FINANCIAL INTEGRATION AND SCOPE EFFICIENCY:
POST GRAMM-LEACH-BLILEY

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ABSTRACT

In this study, we investigate the effects and implications of the Gramm-Leach-Bliley Act of 1999, and empirically document scope efficiency effects from integration across the two formerly separate financial sectors, banking and insurance, using the econometric approach. We test whether there exist cost, revenue, and profit scope economies in the post-GLB U.S. financial services industry, and then examine which types of firms are more likely to realize scope economies. We adopt a two-stage econometric approach. The empirical results indicate that weak cost scope economies, weak revenue scope diseconomies, and substantial profit scope economies exist in the post-GLB integrated banking and insurance industries. The significant profit scope economies shows that the cost scope efficiency gains may offset the revenue scope efficiency losses and contribute to the net profit scope efficiency gains. Furthermore, firm characteristics such as firm size, product mix, business diversifications, product distributions, leverage ratios are found to significantly affect cost, revenue, and profit scope economies of financial conglomerates joint producing banking and insurance products.

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1. INTRODUCTION

The enactment of the Gramm-Leach-Bliley Act (GLB) in 1999 promised the most fundamental reform in the U.S. financial services regulation in more than half century. GLB repealed the 73-year old Glass-Steagall Act (GSA) of 1933 and removed barriers and restrictions on the affiliation between commercial banks and investment banks. GLB substantially modified the 50-year old Bank Holding Company Act (BHCA) of 1956 to permit companies which own commercial banks to engage in insurance underwriting and any other type of financial activities. It allowed subsidiaries of insurance companies, investment banks, and other types of financial institutions to engage in a broad range of financial activities that are not permitted for themselves. By the end of 2003, more than 600 companies elected Financial Holding Company (FHC) status under the GLB Act, more than 1,300 top tier FHCs/BHCs engaged in insurance agency or underwriting activities, and more than 2,500 insurance companies (either agents or risk-bearing underwriters) affiliated with commercial banks and thrift institutions.¹

Economic and finance theory have long discussed the potential effects of diversifying consolidation and an extensive literature has developed to explore the impact of diversifying transactions by non-financial firms on firm value (e.g., Lang and Stulz, 1994; Berger and Ofek, 1995; Servaes, 1996; Campa and Kedia, 2002; Chevalier, 1999; Hyland and Diltz, 2002; Villalonga, 2004) and on productive efficiency (e.g., Lichtenberg and Siegel, 1987; Lichtenberg, 1992; Maksimovic and Phillips, 2001, 2002; Schoar, 2002). However, there is a striking lack of empirical research on the effects of diversification by financial firms. Carow (2001) and Johnston and Madura (2000) documented an increase in the stock prices of both acquirer and target, and gains to banks, insurers, and brokerage firms in response to the Citicorp–Travelers merger, which joined a commercial bank with an insurer, both of which also conducted securities

¹ BHC Statutory Financial Report (multiple years); Federal Reserve Report to Congress, 2003
underwriting. Cybo-Ottone and Murgia (2000) found significant market value gains associated with M&As between banks and insurers in Europe. The remaining available research of financial integration, however, has mostly focused on “within-sector” diversification, e.g., providing deposits and loans within a commercial bank (Berger, Humphrey, and Pulley, 1996) or providing property-liability and life insurance products within an insurance group (Berger, Cummins, Weiss, and Zi, 2000).

One of the important elements in the current debate is the effect integration has on the efficiency of financial institutions. The purpose of this research is to provide the first evidence to inform this debate. In this study, we estimate economies of scope of the cross-sector integration in the post-GLB U.S. financial services industry across cost, revenue and profit measures. Gains from exploiting scope economies and product mix efficiencies are often cited as motives for financial institution integration. The scope efficiency gains can be created by sharing such physical inputs as computers, furniture, or offices; employing common information systems, distribution systems, advertisement department, or investment department; reusing managerial expertise; obtaining external capital by issuing securities in larger sizes; providing consumption complementarities (“one-stop shopping” convenience) to customers. However, scope diseconomies may also arise at the same time because of higher administration and coordination expenses, organizational diseconomies, cross-subsidization in internal capital markets, or losing of specialization expertise when customers need specially tailored products.

Since the 1990s, substantial research has been devoted to measuring the productive efficiency of financial institutions, particularly in commercial banks. Literally hundred of studies have been conducted to estimate various measures of efficiency of financial institutions located
in more than two-dozen countries.\footnote{Berger and Humphrey (1997) critically reviewed more than 130 studies and summarized empirical efficiency estimates of financial institutions in 21 countries.} However, there is little research on the efficiency effects of integrating providers of different categories financial services into universal-type organizations. What little evidence that does exist is extrapolated either from scope efficiency within one sector of the financial industry, e.g., the commercial banking (e.g., Berger, Hanweck, and Humphrey, 1987; Berger, Hancock, and Humphrey, 1993; Berger, Humphrey, and Pulley, 1996) or the insurance industry (e.g., Grace and Timme, 1992; Berger, Cummins, Weiss, and Zi, 2000), or from simulations of risk diversification benefits of diversifying integration in the absence of any synergistic gains (e.g., Kwast, 1989; Boyd, Graham and Hewitt, 1993; Whalen, 1998; Allen and Jagtiani, 2000; Lown, Osler, Strahan, and Sufi, 2000). To the best of our knowledge, this research is the first to evaluate the cost, revenue and profit scope economies resulting from cross-sector integration in the post-GLB financial services industry.

We utilize a two-stage procedure econometric method to investigate economies of scope. The analysis proceeds as follows. We first estimate cost, revenue, and profit scope economy scores using econometric functions. Then, in the second stage, the scores from the first stage are regressed upon a set of variables describing firm characteristics and environment.\footnote{The two-stage procedure is typically used in literature to explain the differences in efficiency. Bank studies include Aly et al. (1990), Berger et al (1993), Pi and Timme (1993), Kwan and Eisenbeis (1995), Mester (1996), Berger and Hannan (1998). Thrift institution studies include Cebenoyan et al. (1993a, 1993b), Mester (1993), and Hermlin and Wallace (1994). Insurance firm studies include Garder and Grace (1993), Berger et al. (2000), and Cummins et al. (2003).} The second stage regression allows us to test whether scope economies exist for firms that jointly produce financial products across multiple sectors and explain the variation of scope economy estimations.

The most likely reason empirical research on the integration of the banking and insurance sectors is so scarce is because the regulatory data sets available to study this issue are product
specific, and there is no convenient way to identify companies affiliated with one another across sectors. In this research, we link the insurance regulatory data sets available from the National Association of Insurance Commissioners (NAIC) with the bank regulatory data sets from the Federal Reserve Board (FRB), the Federal Deposit Insurance Company (FDIC), and the Office of Thrift Supervision (OTS). Therefore, our combined data set consists of all financial conglomerates (bancassurers and assuranks), specialist banks, and specialist insurers in the U.S. banking and insurance industry during the year 2003.

The remainder of the paper is organized as follows: Section 2 discusses the concept of scope economies and reviews the prior research relevant to the U.S. financial services industry. Section 3 describes the hypothesis development. In section 4, we explain the estimation methodologies employed and discuss the data set used in the study. Section 5 presents the estimation of inputs, outputs, and prices. Section 6 reports the empirical results, and Section 7 offers a conclusion.

2. SCOPE ECONOMIES AND RESEARCH EVIDENCE

Financial services integration is broadly defined as any event that combines two or more financial service organizations or combines two or more dimensions of the production of financial services in one organization (Berger 2000). In this paper, we further classify financial services integration as being either within-sector integration or cross-sector integration. Within-sector integration involves offering multiple financial products within the same sector of the financial industry. Cross-sector integration involves offering a broad range of financial products in two or more different sectors of the financial industry.⁴ We specifically focus on cross-sector integration.
integration and refer to financial services cross-sector integration as “financial integration” in short. The most commonly quoted source of potential gains from cross-sector integration is the exploitation of scope economies (Herring and Santomero, 1990; Saunders and Walter, 1994; Calomiris, 1998; Berger, 2000; Yeager, Yeager and Harshman, 2004). Therefore, it is particularly important to evaluate scope and product mix efficiencies of financial conglomerates (e.g., bancassurers and assurbanks). In this section, we briefly review the concept of scope economies and discuss the relevant literature including cost scope economies, revenue scope economies, and profit scope economies by firms in the financial services industries.

2.1. Cost Scope Economies

Cost scope economies refer to the reduction of the average total production costs through producing a wider variety of goods or services. For cross-sector integration, cost scope economies may be realized from the sharing of physical inputs such as computers, software, furniture, or offices; reusing managerial expertise and experience; raising external capital at lower costs because of reduced risks; and employing common service department such as distribution, advertisement, or investment. One of the most desirable things about joint production is that commercial bank and insurer integration may lower total costs by cross-selling and using a joint customer database and information at a lower cost.\(^5\) However, cost scope diseconomies may also arise from integration because of higher coordination and administrative costs, and organizational diseconomies from producing or distributing a broad range of products.

Some studies exist estimating cost scope efficiencies of providing multiple products within a single financial institution. Nevertheless, these studies evaluate cost scope economies of

\(^5\) Jappelli and Pagano (2002) showed that by using a common information system or reusing gathered information, integrated financial institutions can diminish the adverse selection problem and reduce their default rate in credit markets. Mester, Nakamura and Renault (2002) offered empirical evidence showing that information gathered from different financial services gave an advantage to institutions that combined these services over other lending institutions.
within-sector products (e.g., commercial loans and consumer loans) rather than cross-sector products (e.g., commercial loans and life insurance policies). Within the U.S. banking sector, the evidence was mixed and most of studies found no substantial evidence of cost scope economies in commercial banks or in savings and loans (e.g., Mester, 1987, 1993; Berger and Humphrey, 1991; Pulley and Humphrey, 1993; Ferrier, et al., 1993; Jagtiani, Nathan, and Sick, 1995; Rogers, 1998).\(^6\) Two papers found evidence of cost scope diseconomies arising from coordination and administrative costs of banks offering a broad range of products (Cebenoyan, 1990; Winton, 1999). As for the evidence in Europe, Cavallo and Rossi (2001) examined six EU countries and found consistent cost scope economies at all production levels, suggesting that cost scope economies can increase as banks move towards the universal banking model. Valverde and Fernandez (2005) examined Spanish banks and found significant cost scope economies when incorporating off-balance sheet business.


Additionally, Kellner and Mathewson (1983) found cost scope economies in the Canadian life industry. Khaled, Adams, and Pickford (2001) found that small- and medium-sized

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New Zealand life insurance companies experienced cost scope diseconomies, while the large-sized companies had neither economies nor diseconomies of scope. Hirao and Inoue (2004) found statistically significant cost scope economies for Japanese property-liability insurers, and Toivanen (1997) found modest cost scope economies in the Finnish non-life insurance industry. Therefore, scope studies in the financial services industry are limited, with the available research providing unconvincing evidence.

Although studies have investigated scope economies across lines of business within the same sector of the U.S. financial services industry, no evidence exists on whether scope economies exist for offering a wider variety of products across different sectors of the industry. To our knowledge, no empirical study investigates the scope efficiencies of financial conglomerates in the U.S., and only a handful of studies provide evidence on scope economies of financial conglomerates in the EU, with mixed results. Lang and Welzel (1996) found mostly diseconomies of producing loans and investment-oriented services within German universal banks and cost scope economies only for small German banks. By searching for complementarities between loans and investment-related products offered by universal banks, Allen and Rai (1999) found small scope economies for EU universal banking. Vander Vennet (2002) documented limited evidence of cost scope economies of universal banks in Europe.

