Regulatory Competition and Cross-Fertilization in the US Banking Markets

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Regulatory Competition, Cross-Fertilization and Contestability in the US Banking Markets: A Tiebout Extension and Empirical Evidence

Abstract

We examine cross-fertilization in the productivity growth of banks between a state and its neighboring and non-neighboring states before (1971-1977) and during (1982-1995) the interstate multibank holding company (IMBHC) deregulations, upon which, cross-border bank M&As, mainly among neighboring states, could enhance cross-fertilization by injecting new blood and awakening the market for corporate control. Further, the 1978-1981 period offers a natural experiment to examine Baumol's (1982) Contestable Markets Hypothesis (CMH). The legislature of Maine made the first IMBHC deregulatory move in 1978. There was no reciprocity until New York made their moves in 1982. Under CMH, Maine's move should inject a competitive spirit and alter bank performance across banking markets. Results show that cross-fertilization in bank performance, observed among neighboring states during 1971-1977, gets stronger during 1982-1995 and that improvements in bank performance during 1978-1981 support CMH.

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1. Introduction

Regional scientists, urban and real estate economists, and economic geographers have long recognized the importance of geography and have formulated distance- (or space-) based models for economic analyses. Research from other fields also shows that spatial interactions cause diffusion (or contagion) of asset prices, diseases, innovations, and income. Haynes and Fotheringham (HF) (1984, pp. 10 and 11) recognize the importance of spatial interactions[1]:

> "One of the distinguishing aspects of human behavior is the ability to travel or move across the face of earth and to exchange information and goods over distance. Such exchange processes are referred to generically as interaction, and that which occurs over a distance occurs over space. Hence, the general term 'spatial interaction' (emphasis added) has been developed to characterize this common type of geographic behavior. Shopping, migrating, commuting, distributing, collecting, vacationing, and communicating usually occur over some distance, and therefore are considered special forms of this common social behavior – spatial interaction. ... the farther places, people, or activities are apart, the less they interact (emphasis added)."

Research on geography's economic effects on bank performance is, however, relatively new and limited in scope. This rather delayed recognition is surprising for a number of reasons. First, state-level statutory barriers, dating back to the late 19th century, had replaced natural barriers of an earlier era, and helped to preserve a geographically defined and segmented market structure for the banking industry (Kane, 1996). Effectively, these statutory barriers and their updates aimed to protect local monopolies or oligopolies of community banks from outside competition[2]. Second, in spite of some obvious observations and indirect empirical findings[3] of

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[1] We use interchangeably 'cross-fertilization,' 'spatial interactions,' and 'spatial diffusion'. For examples of diverse evidence of spatial interactions, see Christoffersen and Sarkissian (2009), Clapp et al. (1990, 1995), Cliff and Ord (1981), Dolde and Tirtiroglu (2002), Dubin (1988), Garbade and Silver (1978, 1979), Grinblatt and Keloharju (2001), Griliches (1957), Haining (1987), Loughran and Schultz (2005), Mandeville (1985) and Uysal et al. (2008), among others. Helsley and Zenou (2011) offer a mathematical model for spatial interaction arguments.

[2] Jayaratne and Strahan (JS) (1998, p.241) indicate that the banking "industry's efficiency may have been impaired by geographic restrictions because they vitiated corporate control markets by reducing the number of potential acquirers, thereby worsening agency problems between bank owners and managers." These regulations protected inefficient local banks, allowed them to avoid stiff competition from out-of-state banks, kept them profitable, and increased their probability of survival (Kane, 1996; Krozsner and Strahan, 1999; JS, 1996, 1998). Meanwhile, operating costs and loan losses decreased sharply and bank performance improved significantly after states permitted statewide branching and interstate banking (JS, 1998). Other consistent evidence, on the effect of the entry of de novo banks, is in DeYoung et al. (1998) and DeYoung and Hassan (1998).

[3] The geographic concentration in massive bank failures of late 1980s, early 1990s, and late 2000s is obvious. Further evidence of spatial patterns is reported, *albeit as a by-product of some non-geographic research questions*, in a few papers. First, return on equity (ROE) for US commercial banks exhibits a regionally-distinct pattern (Berger and DeYoung (BD), 2001). Second, the

geographically-concentrated bank performance patterns, the huge volume of empirical literature on the productive efficiency of banks have remained largely mute on integrating the effects of spatial interactions in bank performance. Interestingly and as expected, close proximity among sample units within the banking markets is the common thread of these findings. Third, spatial patterns are present in banks' production factors and output. For example, agriculture is a dominant economic activity for many heartland states, leading to a concentration and expertise in agriculture-based loans in the local commercial banks' loan production. Kane (1996) highlights the risks inherent in the under-diversified loan and deposit portfolios of such local commercial banks. Lastly, legal or natural barriers have not restricted either the interstate mobility of human capital or the spread of technological innovations and/or products and services or the ensuing processes arising from such spatial activities (see Greenspan (March 9, 1999) for commentary on the effects of technological change on the US economy).

We agree fully with Strahan (2003) that the US banking industry offers a unique, fertile and natural experimental ground. This paper studies whether and how state-level interstate multibank holding company (IMBHC) deregulations and the following changes in banking geography affect bank performance (see footnote 2). Our spatially-driven empirical approach tracks these deregulations across 48 contiguous states in USA, focuses on the cross-fertilization effects of them on banks' productivity growth[4], (i.e., the measure of bank performance considered here), and examines the following interrelated questions:

(1) Is there any evidence of cross-fertilization in the productivity growth of banks located in (i) a given state and (ii) its neighboring states in banking markets segmented geographically by state-level statutory barriers?

US commercial banks under the jurisdiction of the Third Federal Reserve District have noticeably less X-***in***efficiency than those under the jurisdiction of the remaining eleven Federal Reserve Districts (Mester, 1997). Third, DeLong (2001) shows that bank mergers within close proximity enhance stockholder value considerably more than others (see also Cornett et al. 2006; Delong and DeYoung, 2007 for further evidence). BD (2006), using the agency theory, provide the first direct evidence on geography's effect on banks' performance. Deng and Elyasiani (2008) and DeYoung et al. (2008) also recognize distance in their works.

[4] Amel (1993) provides the details of state legislatures' announcements of IMBHC deregulations. Humphrey (1992) stresses the need for more empirical evidence on TFPG in banking. TFPG has been a commonly used indicator of the role of technology on input productivity. *The Economist* (Oct. 3, 1992, pp.21-24) reported that the investment in technology by US banks went up from about $5.5 billion in 1982 to somewhere around $13 billion in 1991. BD (2006) also note that banks significantly increased their use of and investment in new information processing, telecommunications, and financial technologies over their sample period. Meanwhile, Saunders (1994, p.79) points out that, prior to 1975, almost all transactions in the financial services sector were paper based. Existing evidence suggests low productivity growth for the US banks during the 20th century (see Humphrey, 1992, 1994; Bauer et al., 1993; Daniels and Tirtiroglu, 1998, among others). The literature attributes any positive TFPG findings *mainly* to the growth in technical change. This is because the growth in the US banking industry was in the large regional and money center banks that did not have much scale economies left to be realized in the 20th century.

(2) Do state-level IMBHC deregulations, which allow for bank M&As across state borders and also awaken the forces of the market for corporate control, strengthen or initiate and nurture a cross-fertilization process in bank performance?

(3) Does the mere threat of new entry provide evidence for Baumol's (1982) "Contestable Markets Hypothesis" (CMH henceforth)?

Theoretically, we subscribe to Kane's (1984, 1988, 1996) *regulatory competition* framework, which posits gradual and progressive erosion in the effectiveness of the geographic and product line statutory restraints. This erosion stems mainly from technological advances and weakening enforcement - motivated by legal interpretive changes - roughly between 1930s and 1990s. Further, spatial interactions, as highlighted above by HF (1984), have occurred and affected banks' behavior irrespective of the statutory restrictions. Regulatory competition also explains endogenously the genesis and outcomes of the regulatory evolution.[5] We extend this framework to embrace the behavior that '*firms (i.e., banks) vote with their feet.*' This is a derivate of Tiebout's (1956) well-established behavior in Urban Economics that 'people vote with their feet.'[6] In particular, a state's deregulatory move disturbs the existing regulatory equilibrium among states and triggers other states' statutory responses. Hence, state-level IMBHC deregulations, which occur during our sample period, allow for and motivate a flow of banks, via M&As, from one state mainly to its neighboring ones and/or vice versa. These deregulations can also unleash the forces of the market for corporate control. Banks' geographical movements should enhance cross-fertilization in bank performance, if one were present, in the neighboring banking markets.

There was a four-and-a-half year delay between the first and the second deregulatory declarations, by Maine on January 1, 1978 and by New York on June 28, 1982. Maine announced the national reciprocity (NR) regime but no other state reciprocated until New York

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[5] Kane (1984,1988 and 1996) envisions regulation and deregulation as a dynamic and endogenous bargaining process between regulators and regulatees. On one side of the process, financial services firms (i.e., the regulatees) are changing organizational forms, charter types, office locations, product lines, production and delivery processes to (i) benefit from technological opportunities, (ii) enjoy economies of scale and scope, and / or (iii) decrease net regulatory burden. On the other side of the process, regulatory interference slows the rate of evolution by imposing entry restrictions on the financial services firms. However, competition among local and international regulatory authorities to attract and maintain customers (i.e., regulatees) forces regulators in the long run to enact regulations that promote cost-minimizing regulation and market structures.

[6] Tiebout (1956) considers local governments, which offer goods and services to citizens who have the option to move among distinct communities. If citizens are provided with an array of communities that offer different types or levels of public goods and services, then each citizen chooses the community that best satisfies his/her own particular demands. That is, individuals effectively "vote with their feet" to reveal their preferences.

announced its own NR regime.[7] This delay offers a natural experiment to study Baumol's (1982) CHM that an open-and-present threat of (enhanced) future new entry has firms to assume at present a (more) competitive and disciplined behavior. Under cross-fertilization and contestability, the threat of interstate competition should trigger a surge in banks' performance in both neighboring and non-neighboring banking markets between 1978 and 1982.

From an empirical view, we examine whether a relaxation in an IMBHC regulation either enhances an existing cross-fertilization process or spurs a new one in bank performance. We also study this relaxation's effects on the bank performance of a control sample of randomly chosen non-neighboring states. We study the period before deregulation, 1971-1977, the period when only potential competition existed following Maine's deregulation of branching in 1978 but before New York's in 1982, and the period of expanding deregulation from 1982 to 1995. This choice of periods allows us to compare cross-fertilization during the period when strict state-level statutory barriers allowed tightly restricted expansion mainly into neighboring states to cross-fertilization during the period when interstate competition was a threat but not yet a reality to cross-fertilization during a period of step-by step expansion of interstate competition. The enactment of the Riegle-Neal Interstate Banking and Branching Efficiency Act of 1994 (IBBEA) brings a natural end to our sample period. Focusing on the period of 1971-1995 controls for the confounding effects, introduced via IBBEA (and then the Gramm-Leach-Bliley Act (GLBA) in 1999), especially of *identity transformations* from a relatively simple, constant and well-defined commercial bank to a complex, multi-faceted and ever-evolving financial services firm and also of substantial geographic and/or business line expansions (see Mendonca and Wilson, Sep. 29, 1997, for a discussion of banks' identity transformation).[8]

Results from the pre-IMBHC deregulation period of 1971-1977 reveal mainly significant positive contemporaneous cross-fertilization, in the productivity growth of banks, among neighboring states. Further, the *total across time* of neighboring cross-fertilization effects are

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[7] Alaska, which is excluded from our sample, also declared its deregulation in mid-1982. State legislatures across USA expressed their preferences for relaxing the historical IMBHC regulations in their own states by granting other states either regional reciprocity or national reciprocity or national non-reciprocity. The first two regimes are conditional on receiving reciprocity from other states. The last is free from reciprocity and offers the most relaxed out-of-state IMBHC entry. These legislations empowered, differentially at the state level, the market for corporate control and, through its forces, altered dynamically and geographically the shape and scope of the local banking markets (see footnote 2, too).

[8] Prior to IBBEA and GLBA, (a) legally, the identity of a commercial bank was pretty much constant; (b) state legislatures redefined, in some cases more than once, the local borders of the market for corporate control for banks; (c) there was a set of rich and dynamically evolving activity in state legislatures' experimentations with the IMBHC regulations all over USA. See Mendonca and Wilson (Sep. 29, 1997) for the immense identity changes and their implications.

substantially larger than that of non-neighboring cross-fertilization effects. These findings support the first hypothesis, despite the regulation-induced market segmentation, underline the importance of spatial interactions in bank performance among neighboring banking markets (HF, 1984), and add to the mounting evidence of geography's effects on economic/financial performance in banking. Results from the 1982-1995 period, containing the dynamically evolving state-level IMBHC deregulations, indicate that the flow of banks via bank M&As across state borders and the awakening of the market for corporate control strengthen (reduce) considerably the *total across time* of neighboring (non-neighboring) cross-fertilization effects, respectively. Finally, our results support the contestability in the US banking markets.

Section 2 lays out the theory while section 3 discusses the empirical approach and the data. Section 4 reports the empirical results. Section 5 concludes the paper with some commentary on how our approach relates to a broad range of economic phenomena. Appendices detail the estimation of productivity growth indices.

