Article:
Do big banks have lower operating costs?

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Do big banks have lower operating costs?¹

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Abstract
We examine the relationship between bank holding company (BHC) size and components of non-interest expense (NIE), in order to shed light on the sources of scale economies in banking. Drawing on detailed expense information provided by U.S. banking firms in the memoranda of their regulatory filings, we find a robust negative relationship between size and normalized measures of NIE. The relationship is strongest for employee compensation expenses and components of “other” NIE, such as information technology and corporate overhead expenses. In addition, the authors find no evidence that the inverse relationship between banking firm size and NIE ratios disappears above a given size threshold. In dollar terms, their estimates imply that for a BHC of mean size, an additional U.S.$1 billion in assets reduces NIE by U.S.$1 million to U.S.$2 million per year, relative to a base case where operating cost ratios are unrelated to size.

¹ This article is reprinted with the permission of the Federal Reserve Bank of New York, and will appear in the Federal Reserve Bank of New York Economic Policy Review, vol. 20, no. 2, Forthcoming, available at http://www.newyorkfed.org/research/epr/2014/1403kovn.html. Tables 4 and 7 from the original article, as well as Appendix A, have been omitted from this reprinting because of space constraints. Please see the original article for these materials. Appendix B is an online-only appendix available at: http://www.newyorkfed.org/research/epr/2014/1403kovn_appendixB.pdf.

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Introduction
The largest U.S. banking firms have grown significantly over time, their expansion driven by a combination of merger activity and organic growth. In 1991, the four largest U.S. bank holding companies (BHCs) held combined assets equivalent to 9% of gross domestic product (GDP). Today, the four largest firms’ assets represent 50% of GDP, and six BHCs control assets exceeding 4% of GDP. Despite recent financial reforms, there is still widespread concern that large banking firms remain “too big to fail,” i.e., policymakers would be reluctant to permit the failure of one or more of the largest firms because of fears about contagion or damage to the broader economy [see, for example, Bernanke (2013)].

A growing number of market observers advocate shrinking the size of the largest banking firms in order to limit the problem of too-big-to-fail. The most direct approach would be to simply impose a firm cap on the size of assets or liabilities; for example, Johnson and Kwak (2010) propose a size limit of 4% of nominal GDP. An alternative would be to impose levies or progressively higher capital requirements on large banking firms to encourage them to shed assets.

Would such policies impose any real costs on the economy? A number of recent academic papers suggest that the answer may be “yes” because of the presence of economies of scale in banking. Scale economies imply that the cost of producing an additional unit of output (for example, a loan) falls as the quantity of production increases. A number of papers find evidence of scale economies even among the largest banking firms [Hughes and Mester (2013); Wheelock and Wilson (2012); Feng and Serletis (2010)]. Taken at face value, this research implies that the introduction of limits on bank size would impose deadweight economic costs by increasing the cost of providing banking services.

We contribute to this line of research by studying the relationship between size and components of NIE, with the goal of shedding light on the sources of scale economies in banking. NIE includes a wide variety of operating costs incurred by banking firms: examples include employee compensation and benefits, information technology, legal fees, consulting, postage and stationery, directors’ fees, and expenses associated with buildings and other fixed assets.

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Our hypothesis is that lower operating costs may be a source of scale economies for large BHCs, because large firms can spread overhead such as information technology, accounting, advertising and management over a larger asset or revenue base. Our analysis, therefore, tests for an inverse relationship between BHC size and scaled measures of different components of NIE.

One novel contribution of this paper is to make use of detailed NIE information provided by U.S. banking firms in the memoranda of their quarterly regulatory FR Y-9C filings. The Y-9C reports contain detailed consolidated financial statements and other data for U.S. BHCs (see Section 3 for details). Since 2001, about 35% of total NIE is classified in the Y-9C as part of a broad “other NIE” category. For the period 2008–12, we disaggregate this line item into nine author-defined categories, using memoranda information from Schedule Hl of the Y-9C. In part, this involved manually classifying about 5,500 individual “write-in” text fields reported by individual BHCs. To our knowledge, ours is the first paper to make use of these data.