2.2. Revenue Scope Economies

Scope economies in revenue refer to the increases of total revenue resulting from the production of different categories of services or products. Revenue scope economies may occur because of consumption complementarities or so called the demand super-additivity. By offering “one-stop shopping” convenience, financial conglomerates may reduce consumers search and transactions costs. Further, some customers may be willing to pay more for the convenience of
“supermarket” shopping for their banking and insurance needs. Demand side scope efficiency gains may also arise by cross-selling a broad range of financial products or integrating distribution systems. Reputation recognition can also lead to revenue scope economies when the integration or consolidation associates with a brand name which customers well recognize and prefer. By diversifying across products, financial conglomerates may lower their risk if net cash flows are negatively correlated. In this sense, conglomerates may realize revenue scope economies by charging higher prices because of their lower bankruptcy and financial distress costs. In addition, financial integration may also provide firms with market power in pricing.

However, the existence of revenue scope diseconomies cannot be dismissed, especially if the integration creates or enhances conflicts of interest. The conglomerate form of organization can create internal capital markets, which may somehow worsen inefficient cross-subsidies and investment inefficiencies arising from managerial agency problems (e.g., Jensen, 1993; Lamont, 1997; Shin and Stulz, 1998). Scharfstein and Stein (2000) found inefficient cross-subsidies in internal capital markets and are often “socialist” in nature, whereby weaker divisions receive subsidies from stronger ones. Thus, the failure of a subsidiary may endanger the other subsidiaries and even the group as a whole.

Mester (1992b) argued that the market would view problems in one subsidiary as signaling problems in other subsidiaries and emphasized that BHCs have tended to rescuing their failing affiliates. In a financial conglomerate, catastrophic losses of one business line (e.g., property-liability insurance) could be subsidized by other business lines (e.g., commercial banking) thus leaving customers of commercial banking activities at risk. In this case, revenue scope diseconomies are more likely occur.\(^7\) Revenue scope diseconomies may also arise if

\(^7\) A recent study by Kahn and Winton (2004) investigated optimal subsidiary structures for banks and suggested that banks “bipartite” subsidiary structures, where one subsidiary holds relatively safer loans and the other holds risky
specialists from different types of financial services have better knowledge and expertise in their areas and can provide better-tailored products for customers, and thereby charge higher prices than joint producers.

Little research exists on revenue scope efficiency effects of financial services integration. The studies that do exist, again, are based on within-sector data (e.g., banking or insurance), and results are inconclusive. Berger, Humphrey, and Pulley (1996) and Noula, Miller, and Ray (1993) found little or no evidence of revenue scope efficiency for providing deposits and loans. In addition, both studies showed non-increasing revenue for charging customers for joint consumption benefits. Berger, Cummins, Weiss, and Zi (2000) found revenue scope diseconomies from providing life insurance and property-liability insurance products by integrated insurers. However, using a more sophisticated estimation technique, more recent research by Cummins, Weiss, and Zi (2003) found weak evidence of revenue scope economies in the U.S. insurance industry.

2.3. **Profit Scope Economies**

Profit scope economies generally refer to increased profits from producing a broader range of products. Profit scope economies simultaneously consider both costs and revenues and therefore will reflect differences in product or service quality, which may not be measurable by considering cost or revenue scope efficiency in isolation. For example, customers may prefer “one-stop shopping” by paying more for such consumption convenience that will lead to revenue scope economies. However, financial conglomerates may incur additional expenses in offering one-stop shopping convenience to their customers that leads to cost scope diseconomies. So, revenue scope economies or cost scope diseconomies alone cannot explain the net scope

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loans, are more likely to dominate “unitary” structures, where one subsidiary holds both safer and risky loans, in terms of preventing risk shifting. In the bipartite structures, banks’ safer loans can be insulated from riskier loans, thus reducing risk-shifting incentives in the safer subsidiary.
efficiency gain/loss from integrating different categories of financial products. In this sense, profit scope economies dominate the more commonly used concept of cost and revenue scope economies since estimation of profit scope economies incorporates both cost and revenue efficiency effects.

Studies of profit scope efficiencies generally do not found consistent benefits of either joint production or specialization either within banking or insurance. Studies typically found that joint production was more efficient for some firms and specialization was more efficient for others (Berger, Hancock, and Humphrey, 1993; Berger, Cummins, Weiss, and Zi, 2000; Cummins, Weiss, and Zi, 2003). Few studies analyzing profit efficiencies have found meaningful profit scope economies among traditional deposit and loan outputs although they were found to be significantly different from zero (Humphrey and Pulley, 1997; Rogers, 1998). Vander Vennet (1999, 2002), studied universal banks in Europe, showed that universal banks typically had both higher revenue and higher profitability than specialized banks. Vander Vennet (1996) suggested that EU universal banks appear to be more profit efficient than non-universal banks. Valverde and Fernandez (2005) examined Spanish banks and found significant profit scope economies when incorporating off-balance sheet business.

3. **HYPOTHESES DEVELOPMENT**

To demonstrate that regulations destroy value while deregulation creates value, Rajan (1996) and Benston (1996) have shown that the Glass-Steagall Act had limited financial institutions’ ability to pursue economies of scope, and Mamun *et al.* (2002, 2005) have found that the GLB had provided welfare gains to banks and insurance companies. Although the GLB largely eliminates the barriers and restriction on affiliations across financial sectors, it does not necessarily follow that financial supermarkets will become dominant in the U.S. financial services industry.
Furthermore, we observe the coexistence of both conglomerate and specialization business strategies followed by banks or insurance companies. Whether scope benefits exist for either joint or specialized productions remains an open question for the cross-industry financial conglomeration in the U.S. These suggest the first two general hypotheses regarding economies of scope, stated the null form as follows:

**Hypothesis 1:** Neither scope economies nor diseconomies (cost, revenue, or profit) exist in the post-GLB integrated banking and insurance industries.

**Hypothesis 2:** Economies of scope (cost, revenue, or profit) are invariant among financial conglomerates joint producing banking and insurance products.

As we discuss in Section 2, economies of scope can arise from variety cost complementarities and/or revenue complementarities. Firm-specific characteristics, e.g., the firm size, the products mix, the distribution network, the regulatory regime, may affect those complementarities and then contribute to assorted scope economies or diseconomies. Some banks or insurers could be in a better position to benefit from the diversified producing. We then formulate the following specific hypotheses regarding the relationship between firm-specific characteristics and scope economies, i.e., to address the question of which types of banks and insurers are more likely to realize economies of scope through cross-industry financial integration.

Firm size is regarded as an important factor in the financial institution literature. Akhigbe and Whyte (2001) and Barth *et al.* (2000) found that large banks benefited more from the passage of GLB than small banks. In addition, there is a consensus that firm size may be associated with greater or lesser scope economies, and it is typically found that larger banks or insurance companies could exploit higher scope economies than small ones.⁸ Financial

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conglomerates jointly producing banking and insurance products may gain a competitive advantage through the implicit government guarantees if they are large enough and are considered “too big to fail”. These large conglomerates may also gain a reputational advantage if consumers perceive that the implicit guarantees reduce potential losses. The implicit guarantees may also allow them to borrow funds at lower costs (Kane, 1994, 1999; Carow, 2001). Cost scope economies may exist at small scale from sharing some inputs or fixed resources such as computers or offices, but these cost scope economy gains may be exhausted for larger conglomerates or offset by coordination or management diseconomies. Nevertheless, large scale may be needed to generate revenue economies from consumption complementarities because of the need to maintain a large distribution network. Our third hypothesis is given as follows:

**Hypothesis 3:** Larger financial conglomerates are more likely to exploit economies of scope in joint producing banking and insurance products.

The two primary product segments of insurance sector are life-health insurance and property-liability insurance. The business opportunities offered by the GLB may benefit some lines of insurance business more than others. Carow (2001) found that life insurance companies benefited more from the passage of GLB than property-liability insurers. GAO (1990) study and Saunders and Walter (1994) concluded that synergistic gains are greater for the combination of banks and life insurers than for the combination of banks and property-casualty insurers. Given regulations precluding banks from manufacturing insurance, U.S. banks have long entered distribution alliances with insurance companies in order to engage in the insurance business. Since life insurance products are more like banking products or function as complementarities to the banking products, banks are more interested in life insurance products than property-liability
products (Johnston and Madura, 2000). Carow (1999) documented that life insurance companies receive more intense competition from bank entry than property-liability insurers.\(^9\)

Majority of banks have been offering annuities and credit related life and health insurance to their customers for a long time. A 1996 Life Office Management Association (LOMA) survey of banks and thrifts involved in insurance distribution showed that they were most likely to sell annuities followed by term life and whole life, and were least likely to distribute property-liability products. As a result, many banks and thrifts institutions have received rich experiences in life insurance distribution. Hence, banks could gain greater scope economies when combining with life insurers than others. However, such combination may create competitions and conflicts in selling similar products, attributing to revenue scope diseconomies.

In addition, economies that arise from marketing, distribution, administration, and other functions may be more prevalent in the personal product lines than in the commercial lines. The primary argument in favor of this position is that the marketing, distribution, administration, and other functions tend to be homogeneous in the personal lines and more heterogeneous in the commercial lines. Personal customers may be willing to pay more for such one-stop shopping convenience, whereas commercial customers face relatively trivial search or transaction costs and may care more tailored products for their needs. These arguments suggest the following two hypotheses related with the product mix:

**Hypothesis 4:** Economies of scope are more likely to occur in joint producing life and banking products than in joint producing property-liability and banking products.

**Hypothesis 5:** Economies of scope are more likely to occur in the personal financial product lines than in the commercial lines.

\(^9\) The combination of banks and life insurers may also benefit from risk reduction. Boyd and Graham (1988) and Brewer et al. (1988) document reduced coefficients of variation and reduced bankruptcy risk for bank-life insurance combination.
A sixth hypothesis has to do with distribution systems, which may have an effect on the
level of scope economies. Although a consolidated bank and insurer may lower total costs or
increase the expected revenue by cross-selling, scope economies may vary with distribution
systems. Insurers using vertically integrated distribution systems distribute their products
through exclusive agents, direct marketing (by company employees), or mass marketing (mail
and/or mass media advertising). Insurers using horizontally integrated distribution systems
distribute through brokers or independent agents who sell the products of multiple insurers.10

Banks are expected to sell their insurance affiliates’ products through their branches or
offices. Banks affiliated with vertically integrated insurers may reuse insurers’ relatively large
investments in advertising, marketing, and brand names, creating cost scope economies.
However, revenue scope economies may be less likely for the affiliation between banks and
vertically integrated insurers because this may increase competitions and conflicts within the
group, which is especially serious when bank-sold insurance products are similar to the insurance
products offered by their insurer affiliates, especially annuities.11 In this sense, insurers using
horizontal distributions may be in a better position to gain revenue scope economies when
affiliating with banks. Based these arguments, our next hypothesis is:

**Hypothesis 6 (H6):** Economies of scope are more likely to be present for the
combination of banks and insurers using horizontally integrated distributions than for the
combination of banks and insurers using vertically integrated distributions.