2. Theoretical Framework

This section first motivates why cross-fertilization can occur in spite of the statutory interstate banking barriers. It then provides a brief review of relevant legal banking developments and summarizes the theory that explains the interstate (de)regulatory actions and their economic consequences (for detailed reviews, see Kane, 1996; Strahan, 2003). Relaxations over time in these regulations re-shaped continuously the geography, state-level concentration and the overall market structure of the banking industry in USA.

2.1 Statutory Restrictions and Cross-fertilization in Banking Markets

To our knowledge, no banking regulation has ever restricted mobility of human capital, client movements, distribution of products and services, or advances in technology and their spread across space. So, these factors along with banks' strategic moves to circumvent the IMBHC statutory barriers, such as exercising their option to move under the leapfrog loophole[9], can nurture cross-fertilization (see HF, 1984; Helsley and Zenou, 2011, among others). Also, Kane's (1996)[10] argument that a gradual erosion of regulatory enforcement of statutory restrictions, arising from both the interpretive relaxations and post-government private sector

[9] *Frog-leaping* option for banks, even under the prohibitive equilibrium, is noteworthy (Kane, 1996). Banks of some states could move their headquarters within a 30-35 miles radius, relocating eventually in a bordering neighboring state over a period of time. We thank Ed Kane for his clarifying informal comments on this matter.

[10] Kane (1996) notes: "History suggests that for the U.S. financial-services industry, before an exclusionary statute comes to be formally rescinded, most of the effects targeted by the recission will have already been tolerated by the enforcement system for years." See Wilmarth (1985) for an interesting and highly informative legal history of US banking laws.

employment opportunities for the regulators (i.e., mobility of *highly specialized and experienced* human capital), further contributes to the genesis of cross-fertilization. That is, the closer places, people, or activities are located, the more they interact, leading to positive contemporaneous and possibly lagged cross-fertilization in bank performance between a representative subject state and its neighboring states.

In principle, there should be no cross-fertilization relations in bank performance between a subject state and its randomly chosen non-neighboring states. Yet, these states are members of the same banking geography, share it interactively and concurrently with others, are possibly second or third order neighboring states to the same subject state, and implement pretty much the same technological innovations. Additionally, the geographic restrictions for banks aimed to protect local banking monopolies or oligopolies and prevented these markets from being contestable until Maine's first deregulatory move in 1978 (Baumol, 1982). So, the state-level bank performance metrics of concentrated banking markets could exhibit *cross-sectional* similarities. Thus, the contemporaneous neighboring and non-neighboring cross-fertilization effects on the state-level bank performance could have the same direction. But, increasing distance between a subject state and its non-neighboring states induces increasing costs for the mobility of human capital, allows for increasingly less (locally relevant) information exchange, constrains banks' leaping strategy, and can hence hinder the cross-fertilization process. Therefore, the magnitudes and/or time-lengths of neighboring versus non-neighboring effects on bank performance should differ. The *total across time* of neighboring cross-fertilization effects should be positive and greater than that of non-neighboring cross-fertilization effects.

2.2 A Brief Legal Background

A great majority of federal and state banking regulations was historically formulated in relation to banks' location. Both federal and state banking regulations and their amendments had shaped gradually, at the state-level, a geographically concentrated industry structure until 1995 when IBBEA, which is a federal law, has become effective (Amel, 1993; Kane, 1996).[11]

The Bank Holding Company Act of 1956 (BHCA) supplemented the spirit of the McFadden Act of 1927 and prohibited bank holding companies headquartered in one state from acquiring a bank in another state. Bankers, policymakers and researchers argued that restricting banks to operate only in a state, where they were chartered, might have deprived them of the benefits of diversifying their risks across the country, exposing the entire banking

[11] We are not concerned with the intrastate deregulations in this paper.

system, regulators and the federal deposit insurance administrators to face and deal with the ensuing massive bankruptcies in late 1980s (see Kane, 1989, 1996; BD, 2001, among others). The extant and voluminous literature on bank performance, covering periods prior to IBBEA, documents consistently bank performance that was less than satisfactory.

Concerns about geographic concentration and its potentially adverse economic consequences motivated the integration of the Douglas Amendment to the BHCA. The Douglas Amendment empowered states to control whether, and under what circumstances, out-of-state bank holding companies could own and operate banks within their borders.[12] Starting with Maine on January 1, 1978, state legislatures across USA introduced regulatory relaxations, usually with a condition of reciprocity by other states, in their IMBHC restrictions. This state-led legislative experimentation came to an end with the repeal of the BHCA and its Douglas Amendment under IBBEA, which allowed, starting on September 29, 1995, full nationwide banking across USA regardless of state laws.[13] Repealing provisions of the Glass-Steagall Act by GLBA in 1999 amplified both IBBEA's spirit for nationwide banking and transformation of banks into complex financial services institutions.

2.3 The Tiebout-Extended Regulatory Competition and Cross-fertilization

The BHCA prohibited bank holding companies headquartered in one state from acquiring banks in another state starting in 1956. This prohibition constructs a regulatory equilibrium among states, establishes barriers for out-of-state competition, and also constrains the market for corporate control to state-level dynamics. Maine legislature's announcement of the NR regime to be in effect on January 01, 1978 is the first poke by a state at the prohibitive regulatory equilibrium among states. Upon this announcement, out-of-state banks from any state within USA could engage in interstate M&A with banks headquartered in Maine for as long

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[12] Wilmarth (1985, pp. 1028-1029) notes: "Senator Douglas emphasized that the primary purpose of his amendment was to carry out the long-established federal policy against the undue concentration of financial resources. He declared that this policy was necessary to ensure both political liberty and economic competition. … Therefore, he argued that the pending bill and his amendment were critically needed to "check and, if possible, to roll back the concentration of banking and credit" in the United States." Wilmart (1985) further points out that "In sum, there can be no doubt that Congress delegated to each state, under the Douglas Amendment, a *general and unqualified power* to determine the degree to which *any* out-of-state bank holding company from *any* state could acquire banks within that state's borders."

[13] Two caveats are in order: (i) the BHCA also regulated banks that had formed bank holding companies in order to own both banking and non-banking businesses and (ii) geographic reshaping of the banking industry is an ongoing process in the aftermath of IBBEA and GLBA. US commercial banks have been transforming themselves from being just banks to being complex and multi-faceted financial services firms. Such transformations amplify the changes in and of the banking industry. Certainly, the giant bailout and forbearance costs, which arise from the Global Financial Crisis and massive failures of financial services firms, keep banks and their regulations an extremely important public policy topic all over the world today.

as the state legislature(s) of the out-of-state banks granted reciprocity for Maine's banks to undertake interstate M&A activity in their states. No state reciprocated until 1982 when Alaska and New York announced their initiation of the national non-reciprocity (NN) and NR regimes, respectively (Strahan, 2003). Their announcements provided the momentum for the subsequent rounds of (re)declarations of IMBHC deregulations across USA over a period of more than 10 years. Kane (1996) provides an excellent analysis of the political economy of the IMBHC deregulations. (Also, see Strahan, 2003; KS, 1999, among others).

An effective deregulatory move triggers a number of interrelated political and economic consequences. First, such a move disturbs, at least initially regionally, the existing prohibitive IMBHC regulatory equilibrium, which did not allow for market contestability (Baumol et al., 1982). This move reflects this particular legislature's conviction for capturing competitive and comparative advantages for its banks and banking system - such as enhanced scope and scale economies, reaching out to a larger client base, enjoying geographic diversification benefits, having access to a larger pool of labor market and increased tax revenues - over other states' banks and banking systems in its region. Before the move, local banks would be engaging in lobbying activities to have the legislatures to comprehend these benefits and to spearhead a deregulatory change (Kane, 1996). Given these likely advantages and their newly found freedom upon the legislative move, some banks, imprisoned legislatively within their state borders for decades, would be likely to embrace the Tiebout (1956) behavior of 'voting with their feet.' They would start the process of a flow of banks, via M&A transactions, across *mainly* neighboring states, which are identified in the announcement and expected to grant reciprocity.

Second, even a restricted geographic expansion of the banking market via M&As awakens rapidly the disciplining forces of the market for corporate control, which was put to hibernation by the BHCA of 1956. The intensifying monitoring and enforcement capabilities of the market for corporate control should inject new blood into banks' performance, irrespective of whether a bank is directly involved in any M&A transaction. That is, the 'lingering ghost' of market for corporate control and ongoing interstate M&A transactions within banks' own neighborhoods should affect the behavior of many banks.

Third, the newly arising disequilibrium puts political and economic pressures on the legislatures of other states in the region and forces them to initiate a legislative response of their own. Every legislative response reinforces the behavior of 'banks vote with their feet' and invites further responses from the legislatures of other states. This competitive process of legislative dialectic spreads gradually over the entire country, can encapsulate all or a majority of the states, and can last until a new regulatory equilibrium is reached, which satisfies the particular objectives of banks and state legislatures. As indicated in section 5, this dialectic process can characterize economic agents' and decision makers' behavior in other settings, too.

Fourth, clients, too, vote with their feet in banking markets. Closing a bank account is a client's exercise of his/her abandonment option of a bank and to move to another bank. Also, bank referrals from one customer to another, which is a common form of information transmission and experience-sharing among individuals, also occur over a geographic space. Both of these client-related factors can enhance and foster cross-fertilization in bank performance in the realm of IMBHC deregulations and ongoing urban sprawl in USA.

Dynamically evolving IMBHC deregulations engender, especially among neighboring states, a flow of banks via M&As across state borders, enhanced transfer of technology, intensified mobility of specialized and experienced human capital, and new banking options for clients and also unleash the forces of the market for corporate control. M&A transactions, however, may have some initial adverse effects on banks' performance since two businesses in a M&A need naturally time before they can begin to operate in harmony as one. Under these developments, bank performance across the entire geography should exhibit considerable changes from that during the 1971-1977 period. We posit that geographically expanding banking markets, under dynamically evolving IMBCH deregulations, will either strengthen the *total across time* of cross-fertilization in bank performance, if one were present during the period of pre-IMBHC deregulations, or spur a new process among neighboring states.

During the period of IMBHC deregulations, there should be no or little non-neighboring effects on bank performance. The number of banks in each state in the short run is fixed. Also, bank M&As and mobility of human capital are conjectured to take place mainly across neighboring states. Both factors restrict spatial interactions across increasing distances. This is a fundamental difference of the deregulatory era from its preceding era. The total across time of non-neighboring effects for 1982-1995 should be less than that for 1971-1977.

The framework of Tiebout-extended regulatory competition also explains the evolution of the state-level IMBHC deregulations during the sample period. A disturbance in the competitive equilibrium triggers further responses, including second or even third round deregulatory transitions. Table 1 shows that 37 states chose initially the RR regime between 1978 and 1995, but only 14 states completed the sample period under this regime. A transition from the RR regime to the NR (NN) regime by 18 (five) states followed, respectively. The number of states with an initial choice of NR was seven, of which two declared the NN regime later on, while the number of NR states at the end of 1995 was 23. The deregulatory transitions always sought a more relaxed IMBHC environment, potentially enhancing the strength of cross-fertilization in bank performance over time. The main adopters of the NN regime were western states.

[- insert Table 1 about here -]

2.4 Deregulation, Contestability and Cross-fertilization in the U.S. Banking Markets

A perfectly contestable market is one in which entry is absolutely free and exit is absolutely costless (Baumol, 1982). Either new entry or the threat of new entry drives two important equilibrium welfare properties of perfectly contestable markets. First, a perfectly contestable market never offers more than a normal rate of profit to deter hit-and-run industry entrants. Second, production inefficiencies cannot exist in such markets since inefficiencies would be an invitation to new entrants. In our context, the perfectly contestable markets theory predicts that, in a competitive equilibrium, differences in banking efficiency across states decrease and the profitability of banks converges. Research since Baumol's (1982) contribution has shown that a perfectly contestable market is mainly a theoretical benchmark. At a minimum, entry and exit are not costless. So, contestability of a market is a matter of degree.

Regulations banned out-of-state competition, deprived state-level banking markets of contestability, and protected and nurtured inefficient monopolies or oligopolies for much of the 20th century. To the extent that IMBHC deregulations allowed entry and made exit less costly, banking markets became increasingly contestable and had to endure strong winds of change towards a competitive equilibrium under contestability. In this context, the four-and-a-half year delay between the first and the second IMBHC deregulatory announcements, by Maine on January 1, 1978 and by New York on June 28, 1982, offers a natural experiment. Given the decades-long regulatory protections lent to inefficient banks, the first IMBHC deregulatory move by Maine in 1978 brings about the threat of new entry to the attention of all banks in USA. Under Baumol's (1982) CMH, Maine's move should trigger positive changes in bank performance, irrespective of the location of banks, during this transition period. These changes should arise from a relatively fast exploitation of inefficiencies across the banking geography before the market for corporate control unleashes fully its forces. Following Baumol (1982), we ask: "Does an open-and-present threat of new entry have banks to assume at present a (more) competitive and disciplined behavior during this transition period?"

