal government for program evaluation. Bitler, Gelbach, and Hoynes used data from one of these experiments, Connecticut's Jobs First program, to learn more about the potential impact of welfare reform.

During the early to mid-1990s, before passage of the national welfare reforms of 1996, about half of the states in the U.S. were granted a waiver to experiment with alternatives to the longstanding national program, Aid to Families with Dependent Children, provided that those alternatives underwent careful evaluations. To facilitate those evaluations, some states set up experiments where program participants (in this case, women on welfare) were randomly chosen either to stay with the traditional welfare program or to participate in the new, alternative program. The alternative program could then be evaluated by following participants in both programs over time and examining differences in average outcomes across the two groups. Connecticut's Jobs First program was so designed, producing excellent data for studying incentives, behavior, and outcomes. This program shared many elements with the national welfare reforms passed in 1996, such as time limits (how long an individual could ever receive assistance) and work requirements. In previous research, the authors found that, on average, the participants in Jobs First were more likely to be employed and to have higher earnings than their counterparts in the traditional welfare program several years after the experiment began. An important aspect of their more recent research is that they also dig deeper into the data to examine differences in outcomes; that is, although it may be true that Jobs First participants enjoyed higher earnings on average relative to participants in the traditional welfare program, it does not follow that everyone in Jobs First fared better than everyone in the traditional program. In fact, the authors found that even within narrowly defined subgroups (distinguished by, for example, race, marital status, or number of children), not all Jobs First participants fared well in the labor market. An important lesson from these results is that comparing the average outcome, even across subgroups, may not tell us very much about the distribution of outcomes across all participants and that estimators like those used in their paper may be more appropriate for interpreting the data.

Chetty, Looney, and Kroft used several data sets to examine differences in consumer responses depending on whether sales taxes are clearly marked on products or whether they are not clearly marked but are assessed at checkout. The first data set comes from an experiment where a supermarket posted the total price of a good (that is, a price that also explicitly incorporates sales tax) for a subset of items for three weeks. Perhaps surprisingly, the authors found that the demand for items where the total price was displayed dropped by about 8 percent compared to regularly marked goods.

The authors also examined changes in demand when there is a change in the tax on a product and the tax is embedded in its price. In the case studied, the tax is an excise tax, and the product is beer. The authors found that the demand for beer dropped in response to increases in excise taxes, and the drops in demand are of similar magnitude to the drops in demand for the goods in the supermarket example. While these results provide evidence that consumers behave differently depending on whether taxes on goods are part of the posted price or charged at the register, the explanation for that behavior is less clear. One explanation may involve inattention and imperfect optimization; that is, when shopping, consumers are flooded with information about products and prices,

and therefore they do not consciously compute the prices that would include sales tax. Regardless of the reason, these results suggest that the way policymakers tax goods can have notable effects on the consumption of those goods.

Almond, Hoynes, and Schanzenbach examined the effectiveness of the Food Stamp Program (FSP), one of the mainstays of the 1960s War on Poverty. This program was intended to boost nutrition to low-income families; however, the authors considered whether it also may have had other potentially beneficial effects, and therefore analyzed the relationship between the rollout of the FSP in the 1960s and early 1970s and newborn outcomes, particularly birth weight. The FSP may be related to birth weights because birth weights are related to maternal nutrition; if the FSP increases maternal nutrition, then the fraction of newborns with low birth weight could be reduced. To explore this issue, the authors examined changes in birth weights across counties and how those changes are related to the introduction of FSP in those counties. They found that the introduction of the FSP was associated with a reduction in babies with very low birth weights, especially for babies of unmarried mothers and nonwhite mothers.

Causation or correlation?

A theme of papers presented at the conference was an attempt to distinguish between correlation and causation. A good example of this is in the health and education literature, where it is well documented that education and health tend to be positively correlated; that is, the more education an individual has, the more likely that individual will be healthier later in life. If higher education "causes" better health outcomes, then there could be room for health policies that promote education. One way to test whether education "causes" better health is to look for instances when education suddenly increased and then examine the differences in health between those with higher education compared to those with lower education. One such instance was in 1947, when the United Kingdom increased the minimum age for leaving school from 14 to 15. Using this change in policy, Clark and Royer compared health outcomes of individuals who were the last to face the 14-year age limit to individuals who were the first to face the 15-year age limit. The logic behind this exercise is that these two groups of individuals should be very similar, with the only primary difference being education. Clark and Royer found that the change in the education law did result in increased education and in increased subsequent earnings. However, the authors found that those first to face the 15-year age limit had only slightly better long-run health outcomes than their younger, less-educated counterparts. Therefore the strong correlation between health and education seems likely driven by other mechanisms.