4. METHODOLOGY AND DATA

This section describes the methodology, the two-stage econometric method, utilized and how the
banking and insurance regulatory data sets are linked to create the combined database.

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10 Kim, Mayers , and Smith (1996) had further discussions of the choice of insurance distribution system.
11 Banks and thrift institutions made about 15 percent of individual annuity sales in 1999 and about 23 percent in
4.1. Econometric Approach

The translog functional form, first proposed by Christensen, Jorgenson, and Lau (1973), has been employed to estimate cost functions in several scope economy studies. However, this functional form does not allow for zero production of any product and therefore is not ideal for scope economy estimation. In this study, we use the composite function form first proposed by Pulley and Braunstein (1992). The composite function allows not only zero output from some products but also negative value of the dependent variable. Thus, this functional form is attractive, especially for estimating profit scope efficiencies.\(^\text{12}\)

4.1.1. Function Form

The composite Pulley and Braunstein (P-B) model combines a quadratic structure for outputs and a log-quadratic specification for input prices. It is given by:

\[
C = [\alpha_0 + \sum \alpha_i q_i + (1/2) \sum \sum \alpha_{ij} q_i q_j + \sum \sum \delta_{ik} q_i \ln r_k] \cdot \exp[\beta_0 + \sum \beta_k \ln r_k + (1/2) \sum \sum \beta_{kl} \ln r_k \ln r_l + \sum \sum \mu_{ik} q_i \ln r_k] + \varepsilon \tag{1}
\]

where \(C\) is total costs; \(q_i\) is the \(i\)th output, \(i=1,\ldots,n\); \(r_k\) is the \(k\)th input price, \(k=1,\ldots,m\); \(\alpha, \beta, \delta, \mu\) are coefficient vectors to be estimated; \(\varepsilon\) denotes a random error term. The theoretical requirement that the cost function be homogeneous of degree one in input prices is met by imposing the following restrictions (Brown et al., 1979):\(^\text{13}\)

\[
\sum_k \beta_k = 1 \text{ and } \sum_i \beta_{ki} = \sum_k \beta_{ik} = 0 \quad (k, l = 1, \ldots, m)
\]

\[
\sum_k \delta_{ik} = 0 \quad (k = 1, \ldots, m)
\]

\(^{12}\) This type of model has been used to estimate economies of scope in banking (e.g., Pulley and Humphrey, 1993; McKillop, Glass, and Morikawa, 1996; Berger, Humphrey, and Pulley, 1996) and in insurance (e.g., Berger \textit{et al.}, 2000; Hirao and Inoue, 2004).

\(^{13}\) The function must exhibit homogeneity of degree one in input prices to be a well-behaved cost function. That is a doubling of all input prices exactly doubles costs. Linear homogeneity, a necessary condition for the cost function, is not necessary for the alternative revenue and profit functions.
The symmetry restriction implies $\alpha_j = \alpha_j$ and $\beta_{kl} = \beta_{lk}$. Because of difficulty in estimating both constant terms $\alpha_0$ and $\beta_0$ simultaneously, only $\alpha_0$ is retained in the final P-B composite model (Pulley and Braunstein, 1992; McKillop et al., 1996; Berger et al., 2000). The interaction term $\sum \sum \mu_{ik} q_i \ln r_k$ is also omitted because of the same technically problematical estimation issue, which is also recommended by P-B.\(^{14}\) Therefore, the P-B composite model we use is specified as

\[
C = \left[ \alpha_0 + \sum \alpha_i q_i + (1/2) \sum \sum \alpha_{ij} q_i q_j + \sum \sum \delta_{ik} q_i \ln r_k \right] \cdot \exp \left[ \sum \beta_k \ln r_k + (1/2) \sum \sum \beta_{kl} \ln r_k \ln r_l \right] + \varepsilon
\]  

(2)

Consistent with the literature, we adopt a modified version of the composite cost function form by normalizing dependent variables, output and input variables. It is specified as

\[
\frac{C}{q_n r_m} = \left[ \alpha_0 + \sum \alpha_i y_i + (1/2) \sum \sum \alpha_{ij} y_i y_j + \sum \sum \delta_{ik} y_i \ln s_k \right] \cdot \exp \left[ \sum \beta_k \ln s_k + (1/2) \sum \sum \beta_{kl} \ln s_k \ln s_l \right] + \varepsilon
\]  

(3)

In this normalized composite function, we normalize the dependent variable by dividing by the quantity of the last fixed netput ($q_n$) and the price of the last input ($r_m$). The output (and fixed netput) terms are also normalized by the last fixed netput ($y_i = q_i / q_n$) and input prices are normalized by last input price ($s_k = r_i / r_m$). The normalization by $q_n$ helps control for heteroskedasticity and helps reduce scale biases in estimation; the normalization by $r_m$ imposes linear homogeneity in the input prices, a necessary condition for the cost function.\(^{15}\)

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14 The original P-B model has two constant terms, $\alpha_0$ and $\beta_0$, and two interaction terms, $\sum \mu_{ik} q_i \ln r_k$ and $\sum \delta_{ik} q_i \ln r_k$. Technically, they cannot be simultaneously estimated. P-B (1992) and other literature recommended retaining one in the final model.

15 This normalization approaches have been commonly used in literature, e.g., Berger and Mester (1997, 2003, 2005), Berger, Hancock, and Humphrey (1993), Berger et al. (2000), Berger et al. (2005). Another common normalization is called Fuss normalization, where both dependent variable and input prices variables are divided by last input price only. The fuss normalization has been previously used to the cost function by Berndt et al. (1980), Morrison and Berndt (1981), and Segal (2003), and to the revenue and profit function by Diebert and Ostensoe (1987), Hancock (1992).
The revenue and profit functions estimated in our study are identical to the composite cost function, (2) and (3), except that the dependent variable, cost, is replaced by revenue and profit respectively.\textsuperscript{16} Thus, revenue functions are

\[
R = [\alpha_0 + \sum \alpha_i q_i + (1/2) \sum \sum \alpha_y q_y q_j + \sum \sum \delta_{ik} q_i \ln r_k] \\
\cdot \exp[\sum \beta_k \ln r_k + (1/2) \sum \sum \beta_k \ln r_k \ln r_i] + \varepsilon
\]

(4)

\[
\frac{R}{q_n r_m} = [\alpha_0 + \sum \alpha_i y_i + (1/2) \sum \sum \alpha_y y_i y_j + \sum \sum \delta_{ik} y_i \ln s_k] \\
\cdot \exp[\sum \beta_k \ln s_k + (1/2) \sum \sum \beta_k \ln s_k \ln s_i] + \varepsilon
\]

(5)

and profit functions are

\[
P = [\alpha_0 + \sum \alpha_i q_i + (1/2) \sum \sum \alpha_y q_y q_j + \sum \sum \delta_{ik} q_i \ln r_k] \\
\cdot \exp[\sum \beta_k \ln r_k + (1/2) \sum \sum \beta_k \ln r_k \ln r_i] + \varepsilon
\]

(6)

\[
\frac{P}{q_n r_m} = [\alpha_0 + \sum \alpha_i y_i + (1/2) \sum \sum \alpha_y y_i y_j + \sum \sum \delta_{ik} y_i \ln s_k] \\
\cdot \exp[\sum \beta_k \ln s_k + (1/2) \sum \sum \beta_k \ln s_k \ln s_i] + \varepsilon
\]

(7)

where \( R \) is the revenue; \( P \) is the profit. The modified composite cost, revenue, and profit functions are estimated by non-linear least squares.

4.1.2. Measurement of Economies of Scope

Cost economies of scope (CSCOPE) are measured as the percentage of cost firms could save by producing multiple products jointly instead of producing each product separately in specialist

\textsuperscript{16} Following Berger et al. (2000), we use the same form and independent variables for the cost, revenue, and profit functions to avoid the impact of specification differences on the cost, revenue, and profit scope economies estimations. Although the linear homogeneity is not necessary for the revenue and profit functions, we impose the same normalization firstly to avoid the specification differences effects. Second, output prices generally move with input prices, so we assume that if all input prices double, output prices would approximately double, as would profits and revenues.

Furthermore, these are alternative revenue and profit efficiency functions. Standard profit efficiency takes output prices to be exogenous, and the alternative profit efficiency takes output quantities to be exogenous. It is called the alternative profit function because it includes output quantities rather than output prices. The alternative profit efficiency concept is used primarily because output prices and quality are difficult measure accurately for banks and because output quantities are relatively fixed in the short-run and cannot respond quickly to changing prices as is assumed in the use of standard profit efficiency. For details please see Berger and Mester (1997, 2003).
firm (Panzar and Willig, 1975, 1981). The traditional measure of \( \text{CSCOPE} \) (specified as \( \text{CSCOPE}^T \)) in the case of a firm producing two products \( Q_1 \) and \( Q_2 \) is given by

\[
\text{CSCOPE}^T = \frac{C(q_1, 0; r) + C(0, q_2; r) - C(q_1, q_2; r)}{C(q_1, q_2; r)}
\]  

(8)

Where \( C(\ . \ ) \) is a continuous cost function estimated for conglomerates only; \( q_1 \) and \( q_2 \) are output level of the two products; and \( r \) refers to input price vector. Cost scope economies are believed to be present if \( \text{CSCOPE}^T > 0 \), and diseconomies are present if \( \text{CSCOPE}^T < 0 \). Since data on specialist firms are generally not available, this measure is acceptable and widely used in literature. Recently, this traditional measurement by Panzar and Willig (1981) is criticized by some researchers as it estimates a single cost function using the data of conglomerates only and applies to both specialist firms and conglomerates.

To fix these problems, an alternative measure of scope economies has been developed by Berger, Cummins, Weiss and Zi (2000), who suggested that cost, revenue, or profit functions should be estimated separately for specialist firms and joint producers. This approach is feasible only when data are available on both types of firms. Fortunately, this is the case for our data. Thus, we adopt this alternative approach for our estimation. This approach gives the measure of cost scope economies in case of producing two categories products, \( Q_1 \) and \( Q_2 \), as

\[
\text{CSCOPE} = \frac{C_{S1}(q_1; r_1) + C_{S2}(q_2; r_2) - C_{J1}(q_1; r_1) - C_{J2}(q_2; r_2)}{C_{J1}(q_1; r_1) + C_{J2}(q_2; r_2)}
\]  

(9)

where \( C_{S1}(q_1; r_1) \) is the cost function for the specialist firm \( S1 \) producing \( Q_1 \); \( C_{S2}(q_2; r_2) \) is the cost function for the specialist firm \( S2 \) producing \( Q_2 \); \( C_{J1}(q_1; r_1) \) is the cost function for the division \( J1 \) (producing \( Q_1 \) only) of conglomerates; \( C_{J2}(q_2; r_2) \) is the cost function for the division \( J2 \) (producing \( Q_2 \) only) of conglomerates. Cost scope economies are believed to be present if \( \text{CSCOPE} > 0 \), and diseconomies are present if \( \text{CSCOPE} < 0 \).
Revenue and profit scope economies are generally measured as the percentage increase in revenue or profit when different categories of products are provided jointly instead of being provided separately. The revenue scope economies score \( RSCOPE \) is given by

\[
RSCOPE = \frac{R_{j1}(q_1; r_1) + R_{j2}(q_2; r_2) - R_{s1}(q_1; r_1) - R_{s2}(q_2; r_2)}{R_{j1}(q_1; r_1) + R_{j2}(q_2; r_2)}
\]

and profit scope economies score \( PSCOPE \) is

\[
PSCOPE = \frac{P_{j1}(q_1; r_1) + P_{j2}(q_2; r_2) - P_{s1}(q_1; r_1) - P_{s2}(q_2; r_2)}{P_{j1}(q_1; r_1) + P_{j2}(q_2; r_2)}
\]

where \( R_{s1}( \cdot ), \ R_{s2}( \cdot ), \ P_{s1}( \cdot ), \ P_{s2}( \cdot ) \) are revenue and profit functions for specialist firms \( S1 \) and \( S2 \) respectively; \( R_{j1}( \cdot ), \ R_{j2}( \cdot ), \ P_{j1}( \cdot ), \ P_{j2}( \cdot ) \) are revenue and profit functions for divisions \( J1 \) and \( J2 \) of conglomerates. Similarly, revenue or profit scope economies are believed to be present if \( RSCOPE > 0 \) or \( PSCOPE > 0 \), and scope diseconomies are present if \( RSCOPE < 0 \) or \( PSCOPE < 0 \).