3. Empirical Approach

The IMBHC deregulations took place at the state level. Therefore, we identify "state" as the geographic unit to perform our empirical tests, following Neely and Wheelock, (1997), JS, (1998), Kroszner and Strahan, (1999), Tirtiroglu et al., (2005), and Jeon and Miller (2003, 2007), and use the Federal Deposit Insurance Corporation's (FDIC) state-level annual aggregated data on US commercial banks. Our empirical approach is comprised of three steps:

(1) Computing *state-level* annual unfiltered total factor productivity growth (UTFPG) indices of US commercial banks for 1967-1995 is the first step.[14] JS (1998) point out that deregulations in the 1980s and 1990s enhance the natural tendency of markets to weed out inefficient firms. They document empirically the increase in the likelihood of the selection and survivorship problems, which, as per Heckman (1979), would bias tests based on data from individual banks, during this period. Following JS (1998), we also use commercial banking data, defined at the state level, since they are substantially less prone to these biases than those for individual banks. Further, this state-level approach is consistent with Harrigan's (1997) criticism of international trade economists' assumption that TFPG for each industry is the same in every country (see also Corsetti et al, 2007). We study TFPG because: (a) recent investment in technology in the commercial banking industry has been vast and increasing and (b) to our knowledge, there is not any empirical evidence on the *state-level* TFPG in banking, and (c) also, the evidence on the banking sector's TFPG is rather limited. Thus, understanding the nature of technology and the role it plays in commercial banking is important. Appendix 1 reports the details of UTFPG index estimation.

(2) Filtering the UTFPG indices is the second step. Slade (1989) warns that a) when some input factors are not freely variable, shadow costs and market prices for these factors can differ, b) this kind of measurement error, in turn, leads to biases in UTFPG indices, and c) the bias will manifest itself in a pro-cyclical fashion (see also Sbordone, 1997). The shadow costs and market prices can further differ if the factor markets are not competitive. Absence of competitive factor markets, combined with quasi-fixed inputs, will lead to pro-cyclical bias. These conditions exist in US commercial banking, providing the grounds for pro-cyclical bias.[15]

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[14] Productivity growth measurements by state between 1971 and 1995 are, though not reported, also a contribution of our paper. We will be happy to provide these results to interested readers upon their request.

[15] For example, Noulas et al. (1990) treat non-interest bearing deposits as a quasi-fixed input, while Hannan and Liang (1993) report evidence of lack of perfectly competitive bank deposit markets. Similarly, Humphrey (1992, 1994) recognizes that input prices may not reflect their shadow prices due to the extensive (de)regulations of the banking industry in the 20th century.

Methodological advances, which employ the Kalman-filtering techniques (Kalman, 1960; Kalman and Bucy, 1961) to purge the pro-cyclical bias component from the stochastic trend component of the TFPG indices, enable us to portray a reliable picture of TFPG (Slade, 1989; Sbordone, 1997; Daniels and Tirtiroglu, 1998). We remove the pro-cyclical bias in the state-level UTFPG indices and obtain the state-level filtered total factor productivity growth (FTFPG) indices for 1971-1995.[16] Appendix 2 reports the details of the Kalman filter application. These state-level productivity growth indices are for each of the 48 contiguous sample states and track with precision all dynamic state-level IMBHC regulatory relaxations during our sample period.

(3) Developing a novel *spatio-temporal* empirical model in search of evidence for cross-fertilization in banks' productivity growth is the third step. Close distance among decision units in spatial models serves often as a proxy for information with relatively little noise. We endorse and subscribe to this viewpoint and build accordingly our empirical model. We construct a panel data set on the state-level FTFPG indices and build a balanced *fixed-effects* model. The productivity growth of state i at time t is the dependent variable. The contemporaneous and lagged average productivity growth at time t (i) of neighboring and (ii) of randomly chosen non-neighboring states are the main independent variables. Estimations over different sub-samples, as discussed in section 3.2, unearth evidence for the main research questions.

There is mounting evidence for close proximity's visible effects on banks' performance and valuation (e.g., DeLong 2001; DeLong and DeYoung, 2007; Evanoff and Ors, 2008; and Uysal et al., 2008). Further, both the NR and NN regimes are mute about a concrete empirical content for cross-fertilization. Amel's (1993) work, however, shows that the states invited for reciprocity under the regional reciprocity (RR) regime by state i are, to a large extent, its neighboring states. Thus, the Tiebout-extended regulatory competition framework motivates, with the IMBHC deregulations in place, a spatial empirical model that focuses on cross-fertilization among states with a common border. As a control sample, we choose randomly non-neighboring states for each sample state. The number of non-neighboring states is the same as that of neighboring states.

3.1 Data and Sample

Our data set consists of the annual state-by-state data on insured US commercial banks for 1966-1995, obtained from the FDIC *Historical Statistics on Banking, 1934-1995* database (see www.fdic.gov). Using call reports, the FDIC aggregates commercial banks' data at the

[16]Data for the first few years are used up to initialize filtering.

state level. Appendix 1 provides summary statistics for these data. This data set offers us a spatial distribution over 50 states (and also for DC) for every year between 1966 and 1995, which facilitates the identification of "state" as the geographic unit. Alaska and Hawaii are not within continental USA. Washington DC is not officially a state. Therefore, these two states and Washington DC do not enter the final sample of states, forming the final sample with 48 states. Data on state-level (i) population, (ii) personal income and (iii) per capita income data are available at http://govinfo.library.orst.edu/reis-stateis.html.

The data initialization requirements under the Kalman filter estimations move the sample-beginning year to 1971. So, the total sample period runs from 1971 to 1995 and tracks all state-level announcements on the IMBHC deregulations. As indicated earlier, focusing on this period keeps the identity and definition of a bank relatively simple and constant and avoids the complexities of identity transformations, from a bank to a financial services firm, observed in the immediate aftermath of IBBEA since 1995.

Maine's and then New York's IMBHC deregulatory announcements in 1978 and 1982, respectively, lead us to consider four sub-sample periods: (i) 1971-1977, (ii) 1982-1995, (iii) 1971-1981, and (iv) 1978-1995. The first period examines the homogeneous legal space without any deregulatory distortions while the second focuses on the non-homogenous legal space of dynamically evolving IMBHC deregulations. A comparative examination of the results between the homogenous and non-homogenous sub-sample periods should shed light on the first and second research questions. Comparisons of results between 1971-1977 and 1971-1981 and also between 1978-1995 and 1982-1995 should provide deductive evidence for the third research question. Table 2 provides the means and standard deviations of all relevant variables across these sub-sample periods and reveals visible changes in the means and standard deviations of the dependent, neighboring and non-neighboring variables.

[- insert Table 2 about here -]

3.2 Testing for Cross-Fertilization in Bank Performance[17]

We specify the following spatially-driven fixed effects model for our empirical analyses:

[17] Hausman's (1978) test results indicate that data do not fit the random effects model. We urge the reader to remember that both APGNG and APGNON, by construction, have a cross-sectional dimension. Consequently, the correlation estimates, too, have a cross-sectional dimension and differ from those for variables with a time dimension only. Nevertheless, to address multicollinearity, we experimented with Almon's polynomial model and decided against its implementation. Its adoption led to even higher serial correlation among the lagged variables.

$$\mathrm{PG}_{i,t} = a_0 + \sum_{i=2}^{48}\delta_i * \mathrm{SD}_i + \sum_{t=2+(max j)}^{T}\theta_t * \mathrm{TD}_t + \sum_{j=0}^{3}\gamma_{(j+1)} * \mathrm{APGNG}_{i,(t-j)} + \sum_{j=0}^{3}\varphi_{(j+1)} * \mathrm{APGNON}_{i,(t-j)} + \sum_{k=1}^{4}\beta_k * \mathrm{X}_{k,i,t} + \mathrm{u}_{i,t} \quad [\mathbf{1}]$$

where i, j, k and t refer to the sample states, the number of (time) lags from 0 to 3, the number of other explanatory variables, and each year of the sub-sample periods; $PG_{i,t}$ is the Kalman-filtered TFPG for state i at time t and is a vector of [48xt] where t depends on both the time length of a sub-sample and the number of lagged variables in a model specification; SD_i refers to cross sectional indicator variables for each state (excluding Alaska, Hawaii, and DC); TD_t refers to time related indicator variables for each sample year; $APGNG_{i,t}$ ($APGNON_{i,t}$) refers to the average Kalman-filtered TFPG for commercial banks in state i's bordering neighboring (randomly chosen non-neighboring) states at time t, respectively; $\mathbf{X}_{k,i,t}$ is a [(48xt)x4] matrix with control variables of *Pop Grw* (annual state-level population growth), *Pop Dens* (annual state-level population density), *Inco Grw* (annual growth in state-level real per capita income), and *Branch No* (annual state-level total number of branches) for state i at time t; $u_{i,t}$ refers to the regression error term. Eq. **[1]** captures cross-fertilization effects and allows for a comparative examination of parameter estimates and their sums from one sub-sample period to another. The number of randomly chosen non-neighboring states is the same as that of bordering neighboring states for state i. Table 3 provides a list of neighboring and randomly chosen non-neighboring states for each state and summary statistics.

[- insert Table 3 about here -]

We estimate eq. **[1]** under OLS for each of the four sub-sample periods and consider six alternative model specifications in each sub-period. To avoid perfect collinearity, we drop the cross-sectional indicator variable for Alabama and also the earliest time-related indicator variable as per the sub-sample period. The need for estimating six alternative models arises from multicollinearity in pairs of APGNG (APGNON) and its lags. It is well-known that the distributed lag structure induces serial correlation among the lagged variables. Table 4 presents the pairwise estimates of correlation coefficients for APGNG and APGNON and their lags for each sub-sample and confirms these high correlations. The estimates (unreported) of correlation coefficients for the control variables are low.

[- insert Table 4 about here -]

The coefficient estimates under multicollinearity are unbiased but attain greater standard errors than their counterparts without multicollinearity. So, the net effect of multicollinearity is the increased likelihood of a failure to reject the null hypothesis (i.e., obtaining an insignificant estimate). On the other hand, a rejection of the null hypothesis in the presence of multicollinearity (i.e., obtaining a significant estimate) goes a long way to demonstrate the strength of the posited relation. Our empirical strategy tries to elicit as much information under multicollinearity about the conjectured cross-fertilization in bank performance as possible. So, we run eq. **[1]** without lags, j=0, for APGNG and APGNON (Model 1), then introduce sequentially individual lags, j=1 or 2 or 3, for APGNG and APGNON (Models 2 through 4), and then consider combinations of lags, j=1 and 2 or j=1,2 and 3 (Models 5 and 6).

3.3 Expected Empirical Relations

The IMBHC restrictions were uniformly in place across the banking geography during 1971-1977. There was, however, freedom for the mobility of human capital, spread and adoption of technology by banks and also movements of clients and/or products and services across states. These factors suggest positive contemporaneous estimates for APGNG, but do not motivate, in the presence of annual data, strong *temporal* (i.e., lagged) neighboring relations. The signs of non-neighboring effects on the bank performance of a representative state are an empirical issue. On the one hand, the advances in technology and their adoption by banks occur irrespective of banks' location, loading a positive effect on the contemporaneous estimate of APGNON. Moreover, the restrictions for banks that had protected local banking monopolies or oligopolies during this period might have nurtured state-level bank performance metrics that exhibit *cross-sectional* similarities irrespective of location. On the other hand, the costs of the mobility of human capital and client and/or products and services movements increase as the distance of a non-neighboring state from a subject state increases. These costs may even prohibit the mobility of human capital or client movements or amplify the noise in information exchanges. Hence, potentially negative effects of increasing distance may offset the potentially positive effects of previous factors on the coefficient estimates of APGNON and its lags. From an experimental design perspective, the total of contemporaneous and temporal non-neighboring effects should not be *ideally* different from zero.

The 1982-1995 period is the dynamic IMBHC deregulatory era, allowing for and also witnessing interstate bank M&As mainly among neighboring states, and awakening of the forces of the market for corporate control. The mobility of skilled and experienced human capital and possibly client movements were likely to intensify, following up on the M&A activities, among the neighboring states, too. These economic activities across neighboring states, on the one hand, should inject, especially early on, new blood and discipline to the banks and banking markets in these states and yield a positive and statistically significant contemporaneous coefficient estimate for APGNG. Short distances among neighboring states should enable a relatively fast absorption of these spatial interactions. Initial adverse effects, arising from harmonization efforts, of M&A transactions, on the other hand, act as a counter force and may lessen the magnitude and significance of the expected positive contemporaneous estimate for APGNG. M&A transactions should, however, exert their positive cross-fertilization effects with some delays on the lags of APGNG, amplifying the total of cross-fertilization effects between a subject state and its neighboring states. We expect the coefficient estimates for lagged APGNG to be greater than those obtained for the regulatory equilibrium period of 1971-1977.

The signs and significance of the coefficient estimates for APGNON and its lags are an empirical matter. On the one hand, spread of technology and/or products and services across space and mobility of human capital, though restricted from increasing distances, may exert a positive and delayed cross-fertilization effect. On the other hand, lack of reciprocity contemporaneously among a subject state and its non-neighboring states hinders the interstate M&As at time t. But, non-neighboring states' adoption of either the NR or the NN regime, with a time delay, may nurture interstate M&As among the subject state and its non-neighboring states. These M&A transactions are, however, likely to be from a residual pool of banks of the subject state that did not and could not engage in such a transaction early on, raising concerns, consistent with Roll's (1986) managerial hubris hypothesis, that such M&As may be adding either no incremental value or, even worse, destroying value. Further, dynamically evolving forces of deregulations should lead the state-level bank performance metrics of concentrated banking markets to *not* exhibit *cross-sectional* similarities anymore. Thus, we expect the contemporaneous (lagged) estimate(s) of APGNON to be insignificantly different from zero (either insignificantly different from zero or negative), respectively.