Microeconomic analysis of firms' behavior

In the papers discussed above, much of the data used focused on individuals. However, applied microeconomic researchers also focus on the behavior of businesses, and the conference contained two such papers.

The first paper, by Kremer, Lee, and Robinson, estimated the marginal rate of return on inventories in order to ask how much profit would change if inventories were increased slightly. Estimating the marginal rates of return on inventories is very difficult, mainly because of the unavailability of adequate data. To overcome this data hurdle, the authors developed a data set on the sale of phone cards from a sample of retail shops in western Kenya. The shops were asked periodically how many cards they had sold and if they had sold out; if the shops had sold out, then that implies that potential customers were turned away, resulting in lost profit. Using these data, the authors estimated that many of the shops did frequently sell out of phone cards. Why this happened is puzzling and would be a fruitful subject of future research. Although it is difficult to know the reasons behind these results, this research certainly raises many questions about small business practices in developing countries.

Not surprisingly, applied microeconomists also use business data from more advanced economies. One area of active research has been on the role of increased trade on economies, especially trade between less developed and more developed countries. To gain better insights into how an advanced economy responds to increased trade with China, Bloom, Draca, and Van Reenen examined the history of 30,000 manufacturing establishments spanning 14 European countries. The authors examined whether or not these establishments survived, and, if they did survive, how they changed in response to increased trade competition from China. The authors found that establishments in sectors that were subject to increased import competition from China were more likely to close than establishments in other sectors. Additionally, those establishments that closed were not as technologically intensive as those that remained open. Further, those establishments that did remain open tended to increase their technology intensity. With these facts in hand, the authors concluded that increased trade with China is responsible for only a small portion of the overall increase in technology intensity, implying that other forces may be more important in the increase in overall technology intensity.

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Conference papers

Conference papers are available at
http://www.frbsf.org/economics/conferences/0806/index.html

Almond, Douglas, Hillary Hoynes, and Diane Schanzenbach. "Food Stamps and Infant Health."

Bitler, Marianne, Jonah Gelbach, and Hillary Hoynes. "Can Subgroup-Specific Mean Treatment Effects Explain Heterogeneity in Welfare Reform Effects? Evidence from Connecticut's Jobs First Experiment."

Bloom, Nicholas, Mirko Draca, and John Van Reenen. "Trade Induced Technical Change? The Impact of Chinese Imports on Technology and Employment."

Chetty, Raj, Adam Looney, and Kory Kroft. "Salience and Taxation: Theory and Evidence."

Clark, Damon, and Heather Royer. "The Effect of Education on Adult Mortality and Health: Evidence from the United Kingdom."

Kremer, Michael, Jean Lee, and Jonathan Robinson. "The Return to Capital for Small Retailers in Kenya: Evidence from Inventories."

Research on the Effects of Fiscal Stimulus: Symposium Summary

Reprinted from FRBSF Economic Letter *2008-20, July 3, 2008.*

This *Economic Letter* summarizes the presentations at a symposium held at the Federal Reserve Bank of San Francisco on May 9, 2008, sponsored by the Bank's Center for the Study of Innovation and Productivity (CSIP).

On February 13, 2008, President Bush signed into law the "Economic Stimulus Act of 2008," which consisted of roughly $100 billion of tax rebates and more than $50 billion of investment incentives for businesses. The act was a response to weakness in the economy and prospects for more substantial deterioration in spending and in the labor market. Its enactment has prompted questions about its potential effects—will consumers spend or save the funds from the rebate checks? will the short-lived tax breaks boost business investment?—and has renewed the broader debate about the use of "activist" countercyclical fiscal policy.

On May 9, 2008, just as the first rebate payments were starting to land in taxpayers' checking accounts, the Center for the Study of Innovation and Productivity (CSIP) hosted a symposium on "Research on the Effects of Fiscal Stimulus." The symposium featured four of the foremost economic experts on fiscal policy who spoke about countercyclical fiscal policy and the likely impact of the most recent stimulus package. This *Economic Letter* summarizes their remarks.