4.2. Data

The data used in this study come from a variety of sources. By constructing a linking variable, we have matched the unique company identifiers between the insurance and bank regulatory data sets. This database combines National Association of Insurance Commissioner’s (NAIC) Life/Health and Property/Liability Insurance Industry data sets together with Bank Holding Company FR-Y-9C Financial Report (BHCR), Commercial Bank Reports of Condition and Income (CALL Report), and Thrift Financial Report (TFR). These four data sets are all for year 2003 and contain financial and domicile information for all bancassurers, assurbanks, specialized insurance companies, and specialized banks who were active at year-end 2003. We then screen the database to eliminate firms with zero or negative total assets or net worth. Secondly, those who are not active in the market are also eliminated. For example, insurers with non-positive net
premium written and banks with non-positive total deposits are also excluded from the data set. On the group level, our data contain 46 assurbanks and 41 bancassurers, 7,393 bank specialists and 1,306 insurance specialists. The individual firms contained in the final data set include 951 life insurers, 2,057 property-liability insurers, 7,762 commercial banks, and 1,410 thrift saving banks. Among them, 234 life insurers, 210 property-liability insurers, 124 commercial banks, and 66 saving banks are subsidiaries of the financial conglomerates joint producing banking and insurance products. The firms included account 98 percent the assets of life insurance companies, 92 percent assets of property-liability insurance companies, 99 percent assets of commercial banks, and 99 percent assets of thrift saving banks.

5. ESTIMATION OF OUTPUTS, INPUTS, AND PRICES

Like other service industries, it is difficult to define what financial institutions produce and how the services are priced. In this section we briefly discusses the measurement of outputs, inputs, and prices for insurance companies and banks, respectively.

5.1. Outputs and Prices

Three alternative methods have been used in literature to measure outputs in financial services industry – the asset (financial intermediation) approach (Sealey and Lindley, 1977), the user-cost approach (Donovan, 1978), and the value-added (production) approach (Berger and Humphrey, 1992). Under the asset approach, financial institutions are considered as financial intermediaries that borrow funds from depositors and then lend the money to loan-holders. The user-cost approach determines whether a financial product is an input or output by comparing its contribution to firm’s revenue. If its return on asset exceeds the opportunity cost of funds then the product is treated as an output, otherwise it is considered as an input. The value-added approach treats all asset and liability categories to have both output and input characteristics.
(Berger and Humphrey, 1992; Pulley and Braunstein, 1992; Pulley and Humphrey, 1993; Berger et al., 2000; Cummins et al., 2003). Those categories having significant value added are considered as important outputs and others are treated as inputs, intermediate products, or unimportant outputs. The literature has evolved over time and the value-added approach is believed to be the most appropriate approach to measure outputs of financial services industry. Therefore, consistent with most of the recent literature on financial institutions’ efficiencies, we measure outputs using the value-added approach exclusively.

5.1.1. Insurance Outputs and Prices

Consistent with recent literature on insurance efficiency (e.g., Cummins and Zi, 1998; Berger et al., 2000; Cummins and Weiss, 2001; Cummins, Weiss, and Zi, 2003; Greene and Segal, 2004), we identify three principal services provided by insurance companies – risk pooling and risk-bearing, real financial services, and financial intermediation. The actuarial, underwriting, claim settlement, and associated expenses incurred in operating risk pools are the main components of value added related to risk-pooling and risk-bearing. In life insurance, real financial services include personal financial planning, pension counseling, and commercial benefit plan administration. In property-liability insurance, risk surveys, coverage program design, and consulting on policy deductibles and limits are the major real services related to insured losses. For financial intermediation, interest credited to life insurance policies and premium discounts applied to property-liability insurance policies represent the value added of the insurers’ intermediation function.

Property-Liability Insurance. For property-liability insurers, the present value of real losses incurred \( \text{PI}(L) \) is used as a proxy for insurance output (Berger, Cummins, and Weiss,

\[ \text{Leverty (2005) surveyed the production approach in defining and measuring P&L insurer’s outputs, and discussed the issues in measuring the efficiency of P&L insurers.} \]
1997; Berger, Cummins, Weiss, and Zi, 2000; Cummins, Weiss, and Zi, 2003). Losses incurred are generally defined as the total losses that are expected to be paid by insurers for providing insurance coverage arising from business written during the previous year; specifically they are calculated as the sum of losses paid plus the net change in loss reserves. They are a good representation of risk-pooling and risk-bearing service since this service functions by collecting funds from individual in the pool and then redistributing to those who incur losses. Losses incurred are also a good proxy for real services provided by the insurer. Taking the present value is done to reflect claim settlement lags that may have a significant impact on certain product lines, e.g., liability insurance. Following the insurance literature, we define four output lines of business: personal short-tail lines, personal long-tail lines, commercial short-tail lines, and commercial long-tail lines. Table 1 provides a list of lines of business for each output.

We estimate the proportion of losses incurred from any accident year \( t \) that is paid in year \( t+j \) using the Taylor separation method (Taylor, 2000) and industry aggregate claim data obtained from Schedule P of the A.M. Best Rating Guide 2003. We then discount the expected loss payouts of the company using interest rate data for 2003 U.S. Treasury yield curves obtained from the Federal Reserve. The output of intermediation functions is measured by the annual average real invested assets, which is computed as average of beginning and end-of-year invested assets (Berger, Cummins, and Weiss, 1997; Berger et al., 2000; Cummins, Weiss, and Zi, 1999, 2003; Cummins and Weiss, 2001).

The prices of the four categories of property-liability insurance outputs are computed as 
\[
p_i = \frac{[P_i - PV(L_i)]}{PV(L_i)}, \quad (i = 1, \ldots, 4),
\]
where \( p_i \) refers to the price of output \( i \); \( P_i \) refers to the total premium earned for the output \( i \); and \( PV(L_i) \) is the present value of losses incurred for output \( i \). For the price of the intermediary output, we use the expected rate of return on the
insurer’s invested assets, including the expected returns on both the stocks and other invested assets in insurer’s investment portfolio. Because the expected return on other invested assets such as bonds and notes is typically close to their actual return, the rate of return on other invested assets in the portfolio is represented by the ratio of actual investment income (minus dividends on stocks) to insurer’s total holdings of other investment assets. For stocks, the expected rate of return is calculated as the 90-day Treasury bill rate at the end of the preceding year plus the long-term (1926 to the end of the preceding year) average excess market risk premium on large company stocks from Ibbotson Associates (2003).\(^\text{18}\) Finally, the expected portfolio rate of return is determined as a weighted average of the stocks and other investment assets returns with each proportion weight in the investment portfolio.

Because of the sample size limitation of financial conglomerate property-liability subsidiaries, we use three aggregate insurance outputs for property-liability insurers: (1) personal lines including personal short-tails and personal long-tails products; (2) commercial lines including commercial short-tails and commercial long-tails products; (3) intermediary output – invested assets.

**Life Insurance.** Because of the specific limitations in information reported by life insurers, the present value of benefits incurred for life insurers is not available. Following accepted practice, e.g. Yuengert (1993), Cummins, Tennyson, and Weiss (1999), Berger, Cummins, Weiss, and Zi (2000), Cummins, Weiss, and Zi (2003), we use incurred benefits, which are payments received by policyholders in a year, plus additions to reserves to measure life insurance outputs. Incurred benefits are suitable for measuring the risk-pooling and risk-sharing functions because it reflects the amount of funds pooled and redistributed by life insurers to policyholders for insured events. Increases in reserves are similar to bank deposits and

\(^{18}\) For the equity return, we assume that insurers hold equity portfolios with a market beta coefficient of 1.0.
represent the funds received by insurers but not needed for benefit payments and expenses. The funds backing the reserves are invested by insurers in financial instruments. Thus, additions to reserve should be a good output measure for the intermediation function. In addition, both are highly correlated with the real services provided by life insurers such as personal financial planning and commercial benefit plan management. Consistent with the literature, we define five lines of business: personal life insurance, personal annuities, group life insurance, group annuities, and accident and health insurance. Because of sample size limitation, we use three aggregate outputs for life insurers: (1) life insurance including personal and group life insurance; (2) annuities including personal and group annuities; (3) accident and health insurance.

The prices of the life insurance outputs are computed by the function \( p_i = \frac{P_i + I_i - (L_i + W_i)}{(L_i + W_i)} \), \( (i = 1, \ldots, 5) \), where \( p_i \) is the price of output \( i \); \( P_i \) refers to the total premium earned for the output \( i \); and \( I_i \) is the allocative investment income for output \( i \);\(^{19}\) \( L_i \) represents the incurred benefits for output \( i \); and \( W_i \) is the additions to reserves for output line \( i \).

5.1.2. Banking Outputs and Prices

The definition and measurement of banking outputs and prices are much simpler and easier compared with insurance. The services provided by banks could be traditional financial services (on-balance sheet), new financial services (on-balance sheet), and off-balance sheet (OBS) activities. The traditional financial services include deposits (demand, time and savings) and loans (real estate, commercial, installment), which have been responsible for the great majority of the bank business (Berger et al., 1992; Berger et al., 1997; Pulley and Humphrey, 1991, 1992; Pulley and Braunstein, 1992; Kashyap, Rajan, and Stein, 1999). As noted by Stiroh (2000), the growing fee-based services and off-balance sheet activities have been recognized as a growing

\(^{19}\) Life insurers are required to report allocated investment income by product lines in their NAIC regulatory statement, which is not required for property-liability insurers.
category of bank assets and have accounted for a substantial portion of bank revenue. These activities are especially concentrated in large institutions and failure to account for them may lead to incorrect conclusions.\footnote{Mester (1992a) does not find complementarities between loans and off-balance sheet securitization; while Rogers (1998) finds significant but small complementarities between traditional output and “new financial services”. Jagtiani & Khanthavit (1996) and Clark & Siems (2002) document complementarities when considering a wide range of off-balance sheet activities jointly although they vanish as bank size increases. Valverde and Fernandez (2005) examine the Spanish banks and find that OBS business introduces both cost and profit scope economies compared to a narrow (traditional) definition of output mix.}

New financial services, including the portfolio management, mutual or pension fund distributions, safekeeping services, are expected to reduce risk (Gallo, Apilado, and Kolari, 1996), enhance scale economies and produce cross-selling synergy (Kane, 1995; Golter, 1996). The major off-balance sheet activities are loan commitments (lines of credit and credit cards), credit derivatives, letter of credit, and loan origination, sales, servicing (Jagtiani and Khanthavit, 1996; Clark and Siems, 2002; Rime and Stiroh, 2003).\footnote{Also see DeYoung (1994), Hunter and Timme (1995), Jagtiani, Nathan, and Sick (1995), Berger, Humphrey, and Pulley (1996), Hughes and Mester (1998).}

Following the literature, we identify three categories of outputs – consumer loans, business loans, and other assets.\footnote{It would be ideal if the bank outputs are disaggregated into more categories, e.g., commercial and industrial loans, real estate loans, installment loans to individuals. However, because of the trade off between the degree of aggregation for outputs and degree of freedom, our data cannot afford losing the degree of freedom since the data have small number of observations of bancassurers and assurbanks.} The first output, consumer loans, involves intermediation and loan services and is measured as the sum of the dollar values of residential loans, credit card and other installment loans. The second output, business loans, includes the dollar values of real estate loans, commercial and industrial loans, farm loans and other loans and leases. The price of loans is calculated as total interest and fee earnings on loans divided by the quantity of loans. The last output, “other assets”, reflects another important source of revenues to banks and includes banks’ new financial services and off-balance sheet business. It is measured as the sum of dollar value of securities and investments held by banks and OBS activities. The OBS activities are measured by the risk-weighted (based on Basle Accord risk weights) amounts of
unused commitments, letters of credit, derivatives and other OBS items.\textsuperscript{23} The price for “other assets” is computed as the sum of the total interests and non-interest earnings on these assets divided by the total dollar value of “other assets”.