The sub-sample periods of 1971-1981 and 1978-1995 are inclusive of the 1978-1981 period, which offers a unique natural experiment to test empirically Baumol's (1982) CMH. If his conjecture were influential during this natural experimentation, the results for 1971-1981 (1978-1995) should differ from those for 1971-1977 (1982-1995), respectively. Comparing results from 1971-1977 against those from 1971-1981 should be deductively informative as the former are unconditioned on the first-ever state level IMBHC deregulatory action. Under cross-fertilization and even partially effective contestability, we should observe improvements in the bank performance of both the neighboring and non-neighboring markets during 1971-1981.

Comparing results from 1978-1995 against those from 1982-1995 should also be deductively informative. The 1982-1995 period is conditioned on an increasing number of deregulations in each year. Under cross-fertilization and partially (fully) effective contestability, we should observe either negative (no) neighboring and/or non-neighboring results for 1978-1995.

4. Empirical Results

We report the results for the (i) 1971-1977 period of prohibitive regulatory equilibrium in section 4.1, (ii) 1982-1995 period of IMBHC deregulations in section 4.2, (iii) comparisons between 1971-1977 and 1982-1995 in section 4.3, and (iv) 1971-1981 and 1978-1995 periods, focusing on Baumol's (1982) CHM, in section 4.4. In Tables 5 through 8, Model 1 excludes the lags of APGNG and APGNON while Models 2 through 4 introduce, one by one, the first-year, second-year and third-year lags of both variables. Model 5 (6) includes the first and second (all three) year lags of both variables, respectively. We refrain from interpreting the results for the fixed effects state and time dummy variables and other control variables. All our tables report the number of significant state and time dummy variables under each model.

Our estimation strategy builds on the effects of multicollinearity. In sections 4.1 and 4.2, we first interpret the results under the assumption of no effect from multicollinearity on them. We then re-interpret them, assuming that multicollinearity is the sole reason for the observed insignificance of what should otherwise be significant coefficient estimates of both the neighboring and non-neighboring variables.

4.1 Evidence from the 1971-1977 Regulatory Period

Table 5 reports empirical results from estimating eq. **[1]** for 1971-1977 during which the IMBHC restrictions were intact across all states. The R-squared values indicate a good fit.

[- insert Table 5 here -]

The coefficient estimates of APGNG are, as expected, positive and highly significant in Models 1 through 5. Given the well-known difficulty of rejecting the null hypothesis under multicollinearity, these significant results constitute remarkably strong evidence in support of contemporaneous cross-fertilization among banks of neighboring states in spite of the presence of the IMBHC restrictions. The insignificant coefficient estimate of APGNG in Model 6 is most likely a manifestation of multicollinearity. All coefficient estimates for the lags of APGNG are insignificant, small in magnitude, and positive, (except for -0.042 for L3-APGNG in Model 6). Panel A-Table 4 shows that the estimate of the correlation coefficient between APGNG and L3-APGNG is only 27%, indicating that multicollinearity is not the cause of insignificance of the estimates of L3-APGNG in Models 5 and 6. This observation implies that cross-fertilization in neighboring banking markets must have lasted no more than two years. Overall, our results offer evidence for cross-fertilization in bank performance among neighboring states. It was at least a contemporaneous process during 1971-1977.

All estimates of pairwise correlation for the non-neighboring variables in Panel A-Table 4 are high. So, an examination of *all non-neighboring results*, going from the most restricted model, Model 1, to the full model, Model 6, is useful. The estimate of APGNON is negative, -0.088, and insignificant in Model 1. In spite of multicollinearity, the negative and significant coefficient estimate of an individual lag of APGNON, in Models 2 or 3 or 4, tends to offset the positive and significant coefficient estimate of APGNON in the same model. These significant results on the lagged variables suggest that the negative and insignificant coefficient estimate of APGNON in Model 1 is likely an outcome of a simultaneous loading of the contemporaneous and temporal effects into a single estimate, -0.088. In Model 5, the coefficient estimate of APGNON (L2-APGNON) is positive (negative) and significant (significant), respectively, while that of L1-APGNON is positive, small, and insignificant. These results are also consistent with the preceding comments in this paragraph. In the full model of Model 6, the coefficient estimates for all non-neighboring variables are insignificant. Multicollinearity is the likely culprit of these results in this model.

The positive and significant contemporaneous non-neighboring results are consistent with the spread of technology and/or client or products/services movements across space and also with state-level bank performance metrics that exhibit *cross-sectional* similarities irrespective of location under the long-lasting regulatory protections.[18] The negative and significant coefficient estimates for the lags of APGNON in Models 2 through 5, in spite of multicollinearity, are consistent with the adverse effect(s) of increasing distances between a subject state and its non-neighboring states. As expected, the magnitudes and/or time-lengths of neighboring versus non-neighboring effects on the state-level bank performance differ.

Now let us suppose that multicollinearity is the sole reason that accounts for the observed insignificance of otherwise significant and mainly positive coefficient estimates for the neighboring and non-neighboring variables. Though we do not perform significance tests due to multicollinearity, the total across time of cross-fertilization between a subject state and its neighboring states, SUM-NG, is positive and greater than that between a subject state and its

[18] Section 4.3 examines in some detail the likely source of these results.

non-neighboring states, SUM-NON, in all models. Further, in all models, the magnitude of SUM-NG is *at least* as large as that of APGNG alone, while the magnitude of SUM-NON is *at most* as large as that of APGNON alone. These findings do nothing but add strength to the finding of cross-fertilization in the neighboring banking markets in the presence of IMBHC restrictions.

4.2 Evidence from the 1982-1995 Deregulation Period

Table 6 reports empirical results from estimating eq. **[1]** for 1982-1995 during which the IMBHC restrictions were lifted in different intensities across all states (except Hawaii). The R-squared values indicate a good fit. The pairwise correlation estimates for the neighboring and non-neighboring variables in Panel B-Table 4 are high.

[- insert Table 6 here -]

The coefficient estimates of APGNG are positive and highly significant in Models 1 through 5. The coefficient estimate of APGNG in Model 6 is also positive and remarkably almost significant at 10% in spite of the highest degree of multicollinearity across all models. All these results, under multicollinearity, are strong evidence for the contemporaneous cross-fertilization effects among banks of neighboring states and are also consistent with the view that M&A activities and the market for corporate control inject new blood and discipline across neighboring banking markets. All coefficient estimates for the lags of APGNG in Models 2, 3, 5, and 6 are insignificant and positive. In spite of the observed multicollinearity, the coefficient estimate, 0.273, of L3-APGNG in Model 4 is significant at 5% and differs substantially from its insignificant counterpart of 0.051 in Table 5. This finding offers some evidence of potential time delays, from M&A harmonization efforts, in the cross-fertilization of bank performance among neighboring banking markets. Overall, these results offer evidence of cross-fertilization in bank performance among neighboring states. It was certainly, once again, at least a contemporaneous process during 1982-1995.

For *all the non-neighboring results*, the contemporaneous coefficient estimates of APGNON are insignificant in all models. Results for APGNON and its lags in Model 2, 3, and 4 suggest, with a silent voice, a simultaneous loading of contemporaneous and temporal effects into the coefficient estimate of APGNON in Model 1. These results are mainly insignificant. L3-APGNON in Model 4 is the only lagged non-neighboring variable with a significant, at 5%, coefficient estimate. It is negative. It is not accompanied by a significant coefficient estimate of APGNON while that in Table 5 under Model 4 is. The negative estimate of L3-APGNON hints that the IMBHC deregulations might have channeled the flow of human capital from a representative state to its neighboring states at the expense of its non-neighboring states. Overall, we find that there were little to no spatial interactions in the bank performance of a subject state and its non-neighboring states during 1982-1995.

Let's suppose, once again, that multicollinearity is the sole reason that accounts for the observed insignificance of otherwise significant and mainly positive coefficient estimates for the neighboring and non-neighboring variables. Though we do not perform significance tests due to multicollinearity, the total across time of neighboring effects, SUM-NG, are positive and much greater than that of non-neighboring effects, SUM-NON, across all models. The magnitudes of SUM-NON are mainly negative and close to zero. Once again, the magnitude of SUM-NG in all models is *at least* as large as that of APGNG alone. The magnitude of SUM-NON in all models (except Model 4), however, is *at most* as large as that of APGNON alone. Again, these findings do nothing but add strength to the finding of cross-fertilization in the neighboring banking markets during IMBHC deregulations.

4.3 A Comparison of Results Between 1982-1995 and 1971-1977

This section compares results in Tables 6 and 5 to address whether the flow of banks, mainly among neighboring states, upon IMBHC deregulations and/or awakening market for corporate control, enhance the cross-fertilization in bank performance among neighboring states. We begin by noting that the coefficient estimates of APGNG under Models 1, 2, 5 and 6 in Table 6 are greater and mainly more significant than their counterparts in Table 5 and that the coefficient estimates of APGNON under Models 2 through 6 in Table 5 are positive and mainly significant while none of them is significant in Table 6.

Table 7-Panel A tabulates the SUM-NG and SUM-NON results for both sample periods, across all model specifications, under four cases and without providing significance tests due to multicollinearity. Case 1 assumes that multicollinearity is the sole reason that leads to the observed insignificance of what should in fact be statistically significant coefficient estimates of the neighboring and non-neighboring variables in Tables 5 and 6. Case 2 assumes that multicollinearity has no confounding influence on the results and that they are as reported in Tables 5 and 6. Case 2 assigns a value of 0 for an insignificant estimate. Case 3 and Case 4 consider the scenarios when only the neighboring results are under the influence of multicollinearity and the non-neighboring results are not, and vice versa. We do not interpret results under Case 3 and Case 4; overall, they support the interpreted ones below. Table 7-Panel B reports the differences in some of the estimates of pairwise correlation coefficients

between 1971-1977 and 1982-1995.

[- insert Table 7 here -]

Under Case 1, each SUM-NG for 1982-1995 is greater than its corresponding SUM-NG for 1971-1977. While the coefficient estimates of APGNG under Models 3 and 4 in Table 6 are less than those in Table 5, SUM-NGs under both models for 1982-1995 are greater than those for 1971-1977. Interestingly, all SUM-NONs, except for that under Model 1, for 1982-1995 are considerably less than their counterparts for 1971-1977. All SUM-NONs for 1982-1995 are close to zero and mostly, as expected, negative. SUM-NGs are considerably greater than SUM-NONs across all models. Under Case 2, the results discussed in the previous paragraph, with one exception, also hold. The exception occurs under Model 3 when SUM-NG, 0.591, for 1971-1977 comes up larger than that, 0.512, for 1982-1995.

Some caveats for the results in Panel A are in order. First, the estimates of pairwise correlation coefficients in Table 4 (see also Panel B-Table 7) show that (i) the neighboring variables attain remarkable significance in spite of being exposed to larger amounts of correlations during 1982-1995 than during 1971-1977, (ii) the non-neighboring variables attain (do not necessarily attain) significance during 1971-1977 (1982-1995), respectively, in spite of any noteworthy changes in multicollinearity from 1971-1977 to 1982-1995, (iii) none of the coefficient estimates of APGNON in Table 6 is significant while the correlation between PG and APGNON for 1982-1995 is more than twice less than that for 1971-1977, and (iv) while the estimates of pairwise correlation coefficients for the neighboring variables are about the same as those for the non-neighboring variables during 1982-1995, the results for this period in Table 6 show seven (only one) significant coefficient estimates for the neighboring (non-neighboring) variables, respectively.

Overall, these findings support the enhancing effects of the flow of banks on bank performance in the neighboring banking markets during 1982-1995 via M&As across state borders, monitoring by the market for corporate control, and/or the flow of specialized and experienced human capital.

We now examine whether the IMBHC deregulations during 1982-1995 dispelled the cross-sectional similarities in the state-level bank performance metrics. Table 7-Panel B reports the significance test (i.e., the Fisher r-to-z transformation) results on the differences between the estimates of pairwise correlation coefficients for 1971-1977 and those for 1982-1995. The estimates of pairwise correlation coefficients in the neighboring variables are highly significantly greater during 1982-1995 than during 1971-1977. The non-neighboring variables do not exhibit any statistically discernible differences in their correlations from 1971-1977 to 1982-1995. Also, the correlations of non-neighboring variables with the dependent variable, PG, exhibit highly significant declines from 1971-1977 to 1982-1995. Further, the estimates of pairwise correlation coefficients between the neighboring variables and non-neighboring variables exhibit considerable and significant declines from 1971-1977 to 1982-1995.

We take all these results to mean that the state-level bank performance metrics exhibited cross-sectional similarities irrespective of location between 1971 and 1977 and that the IMBHC deregulations dispelled the similarities for the non-neighboring states and enhanced them among the neighboring states. So, we suggest that the positive and significant cross-fertilization results, based on APGNON, for 1971-1977 in Table 5 depend more on the cross-sectional similarities, arising from the long-lasting IMBCH and other regulatory protections, in the state-level bank performance metrics rather than the spread of technology and/or mobility of human capital across space (see footnote 18).