We start by estimating the relationship between BHC size (measured by the natural logarithm of total assets) and total NIE scaled by net operating revenue, assets or risk-weighted assets (RWA). We find a statistically and economically significant negative relationship between BHC size and these NIE ratios, robust to the expense measure or set of controls used. Quantitatively, a 10% increase in assets is associated with a 0.3% to 0.6% decline in NIE scaled by income or assets, depending on the specification. In dollar terms, our estimates imply that for a BHC of mean size, an additional U.S.$1 billion in assets reduces NIE by U.S.$1 million to U.S.$2 million per year, relative to a base case in which operating cost ratios are unrelated to size.\(^3\)

These results hold across the size distribution of banking firms, and over different parts of our sample period. We find no evidence that these lower operating costs flatten out above some particular size threshold. The point estimate of the slope of the relationship steepens, if anything, although the statistical uncertainty associated with the estimate becomes larger owing to the small sample.

\(^3\) For details of this calculation, see Appendix B, available as a separate file at http://www.newyorkfed.org/research/epr/2014/1403kovn appendixB.pdf. The appendix was omitted from the original article because of space constraints.
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The relationship between size and the NIE ratio is negative for each of the three main components of NIE reported in BHC regulatory filings: employee compensation, premises and fixed asset expenses, and other NIE. Using our novel by-hand classification of other NIE into nine subcomponents, however, we find significant variation in the size-expense relationship among the subcomponents. The inverse relationship between size and expense is particularly pronounced for corporate overhead (for example, accounting, printing and postage), information technology (IT) and data processing, legal fees, other financial services, and directors’ fees and other compensation. In contrast, large BHCs spend proportionately more on consulting and advisory services than do smaller firms, relative to revenue or assets. Large BHCs also incur proportionately higher expenses relating to amortization and impairment of goodwill and other intangible assets.

Overall, our results are consistent with the presence of scale economies in banking, as found in recent academic literature [for example, Wheelock and Wilson (2012); Hughes and Mester (2013); Feng and Serletis (2010)] and industry research [Clearing House Association (2011)]. In particular, our findings suggest that these scale economies stem in part from an operating cost advantage of large BHCs in areas such as employee compensation, information technology and corporate overhead expenses.

We emphasize that a number of caveats apply to our results. First, our estimates represent reduced-form statistical correlations; caution should be exercised in drawing a causal interpretation from them. Although our regressions control for a wide range of BHC characteristics, firm size may still be correlated with omitted variables that are also associated with lower expenses, such as the quality of management. This caveat also seems to apply more generally to the existing literature on scale economies in banking.

Second, our results may also reflect factors other than scale economies. One possibility, closely related to scale economies but conceptually distinct, is that large firms operate closer to their production frontier on average; that is, they have greater X-efficiency (see Section 2 for a discussion).

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4 Our analysis does not attempt to separate the effects of X-efficiency from those of scale economies. We note, however, that Hughes et al. (2001) and Hughes and Mester (2013) find that estimated scale economies are larger for more efficient banks than for less efficient ones, controlling for size.
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Another possibility is that large banking firms have greater bargaining power vis-à-vis their suppliers and employees. If cost differences are due only to bargaining power effects, then limiting the size of the largest BHCs would not necessarily generate deadweight economic costs, although it might instead reallocate rents to employees or suppliers. An additional possibility is that our results are influenced by too-big-to-fail subsidies for large BHCs. Our prior is that such subsidies would be more likely to be manifested as a lower cost of funds for large firms, or a more leveraged capital structure, than as lower operating costs. However, it is still possible that a too-big-to-fail banking firm could respond by reducing expenditures on functions such as information technology or risk management; these would show up as part of NIE.

These caveats aside, our results and those of related research suggest that imposing size limits on banking firms is unlikely to be a free lunch. For example, taking our estimates at face value, a back-of-the-envelope calculation implies that limiting BHC size to no more than 4% of GDP would increase total industry NIE by U.S.$2 billion to U.S.$4 billion per quarter. Limiting the size of banking firms could still be an appropriate policy goal, but only if the benefits of doing so exceeded the attendant reductions in scale efficiencies.

A second contribution of this article is to present new evidence on other determinants of BHC operating costs. In particular, we find that proxies for organizational complexity (for example, the number of distinct legal entities controlled by the BHC), as well as measures of the diversity of business activities, are robustly correlated with higher expense ratios. This result appears consistent with prior research on the diversification discount in banking [for example, Goetz et al. (2013)]. A third contribution is to present new stylized facts about the composition of NIE, based on our data collection efforts. For example, we document the large share of NIE that is composed of corporate overhead, investment technology and data processing, consulting and advisory services, and legal expenses.

5 Details of this calculation are presented in Appendix B, http://www.newyorkfed.org/research/epr/2014/1403kovn_appendixB.pdf.
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The remainder of the article proceeds as follows: Section 2 presents background and reviews the literature on economies of scale in banking. Section 3 describes the data, discusses our method for classifying other NIE and presents descriptive statistics. Section 4 presents multivariate analysis of the relationship between size and NIE ratios. Section 5 studies components of NIE. Section 6 summarizes our findings.