We include equity capital as the fixed netput for both insurers and banks as additional controls for firm size and capital structure. The equity capital is believed to be built up over long time and therefore cannot change in the short-run. Providing a cushion against unexpected losses, it is determined by both the firm operation and regulatory rules, especially the risk-based capital requirement.

\section{5.2. Inputs and Prices}

Unlike output definition, there is general agreement in the literature on the measurement of inputs in financial services industry.

\subsection*{5.2.1. Insurance Inputs and Prices}

The inputs of property-liability and life insurers are very similar, and since they are similarly defined we discuss them together for both type of insurers. Generally, the inputs to insurance fall into four principal groups – home office administrative labor, agent labor, material and physical capital, and financial equity and debt capital.

Since insurers are not required to report detail information about the number of employees and quantity of materials used in business, we impute them from the dollar value of related expenses reported in their regulatory statements divided by the price. The price of the home office labor is obtained from average weekly wage rates for life insurers (NAICS

\textsuperscript{23} The use of the Basle Accord risk weights indicates that the OBS items have approximately the same perceived credit risk and the same origination, monitoring, and control costs as loans. Since the correct risk weights specified by the RBC requirements vary according to maturity, type of contracts, and other characteristics, we assume the risk weights are 100 percent for letters of credit, 50 percent for unused loan commitments, and 10 percent for derivatives and all the other OBS items (Jagtiani and Khanthavit, 1996; Berger and Mester, 1997; Berger and DeYoung, 2001).

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categories 524113)\textsuperscript{24} and property-liability insurers (NAICS categories 524126) in their domicile state available from the U.S. Department of Labor. Similarly, the price of agent labor is defined as the premium-weighted average weekly wage rates for insurance agents (NAICS code 524210) in states where the insurer operates. The weight is the proportion of the insurer’s direct business written in each state. The price of the materials and business services is defined as the U.S. Department of Labor average weekly wage rates for business services. We use the national index consistent with materials being available for the same price nationwide.

The quantity of home office labor is defined as $Q_{HL} = \frac{E_{HL}}{w_{HL}}$, where $E_{HL}$ denotes the dollar expenditures on home office labor and $w_{HL}$ refers to price of home office labor. The dollar expenditure on home office labor is defined as sum of salaries, payroll taxes, and employee welfare reported in insurer’s regulatory statement. Similarly, the quantity of agent labor is specified as $Q_{AL} = \frac{E_{AL}}{w_{AL}}$, where $E_{AL}$ is the dollar expenditures on agent labor and $w_{AL}$ refers to price of agent labor. The dollar expenditure on agent labor is defined as sum of net commissions, brokerage fees and allowance to agents. The quantity of material and physical capital is defined as the dollar value of net premises and fixed assets available in insurer’s regulatory report, and the price of physical capital is obtained as occupancy and fixed asset expenditures divided by the quantity of physical capital.

In addition to labor and physical inputs, we include two proxies for the capital of the industry: equity capital and debt capital. Financial equity capital plays an important role in reducing the insolvency risk\textsuperscript{25} and is viewed as one of the important inputs in literature (e.g.,

\textsuperscript{24} North America Industry Classification System categories can be found at w w w.census.gov.
\textsuperscript{25} The insurance pricing theory predicts that insurers have optimal capital structures and insurance product price is inversely related to insurers’ default risk (Cummins and Sommer, 1996; Cummins and Danzon, 1997).
Berger, Cummins, and Weiss, 1997; Hughes and Mester, 1998; Hughes, Mester, and Moon, 2001). An insurer’s financial equity capital is defined as the statutory policyholders surplus measured as the average of beginning and end-of-year equity capital for a given year. To measure the price of financial equity capital, we use the book-value approach proposed by Cummins and Weiss (2000), which assumes a constant cost of equity across all insurers in the industry.26 So the price of financial equity capital in the given year is calculated as the average 90-day Treasury bill rate plus the long-term (1926 to the end of year t) average market risk premium on large company stocks from Ibbotson Associates.

The debt capital of insurers is defined as the funds borrowed from policyholders, which is comprised of loss reserves and unearned premiums reserves. The price of policyholder supplied debt capital is calculated as total expected investment income minus expected investment income attributed to equity capital divided by average debt capital. The expected investment income attributed to equity capital is calculated as the expected rate of investment return multiplied by average equity capital (Cummins and Weiss, 2001).

5.2.2. Banking Inputs and Prices

Similar to the inputs for insurance companies, the four inputs for banks (both commercial banks and thrift saving institutions) are widely recognized as deposits, labor, physical capital, and purchased funds (e.g., Berger et al., 2005; Berger and Mester, 2003; Berger and DeYoung, 2001; Berger and Humphrey, 1992; Berger et al., 1996; Hughes, Mester, and Moon, 2001).

The first input, deposits, includes demand deposits, time and saving deposits. The quantity of deposits is directly measured as the total dollar value of demand deposits, time and saving deposits liabilities of the bank. The price of deposit output is calculated as total interest

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26 The market equity return is the perfect measure for the price of financial equity capital, but majority of insurers are not publicly traded and the market equity return is not available for most insurers.
expense on these deposits divided by the quantity of deposits. The quantity of labor is defined as the number of employees reported in the bank’s regulatory report, and the price of labor is calculated as the salary, wage and welfare per employee. The quantity of physical capital is defined as the dollar value of net premises and fixed assets available in bank’s regulatory report, and the price of physical capital is obtained as occupancy and fixed asset expenditures divided by the quantity of physical capital. For the input of purchased funds, since they require very small amounts of physical inputs like labor and capital, purchased funds are treated as financial inputs to the intermediation process, and include federal funds purchased, large CDs, foreign deposits, demand notes, and other liabilities for borrowed money. The price of purchased funds is measured as interest paid on these funds divided by the total dollar value of these funds, which is the quantity of purchased funds.

6. EMPIRICAL RESULTS

This section reports the empirical results of economies of scope for U.S. financial institutions joint producing banking and insurance products. We first present the cost, revenue, and profit scope economy estimates by estimating the composite cost, revenue, and profit functions. Then, the results of scope economy regressions are discussed.

6.1. Scope Economy Estimates

Scope economy estimates for the joint producers (bancassurers and assurbanks) are obtained by applying the scope economy formulas for each of them with the coefficients estimated from the composite functions.²⁷ Scope economy estimates for the specialists are obtained by simulating

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²⁷ Since it is well recognized that cost, revenue, and profit functions may vary for small and large firms due to different business strategies, we estimate the composites functions for small and large diversified or specialist firms respectively (the threshold is $100M for banks and $50M for insurers). Because of the space constraining, we do not show the estimated composite function coefficients. A complete list of the coefficients is available from authors upon request.
mergers of insurance specialists with bank specialists (Berger et al., 2000). We use partial Cartesian product (or called direct product) to create the synthetic financial conglomerates.

Firms under common ownership in our sample are aggregated to the group level. We aggregate the data of each group’s life, property-liability, commercial banks, and saving bank subsidiaries separately to obtain the divisional totals. Unless other specified, firms in following refer to the group level decision making units. Our sample contains 7,393 bank specialists and 1,306 insurance specialists. We first split the bank specialists and insurance specialists into 10 groups respectively by assets size, with 10 percentile firms in each group. Second, the selected samples are created by randomly selecting half of the firms in each size group. Then, the synthetic financial conglomerates are created by merging every insurance specialist with every bank specialist in the selected samples. Thus, 2,413,488 simulated joint firms are obtained. Although it would be ideal if the synthetic financial conglomerates were created by merging every insurance specialist with every bank specialist, our selected specialist firm samples are sufficient enough to represent the original specialist firm groups.28

One common approach in inferring scope economies is to evaluate at a single point, e.g., the mean or median of the data. Nevertheless, this point estimation method has been criticized for its weak representation, as it may not provide a good approximation for the whole sample (Hirao and Inoue, 2004; Berger et al., 2000). We present our scope economy estimations in several different ways. The cost, revenue, and profit scope economies are evaluated for the actual and the synthetic financial conglomerates respectively at the whole sample level and the three sub-groups level. The three sub-groups are the first size quartile (small size), the second and

28 The reason is that the Cartesian product of the complete insurance and bank specialists considers all possible firm pairs and, therefore, can reduce the potential for bias resulting from arbitrarily excluding ex ante some firm combinations that might be associated with scope economies or diseconomies. The complete Cartesian product will create 9,655,258 (7,393 × 1,306) synthetic joint producers, which will significantly reduce the computation efficiency. Our method creates 2,413,488 (3696 × 653) simulated conglomerates and the selection bias is minimized.
third quartiles (medium size), and the fourth size quartile (large size). The scope economy scores, then, are evaluated at three points, the 25\textsuperscript{th} (Q1), 50\textsuperscript{th} (median), and 75\textsuperscript{th} (Q3) percentile, of each group.

Table 2 summaries the estimates of cost, revenue, and profit scope economy scores for the actual joint producers and the simulated joint producers.\textsuperscript{29} Focusing first on cost scope economies, Panel A shows significant cost scope economies for larger actual joint producers when producing both banking and insurance products. For example, huge size joint producers have achieved significant cost scope economies of 19.7 percent at median and 57.9 percent at Q3, while medium size ones show cost scope economies at Q3 only and it’s not statistically significant. For specialist firms, cost scope economy scores are all positive at the median and Q3 percentile for any size sub-groups. Furthermore, these cost scope economies are all statistically significant at 1 percent confidence level. The results predict that specialist firms can benefit from significant cost scope economies by joint offering banking and insurance services and products.

This finding can reject the Hypothesis 1 and suggests that cost scope economies exist in financial conglomerates when producing both banking and insurance products. The finding of cost scope economies supports production complementaries that shared resources such as marketing systems, information databases, computers, and offices could be exploit by joint producers and thus create cost scope economies. Furthermore, these cost savings could offset the extra costs possibly incurred in the joint producing process.