Perspectives on fiscal stimulus

Michael Boskin of Stanford University kicked off the symposium with an overview of the progression of economic thinking on the topic of fiscal stimulus. Stepping back from the particulars of the 2008 or earlier fiscal stimulus measures, Boskin considered how economic thinking has evolved about the desirability of countercyclical discretionary fiscal policy. "Discretionary" or "activist" fiscal policy means government expenditure and/or tax policy that is explicitly changed, typically through legislation, in response to current economic activity. This is distinct from nondiscretionary or "automatic" policy, by which expenditures and tax revenues change as a result of changes in economic activity without any action on the part of policymakers.

Until recently, the consensus view in mainstream economics was that such countercyclical discretionary fiscal policy actions were undesirable and/or ineffective. However, in the last few years, this consensus has unraveled and perhaps even begun to converge upon the opposite viewpoint, namely, that discretionary countercyclical fiscal policy can be effective and potentially more timely than monetary policy in counteracting the harm of economic downturns.

So, Boskin asked, what has changed? Is the current downturn more severe or otherwise qualitatively different from past downturns? Boskin first analyzed the causes and severity of the current downturn—and thus motivation for fiscal stimulus—relative to previous downturns, in particular, the recessions of 1990–1991 and 2001. The current downturn shares many of the same contributing factors with those past episodes but, at least so far, it is far milder. Economic growth in the current episode has not yet turned negative, and the level of job losses has been modest compared to the earlier downturns. In addition, in the current episode, monetary policy arguably has been at least as responsive as in the past, if not more so.

If the answer is not that the current downturn is more severe or qualitatively different than past downturns, what has changed? Boskin points to two changes in economic thinking. First, it is now widely recognized that economic agents (consumers, workers, investors, firms, etc.) are quite limited in the extent to which they save and borrow to smooth consumption over time. Such smoothing behavior would tend to mitigate the effectiveness of temporary fiscal stimuli. Second is the recognition that, while monetary policy's effects on the economy come at a substantial lag, the impact from prompt fiscal policy actions may be more immediate.

Lessons from 2001–2004 and prospects for 2008

Matthew Shapiro of the University of Michigan discussed the empirical evidence on the effects of the fiscal stimulus measures of 2001–2004, which, like those of 2008, consisted primarily of tax rebates and investment tax incentives, and he presented some preliminary findings on the effects of the 2008 tax rebates. Looking at the effects of the earlier measures provides an indication of what can be expected from the current measures.

Roughly one-third of the cost of the fiscal stimulus package in 2008 comes from a temporary bonus depreciation allowance, aimed at reducing taxes for firms that invest in qualified equipment and structures during 2008. This allowance is essentially a repeat of the bonus depreciation allow-

ances enacted in 2002 and 2003. His paper on the impacts of the 2002–2003 rebates on business investment (House and Shapiro 2008) analyzed data on quarterly investment over this time frame broken out by the length of service life of the underlying assets. As in 2008, assets that have service lives above 20 years did not qualify for the tax incentives, but among qualifying asset types, the value of the incentives increased with their service lives. Comparing investment across assets of different service lives, House and Shapiro found that, during the period in which the bonus depreciation allowances were in effect, aggregate investment shifted away from the nonqualifying assets and toward the qualifying assets, especially those with the longest service lives. Nonetheless, Shapiro concluded that while the effects on the composition of investment were significant, the effect on the level of aggregate investment was modest and the overall effect on GDP likely was quite small.

Shapiro then discussed research he and others have conducted on the effectiveness of the 2001 tax rebates in terms of stimulating consumer spending. In particular, he discussed the results that he and his coauthor Joel Slemrod have obtained from surveying individuals directly (through the University of Michigan Survey of Consumers), asking them what they planned to do with their rebate payments (Shapiro and Slemrod, 2003). Shapiro reported that 45 percent of rebate-receiving respondents said they would mostly use their rebate to pay down debt; 34 percent said they would mostly save the rebate; and just 21 percent said they would spend it. A "mostly spend" proportion around 20 percent, according to Shapiro, translates into a marginal propensity to consume of about one-third, meaning that out of each $1 of rebate payments, about 33 cents tends to go to consumption in the short run. Shapiro and Slemrod conducted a similar survey in 2008, and found strikingly similar results.