2. Background and literature
Our analysis is closely related to academic literature on scale economies and organizational efficiency in banking. In a microeconomic production model, the cost function traces out the relationship between output and the minimum total cost required to produce that output, for a given set of input prices. A firm exhibits economies of scale if minimum cost increases less than proportionately with output – for example, if the firm could double its output by less than doubling its costs, holding input prices fixed.

A large literature empirically estimates the cost function for banks and/or BHCs, and tests for the presence of scale economies by measuring whether the elasticity of total costs with respect to output is greater than, equal to, or less than unity (indicating diseconomies of scale, constant returns to scale or economies of scale, respectively).

The earliest studies of scale economies in banking (for example, Benston (1972)), estimated during an era when U.S. banking organizations were on average much smaller than today, found evidence of modest economies of scale. Subsequent research, using more flexible cost functions, found that these scale economies were limited to small banks (for example, Benston et al. (1982) and Peristiani (1997); see also Berger and Humphrey (1994) for a survey).

More recent research, however, has found evidence of scale economies even among the class of large banks and bank holding companies. Examples include Wheelock and Wilson (2012), Hughes and Mester (2013), Feng and Serletis (2010) and Hughes et al. (2001). This departure from earlier findings reflects greater statistical power, attributable to the use of larger datasets with many more observations for large banking firms, as well as the evolution of empirical techniques.
For example, Wheelock and Wilson (2012) estimate a non-parametric cost function rather than the typical parametric translog function estimated in earlier literature, while Hughes and Mester (2013) and Hughes et al. (2001) endogenize bank risk and capital structure decisions. The difference in time periods may also play a role (for example, the greater use of information technology may have changed the extent to which scale economies are present).

The theoretical derivation of the cost function assumes that the bank maximizes profits, or equivalently, minimizes costs for any given level of output. A related body of literature on bank efficiency, however, finds evidence of surprisingly large cost differences between otherwise similar banks. These differences are viewed as evidence of X-inefficiencies, that is, firms operating inside their production possibilities frontier because of agency conflicts, management problems or other inefficiencies [DeYoung (1998); Berger et al. (1993); Berger and Humphrey (1991)].

Rather than analyzing total scale economies or X-efficiency, this paper presents disaggregated evidence on the relationship between firm size and detailed components of NIE. We have in mind the idea that operational and technological efficiencies related to size are likely to show up in the data in the form of lower operating costs in areas such as information technology and corporate overhead (for example, accounting and human resources) because large BHCs are able to spread the fixed component of these costs over a broader revenue or asset base. Our goal is to shed additional light on the mechanisms driving differences in efficiency between small and large firms. We note that our empirical finding that large BHCs have lower average operating costs could be driven by the presence of scale economies in the production of banking services, higher average X-efficiency for large firms, or both. For some categories of NIE, it could also be possible that lower costs for larger banking firms not only reflect technological efficiencies, but also greater bargaining power relative to suppliers, customers or employees.

Our analysis is related to recent research by the Clearing House Association (2011) that uses proprietary management information systems data from a number of large banks to estimate product-specific scale curves in seven areas: online bill payment, debit cards, credit cards, wire transfers, automated clearing house, check processing and trade processing.
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The Clearing House finds that in each of these areas, unit costs are decreasing in production volume, a conclusion that suggests the presence of fixed costs or other technological benefits of size. The economies of scale associated with these seven services are estimated to total U.S.$10 billion to U.S.$25 billion per year.

Although our approach is similar in some respects to the analysis by the Clearing House, we make use of data from audited regulatory filings, rather than internal management information system data, and study components that together sum up to total NIE, rather than just a subset of NIE (the seven items studied by the Clearing House together cover only 7% to 10% of NIE). We also study the entire cross section of BHCs, while the Clearing House sample consists of only six firms.

Our approach is related to the literature on banking mergers that uses accounting variables to estimate the effects of mergers on operating performance. Kwan and Wilcox (2002) find evidence that bank mergers reduced operating costs, although more so for the early 1990s than the late 1980s. Cornett et al. (2006) examine different measures of efficiency improvements for large mergers, and find evidence for cost-efficiency improvements in addition to other revenue improvements. Hannan and Pilloff (2006) show that cost-efficient banks tend to acquire relatively inefficient targets. Using German banking data, Niepmann (2013) finds a negative correlation between size and scaled operating costs – a result consistent with our findings for U.S. firms.