Panel A also presents that the huge size actual joint firms have higher cost scope economies than the other size sub-groups. It suggests that giant firms may save more in costs

\textsuperscript{29} Small size firms have less than $100M total assets; Medium size firms have more than $100M and less than $1B total assets; Large size firms have more than $1B and less than $10B total assets; Huge size firms have more than $10B total assets. The sample used to evaluate scope economies contains 87 actual joint firms (0 small size, 15 medium size, 29 large size, and 43 huge size) and 2,413,488 synthetic joint firms (458,570 small size, 1,472,360 medium size, 380,220 large size, and 102,338 huge size).
when offering both banking and insurance products. However, the Kruskal Wallis Test indicates insignificant difference among the three size sub-groups.\footnote{Kruskal Wallis test is a multi-sample location test and test whether the medians of multiple samples are significant different.} For specialists, the cost scope economies are predicted to be higher for small size and giant synthetic joint firms than for medium and large size ones. The Kruskal Wallis Test shows statistically significant differences among the three size groups. We can reject the Hypothesis 2 and 3 based on these findings and the evidence suggests that cost scope economies may vary for different size firms. The relation between scope economies and firm size will be further discussed in the regression analysis.

Panel B of Table 2 presents the revenue scope economies estimates. All the sub-groups of actual joint firms show significant revenue scope economies at Q3 only. At median, huge size actual joint firms realize significant revenue scope diseconomies of 11.49 percent, but medium and large size firms do not realize either significant revenue scope economies or diseconomies. For simulated joint firms, the revenue scope economies (1.07 percent) are predicted to be present at whole group level, which could be dominated by the medium size sub-group (2.12 percent of revenue scope economies), but the other three sub-groups show the prediction of revenue scope diseconomies (-1.1 percent for small size, -0.2 percent for large size and -4.82 percent for huge size synthetic joint firms). All these revenue scope economy estimates are statistically significant for synthetic joint firms. This evidence rejects the Hypothesis 1 and indicates that revenue scope economies or diseconomies may exist for different firms when joint offering banking and insurance products.

In terms of the pattern between revenue scope diseconomies and the firm size, the Kruskal Wallis Test indicates statistically insignificant differences among three sub-groups of actual joint firms and statistically significant differences among three sub-groups of synthetic
firms. For example, at median only the medium size synthetic joint firms are predicted to be able to increase sales revenue by joint producing, and other size sub-groups are predicted to suffer from sales revenue decrease by joint producing. The huge size firms tend to have the lowest revenue scope economy scores among the four size sub-groups, meaning that the giant firms are less likely to benefit from sales increase in such joint production. This is an evidence for rejecting the Hypothesis 2 and 3 and indicates that revenue scope economies/diseconomies may vary for different size firms. It further supports our arguments that firms with different characteristics may exploit scope economies to a varied extent. This finding suggests that medium size firms are the most efficient in utilizing cross-selling and exploiting one-stop-shopping convenience when providing banking and insurance products simultaneously. And it is not surprise to see that small size firms are less capable of benefiting by such production complementaries.

The findings of varied cost and revenue scope economies or diseconomies support our contention that profit scope economies dominate the commonly used concept of cost or revenue scope economies. Neither the cost nor the revenue scope economies can explain net effects of integrating the banking and insurance manufacturing on financial conglomerate operations. Focusing on either cost or revenue economies may lead to misleading results.

Panel C of Table 2 provides the summary of profit scope economy score estimations. Similar to the cost scope economies in Panel A, larger actual joint producers, show higher profit scope economies when producing both banking and insurance products. For example, huge size joint producers have achieved significant profit scope economies of 36.66 percent at median and 81.64 percent at Q3, while medium size ones show significant profit scope economies of 16.21 percent at Q3 only. For specialist firms, profit scope economy scores are all positive and
statistically significant at the median and Q3 percentile for any size sub-groups, suggesting that specialist firms could benefit from significant profit scope economies by joint offering banking and insurance services and products. The Hypothesis 1 is rejected and profit scope economies exist in the post-GLB integrated banking and insurance industries. The finding of profit scope economies also indicates that cost scope economies dominate revenue scope diseconomies for both existing and synthetic joint firms, and achieve the final net profit scope economies.

In terms of the relationship between firm size and profit scope economies, for actual joint firms the huge size sub-group has the highest profit scope economies, but the Kruskal Wallis Test does not show statistically significant difference among the three sub-groups. For specialist firms, the huge size firms are predicted to have highest profit scope economies and the medium size firms are predicted to have the lowest profit scope economies among the four sub-groups. The differences among the sub-groups are statistically significant by the Kruskal Wallis Test. The net scope efficiencies results from cost scope economies offsetting the revenue scope diseconomies and all size joint producers have net significant profit scope economies, i.e., cost savings from joint producing banking and insurance products can compensate the revenue decrease and thus attribute to the profit increases. Although only medium size synthetic joint firms show the revenue scope economies, their lower cost scope economies attributes to their lower net profit scope economies. We reject the Hypothesis 2 and 3 and conclude that profit scope economies are variant among different sized firms.

6.2. Regression Analysis

In the second stage, the cost, revenue, and profit scope economy scores are regressed on a set of firm characteristic variables. The regression results discussed in this section reveal the effects of firm characteristics on economies of scope and test the hypotheses presented in Section 3.
Because of the small observations of actual joint producers, we only use the synthetic joint producers for the regression analysis. There are potential 2,413,488 \((3,696\times653)\) simulated conglomerates. We exclude some of the observations with missing variables or inactive operation, e.g., zero or negative insurance net premium written, zero or negative deposits and loans. Observations with extreme scope economy scores, e.g., scope economy scores >1 or < -1, are also excluded from the sample. The final sample used in the regression contains 1,583,278 joint producers.

Table 3 summaries the descriptive statistics of variables employed and Table 4 shows the coefficient results for cost, revenue, and profit scope economy regressions. The dependent variables are the cost, revenue, and profit scope economy scores. To test Hypothesis 3, we use two sets of variables commonly used in literature to examine the firm size effect on scope economies. The gross total assets as the proxy of firm size (LASSETGTA) is measured as log of sum of insurance division assets and bank division assets and allowance for loans and leases. The square of the log gross total assets (LASSETGTA_2) is also included to measure the possible non-linear relationship between scope economies and the firm size. A set of firm size dummy variables includes: small group dummy \((S\_GROUP=1\) if gross total assets \(<=\$100M\)), medium group dummy \((M\_GROUP=1\) if \$100M < gross total assets \(<= \$1B\)), large group dummy \((L\_GROUP=1\) if \$1B < gross total assets \(<= \$10B\)), and huge group dummy \((H\_GROUP=1\) if \$10B < gross total assets). As shown in Table 4, the regression 1, 2, and 3 use the set of firm size dummy variables as the firm size measure and the regression 4, 5, and 6 use the gross total asset variables.

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31 Ideally, the actual and synthetic joint firms should run the regression separately as the exogenous variables may have different effects on these two groups. However, there are only 87 actual joint producers in our sample, and the sample size is too small to run the regression. The degree of freedom would not be acceptable for any meaningful results.
The coefficient on LASETGTA is negative and the coefficient on LASETGTA_2 is positive in the cost, revenue and profit regressions (regression 4, 5 and 6). All these coefficients are statistically significant. Consistent with the Panel A and C in Table 2, the coefficients suggest that cost and profit scope economies first decrease when the firm size increases and then increase when firm size increases continuously. In other words, the smaller and largee joint firms are more likely to realize cost and profit scope economies. The coefficients on the firm size dummy variables (regression 1, 2, and 3) show the similar results for the cost and profit scope regressions: M_GROUP has the lowest coefficients in the cost and profit scope regressions, i.e., medium size firms are less likely to exploit cost and profit scope economies. The huge group dummy is dropped because of the linearity.

We then consider the business and product mix to test the Hypothesis 4 and 5. The variables used are: the personal product share in the insurance division measured as the personal insurance outputs divided by total insurance outputs (P_SHARE),\(^{32}\) the personal banking product share in the banking division measured as the personal banking outputs divided by total banking outputs (P_SHARE_B),\(^{33}\) the life insurance business share measured as the revenue from the life insurance business divided by the total group revenue (LH_SHARE), the property-liability insurance business share measured as the revenue from the property-liability insurance business divided by the total group revenue (PC_SHARE), the banking business share measured as the revenue from banking business divided by the total group revenue (BK_SHARE). We also include the variables controlling for the business diversifications: the insurance product

\(^{32}\) Personal property-liability insurance products include personal short-tail lines, personal long-tail lines; Personal life insurance products include individual life insurance and individual annuity insurance.

\(^{33}\) Personal banking products include residential real estate loans, credit card and other installment loans, and core deposits.
Herfindahl index (PRODHII), the banking product Herfindahl index (PRODHII_B),\textsuperscript{34} the insurance division geographic business HHI (DPWHHI_58),\textsuperscript{35} log of the number of domestic offices and branches in the banking division (LOFFDOM).

These variables measure the banking and insurance divisions’ emphasis on different lines of business and on business diversifications. As shown in Table 4, both personal product share variables, P\_SHARE and P\_SHARE\_B, have significant positive coefficients in the cost scope economy regression and significant negative coefficients in the revenue scope regression. The coefficient of P\_SHARE is significantly positive in the profit scope regression, but the coefficient of P\_SHARE\_B is significantly negative in the profit scope regression. The interaction term of insurance and banking personal product share has negative coefficient in revenue and profit scope economy regressions. These results suggest that joint firms are more likely to realize cost scope economies but less likely to realize revenue scope economies when they emphasize more on banking or insurance personal insurance products. The larger personal insurance business share may contribute to higher profit scope efficiency gains, but the larger personal banking business share may contribute to profit scope efficiency losses.

As discussed in Section 3, since life insurance products are more like banking products compared with property-liability insurance products, higher economies of scope are expected to occur in joint producing life and banking products than in joint producing property-liability and banking products. The result in Table 4 shows positive and significant coefficients on

\textsuperscript{34} Herfindahl index (HII) for a firm producing \( n \) types of products is measured as \((Y1^2 + Y2^2 + \ldots + Yn^2) / (Y1 + Y2 + \ldots + Yn)^2\), where \( Y_i \) is the \( i \)th product output. Insurance products include property-liability insurance (personal short-tail lines, personal long-tail lines, commercial short-tail lines, and commercial long-tail lines) and life insurance (individual life insurance, individual annuity, group life insurance, group annuity, and accident and health insurance). Banking products include residential real estate loans, commercial real estate loans, credit card and other installment loans, farm loans, commercial & industrial loans, other loans, demand deposits, and time and saving deposits.

\textsuperscript{35} Herfindahl index for insurers operating in \( m \) states is measured as \((Y1^2 + Y2^2 + \ldots + Ym^2) / (Y1 + Y2 + \ldots + Ym)^2\), where \( Y_i \) is the direct premium written in the \( i \)th state.
LH_SHARE and PC_SHARE in the cost and the profit scope regressions, but negative and
significant coefficient in the revenue scope regression. (Banking business share variable is
dropped because of the linearity.) That is, joint firms with higher life or property-liability
insurance business share are more likely to realize the cost and profit scope economies but are
less likely to realize the revenue scope economies. Nevertheless, the life insurance business share
tends to contribute to higher cost and profit scope economies and lower revenue scope
economies than the property-liability insurance business share. Consistent with the benefits from
production complementaries, cost scope efficiency gains from joint producing life insurance and
banking products can offset the revenue scope diseconomies and contribute to the net profit
scope economy gains.