In both their 2001 and 2008 surveys, Shapiro and Slemrod also asked the "mostly save" and "mostly pay down debt" respondents whether that was a short-run response to be followed by increased spending later. The vast majority of respondents indicated that they planned for their saving or debt pay-down to be permanent. So even in the long run, less than 30 percent of survey respondents said they would eventually mostly spend their rebate payments.

Evidence on the 2001 rebates from credit card and consumer expenditures data

What people say they will do and what people do are not always the same, however. As Shapiro points out, the survey evidence should be complemented with data on individuals' actual consumption and savings behavior to get a full picture of the rebates' effects. The third speaker of the symposium, Nicholas Souleles of the University of Pennsylvania, has been at the forefront of the research looking at such individual level data and has coauthored two of the most important papers in this area.

Both studies exploit a little noticed feature of the IRS's rebate disbursement process. To minimize on logistical and mailing burdens, the IRS spaced out the check mailings over several months into separate batches according to the penultimate digit in the recipient's social security number, a digit that is essentially random. This randomness in when people receive their rebates allowed Souleles and his coauthors to isolate the effect on an individual's spending and saving behavior coming from the rebate from any macroeconomic effects that would affect all people at the same time.

In the first study, Johnson, Parker, and Souleles (2006), the authors looked at data on household expenditures from the Consumer Expenditure Survey. They found that, in terms of spending on nondurables, a little more than one-third of the average rebate was spent in the first quarter after receiving the rebate, a result closely matching the direct survey results of Shapiro and Slemrod. However, in contrast to those results, Souleles and his coauthors found that more than two-thirds is spent by the end of the third quarter after receipt.

In a second study, Agarwal, Liu, and Souleles (2007) looked at credit card data from a large, national credit card company. Using a representative sample of card customers over the 2000–2002 period, the researchers separated individuals in the sample according to the penultimate digit of their social security numbers. This allowed them to identify when each individual received the 2001 rebate check. They then looked at what happened to credit card spending and debt pay-down for the average credit card holder in the month of, as well as several months after, the receipt of the rebate. The results reveal that the typical credit card holder primarily paid down debt in the first couple of months but then began increasing spending and reaccumulating debt, returning to pre-rebate debt levels by six months after receiving the rebate.

These results suggest that the 2008 rebates could in fact provide a substantial boost to consumer spending. Souleles noted, however, that the 2008 rebate effect could be smaller because consumers' overall balance sheets are weaker in 2008 given the declines in housing wealth.

The responsiveness of fiscal policy to economic activity

Alan Auerbach of the University of California, Berkeley, closed out the symposium with a broad discussion of the extent to which fiscal policy historically has been countercyclical and whether countercyclical discretionary fiscal policy can actually be destabilizing. Auerbach first analyzed the extent to which discretionary fiscal policy in general responds

to the state of the economy. He found that, at least over the last 25 years, discretionary changes to federal government revenues (tax policy) tended to be procyclical while discretionary changes in government spending were countercyclical. Thus, both revenue and spending (discretionary) policies have tended to have a stabilizing effect on the economy, pushing up economic activity in bad times and applying the brakes in good times.

Auerbach then discussed the cyclical properties of investment incentives over recent decades. His analysis indicated that tax incentives aimed at spurring investment, e.g., the recent bonus depreciation allowances, have tended to be countercyclical, as one might expect. Interestingly, though, he suggested that part of the countercyclicality of investment incentives may in fact be due to businesses holding back investment in anticipation of investment incentives rather than fiscal policy responding to weak (strong) economic activity by increasing (decreasing) investment incentives. In this sense, predictable investment incentives could actually be destabilizing since they contribute to lower investment during downturns and higher investment during recoveries. Along these lines, Auerbach discussed research that found that investment incentives, while perhaps countercyclical, do contribute to increased volatility of investment.