Davies and Tracey (2014) argue that standard estimates of scale economies for large banks are influenced by too-big-to-fail (TBTF) subsidies, and that scale economies are no longer present after controlling for TBTF factors. Hughes and Mester (2013) dispute this conclusion, arguing that the cost function used by Davies and Tracey is misspecified. One potential advantage of our focus on NIE is that operating costs (for example, information technology, printing, postage and advertising) may be relatively more likely to reflect technological features of the firm's production process than any distortions due to TBTF. Instead, TBTF seems most likely to affect the firm's funding costs and capital structure. It seems difficult, however, to rule out the possibility that TBTF subsidies may affect our results or those of previous literature.
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3. Data and descriptive statistics
Our analysis is based on quarterly FR Y-9C regulatory data filed by U.S. BHCs. The Y-9C filings include detailed balance sheet and income data, as well as information about loan performance, derivatives, off-balance-sheet activities and other aspects of BHC operations. Data are reported on a consolidated basis, incorporating both bank and nonbank subsidiaries controlled by the BHC [see Avraham et al. (2012) for more details]. Our analysis considers only “top-tier” BHCs – that is, the ultimate parent U.S. entity. Our sample includes top-tier U.S. BHCs with a foreign parent, although it excludes “stand-alone” commercial banks that are not owned by a BHC, and BHCs that are too small to file the Y-9C (the Y-9C reporting threshold varies over time, but is currently U.S.$500 million). Our sample excludes investment banks, thrifts and other types of financial institutions, unless those firms are owned by a commercial BHC.

NIE is reported in the consolidated Y-9C income statement (Schedule HI), broken down into five categories. Note that NIE does not include loan losses due to defaults, trading losses, gains and losses on owned securities or taxes; these are recorded in other parts of the income statement. Our analysis focuses on NIE because it is the most likely area in which firms would realize operating cost advantages from size.

We compute several normalized measures of NIE. The first measure, widely used by practitioners and industry analysts, is the “efficiency ratio,” defined as the ratio of NIE to “net operating revenue,” the sum of net interest income and non-interest income:

\[
\text{Efficiency ratio} = \frac{\text{Non-interest expense}}{\text{Net interest income + Non-interest income}}
\]

BHC net income in Schedule HI is calculated as follows: net income = net interest income + noninterest income – NIE - provision for loan and lease losses + realized securities gains (losses) – taxes + extraordinary items and other adjustments – net income attributable to noncontrolling interests. See Copeland (2012) for descriptive information on how the main components of BHC income have evolved over time.
A higher efficiency ratio indicates higher expenses, or equivalently, lower efficiency. Effectively, this ratio measures the operating cost incurred to earn each dollar of revenue. Efficiency ratios vary widely across BHCs, as we document below, but typical values range from 50% to 80%. Efficiency ratios are sometimes computed excluding certain noncash items from NIE, such as amortization of intangible assets. We refer to such measures as “cash” efficiency ratios.

One limitation of the efficiency ratio is that it is sensitive to quarter-to-quarter movements in net operating revenue. For example, ratios spiked for many BHCs during the financial crisis, because of trading losses and other non-interest losses. (In rare cases, the efficiency ratio even flips sign, because the sum of net interest and non-interest income is negative.) To provide an alternative normalization that is less sensitive to these concerns, we also present results based on scaling NIE by total assets or RWA, rather than net operating revenue:

\[
\text{Expense asset ratio} = \frac{\text{Non-interest expense}}{\text{Total assets (or risk-weighted assets)}}
\]

These normalizations can be computed for total NIE, or for NIE sub-components such as compensation.

3.1 Descriptive statistics
Table 1 presents descriptive statistics for NIE over the period from first-quarter 2001 to fourth-quarter 2012. We selected this period to take advantage of additional detail on non-interest income expense that was added to the Y-9C in 2001, thereby allowing us to separate non-interest income (which we use as a control) into components such as investment banking fees, income from insurance fees, deposit fees and servicing fees. Note that the sample period for our regression analysis in Section 4 begins in first-quarter 2002 because we incorporate lagged income variables from the previous four quarters. A total of 2,810 BHCs are present in the sample for at least one quarter.
Panel A of the table reports summary statistics for four normalized measures of NIE: the efficiency ratio, the cash efficiency ratio (which excludes goodwill impairment and amortization from NIE), NIE scaled by total assets and NIE scaled by RWA. The industry efficiency ratio averages 66.3% over 2001–12, although it is somewhat higher (71.7%) in 2012. The standard efficiency ratio and the cash efficiency ratio differ little on average, reflecting the fact that goodwill impairment and amortization expense generally represent a small total of total NIE.