We then consider the product portfolio and business diversifications for the insurance and
banking divisions of joint firms. The coefficients on these variables are all statistically
significant. The maximum products Herfindahl index of 1.0 indicates a single product
manufacturing and as such, higher index values, PRODHHI and PRODHHI_B, indicate a
decrease in product diversification. The result shows that PRODHHI and PRODHHI_B have
opposite effects on scope economies. That is, the more products diversified in the insurance
division the less likely to exploit cost scope economies but the more likely to exploit revenue and
profit scope economies. And the more products diversified in the banking division the more
likely to realize cost scope economies but the less likely to realize revenue and profit scope
economies. The insurance geographic business Herfindahl index and the number of bank offices
and branches are included to control for the effects of national or local operation strategies. The
higher the insurance geographic diversification variable, DPWHHI_58, and the lower the
number of bank offices, LOFFDOM, the less geographic diversified. The result shows that joint
firms with more geographic diversified insurance or banking business are more likely to exploit
cost scope economies but are less likely to exploit revenue and profit scope economies,
suggesting that national operations will contribute to the net profit scope economy loss.

To test our last hypothesis, we use the dummy variable for insurance vertical integrated
distribution (DV_MKT_V = 1, if insurance vertical integrated distribution channels are used).\textsuperscript{36} The coefficient is negative and significant in the cost and the profit scope regression, and
positive and significant in the revenue scope regression. This finding is not consistent with our
hypothesis in Section 3. Banks affiliated with vertically integrated insurers may not be able to
benefit from reusing insurers’ relatively large investments in advertising, marketing, and brand
names, but they may benefit from cross-selling which could offset the internal competition and
selling conflicts and lead to revenue scope economies. However, the net result is the profit scope
efficiency loss as the revenue scope economies are not enough to offset the cost scope
diseconomies.

Some other variables included in the regressions are: the capital to asset ratio (C_TO_A) which
measures the leverage level and risks since low capital-to-asset ratios are believed to be
related with high risks. Scope economies may be related to risk. The results show that higher
capital to asset ratios can lead to higher cost and revenue scope economies and lower profit scope
economies. Finally, the organizational form variables are included to account for the possible
effects. They are the insurance group dummy (DV_INSGRP=1 if the insurance division is
organized as a group), the banking group dummy (DV_GRPBK=1 if the banking division is
organized as a group), and two interaction terms of group dummy variables and company size
variable.

\textsuperscript{36} Vertical integrated distribution channels include Exclusive/Captive Agents, Direct Response, Internet, Affinity
Group Marketing, Worksite Marketing. Horizontal integrated distribution channels include Independent Agency,
Broker, General Agent, Career Agent, Bank.
7. CONCLUSION

This paper has sought to contribute new evidence on scope efficiencies from joint producing insurance and banking products after the passage of the GLB Act. We evaluate cost, revenue, and profit scope economies for U.S. banks and insurers by estimating the composite cost, revenue, and profit functions. Then, to explain the variation of scope economy estimations and examine the relationship between scope economies and firm characteristics, we regress the scope economy estimates upon a set of variables describing firm characteristics and environment.

The results suggest that weak cost scope economies, weak revenue scope diseconomies, and substantial profit scope economies exist in the post-GLB integrated banking and insurance industries. The finding of cost scope economies supports production complementarities that shared resources such as marketing systems, information databases, computers, and offices could be exploit by joint producers and thus create cost scope economies. Furthermore, these cost savings could offset the extra costs possibly incurred by joint producers. The finding of revenue scope diseconomies suggests that customers may want to pay more for specialized services or products offered by specialist firms although the “one-stop-shopping” convenience by diversified firms is available. The significant profit scope economies shows that the cost scope efficiency gains can offset the revenue scope efficiency losses and contribute to the net profit scope efficiency gains.

These cost, revenue, and profit scope economies vary among different firms as indicated in the second stage regression analysis. Compared with small and large firms, medium size firms are more likely to realize revenue scope economies, but are less likely to realize cost and profit scope economies when offering both banking and insurance products. Joint firms are more likely to realize cost scope economies but less likely to realize revenue scope economies when they emphasize more on personal insurance products. The higher personal insurance share may
contribute to higher profit scope efficiency gains, but the higher personal banking business share may contribute to profit scope efficiency losses. Joint firms joint producing life insurance and banking products are more likely to realize the cost and profit scope economies but are less likely to realize the revenue scope economies. Consistent with the benefits from production complementaries, cost scope efficiency gains from joint producing life insurance and banking products can offset the revenue scope diseconomies and can still contribute to the net profit scope economies.

Financial conglomerates with more diversified insurance business are less likely to exploit cost scope economies but more likely to exploit revenue and profit scope economies. On the contrary, financial conglomerates with more diversified banking business are more likely to exploit cost scope economies but less likely to exploit revenue and profit scope economies. In addition, national insurance or banking operations are less likely to lead to cost scope economies but more likely to lead to revenue and profit scope economy gains.

Banks affiliated with vertically integrated insurers may not be able to benefit from reusing insurers’ relatively large investments in advertising, marketing, and brand names, but they may benefit from cross-selling which could offset the internal competition and selling conflicts and lead to revenue scope economies. However, the net result is the profit scope efficiency loss as the revenue scope economies are not enough to offset the cost scope diseconomies.
REFERENCE


Table 1: Property-liability Insurers Outputs and Lines of Business Definitions

<table>
<thead>
<tr>
<th>Personal Product Lines</th>
<th>Outputs</th>
<th>Lines of Business</th>
</tr>
</thead>
<tbody>
<tr>
<td>Personal Short-Tail</td>
<td></td>
<td>Private passenger auto physical damage;</td>
</tr>
<tr>
<td>Personal Long-Tail</td>
<td></td>
<td>Farmowners peril;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Homeowners peril;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Private passenger auto liability;</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Commercial Product Lines</th>
<th>Outputs</th>
<th>Lines of Business</th>
</tr>
</thead>
<tbody>
<tr>
<td>Commercial Short-Tail</td>
<td></td>
<td>Fire;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Allied lines;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Mortgage guaranty;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Inland marine;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Financial guaranty;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Earthquake;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Group accident and health;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Credit accident and health;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Other accident and health;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Fidelity;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Surety;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Burglary and theft;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Credit;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Commercial auto physical damage;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Aggregate write-ins;</td>
</tr>
</tbody>
</table>

| Commercial Long-Tail | | Commercial multiple peril; |
|                     | | Ocean marine; |
|                     | | Medical malpractice (occurrence, claims-made); |
|                     | | Workers’ compensation; |
|                     | | Other liability (occurrence, claims-made); |
|                     | | Products liability (occurrence, claims-made); |
|                     | | Commercial auto liability; |
|                     | | Aircraft; |
|                     | | Boiler and machinery; |
|                     | | International; |
|                     | | Reinsurance; |
Table 2. Scope Economy Estimates for Joint Firms and Synthetic Joint Firms.

**Panel A: Cost Scope Economies.**

<table>
<thead>
<tr>
<th></th>
<th>Joint Firms</th>
<th>Synthetic Joint Firms</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>All</td>
<td>Small Size</td>
</tr>
<tr>
<td>Q1</td>
<td>-0.0867 ***</td>
<td>-0.1627 ***</td>
</tr>
<tr>
<td>Median</td>
<td>0.0549</td>
<td>-0.0240</td>
</tr>
<tr>
<td>Q3</td>
<td>0.3693 ***</td>
<td>0.1500</td>
</tr>
</tbody>
</table>

# firms 87 0 15 29 43 2,413,488 458,570 1,472,360 380,220 102,338

**Panel B: Revenue Scope Economies.**

<table>
<thead>
<tr>
<th></th>
<th>Joint Firms</th>
<th>Synthetic Joint Firms</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>All</td>
<td>Small Size</td>
</tr>
<tr>
<td>Q1</td>
<td>-0.3165 ***</td>
<td>-0.0004</td>
</tr>
<tr>
<td>Median</td>
<td>-0.0233</td>
<td>0.0520</td>
</tr>
<tr>
<td>Q3</td>
<td>0.1701 ***</td>
<td>0.1917 **</td>
</tr>
</tbody>
</table>

# firms 87 0 15 29 43 2,413,488 458,570 1,472,360 380,220 102,338

**Panel C: Profit Scope Economies.**

<table>
<thead>
<tr>
<th></th>
<th>Joint Firms</th>
<th>Synthetic Joint Firms</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>All</td>
<td>Small Size</td>
</tr>
<tr>
<td>Q1</td>
<td>-0.1866 ***</td>
<td>-0.2424 **</td>
</tr>
<tr>
<td>Median</td>
<td>0.0831 *</td>
<td>-0.0408</td>
</tr>
<tr>
<td>Q3</td>
<td>0.5124 ***</td>
<td>0.2083</td>
</tr>
</tbody>
</table>

# firms 87 0 15 29 43 2,413,488 458,570 1,472,360 380,220 102,338

Notes: Scope economy is present if the scope economy score is greater than zero; Scope diseconomy is present if the scope economy score is less than zero; Neither scope economy nor diseconomy is present if the scope economy score equals zero. Joint firms are actual financial conglomerates jointly producing banking and insurance products during the year 2003. Synthetic joint firms are created by merging every bank specialist and every insurance specialist in our selected samples. Small size firms have less than $100M total assets; Medium size firms have more than $100M and less than $1B total assets; Large size firms have more than $1B and less than $10B total assets; Huge size firms have more than $10B total assets. The sample used to evaluate scope economies contains 87 actual joint firms (0 small size, 15 medium size, 29 large size, and 43 huge size) and 2,413,488 synthetic joint firms (458,570 small size, 1,472,360 medium size, 380,220 large size, and 102,338 huge size).