4.4 Evidence on the Contestable Markets Hypothesis

Table 8 reports empirical results for 1971-1981 (in Panel A) and 1978-1995 (in Panel B). We compare these results against those for 1971-1977 and 1982-1995, respectively, to be able to elicit evidence on Baumol's (1982) CMH during 1978-1981, when Maine's declaration of the first-ever IMBHC deregulation in 1978 went unreciprocated until New York's deregulation in mid-1982. The R-squared values in Table 8 indicate a good fit. Table 4-Panel B shows that, once again, multicollinearity is present, influential mainly on the lagged neighboring and non-neighboring variables, and stronger than that in Table 4-Panel A. It has the highest influence on the full model of Model 6.

[- insert Table 8 here -]

A comparison of results for 1971-1981 and 1971-1977 is informative since the latter period is not conditioned on any information about deregulations. The coefficient estimates for both APGNG and APGNON in Table 8-Panel A are positive across all six models. These estimates for APGNG (APGNON) attain significance, either at 1% or 5% (5% or 10%), in Models 1 through 5 (2 through 4), respectively. The coefficient estimates for L2-APGNG and L3-APGNG in Models 3 and 4 are positive and significant at 10% and 5%, respectively. All coefficient estimates of the lags of APGNON are positive and insignificant. Meanwhile, results under Models 2 through 5 in Table 5 for 1971-1977 demonstrate negative and significant lagged

APGNON effects and no significant lagged APGNG effects. These comparative results suggest that the open-and-present threat injected some degree of competitive spirit across the entire geographic spectrum of the US banking markets. At a minimum, the negative and significant temporal non-neighboring effects of 1971-1977 disappear and are replaced with positive and insignificant non-neighboring effects of 1971-1981. This evidence indicates that a threat of competition may be sufficient to spark bank performance across geography.[19]

A comparison of results for 1978-1995 and 1982-1995 is also informative as the sub-period of 1978-1981 is conditioned only on Maine's declaration while the results in Table 6 for 1982-1995 are conditioned on the effects of evolving IMBHC deregulations across states. It is useful to remind that under full (partial) contestability, there should be no (negative) changes in the results for 1978-1995 and for 1982-1995, respectively. The coefficient estimates for APGNG in Table 8-Panel B are positive and significant at 1% across all six models. The coefficient estimates of APGNON are positive and attain significance, either at 5% or 10%, in Models 2, 3, and 4 and are negative and significant (insignificant) at 10% in Model 1 (Models 5 and 6), respectively. While the individual estimates of coefficients for L1-APGNON, L2-APGNON, and L3-APGNON are negative and significant (either at 1% or 5%) in Models 2, 3, and 4, their neighboring counterparts are also negative but insignificant. In Model 5, while the estimates for the coefficients of APGNG and L2-APGNG (L1-APGNG) are positive (negative) and significant, either at 1% or 5%, (1%), respectively, only the negative estimate of coefficient for L2-APGNON attains significance at 5%. In Model 6, the estimate of coefficient for APGNG is positive and also the only significant one, at 1%.

Before embarking on a comparison of results in Table 8-Panel B with those in Table 6, we point out that the significant coefficient estimates of the lagged variables in Model 5 differ from those reported in Tables 5, 6, and 8 (Panel A). Further, results in Panel B are overall consistent with partial contestability and our conjecture that an open-and-present threat of (enhanced) future competition has banks assume a more competitive posture across the entire US banking geography. Comparisons of the results in Table 6 and Table 8-Panel B indeed

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[19] The means of PG, APGNG and APGNON, though close to zero in both cases, go from positive during 1971-77 to negative for 1971-81 in Table 2. In the same table, the mean of the number of branches, BRANCH NO, goes from 293.12 during 1971-77 to 298.96 (our computation) during 1978-81 and to 264.56 during 1982-95. Maine's declaration appears to have stirred a surge in the number of branches across USA until New York's declaration in mid-1982. Costs associated with an increasing number of branches are large and explain, at least partially, the decline in the means of PG, APGNG and APGNON during both 1978-81 and 1971-81. The 1982-95 deregulatory period witnesses a remarkable plummet in the number of branches and a corresponding surge in PG, APGNG and APGNON across USA.

supplement the evidence in support of this conjecture. The only statistically significant temporal neighboring effect, at 5%, in Table 6 originates from L3-APGNG. There is no contemporaneous non-neighboring effect while the only significant (at 5%) temporal non-neighboring effect originates from the negative coefficient estimate of L3-APGNON. Meanwhile, in spite of greater multicollinearity during 1978-1995 than during 1982-1995, Models 2, 3 and 4 of Table 8-Panel B contain statistically significant positive (negative) coefficient estimates for APGNON (the lags of APGNON), respectively. Model 1 coefficient estimate for APGNON is negative and significant at 10%. Results for the lags of APGNG in Table 8-Panel B are all negative and insignificant under Model 2 through 4. Overall, these results are consistent with those in Panel A, support Baumol's (1982) CMH, and reveal a partially contestable market structure.

5. Summary and Concluding Comments

Restrictions on the interstate bank acquisitions, introduced via the BHCA of 1956, remained effective until the legislature of Maine declared its IMBHC deregulation, conditioned on reciprocity from other states, in 1978. No reciprocity was offered in response to Maine's declaration until New York (and also Alaska) declared their IMBHC deregulations, also conditioned on reciprocity, to be effective in mid-1982. The IBBEA of 1994, under which a commercial bank could transform its identity to a complex financial services firm, brought an end to this period. This natural experiment offers us three questions on cross-fertilization in bank performance among neighboring states.

Historically, natural barriers and/or political and legal processes have crafted a state-centric segmented market structure for the banking industry. But, no regulation has ever restricted either the mobility of human capital or the adoption of technology across space. Such mobility across space is a source of spatial interactions (i.e., cross-fertilization) especially in nearby banking markets (HF, 1984; Kane, 1996). We examine whether cross-fertilization affects productivity growth of banks among neighboring and randomly chosen non-neighboring states during 1971-1977 when the interstate banking restrictions were effective. We find evidence, consistent with HF (1984) and Kane (1996), of a positive cross-fertilization process among neighboring states. This finding highlights the importance of spatial proximity's effects of firms' economic performance, even in protected and concentrated markets.[20]

[20] This view has interesting implications for the banking industry. For example, extensive systems of local branches give commercial banks and thrifts comparative advantage over the large national and international lenders in developing local expertise (Geltner and Miller, 2001). This, in turn, allows them to produce the majority of the construction (mortgage) loans,

New York and Alaska's IMBHC deregulations triggered a rich set of deregulations (even re-deregulations) across all states, except Hawaii, between 1982 and 1995. With the state-level IMBHC deregulations, banks were given their freedom to move across the banking geography and the market for corporate control could begin to exert its forces. We integrate Tiebout's (1956) 'individuals vote with their feet' behavior to Kane's (1984, 1988 and 1996) regulatory competition framework to study empirically cross-fertilization patterns in banks' productivity growth during this period. While we cast our theoretical amalgamation in a banking context, its reach is quite broad and covers the effects of regulatory or policy changes for welfare payments across US states, property development in residential areas with enforced zoning, or creating incentives for multinational firms or wealthy individuals to migrate to a country, among others.[21] The flow of banks, via interstate M&As, could either enhance an existing or trigger a new process of cross-fertilization in bank performance. We find that cross-fertilization in bank performance among neighboring states, detected for 1971-1977, gets stronger during 1982-1995. These results, once again, highlight the importance of economic geography's effects for the banks and banking markets.

The four-and-a-half year silence of state legislatures, in response to Maine's first-ever deregulation in 1978, offers a unique opportunity to test empirically Baumol's (1982) CHM. Under this hypothesis, the mere threat of new entry into concentrated banking markets is

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which have a short-term maturity, are dispensed over time, and are not backed by an existing collateral commercial property. The short-term nature of construction loans matches with the short-term nature of banks' deposit liabilities. Clapp et al. (1990) and Ning and Haining (2003) show geography's effects on the market structure of insurance agencies and gasoline stations.

[21] Our approach may be applied to study the cross-fertilization effects of a broad range of economic phenomena that occur across the face of the earth. For example, there has been a recent trend for multinational firms and wealthy individuals to relocate to countries that offer tax incentives. Alderman (August 07, 2012) and Amiel (September 08, 2012) report that the proposed tax hikes for the wealthy in France has already had Belgium, a neighboring country with tax advantages, to benefit in capital as well as human capital flows and increasing property values. The recent move of one of the founders of *Facebook* from USA to Singapore, a country with tax incentives and substantial growth in key performance metrics is worth noting (Solomon, May 11, 2012). Similarly, MacKinnon (August 29, 2012) reports that, "More big U.S. companies are reincorporating abroad despite a 2004 federal law that sought to curb the practice. One big reason: Taxes. … Lawmakers of both parties have said the U.S. corporate tax code needs a rewrite and they are aiming to try next year. One shared source of concern is the top corporate tax rate of 35% - the highest among developed economies. By comparison, Ireland's rate is 12.5%. The Obama Administration has proposed lowering the rate to 28%, while Republican rival Mitt Romney has proposed 25%." The recent move of US corporations to other countries with tax incentives led the House Ways and Means Chairman Dave Camp (R., Mich.) to state that "comprehensive tax reform that lowers rates and transitions the U.S. to a territorial approach that is used by our global competitors is critical to making America a more attractive place to invest and hire." (MacKinnon, August 29, 2012). For company relocations, see Alli, et al., (1991) and Tirtiroglu et al. (2004). A similar example, in a regional context, occurs when a state legislature either restricts or removes its welfare benefits. This move gives incentives to the welfare-needy residents of this state to move to neighboring states, which continue to offer welfare benefits. There would be pressure on states to lower or modify their benefits. We thank Nejat Anbarci for this example.

sufficient to inject, irrespective of the location of banks, a competitive spirit. We offer two sets of comparative evidence. The first (second) is in relation to the 1971-1977 (1982-1995) period when bank performance metrics were not (were) conditioned on Maine's announcement, respectively. Both sets of our evidence show changes in bank performance, congruent with the predictions of CMH, among neighboring and also non-neighboring states. Contestability's force generates a large-scale spatial interaction in bank performance across US banking geography.

These results highlight the importance of banking geography on commercial banks' operating performance. The recent finance literature has also demonstrated increasingly the strength and importance of the spatial interactions for investment patterns and performance, mutual fund flows, and M&As. So, future research, which captures geographic variations, should provide new and important insights into commercial banks' behavior and the intensity of competition in this sector. This, in turn, should lead to better and more informed public policies and decisions, and also improvements in the quality of empirical measurements. Recent papers BD (2001, 2006), DeYoung et al. (2008) and Deng and Elyasiani (2008) offer some guidance.

Table 1: Evolution of the state-level IMBHC regulatory movements.

This table shows the transitions and evolution of the IMBHC regulatory regimes between 1978 and 1995. Oklahoma declared NN on July 1, 1987, conditional on a four-year delay, imposing this regime to take effect on and after July 1, 1991. Oregon was the only state with the regional non-reciprocity regime.

a) The distribution of the state level IMBHC regulations as of the end of 1995:

Regulatory Regime	No. of States
Regional Reciprocity	14
National Reciprocity	23
National Non-reciprocity	13
No Transitions Yet	1
Total	51 (including the District of Columbia)

b) The distribution of the transitions of state level IMBHC regulatory regime until 1995.

Transition	Initial No. of States	No. of States Remaining (1995)
Initial Transition to Regional Reciprocity	37	14
Initial Transition to Regional Non-reciprocity	1	0
Initial Transition to National Reciprocity	7	5
Initial Transition to National Non-reciprocity	5	5
No Transitions Yet	1	1
From Regional Reciprocity to National Reciprocity		18
From Regional Reciprocity to National Non-reciprocity		5
From Regional Non-reciprocity to National Non-reciprocity		1
From National Reciprocity to National Non-reciprocity		2

Note: Authors' work based on Amel (1993).

Table 2: Means and standard deviations across different sub-sample periods for the variables in the main estimating equation.

This table reports the means and standard deviations across all sub-sample periods for all variables in eq. **[1]**. PG, APGNG and APGNON are state-level (i) productivity growth of banks in state i, (ii) average productivity growth of banks in neighboring states to state i, and (iii) average productivity growth of banks in randomly chosen non-neighboring states to state i. L1-APGNG, L2-APGNG, and L3-APGNG (L1-APGNON, L2-APGNON, and L3-APGNON) are the annual lags of APGNG (APGNON), respectively. PG is the dependent variable. POP GRW, POP DENS, BRANCH NO and INCO GRW are all state-level control variables and refer to population growth, population density, number of bank branches and income growth in each of the four sample periods. The 1971-1977 period is free from IMBHC deregulations while the 1971-1981 period covers the very first IMBHC deregulatory announcement, which did not receive reciprocity until 1982, by Maine in 1978. The 1978-1995 period includes all IMBHC deregulation (re)announcements, while the 1982-1995 period excludes Maine's very first announcement as it did not receive any reciprocity until New York's announcement in mid-1982.