Lastly, Auerbach asked whether so-called "automatic stabilizers"—aspects of current fiscal policy (i.e., current tax code and current expenditure plans) that tend to weaken the government's budget during downturns and strengthen the budget during booms—have become more or less stabilizing over time. Auerbach's analysis of the responsiveness of the tax code to changes in output over the last several decades indicates that the responsiveness rose to a historical peak during the 1970s, fell during the 1980s, rose moderately during the 1990s, and fell sharply during 2001–2003. Since 2003, responsiveness has been rising again but is still far below the peak around 1981. The decline in the role of automatic stabilizers could be part of the explanation for why nonautomatic (discretionary) countercyclical fiscal policy has once again become an important instrument in the fiscal policymaking toolbox.

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Shapiro, Matthew, and Joel Slemrod. 2003. "Consumer Response to Tax Rebates" *American Economic Review* 93(1) (March) pp. 381–396.

Symposium presentations

Links to some of the symposium presentations are available at http://www.frbsf.org/csip/research/symposium200805.pdf

Auerbach, Alan. "How Much Should We Rely on Fiscal Stimulus?"

Boskin, Michael. "Perspectives on Fiscal Stimulus."

Shapiro, Matthew. "Economic Stimulus: Lessons from 2001–2004 and Prospects for 2008."

Souleles, Nicholas. "Consumer Spending and the 2001 Tax Rebates."

The Outlook for Productivity Growth: Symposium Summary

Reprinted from FRBSF Economic Letter *2009-11, March 20, 2009*

This *Economic Letter* summarizes several papers presented at the symposium "The Outlook for Future Productivity Growth" hosted November 14, 2008, by the Federal Reserve Bank of San Francisco's Center for the Study of Innovation and Productivity (CSIP).

The goal of the symposium was to bring together leading experts in the field of productivity growth to present their recent research. The papers varied in their methodologies but came to somewhat similar conclusions, that productivity is poised to grow at about 2 percent over the next several years, a pace similar to the postwar average but below the rapid growth rates achieved from the mid-1990s through the mid-2000s.

An overview of productivity growth

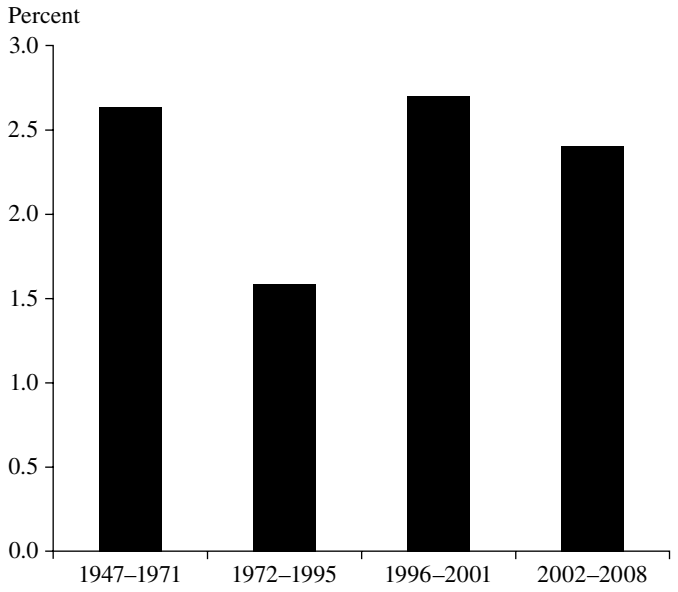
Productivity measures the amount of output per unit of input. One of the more common productivity concepts is labor productivity, a measure of how much output is produced per unit of human labor, usually expressed in terms of output per hour. Often, the phrase "productivity growth" refers specifically to labor productivity, and that will be the case in this *Letter* unless otherwise noted.

Labor productivity growth receives a lot of attention for several reasons. The first is that rising productivity is key for increasing the standard of living. Another reason is that labor productivity growth is an important determinant of the rate of overall economic growth. Therefore, the ability to predict productivity gains helps fiscal and monetary authorities prepare the economic forecasts they need to set policy.

Forecasting labor productivity growth has proven difficult, however, in part because such increases fluctuate greatly over time. For example, Figure 1 shows the average annual growth in labor productivity over several time periods. These productivity statistics are restricted to the nonfarm business sector, which makes up slightly more than three-quarters of all economic activity. For instance, from 1947 to 1972, labor productivity growth averaged 2.6 percent per year. A "productivity slowdown" began in the early 1970s, and from 1972 to 1995, productivity growth averaged only 1.6 percent per year. The cause of this sharp deceleration has been the subject of much debate and speculation.