**Significant at 1%**
**Significant at 5%**
*Significant at 10%
Table 3. Descriptive Statistics of Regression Variables (N=1,583,278).
This table provides summary statistics of regression variables for synthetic financial groups joint producing banking and insurance products. The synthetic joint producers are created by first randomly selecting 50 percent of bank specialists (7,393) and insurance specialists (1,306) in every 10 groups by firm size, and then merging every selected bank specialists with every selected insurance specialists. Some of the synthetic groups are excluded because of missing variables, inactive operation, or extreme scope economy scores. The final sample include 1,583,278 observations for the regression analysis.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Definition</th>
<th>Mean</th>
<th>Std. Dev.</th>
<th>Min</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSCORE</td>
<td>Cost scope economy score</td>
<td>0.03597</td>
<td>0.21939</td>
<td>-0.99778</td>
<td>0.99998</td>
</tr>
<tr>
<td>RSCORE</td>
<td>Revenue scope economy score</td>
<td>0.01449</td>
<td>0.25256</td>
<td>-0.99994</td>
<td>0.99975</td>
</tr>
<tr>
<td>PSCORE</td>
<td>Profit scope economy score</td>
<td>0.17236</td>
<td>0.44645</td>
<td>-1.00000</td>
<td>1</td>
</tr>
<tr>
<td>LASSETGTA</td>
<td>Log ( Total group assets)</td>
<td>19.71512</td>
<td>1.46516</td>
<td>16.76302</td>
<td>25.99545</td>
</tr>
<tr>
<td>LASSETGTA_2</td>
<td>(Log ( Total group assets)) ^ 2</td>
<td>390.83262</td>
<td>60.13587</td>
<td>280.99886</td>
<td>675.76359</td>
</tr>
<tr>
<td>S_GROUP</td>
<td>Small group dummy = 1 if gross total assets &lt;= $100M</td>
<td>0.16882</td>
<td>0.37459</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>M_GROUP</td>
<td>Medium group dummy = 1 if $100M &lt; GTA &lt;= $1B</td>
<td>0.63728</td>
<td>0.48078</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>L_GROUP</td>
<td>Large group dummy = 1 if $1B &lt; GTA &lt;= $1B</td>
<td>0.15139</td>
<td>0.35843</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>H_GROUP</td>
<td>Huge group dummy = 1 if $1B &lt; GTA</td>
<td>0.04251</td>
<td>0.20175</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>P_SHARE</td>
<td>Insurance Personal products share (%)</td>
<td>0.42406</td>
<td>0.40606</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>P_SHARE_B</td>
<td>Banking Personal products share (%)</td>
<td>0.66934</td>
<td>0.12321</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>P_SHARE_2</td>
<td>Interaction of P_SHARE * P_SHARE_B</td>
<td>0.28412</td>
<td>0.28139</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>LH_SHARE</td>
<td>Life insurance business share (%)</td>
<td>0.14122</td>
<td>0.28193</td>
<td>0</td>
<td>0.99998</td>
</tr>
<tr>
<td>PC_SHARE</td>
<td>PC insurance business share (%)</td>
<td>0.40914</td>
<td>0.36197</td>
<td>0.00001</td>
<td>0.99999</td>
</tr>
<tr>
<td>BK_SHARE</td>
<td>Banking business share (%)</td>
<td>0.44964</td>
<td>0.33518</td>
<td>0.00001</td>
<td>0.99999</td>
</tr>
<tr>
<td>PRODHII</td>
<td>Insurance product mix HHI</td>
<td>0.68805</td>
<td>0.25459</td>
<td>0.19443</td>
<td>1</td>
</tr>
<tr>
<td>PRODHII_B</td>
<td>Banking product mix HHI</td>
<td>0.32761</td>
<td>0.06764</td>
<td>0.07484</td>
<td>1</td>
</tr>
<tr>
<td>DPWHHI_58</td>
<td>Insurance geographic business HHI</td>
<td>0.43725</td>
<td>0.21516</td>
<td>0.03918</td>
<td>1</td>
</tr>
<tr>
<td>LOFFDOM</td>
<td>Log ( number of bank division offices )</td>
<td>1.30410</td>
<td>1.09958</td>
<td>0</td>
<td>7.22766</td>
</tr>
<tr>
<td>HHIS58_OFFDOM</td>
<td>Interaction of (1-DPWHHI_58) * LOFFDOM</td>
<td>0.73431</td>
<td>0.71902</td>
<td>0</td>
<td>6.94445</td>
</tr>
<tr>
<td>DV_MKT_V</td>
<td>Insurance vertical distribution dummy</td>
<td>0.16853</td>
<td>0.37433</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>C_TO_A</td>
<td>Capital to assets ratio</td>
<td>0.19166</td>
<td>0.10866</td>
<td>0.03677</td>
<td>0.76896</td>
</tr>
<tr>
<td>DV_GRPINS</td>
<td>Insurance group dummy</td>
<td>0.39755</td>
<td>0.48939</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>DV_GRPBK</td>
<td>Banking group dummy</td>
<td>0.67774</td>
<td>0.46734</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>LASET_DV_GRPINS</td>
<td>Log ( Ins. division assets) * Ins. group dummy</td>
<td>7.78243</td>
<td>9.66794</td>
<td>0</td>
<td>25.18890</td>
</tr>
<tr>
<td>LGTA_DV_GRPBK</td>
<td>Log ( Banking division assets) * Banking group dummy</td>
<td>12.81466</td>
<td>8.89088</td>
<td>0</td>
<td>25.40415</td>
</tr>
</tbody>
</table>
Table 4. Scope Economies Regression Analysis

This table provides the regression results for synthetic financial conglomerates joint producing banking and insurance products. The dependent variable for the regression <1> and <4> is cost scope economy score; the dependent variable for the regression <2> and <5> is revenue scope economy score; the dependent variable for the regression <3> and <6> is profit scope economy score.

<table>
<thead>
<tr>
<th>Independed Variables</th>
<th>Cost Scope Economies &lt;1&gt;</th>
<th>Revenue Scope Economies &lt;2&gt;</th>
<th>Profit Scope Economies &lt;3&gt;</th>
<th>Cost Scope Economies &lt;4&gt;</th>
<th>Revenue Scope Economies &lt;5&gt;</th>
<th>Profit Scope Economies &lt;6&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coefficient</td>
<td>t stat.</td>
<td>Coefficient</td>
<td>t stat.</td>
<td>Coefficient</td>
<td>t stat.</td>
<td>Coefficient</td>
</tr>
<tr>
<td>Intercept</td>
<td>-0.2079</td>
<td>-93.49 ***</td>
<td>0.1623</td>
<td>64.74 ***</td>
<td>0.4524</td>
<td>99.59 ***</td>
</tr>
<tr>
<td><strong>Firm size variables</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Small group dummy = 1 if gross total assets &lt;= $100M</td>
<td>0.0093</td>
<td>6.61 ***</td>
<td>-0.0277</td>
<td>-17.57 ***</td>
<td>0.0224</td>
<td>7.85 ***</td>
</tr>
<tr>
<td>Medium group dummy = 1 if $100M &lt; GTA &lt;= $1B</td>
<td>-0.0299</td>
<td>-24.90 ***</td>
<td>-0.0016</td>
<td>-1.17</td>
<td>-0.0503</td>
<td>-20.52 ***</td>
</tr>
<tr>
<td>Large group dummy = 1 if $1B &lt; GTA &lt;= $10B</td>
<td>-0.0284</td>
<td>-27.44 ***</td>
<td>0.0190</td>
<td>16.28 ***</td>
<td>0.0568</td>
<td>26.92 ***</td>
</tr>
<tr>
<td>Log (Total group assets)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Log (Total group assets))^2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Business and product mix variables</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Insurance Personal products share (%)</td>
<td>0.0554</td>
<td>24.17 ***</td>
<td>-0.0584</td>
<td>-22.62 ***</td>
<td>0.0125</td>
<td>2.67 ***</td>
</tr>
<tr>
<td>Banking Personal products share (%)</td>
<td>0.3086</td>
<td>149.85 ***</td>
<td>-0.3079</td>
<td>-132.61 ***</td>
<td>-0.4080</td>
<td>-96.97 ***</td>
</tr>
<tr>
<td>Interaction of ins. &amp; banking personal product share</td>
<td>0.0012</td>
<td>0.34</td>
<td>-0.0522</td>
<td>-13.87 ***</td>
<td>-0.1057</td>
<td>-15.50 ***</td>
</tr>
<tr>
<td>Life insurance business share (%)</td>
<td>0.1637</td>
<td>176.89 ***</td>
<td>-0.0994</td>
<td>-95.27 ***</td>
<td>0.2827</td>
<td>149.55 ***</td>
</tr>
<tr>
<td>PC insurance business share (%)</td>
<td>0.0868</td>
<td>95.39 ***</td>
<td>-0.1256</td>
<td>-122.43 ***</td>
<td>0.2001</td>
<td>107.61 ***</td>
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<tr>
<td><strong>Business diversification variables</strong></td>
<td></td>
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<tr>
<td>Insurance product mix HHI</td>
<td>-0.0572</td>
<td>67.02 ***</td>
<td>-0.0872</td>
<td>-90.67 ***</td>
<td>-0.0248</td>
<td>-14.20 ***</td>
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<tr>
<td>Banking product mix HHI</td>
<td>-0.2145</td>
<td>-75.06 ***</td>
<td>0.1414</td>
<td>43.90 ***</td>
<td>0.0337</td>
<td>5.78 ***</td>
</tr>
<tr>
<td>Insurance geographic business HHI</td>
<td>-0.0510</td>
<td>-38.33 ***</td>
<td>0.1373</td>
<td>91.60 ***</td>
<td>0.0419</td>
<td>15.41 ***</td>
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<tr>
<td>Log (number of bank division offices)</td>
<td>0.0093</td>
<td>18.82 ***</td>
<td>0.0048</td>
<td>-30.60 ***</td>
<td>0.0019</td>
<td>27.10 ***</td>
</tr>
<tr>
<td>Interaction of (1-DPWHHI_58) * LOFFDOM</td>
<td>-0.0059</td>
<td>-8.12 ***</td>
<td>-0.0018</td>
<td>-32.68 ***</td>
<td>0.0020</td>
<td>3.98 ***</td>
</tr>
<tr>
<td><strong>Insurance distribution system variables</strong></td>
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<tr>
<td>Insurance vertical distribution dummy</td>
<td>-0.0190</td>
<td>-41.46 ***</td>
<td>0.0027</td>
<td>5.25 ***</td>
<td>-0.0395</td>
<td>-42.23 ***</td>
</tr>
<tr>
<td><strong>Leverage variable</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Capital to assets ratio</td>
<td>0.1417</td>
<td>63.80 ***</td>
<td>0.7193</td>
<td>287.23 ***</td>
<td>-0.1919</td>
<td>-42.27 ***</td>
</tr>
<tr>
<td><strong>Organizational variables</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bank Holding Company dummy</td>
<td>-0.0057</td>
<td>-8.58 ***</td>
<td>-0.0002</td>
<td>-0.24</td>
<td>-0.0040</td>
<td>-2.93 ***</td>
</tr>
<tr>
<td>Insurance group dummy</td>
<td>0.0718</td>
<td>19.03 ***</td>
<td>0.3615</td>
<td>85.00 ***</td>
<td>0.2542</td>
<td>32.99 ***</td>
</tr>
<tr>
<td>Banking group dummy</td>
<td>0.1380</td>
<td>28.31 ***</td>
<td>0.1770</td>
<td>-32.21 ***</td>
<td>0.3262</td>
<td>32.76 ***</td>
</tr>
<tr>
<td>Log (Ins. division assets) * Ins. group dummy</td>
<td>-0.0044</td>
<td>-21.87 ***</td>
<td>-0.0194</td>
<td>-84.79 ***</td>
<td>-0.0110</td>
<td>-26.49 ***</td>
</tr>
<tr>
<td>Log (Banking division assets) * Bank group dummy</td>
<td>-0.0069</td>
<td>-26.56 ***</td>
<td>0.0089</td>
<td>30.06 ***</td>
<td>-0.0212</td>
<td>-39.71 ***</td>
</tr>
<tr>
<td><strong>Average value of dependent variable</strong></td>
<td>0.0360</td>
<td>0.0145</td>
<td>0.1724</td>
<td>0.0360</td>
<td>0.0145</td>
<td>0.1724</td>
</tr>
<tr>
<td>Adjusted R^2</td>
<td>8.39%</td>
<td>12.13%</td>
<td>7.64%</td>
<td>8.38%</td>
<td>12.19%</td>
<td>7.58%</td>
</tr>
<tr>
<td>Number of observations</td>
<td>1,583,278</td>
<td>1,583,278</td>
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<td>1,583,278</td>
<td>1,583,278</td>
<td>1,583,278</td>
</tr>
</tbody>
</table>

*** Significant at 1%
** Significant at 5%
* Significant at 10%