	1971-1977			**1971-1981**			**1978-1995**			**1982-1995**		
Variable	**N**	**Mean**	**Std Dev**	**N**	**Mean**	**Std Dev**	**N**	**Mean**	**Std Dev**	**N**	**Mean**	**Std Dev**
PG (in %)	336	0.168	1.318	528	-0.120	1.431	864	1.784	2.213	672	2.472	1.881
APGNG (in %)	336	0.164	0.943	528	-0.149	1.104	864	1.767	1.834	672	2.471	1.309
APGNON (in %)	336	0.012	0.812	528	-0.248	0.845	864	1.752	1.707	672	2.452	1.181
POP GRW	336	0.016	0.060	528	0.015	0.049	864	0.030	0.438	672	0.035	0.497
POP DENS	336	0.146	0.209	528	0.148	0.208	864	0.158	0.215	672	0.160	0.217
BRANCH NO	336	293.122	284.960	528	295.244	290.051	864	272.201	286.999	672	264.557	283.101
INCO GRW	336	0.092	0.039	528	0.099	0.036	864	0.067	0.034	672	0.055	0.024
L1-APGNG (in %)	288	0.288	0.926	480	-0.132	1.087	816	1.693	1.838	624	2.428	1.307
L1-APGNON (in %)	288	0.129	0.797	480	-0.244	0.854	816	1.690	1.705	624	2.426	1.161
L2-APGNG (in %)	240	0.429	0.927	432	-0.062	1.047	768	1.600	1.837	576	2.366	1.308
L2-APGNON (in %)	240	0.266	0.786	432	-0.188	0.852	768	1.609	1.699	576	2.379	1.146
L3-APGNG (in %)	192	0.597	0.948	384	0.045	0.988	720	1.484	1.825	528	2.277	1.303
L3-APGNON (in %)	192	0.426	0.781	384	-0.096	0.833	720	1.503	1.683	528	2.304	1.128

Table 3: Bordering neighboring and randomly assigned non-neighboring states for each state.

This table shows for each state its bordering neighboring and randomly assigned non-neighboring states. The averages of the Kalman-filtered productivity growths in the neighboring and the randomly assigned non-neighboring states are used in the spatio-temporal model for empirical tests in Tables 5, 6, and 7. Alaska and Hawaii do not have neighboring states, and DC is not a state. They are excluded.

States	Neighboring States	Non-neighboring States
Alabama	Florida, Georgia, Mississippi, Tennessee	Oregon, Washington, Kansas, Missouri
Arizona	California, Colorado, Nevada, New Mexico,Utah	Alabama, Iowa, Louisiana, Massachusetts, West Virginia
Arkansas	Louisiana, Mississippi, Missouri, Oklahoma, Tennessee, Texas	Connecticut, Wisconsin, Arizona, Wyoming, Minnesota, Iowa
California	Arizona, Nevada, Oregon	Michigan, Delaware, Kentucky
Colorado	Arizona, Kansas, Nebraska, New Mexico, Oklahoma, Utah, Wyoming	Nevada, Maryland, Virginia, Delaware, South Carolina, Georgia, Illinois
Connecticut	New York, Massachusetts, Rhode Island	California, Ohio, South Carolina
Delaware	Maryland, New Jersey, Pennsylvania	Georgia, Utah, Illinois
Florida	Alabama, Georgia	Pennsylvania, Tennessee
Georgia	Alabama, Florida, South Carolina, Tennessee	Mississippi, Delaware, California, New York
Idaho	Montana, Nevada, Oregon, Utah, Washington, Wyoming	Maryland, Indiana, Rhoda Island, New Mexico, California, North Dakota
Illinois	Indiana, Iowa, Kentucky, Missouri, Wisconsin	Texas, Maine, Alabama, Tennessee, Michigan
Indiana	Illinois, Kentucky, Michigan, Ohio	Wisconsin, Florida, Iowa, Mississippi
Iowa	Illinois, Minnesota, Nebraska, South Dakota, Missouri, Wisconsin	Maine, Kansas, Oregon, West Virginia, Idaho, Vermont
Kansas	Colorado, Missouri, Nebraska, Oklahoma	Maryland, Kentucky, Iowa, Alabama
Kentucky	Illinois, Indiana, Missouri, Ohio, Tennessee, Virginia, West Virginia	Oklahoma, Minnesota, Delaware, Texas, North Carolina, Florida, Arkansas
Louisiana	Arkansas, Mississippi, Texas	Missouri, North Carolina, Utah
Maine	New Hampshire, Massachusetts	Wyoming, Montana
Maryland	Delaware, Pennsylvania, Virginia, West Virginia	Iowa, Connecticut, Tennessee, Minnesota
Massachusetts	Connecticut, Maine, New Hampshire, New York, Rhode Island, Vermont	Arkansas, Florida, California, Iowa, New Jersey, Utah
Michigan	Indiana, Ohio, Wisconsin	Minnesota, Arizona, California
Minnesota	Iowa, North Dakota, South Dakota, Wisconsin	Colorado, Utah, Massachusetts, Delaware
Mississippi	Alabama, Arkansas, Louisiana, Tennessee,	Rhoda Island, Kentucky, Vermont, New Mexico
Missouri	Arkansas, Illinois, Iowa, Kansas, Kentucy, Nebraska, Oklahoma, Tennessee	Georgia, Wisconsin, Maine, New Jersey, New York, Delaware, North Carolina, Vermont
Montana	Idaho, North Dakota, South Dakota, Wyoming	Illinois, Maryland, New Hampshire, Arizona
Nebraska	Colorado, Iowa, Kansas, Missouri, South Dakota, Wyoming	Florida, Rhode Island, Tennessee, New Jersey, Idaho, Maine
Nevada	Arizona, California, Idaho, Oregon, Utah	Colorado, Pennsylvania, New Hampshire, Maryland, Vermont
New Hampshire	Maine, Vermont, Massachusetts	Wisconsin, Louisiana, Arizona
New Jersey	New York, Pennsylvania, Delaware	Mississippi, Indiana, Nebraska
New Mexico	Arizona, Utah, Colorado, Oklahoma, Texas	Florida, South Dakota, Oregon, Michigan, Idaho
New York	Vermont, Massachusetts, Connecticut, Pennsylvania, New Jersey	New Mexico, Rhode Island, Illinois, Kentucky, Maryland

North Carolina	Virginia, Tennessee, South Carolina	Iowa, Maryland, West Virginia
North Dakota	South Dakota, Minnesota, Montana	Kansas, Michigan, Iowa
Ohio	Michigan, Pennsylvania, West Virginia, Kentucky, Indiana	Arizona, Virginia, Alabama, New Jersey, Oregon
Oklahoma	Arkansas, Colorado, Kansas, Missouri, New Mexico, Texas	Virginia, Delaware, Kentucky, Nebraska, Wisconsin, North Carolina
Oregon	Washington, Idaho, California, Nevada	Kansas, Illinois, Missouri, Rhode Island
Pennsylvania	New York, New Jersey, Delaware, Maryland, West Virginia, Ohio	Indiana, Kansas, Colorado, Massachusetts, Arkansas, Montana
Rhode Island	Massachusetts, Connecticut	Iowa, California
South Carolina	North Carolina, Georgia	Alabama, Nebraska
South Dakota	North Dakota, Minnesota, Iowa, Nebraska, Wyoming, Montana	New Mexico, Illinois, Utah, North Carolina, Oregon, New Jersey
Tennessee	Kentucky, Virginia, North Carolina, Georgia, Alabama, Mississippi, Arkansas, Missouri	Minnesota, Wyoming, Indiana, Pennsylvania, South Dakota, New York, Delaware, Maine
Texas	Oklahoma, Arkansas, Louisiana, New Mexico	Illinois, Nebraska, New Hampshire, Florida
Utah	Idaho, Wyoming, Colorado, New Mexico, Arizona, Nevada	Connecticut, Iowa, Oklahoma, South Carolina, Kansas, Montana
Vermont	New Hampshire, Massachusetts, New York	Wisconsin, Idaho, Virginia
Virginia	West Virginia, Maryland, North carolina, Tennessee, Kentucky	South Carolina, Delaware, Pennsylvania, New Hampshire, Michigan
Washington	Idaho, Oregon	New Hampshire, California
West Virginia	Pennsylvania, Virginia, Maryland, Kentucky, Ohio	New Mexico, Connecticut, Florida, Utah, South Carolina
Wisconsin	Michigan, Illinois, Iowa, Minnesota	Nevada, Delaware, Arizona, Rhode Island
Wyoming	Colorado, Idaho, Montana, Nebraska, South Dakota, Utah	North Carolina, Iowa, Alabama, North Dakota, Kentucky, Nevada

Table 4: Estimates of pairwise correlation among the dependent variable and some key independent variables before and during IMBHC deregulations.
Panels A and B report the estimates of pairwise correlation for some of the key variables for the four sub-sample periods. PG, APGNG and APGNON are state-level (i) productivity growth of banks in state i, (ii) average productivity growth of banks in neighboring states to state i, and (iii) average productivity growth of banks in randomly chosen non-neighboring states to state i. L1-APGNG, L2-APGNG, and L3-APGNG (L1-APGNON, L2-APGNON, and L3-APGNON) are the annual lags of APGNG (APGNON), respectively. PG is the dependent variable in eq. **[1]**. Correlation estimates for other control variables in eq. **[1]** are low and available upon request from the authors.

Panel A: Before IMBHC deregulations. *The upper (lower) half of the correlation matrix contains, in bolded print (not bolded print), the pairwise estimates for the 1971-1981 (1971-1977) period, respectively.*

						1971-77					
	Variable	PG	APGNG	APGNON	L1-APGNG	L1-APGNON	L2-APGNG	L2-APGNON	L3-APGNG	L3-APGNON	N
	PG	1.000	**0.503**	**0.365**	**0.444**	**0.307**	**0.351**	**0.213**	**0.262**	**0.148**	**528**
	APGNG	0.473	1.000	**0.391**	**0.923**	**0.326**	**0.722**	**0.210**	**0.498**	**0.134**	**528**
	APGNON	0.464	0.530	1.000	**0.335**	**0.928**	**0.233**	**0.753**	**0.158**	**0.558**	**528**
	L1-APGNG	0.415	0.920	0.482	1.000	**0.464**	**0.934**	**0.409**	**0.735**	**0.305**	**480**
1971-81	L1-APGNON	0.429	0.466	0.963	0.502	1.000	**0.435**	**0.957**	**0.368**	**0.837**	**480**
	L2-APGNG	0.300	0.640	0.388	0.917	0.436	1.000	**0.517**	**0.929**	**0.459**	**432**
	L2-APGNON	0.355	0.330	0.841	0.430	0.962	0.444	1.000	**0.489**	**0.966**	**432**
	L3-APGNG	0.164	0.270	0.301	0.623	0.916	0.321	0.358	1.000	**0.536**	**384**
	L3-APGNON	0.298	0.229	0.652	0.270	0.352	0.840	0.960	0.357	1.000	**384**
	N	336	336	336	288	288	240	240	192	192	

Panel B: During IMBHC deregulations. *The upper (lower) half of the correlation matrix contains, in bolded print (not bolded print), the pairwise estimates for the 1978-1995 (1982-1995) period, respectively.*

						1982-95					
	Variable	PG	APGNG	APGNON	L1-APGNG	L1-APGNON	L2-APGNG	L2-APGNON	L3-APGNG	L3-APGNON	N
	PG	1.000	**0.712**	**0.525**	**0.683**	**0.491**	**0.626**	**0.427**	**0.548**	**0.342**	**864**
	APGNG	0.538	1.000	**0.655**	**0.976**	**0.638**	**0.914**	**0.592**	**0.825**	**0.524**	**864**
	APGNON	0.172	0.287	1.000	**0.627**	**0.979**	**0.571**	**0.923**	**0.497**	**0.841**	**864**
	L1-APGNG	0.473	0.961	0.207	1.000	**0.670**	**0.976**	**0.649**	**0.916**	**0.599**	**816**
1978-95	L1-APGNON	0.103	0.231	0.959	0.313	1.000	**0.641**	**0.980**	**0.587**	**0.929**	**816**
	L2-APGNG	0.393	0.861	0.134	0.962	0.233	1.000	**0.677**	**0.977**	**0.650**	**768**
	L2-APGNON	0.039	0.183	0.851	0.248	0.963	0.325	1.000	**0.645**	**0.982**	**768**
	L3-APGNG	0.305	0.718	0.072	0.869	0.159	0.965	0.240	1.000	**0.672**	**720**
	L3-APGNON	-0.017	0.145	0.696	0.193	0.865	0.247	0.967	0.314	1.000	**720**
	N	672	672	672	624	624	576	576	528	528	

Table 5: Results from the spatio-temporal model for the homogenous legal space of the 1971-1977 sub-sample.
During the sub-sample period of 1971-1977, the Bank Holding Company Act of 1956 was effective and prohibited interstate bank mergers and acquisitions in USA. The results reported below come from $\mathrm{PG}_{i,t} = a_0 + \sum_{i=2}^{48}\delta_i * \mathrm{SD}_i + \sum_{t=2+(max\,j)}^{T}\theta_t * \mathrm{TD}_t + \sum_{j=0}^{3}\gamma_{(j+1)} * \mathrm{APGNG}_{i,(t-j)} + \sum_{j=0}^{3}\varphi_{(j+1)} * \mathrm{APGNON}_{i,(t-j)} + \sum_{k=1}^{4}\beta_k * \mathrm{X}_{k,i,t} + \mathrm{u}_{i,t}$ where i, j, k and t refer to the sample states, the number of (time) lags, the number of other explanatory variables, and each year of the sub-sample period; $PG_{i,t}$ is the Kalman-filtered TFPG for state i at time t; SD_i refers to cross sectional indicator variables for each state (excluding Alaska, Hawaii, and DC, since the first two are outside the realm of bordering neighboring US states, while the last is not a state); TD_t refers to time related indicator variables for each sample year; $APGNG_{i,t}$ ($APGNON_{i,t}$) refers to the average Kalman-filtered TFPG for commercial banks in state i's bordering neighboring (randomly chosen non-neighboring) states at time t, respectively; $u_{i,t}$ refers to the regression error term; $\mathbf{X}_{k,i,t}$ is a [(48xt)x4] matrix with control variables of *Pop Grw* (annual state-level population growth), *Pop Dens* (annual state-level population density), *Inco Grw* (annual growth in state-level real per capita income), and *Branch No* (annual state-level total number of branches) for state i at time t. SUM-NG (SUM-NON) is the sum of the coefficient estimates of neighboring (non-neighboring) variables in a given model. The number of randomly chosen non-neighboring states is the same as that of bordering neighboring states for state i. Table 3 provides a list of neighboring and randomly chosen non-neighboring states for each state. ***, **, and * indicate statistical significance at the 10%, 5% and 1% levels, respectively. Due to multicollinearity (see Table 4), we do not perform significance tests on SUM-NG and SUM-NON in Models 2 through 6.