Labor productivity growth accelerated in the mid-1990s and averaged 2.7 percent between 1996 and 2001. Many papers have been written about this productivity resurgence, often with a great emphasis placed on the role of the information technology (IT) revolution.

Figure 1: Average Long-term Labor Productivity Growth (Nonfarm Business Sector)



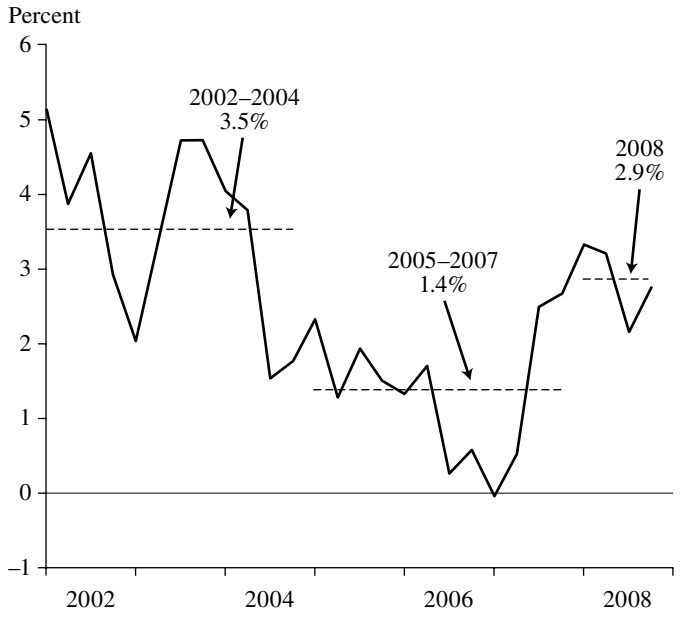
Source: Bureau of Labor Statistics.

From 2002 to 2008, productivity growth averaged 2.4 percent. However, these average growth rates mask the extent to which growth fluctuated. As shown in Figure 2, productivity growth can be quite volatile from year to year. For example, labor productivity growth averaged an extremely high 3.5 percent in the years 2002 to 2004 but slowed to an average of 1.4 percent over the period 2005 to 2007. More recently, productivity growth surged to 2.9 percent in 2008. A further complication is that productivity growth is often revised as better data become available. For instance, recent revisions lowered the estimates of average annual productivity growth by about ¼ percentage point from 2005 to 2007.

Modeling productivity growth

Given the difficulties in forecasting, the question remains: What is the outlook for future productivity growth? The pa-

Figure 2: Labor Productivity
(Nonfarm Business Sector,
Year-over-year Percent Change)



Source: Bureau of Labor Statistics.

pers presented at the symposium use different approaches for projecting future trends. Productivity growth depends on such factors as human capital (that is, the quality of the workforce, often measured by education) and the amount and types of physical capital, such as computers, motor vehicles, and buildings. Another important determinant is a variable known as total factor productivity (TFP), which gauges the efficiency of production, holding constant such inputs as labor and physical capital. For instance, if a factory becomes more productive by reorganizing its production line, but without changing its capital, then this would be an increase in TFP. Researchers have found that TFP plays a large role in overall productivity growth.

Several of the papers model productivity growth by developing complicated sets of equations to translate these factors into aggregate productivity forecasts. These sets of equations vary along many dimensions—including the number of sectors, the linkages between sectors, and judgments about how much emphasis should be placed on each factor—and each paper presents a different variation on this underlying model.

In an ambitious study, Jorgenson and Vu project not only productivity growth in the United States but also overall economic growth for over 100 countries. In previous work with a variety of coauthors, Jorgenson has emphasized the role of IT in productivity growth, particularly for understanding the U.S. increase in the mid-1990s. When thinking about how IT affects productivity, Jorgenson and Vu emphasize productivity growth within the IT sector itself (that is, how productive the U.S. is at manufacturing IT goods) and within sectors that use IT, such as the financial services industry. An important assumption in their framework is the pace of technological change in the IT sector. According to several measures, technological progress in the IT sector appears to have accelerated beginning in the mid-1990s continuing through the early 2000s. This technological progress boosted labor productivity greatly in the computer, semiconductor, and communications-equipment industries. The authors then show that in the 2000s the strong rate of growth was sustained by fast increases in productivity in sectors of the economy that were heavy IT users, such as financial services. This analysis suggests that productivity growth depends on technological progress in the IT sector, the size of the IT-producing sector, and the extent to which IT is adopted in other sectors of the economy.