	Model 1	Model 1	Model 2	Model 2	Model 3	Model 3	Model 4	Model 4	Model 5	Model 5	Model 6	Model 6
Variable	**Estimate**	**t Value**	**Estimate**	**t Value**	**Estimate**	**t Value**	**Estimate**	**t Value**	**Estimate**	**t Value**	**Estimate**	**t Value**
Intercept	-4.531	(-3.55)*	-3.306	(-2.31)**	-2.785	(-1.81)***	-3.021	-1.23	-2.797	(-1.80)***	-3.337	-1.35
APGNG	0.456	5.89*	0.498	2.19**	0.591	4.17*	0.537	3.69*	0.580	2.90*	0.299	1.17
APGNON	-0.088	-0.66	0.861	2.40**	0.746	3.68*	0.692	3.61*	0.669	2.14**	0.549	1.30
L1-APGNG	N/A	N/A	0.015	0.07	N/A	N/A	N/A	N/A	0.022	0.08	0.290	0.91
L1-APGNON	N/A	N/A	-0.796	(-2.35)**	N/A	N/A	N/A	N/A	0.150	0.32	0.222	0.39
L2-APGNG	N/A	N/A	N/A	N/A	0.044	0.42	N/A	N/A	0.033	0.20	0.083	0.31
L2-APGNON	N/A	N/A	N/A	N/A	-0.454	(-2.51)**	N/A	N/A	-0.529	(-1.78)***	-0.094	-0.20
L3-APGNG	N/A	N/A	N/A	N/A	N/A	N/A	0.051	0.58	N/A	N/A	-0.042	-0.24
L3-APGNON	N/A	N/A	N/A	N/A	N/A	N/A	-0.267	(-1.66)***	N/A	N/A	-0.218	-0.74
POP GRW	-0.749	-1.04	-0.543	-0.91	-0.490	-1.02	-0.631	-1.40	-0.487	-1.01	-0.592	-1.31
POP DENS	38.599	2.12**	29.925	1.67***	40.569	2.27**	76.031	2.44**	40.759	2.27**	75.503	2.40**
BRANCH NO	0.010	3.66*	0.008	2.79*	0.003	0.89	-0.006	(-1.70)***	0.003	0.87	-0.005	-1.37
INCO GRW	1.970	1.52	1.355	1.23	0.850	0.95	0.574	0.51	0.862	0.96	0.578	0.51
TIME DUMM		6/6 Sig		4/5 Sig		0/4 Sig		0/3 Sig		0/4 Sig		0/3 Sig
STATE DUM		38/47 Sig		31/47 Sig		32/47 Sig		32/47 Sig		34/47 Sig		31/47 Sig
SUM - NG	0.456	5.89*	0.513	N/A	0.635	N/A	0.588	N/A	0.635	N/A	0.630	N/A
SUM - NON	-0.088	-0.66	0.065	N/A	0.292	N/A	0.425	N/A	0.290	N/A	0.459	N/A
N		336		288		240		192		240		192
R-Squ		0.745		0.776		0.831		0.877		0.831		0.879

Table 6: Results from the spatio-temporal model for the non-homogenous legal space of the 1982-1995 sub-sample.

During the 1982-1995 sub-sample period, state legislatures deregulated, usually on a reciprocity basis, the restrictions on the interstate bank mergers and acquisitions. Table 1 provides a summary of these dynamic legislative acts across all states in USA. The results reported below come from $PG_{i,t} = a_0 + \sum_{i=2}^{48}\delta_i * SD_i + \sum_{t=2+(maxj)}^{T}\theta_t * TD_t + \sum_{j=0}^{3}\gamma_{(j+1)} * APGNG_{i,(t-j)} + \sum_{j=0}^{3}\varphi_{(j+1)} * APGNON_{i,(t-j)} + \sum_{k=1}^{4}\beta_k * X_{k,i,t} + u_{i,t}$ where i, j, k and t refer to the sample states, the number of (time) lags, the number of other explanatory variables, and each year of the sub-sample period; $PG_{i,t}$ is the Kalman-filtered TFPG for state i at time t; SD_i refers to cross sectional indicator variables for each state (excluding Alaska, Hawaii, and DC, since the first two are outside the realm of bordering neighboring US states, while the last is not a state); TD_t refers to time related indicator variables for each sample year; $APGNG_{i,t}$ ($APGNON_{i,t}$) refers to the average Kalman-filtered TFPG for commercial banks in state i's bordering neighboring (randomly chosen non-neighboring) states at time t, respectively; $u_{i,t}$ refers to the regression error term; $\mathbf{X}_{k,i,t}$ is a [(48xt)x4] matrix with control variables of *Pop Grw* (annual state-level population growth), *Pop Dens* (annual state-level population density), *Inco Grw* (annual growth in state-level real per capita income), and *Branch No* (annual state-level total number of branches) for state i at time t. SUM-NG (SUM-NON) is the sum of the coefficient estimates of neighboring (non-neighboring) variables in a given model. The number of randomly chosen non-neighboring states is the same as that of neighboring states for state i. Table 3 lists the neighboring and randomly chosen non-neighboring states for each state. ***, **, and * indicate statistical significance at the 10%, 5% and 1% levels, respectively. Due to multicollinearity (see Table 4), we do not perform significance tests on SUM-NG and SUM-NON in Models 2 through 6.

Variable	Model 1 Estimate	Model 1 t Value	Model 2 Estimate	Model 2 t Value	Model 3 Estimate	Model 3 t Value	Model 4 Estimate	Model 4 t Value	Model 5 Estimate	Model 5 t Value	Model 6 Estimate	Model 6 t Value
Intercept	-0.113	-0.22	-0.146	-0.25	0.107	0.18	0.325	0.53	0.014	0.020	0.238	0.37
APGNG	0.627	10.04*	0.534	2.50**	0.512	4.15*	0.497	5.1*	0.794	2.31**	0.622	*1.61*
APGNON	0.010	0.14	0.412	1.33	0.235	1.37	0.201	1.60	-0.256	-0.51	0.030	0.05
L1-APGNG	N/A	N/A	0.128	0.57	N/A	N/A	N/A	N/A	-0.508	-0.85	0.015	0.02
L1-APGNON	N/A	N/A	-0.433	-1.29	N/A	N/A	N/A	N/A	0.968	1.08	-0.068	-0.06
L2-APGNG	N/A	N/A	N/A	N/A	0.198	1.44	N/A	N/A	0.445	1.36	-0.347	-0.45
L2-APGNON	N/A	N/A	N/A	N/A	-0.292	-1.46	N/A	N/A	-0.799	-1.60	0.645	0.61
L3-APGNG	N/A	N/A	N/A	N/A	N/A	N/A	0.273	2.45**	N/A	N/A	0.509	1.40
L3-APGNON	N/A	N/A	N/A	N/A	N/A	N/A	-0.309	(-1.99)**	N/A	N/A	-0.752	-1.45
POP GRW	0.438	3.03*	0.391	2.73*	0.351	2.48**	0.309	2.24**	0.339	2.40**	0.302	2.18**
POP DENS	-7.174	(-2.61)*	-6.235	(-2.27)**	-5.377	(-1.98)**	-4.335	(-1.63)***	-5.017	(-1.84)***	-3.970	-1.48
BRANCH NO	-0.003	(-3.08)*	-0.002	(-2.9)*	-0.002	(-2.67)*	-0.002	(-2.35)**	-0.002	(-2.65)*	-0.002	(-2.33)**
INCO GRW	9.500	3.78*	9.150	3.59*	7.938	3.08*	5.915	2.27**	7.627	2.95*	5.514	2.07**
TIME DUMM		8/13 Sig		2/12 Sig		0/11 Sig		0/10 Sig		0/11 Sig		0/10 Sig
STATE DUM		34/47 Sig		32/47 Sig		30/47 Sig		30/47 Sig		30/47 Sig		30/47 Sig
SUM - NG	0.627	10.04*	0.662	N/A	0.710	N/A	0.770	N/A	0.731	N/A	0.799	N/A
SUM - NON	0.010	0.14	-0.021	N/A	-0.057	N/A	-0.108	N/A	-0.087	N/A	-0.145	N/A
N		672		624		576		528		576		528
R-Squ		0.641		0.630		0.631		0.647		0.633		0.649

Table 7: Comparative results, 1982-1995 versus 1971-1977.

Panel A: Results below are based on those reported in Tables 5 and 6. They are for SUM-NG (SUM-NON), the sum of coefficient estimates for the neighboring (non-neighboring) variables, respectively, for the relevant comparison periods. Model 1 is the most restricted model and includes only the relevant contemporaneous neighboring and non-neighboring variables. Model 6 is the full model and includes contemporaneous and three lags of both neighboring and non-neighboring variables. Other models introduce sequentially the lags of neighboring and non-neighboring variables. Table 4 documents the multicollinearity for the neighboring and non-neighboring variables; therefore, we do not perform significance tests on SUM-NGs and SUM-NONs below.

		Case1 - NG variables - assumed signi. (multicollinearity correction)							Case2 - NG variables - signi. only if signi. in Table 5 or 6; otherwise 0					
		Case1 - NON variables - assumed signi. (multicollinearity correction)							Case2 - NON variables - signi. only if signi. in Table 5 or 6; otherwise 0					
Variable	**Period**	**Model 1**	**Model 2**	**Model 3**	**Model 4**	**Model 5**	**Model 6**		**Model 1**	**Model 2**	**Model 3**	**Model 4**	**Model 5**	**Model 6**
SUM - NG	1982-95	0.627	0.662	0.710	0.770	0.731	0.799		0.627	0.534	0.512	0.770	0.794	0.622
SUM - NG	1971-77	0.456	0.513	0.635	0.588	0.635	0.630		0.456	0.498	0.591	0.537	0.580	0
SUM - NON	1982-95	0.010	-0.021	-0.057	-0.108	-0.087	-0.145		0	0	0	-0.309	0	0
SUM - NON	1971-77	-0.088	0.065	0.292	0.425	0.290	0.459		0	0.065	0.292	0.425	0.140	0
		Case3 - NG variables - assumed signi. (multicollinearity correction)							Case4 - NG variables - signi. only if signi. in Table 5 or 6; otherwise 0					
		Case3 - NON variables - signi. only if signi. in Table 5 or 6; otherwise 0							Case4 - NON variables - assumed signi. (multicollinearity correction)					
SUM - NG	1982-95	0.627	0.662	0.710	0.770	0.731	0.799		0.627	0.534	0.512	0.770	0.794	0.622
SUM - NG	1971-77	0.456	0.513	0.635	0.588	0.635	0.630		0.456	0.498	0.591	0.537	0.580	0
SUM - NON	1982-95	0	0	0	-0.309	0	0		0.010	-0.021	-0.057	-0.108	-0.087	-0.145
SUM - NON	1971-77	0	0.065	0.292	0.425	0.140	0		-0.088	0.065	0.292	0.425	0.290	0.459

Panel B: Results below are for the differences, between 1971-1977 and 1982-1995, in the estimates of pairwise correlation coefficients for the relevant variables. PG, APGNG and APGNON refer to (i) the state-level productivity growth of banks for state i at time t (dependent variable in the estimations), (ii) the average of productivity growth of banks of neighboring states to state i at time t, (iii) the average of productivity growth of banks of randomly assigned non-neighboring states to state i at time t. Other variables are lags of APGNG and APGNON. The correlation estimates are from Table 4. The significance test results are based on the Fisher r-to-z transformation. ** and * refer to 5% and 1% significance levels, respectively.

	Estimate	**Estimate**	**Diff**	**Estimate**	**Estimate**	**Diff**	**Estimate**	**Estimate**	**Diff**
	1971-77	**1982-95**	**z-stat**	**1971-77**	**1982-95**	**z-stat**	**1971-77**	**1982-95**	**z-stat**
Variable	**PG**			**APGNG**			**APGNON**		
APGNG	0.47	0.54	-1.3	1	1	N/A	0.53	0.29	4.35*
L1-APGNG	0.42	0.47	-1.08	0.92	0.96	-5.51*	0.48	0.21	4.71*
L2-APGNG	0.30	0.39	-1.58	0.64	0.86	-8.04*	0.39	0.13	4.09*
L3-APGNG	0.16	0.31	-2.23**	0.27	0.72	-9.41*	0.30	0.07	3.56*
APGNON	0.46	0.17	4.9*	0.53	0.29	4.35*	1	1	N/A
L1-APGNON	0.43	0.1	5.3*	0.47	0.23	4.02*	0.96	0.96	0.78
L2-APGNON	0.36	0.04	4.95*	0.33	0.18	2.35**	0.84	0.85	-0.52
L3-APGNON	0.30	-0.02	4.84*	0.23	0.15	1.35	0.65	0.70	-1.20

Table 8: Results from the spatio-temporal model for the transition period of 1978-1981.

Panel A (B) reports results between 1971-1981 (1978-1995), respectively, to be able to extract the effects on bank performance of the first-ever deregulation announcement, by the legislature of Maine in 1978, in the interstate multi bank holding company regulations in USA. Maine's deregulatory move was conditioned on reciprocity by other states. There was no reciprocity until the legislatures of New York and Alaska announced their deregulations to be effective in mid-1982. This silent four-and-a-half year period provides a unique opportunity to test for the hypothesis that the open threat of competition is sufficient to have banks alter their behavior and assume a more competitive posture (Baumol, 1982). The results reported below come from $\mathrm{PG}_{i,t} = a_0 + \sum_{i=2}^{48} \delta_i * \mathrm{SD}_i + \sum_{t=2+(max\,j)}^{T} \theta_t * \mathrm{TD}_t + \sum_{j=0}^{3} \gamma_{(j+1)} * \mathrm{APGNG}_{i,(t-j)} + \sum_{j=0}^{3} \varphi_{(j+1)} * \mathrm{APGNON}_{i,(t-j)} + \sum_{k=1}^{4} \beta_k * \mathrm{X}_{k,i,t} + \mathrm{u}_{i,t}$ where i, j, k and t refer to the sample states, the number of (time) lags, the number of other explanatory variables, and each year of the sub-sample period; $PG_{i,t}$ is the Kalman-filtered TFPG for state i at time t; SD_i refers to cross sectional indicator variables for each state (excluding Alaska, Hawaii, and DC, since the first two are outside the realm of bordering neighboring US states, while the last is not a state); TD_t refers to time related indicator variables for each sample year; $APGNG_{i,t}$ ($APGNON_{i,t}$) refers to the average Kalman-filtered TFPG for commercial banks in state i's bordering neighboring (randomly chosen non-neighboring) states at time t, respectively; $u_{i,t}$ refers to the regression error term; $\mathbf{X}_{k,i,t}$ is a [(48xt)x4] matrix with control variables of *Pop Grw* (annual state-level population growth), *Pop Dens* (annual state-level population density), *Inco Grw* (annual growth in state-level real per capita income), and *Branch No* (annual state-level total number of branches) for state i at time t. The number of randomly chosen non-neighboring states is the same as that of bordering neighboring states for state i. Table 3 provides a list of neighboring and randomly chosen non-neighboring states for each state. ***, **, and * indicate statistical significance at the 10%, 5% and 1% levels, respectively.

Panel A: The 1971-1981 sub-sample results.

Variable	Model 1 Estimate	Model 1 t Value	Model 2 Estimate	Model 2 t Value	Model 3 Estimate	Model 3 t Value	Model 4 Estimate	Model 4 t Value	Model 5 Estimate	Model 5 t Value	Model 6 Estimate	Model 6 t Value
Intercept	-5.185	(-4.92)*	-4.116	(-3.57)*	-3.752	(-3.11)*	-3.747	(-2.70)*	-3.746	(-3.09)*	-3.822	(-2.75)*
APGNG	0.479	8.25*	0.403	1.99**	0.380	3.20*	0.305	2.93*	0.413	2.11**	0.092	0.42
APGNON	0.079	0.77	0.620	1.98**	0.435	2.45**	0.258	1.69***	0.402	1.23	0.093	0.26
L1-APGNG	N/A	N/A	0.118	0.65	N/A	N/A	N/A	N/A	-0.068	-0.22	0.285	0.81
L1-APGNON	N/A	N/A	-0.420	-1.47	N/A	N/A	N/A	N/A	0.065	0.12	0.398	0.65
L2-APGNG	N/A	N/A	N/A	N/A	0.177	1.82***	N/A	N/A	0.213	1.10	0.032	0.09
L2-APGNON	N/A	N/A	N/A	N/A	-0.164	-1.10	N/A	N/A	-0.198	-0.60	-0.350	-0.59
L3-APGNG	N/A	N/A	N/A	N/A	N/A	N/A	0.217	2.67*	N/A	N/A	0.112	0.57
L3-APGNON	N/A	N/A	N/A	N/A	N/A	N/A	-0.013	-0.10	N/A	N/A	0.115	0.36
POP GRW	-1.270	-1.45	-1.002	-1.32	-0.843	-1.31	-0.696	-1.19	-0.840	-1.30	-0.659	-1.12
POP DENS	94.656	7.49*	84.269	6.40*	81.081	6.06*	81.399	5.27*	80.919	6.03*	82.949	5.35*
BRANCH NO	-0.004	(-2.38)**	-0.006	(-3.76)*	-0.008	(-5.23)*	-0.009	(-6.09)*	-0.008	(-5.21)*	-0.009	(-6.06)*
INCO GRW	4.027	2.93*	3.039	2.52**	2.091	2.00**	0.942	0.80	2.083	1.98**	0.988	0.84
TIME DUMM		10/10 Sig		6/9 Sig		1/8 Sig		0/7 Sig		1/8 Sig		0/7 Sig
STATE DUM		45/47 Sig		43/47 Sig		41/47 Sig		40/47 Sig		41/47 Sig		40/47 Sig
N		528		480		432		384		432		384
R-Squ		0.644		0.694		0.763		0.814		0.763		0.816

Panel B: The 1978-1995 sub-sample results.

	Model 1	Model 1	Model 2	Model 2	Model 3	Model 3	Model 4	Model 4	Model 5	Model 5	Model 6	Model 6
Variable	**Estimate**	**t Value**	**Estimate**	**t Value**	**Estimate**	**t Value**	**Estimate**	**t Value**	**Estimate**	**t Value**	**Estimate**	**t Value**
Intercept	-1.190	(-2.09)**	-1.201	(-2.12)**	-1.111	(-2.01)**	-1.372	(-2.35)**	-1.189	(-2.12)**	-1.480	(-2.45)**
APGNG	0.377	6.68*	0.673	3.93*	0.573	6.03*	0.587	8.09*	1.230	4.18*	1.105	3.54*
APGNON	-0.122	(-1.79)***	0.503	1.99**	0.256	1.91***	0.172	1.78***	-0.332	-0.78	-0.115	-0.26
L1-APGNG	N/A	N/A	-0.287	-1.57	N/A	N/A	N/A	N/A	-1.234	(-2.33)**	-0.684	-0.99
L1-APGNON	N/A	N/A	-0.691	(-2.49)**	N/A	N/A	N/A	N/A	1.211	1.50	0.286	0.29
L2-APGNG	N/A	N/A	N/A	N/A	-0.130	-1.22	N/A	N/A	0.516	1.72***	-0.039	-0.06
L2-APGNON	N/A	N/A	N/A	N/A	-0.460	(-2.87)*	N/A	N/A	-1.114	(-2.43)**	0.317	0.32
L3-APGNG	N/A	N/A	N/A	N/A	N/A	N/A	-0.051	-0.61	N/A	N/A	0.221	0.67
L3-APGNON	N/A	N/A	N/A	N/A	N/A	N/A	-0.380	(-3.05)*	N/A	N/A	-0.725	-1.52
POP GRW	0.675	4.49*	0.616	4.07*	0.562	3.75*	0.492	3.35*	0.533	3.56*	0.469	3.19*
POP DENS	-12.405	(-4.44)*	-11.233	(-3.97)*	-10.002	(-3.54)*	-8.289	(-2.98)*	-9.276	(-3.29)*	-7.634	(-2.74)*
BRANCH NO	-0.002	(-2.89)*	-0.002	(-2.90)*	-0.002	(-2.87)*	-0.002	(-2.95)*	-0.002	(-2.91)*	-0.002	(-3.02)*
INCO GRW	9.775	4.42*	10.520	4.43*	10.166	4.23*	10.281	4.19*	9.786	4.08*	9.923	4.04*
TIME DUMM		15/17 Sig		14/16 Sig		14/15 Sig		14/14 Sig		14/15 Sig		14/14 Sig
STATE DUM		30/47 Sig		30/47 Sig		33/47 Sig		33/47 Sig		32/47 Sig		34/47 Sig
N		864		816		768		720		768		720
R-Squ		0.687		0.680		0.669		0.658		0.673		0.662

Appendix 1: Measurement and Computation of the UTFPG

We follow a two-step procedure, identical to that used in Daniels and Tirtiroglu (1998). The first step employs the Tornqvist (1936) index to compute UTFPG indices for each sample year and for each state and DC, while the second step separates UTFPG into its stochastic trend and pro-cyclical components. The Tornqvist (1936) index computation for UTFPG indices is as follows:

$$UTFPG_{i,t} = (\ln O_{i,t} - \ln O_{i,t-1}) - \sum_{n=1}^{N} 0.5\left[cs_{n,i,t} + cs_{n,i,t-1}\right] * \left[\ln I_{n,i,t} - \ln I_{n,i,t-1}\right] \qquad \textbf{(A1)}$$

where i = Alabama, ..., Wyoming, including DC; ln $O_{i,t}$ is the natural log of output for state i at time t; $cs_{n,i,t}$ is the respective input cost share for state i, at time t, defined as the cost of the respective input divided by total cost; ln $I_{n,i,t}$ is the natural log of each input quantity for state i, at time t; and N is the number of inputs, respectively (to simplify notation, we suppress i, unless explicitly needed).

Following Humphrey (1992), and Daniels and Tirtiroglu (1998), we construct a model with a single output and three factors of production in defining the variables to estimate UTFPG. Our variable definitions follow from Humphrey's (1992) real balance measure (in Humphrey's notation, it is QD). The single output, denoted by O, is the real dollar value of deposit and loan balances. Labor (W), capital (K), and loanable funds (F) are the inputs. We use a single output to keep our work simple. Existing literature shows that US commercial banks' productivity growth has been low and that the measurement of productivity growth does not differ under a multiple output or a single output specification. All these variables are stock measurements since our data do not allow us to implement flow measurements. Humphrey (1992, 1994) establishes that there is not much difference in the predictive accuracy of aggregate productivity based on stock or flow measurements. Table A1.1 lists the definition of each variable.

- insert Table A1.1 about here -

Eq. **(A1)** computes UTFPG with data from two consecutive years. So, 1967 is the earliest year for a UTFPG estimate. We deflate the data by the GNP deflator using 1987 as the base year. Table A1.2 provides the summary statistics for the variables in eq. **(A1)**. All variables are measured at year-end.

- insert Table A1.2 about here -

Our production model omits a growing aspect of bank production, namely, the off-balance sheet activities, which now generate a substantial portion of bank income. We note, however, that our productivity growth indices are for the period of 1971-1995, during which the off-balance sheet activities were not as much prominent as they are *now*. In fact, Humphrey's (1992) work support that our production model describes well the productivity growth of US commercial banks between 1970s and mid-1990s.

Appendix 2: Removing the Pro-cyclical Bias, via Kalman Filtering, in UTFPG

Following Slade (1989), Daniels and Tirtiroglu (1998) use a latent variable approach to purge the pro-cyclical bias from the true or filtered TFPG. This is achieved by modeling the FTFPG as a stochastic trend, and the measurement error as the residual bias. State-space techniques are a natural method of handling latent variables. The latent variable is the stochastic trend component of the UTFPG index:

UTFPG(t) = FTFPG(t) + e(t) **(A2.a)**

FTFPG(t) = θ*FTFPG(t-1) + w(t) **(A2.b)**

where UTFPG(t) is the unfiltered index of TFPG; FTFPG(t) is the filtered TFPG modeled as a stochastic trend; e(t) is the measurement error of the UTFPG index; w(t) is the white-noise error term for FTFPG(t) with mean and variance $(0,\Phi^2{}_w)$. Equations **(A2a,b)** are estimated by maximum-likelihood techniques, using the Kalman filter. Eq. **(A2.a)** is the observation equation, and eq. **(A2.b)** is the transition equation. In our analysis, the conditional distribution of UTFPG(t) is normal with the following mean and likelihood functions:[22]

E[UTFPG(t)|(t-1)] = FTFPG(t) **(A3)**

$$LogL = -(T/2)\log 2B - (1/2)\sum_{t=1}^{T}\log\Phi_e^2 - (1/2)\sum_{t=1}^{T}\left[e_t^2/\Phi_e^2\right] \quad \textbf{(A4)}$$

where Log L is maximized with respect to the parameters μ (the FTFPG(t)), Σ (a (NxN) covariance matrix), Φ, and B (the covariance of the residuals from the observation equation) . Initializing the Kalman filter estimations require data for 1967-1970 for each state, reducing the time period for the FTFPG estimates from 1967-1995 to 1971-1995.

[22] See Daniels and Tirtiroglu (1998) for more details of the estimation procedure. The results of the maximum likelihood estimations are available from the authors upon request.