According to Jorgenson and Vu, U.S. productivity growth should continue at about a 2 to 2.5 percent pace over the next five years, based on the assumption that technological progress in the IT sector will increase at a rate close to its historical average, not at the higher rate witnessed during the latter half of the 1990s. At the same time, productivity should grow rapidly in sectors such as health care and education that have not fully reaped the gains from IT.

Oliner and Sichel, in an update to Oliner, Sichel, and Stiroh (2007), also examine the relative importance of various factors for past productivity growth. They emphasize what is known as "intangible" capital, which is widely acknowledged to play an important role in productivity but can be difficult to measure. When examining economic and productivity growth, economists often measure physical capital. But firms also possess intangible capital, which can include such assets as firm-specific organizational structure, brand equity, and knowledge created by research and development. Using measures of intangible capital based on the work of Corrado, Hulten, and Sichel (2006), Oliner and Sichel show that growth in intangible capital helped boost productivity growth in the latter half of the 1990s but had a dampening effect on productivity growth in the 2000s.

The authors employ a complicated steady-state model with five sectors, including four IT sectors and another sector representing the rest of nonfarm business. The model relies on roughly 30 parameters to project future productivity growth, yielding a wide range of estimates, but with a midpoint of around 2 percent, on par with those produced by Jorgenson and Vu. Oliner and Sichel's estimates depend on certain key assumptions, such as the rate of technological change in the IT sector and TFP growth in the remaining portion of the nonfarm business sector.

Basu and Fernald address not only productivity growth, but also a broader concept of potential output. Although the definition of potential output growth can vary, it is often meant to be the sum of the sustainable growth in labor, such as the growth that occurs through an increasing population, combined with productivity growth. Potential output is often taken into account when discussing monetary policy, for example, to identify when the economy is growing faster or slower than its "potential." The Basu-Fernald model has two sectors, one producing investment goods (capital) and another producing consumer goods. The authors demonstrate the importance of technological change that drives down the price of capital goods, akin to the discussions of the price of IT goods by both Oliner and Sichel, and Jorgenson and Vu. The Basu and Fernald model produces labor productivity growth of about 2 percent in equilibrium, close to projections in the other two papers.

More judgment-based views of future productivity growth

Gordon also examines potential output growth by focusing specifically on productivity. He argues that the high rates of productivity growth from the mid-1990s to the mid-2000s were an extreme event not likely to be repeated, a view shared by the other authors. The share of IT investment in GDP was abnormally high in those years because of the synergies between computers and communications equipment as the Internet grew explosively. Additionally, Gordon argues that those IT applications that yield the greatest increases in productivity have already been implemented, and future advances in IT will likely yield lower efficiency gains than those seen in the past. He is less convinced than Jorgenson and Vu that the health and education sectors will experience large productivity gains in the future. He projects future productivity growth closer to the rates seen from 1987 to 1997 and 2004 to 2008, about 1.7 percent, slightly lower than the estimates provided in the other three papers.

Summary

Given its importance, it is not surprising that many sophisticated methods have evolved to forecast productivity growth. Authors at the symposium offered a consensus view centered around 2-percent productivity growth in the years ahead, with some arguing that 2 percent is conservative and others maintaining that 2 percent is optimistic.

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Oliner, Stephen D., Daniel E. Sichel, and Kevin Stiroh. 2007. "Explaining a Productive Decade." *Brookings Papers on Economic Activity* 38(2007-1) pp. 81–152.

Symposium papers

Links to some of the symposium papers are available at http://www.frbsf.org/csip/research/symposium200811.pdf

Basu, Susanto, and John G. Fernald. "What Do We Know and Not Know about Potential Output?"

Gordon, Robert J. "The Slowest Potential Output Growth in U.S. History: Measurement and Interpretation."

Jorgenson, Dale, and Khuong M. Vu. "Projecting World Economic Growth: The Contribution of Information Technology."

Oliner, Stephen D., and Daniel E. Sichel. "Explaining a Productive Decade: An Update."

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