The distribution of the expense ratios is skewed to the right. For example, the difference between the 5th percentile of the efficiency ratio and its median is 19.5%, significantly smaller than the difference of 28.0% between the median and the 95th percentile value. Furthermore, the right tail includes some extremely high values (for example, the 99.5th percentile is 198.4%), likely driven by one-time spikes in revenue. To reduce the influence of outliers, our regression analysis winsorizes the top and bottom 0.5% of observations for each NIE ratio (all data below and above the bottom and top 0.5th percentiles, respectively, are set equal to the 0.5th and 99.5th percentiles).

We examine the components of NIE in Panel B of the table, based on the five NIE categories reported on Schedule H1.\footnote{A detailed definition of these five variables can be found in the Federal Reserve Microdata Reference Manual data dictionary, available at http://www.federalreserve.gov/apps/mdrm/data-dictionary.}

- **Compensation** (49.4% of industry total over the sample time period, reported on FR Y-9C as “salaries and employee benefits”) includes wages and salaries, bonus compensation, contributions to social security, retirement plans, health insurance, employee dining rooms and other components of employee compensation.
- **Premises and fixed assets** (11.6% of total, reported on Y-9C as “expenses of premises and fixed assets net of rental income”) includes depreciation, lease payments, repairs, insurance and taxes on premises, equipment, furniture and fixtures. It excludes mortgage interest on corporate real estate.
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- **Goodwill impairment** (1.8% of total, reported on Y-9C as “goodwill impairment losses”) represents losses incurred when goodwill exceeds implied fair value and is revalued downwards. This item is reported separately from “other NIE” from 2002 onward.
- **Amortization expense** (1.9% of total, reported on Y-9C as “amortization expense and impairment losses for other intangible assets”) includes amortization of goodwill and other intangible assets owned by the BHC, as well as impairment losses for intangible assets other than goodwill. This item is also available from 2002 onward.
- **Other** (35.0% of total) includes a broad range of other operating costs, such as telecommunication and information technology costs, legal fees, deposit insurance, advertising, printing, postage and so on. Additional information on these expenses is provided in the memoranda to Schedule HI, as we explain in detail below.

### Table 1: NIE summary statistics

<table>
<thead>
<tr>
<th>Industry</th>
<th>Individual observations</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Full sample 2012</td>
</tr>
<tr>
<td>Efficiency ratio</td>
<td>66.32</td>
</tr>
<tr>
<td>Cash efficiency ratio</td>
<td>63.29</td>
</tr>
<tr>
<td>Expense-to-asset ratio</td>
<td>0.82</td>
</tr>
<tr>
<td>Expense-to-RWA ratio</td>
<td>1.22</td>
</tr>
</tbody>
</table>

### Panel A: Efficiency measures, in percentage: 2001-12

### Panel B: Components of NIE, as a percentage of total: 2001-12

<table>
<thead>
<tr>
<th>Compensation</th>
<th>Premises and fixed assets</th>
<th>Goodwill impairment</th>
<th>Amortization expense</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>49.36</td>
<td>11.63</td>
<td>1.75</td>
<td>1.93</td>
<td>34.95</td>
</tr>
<tr>
<td>48.68</td>
<td>9.64</td>
<td>0.02</td>
<td>1.78</td>
<td>39.88</td>
</tr>
<tr>
<td>18.08</td>
<td>2.79</td>
<td>0.00</td>
<td>-0.03</td>
<td>10.02</td>
</tr>
<tr>
<td>40.45</td>
<td>7.78</td>
<td>0.00</td>
<td>0.00</td>
<td>20.93</td>
</tr>
<tr>
<td>50.31</td>
<td>11.47</td>
<td>0.00</td>
<td>0.00</td>
<td>26.22</td>
</tr>
<tr>
<td>54.67</td>
<td>13.67</td>
<td>0.00</td>
<td>0.00</td>
<td>30.04</td>
</tr>
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<td>58.58</td>
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<td>0.00</td>
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<td>64.59</td>
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<td>0.00</td>
<td>45.82</td>
</tr>
<tr>
<td>74.30</td>
<td>26.53</td>
<td>0.00</td>
<td>0.97</td>
<td>69.29</td>
</tr>
<tr>
<td>53.96</td>
<td>13.84</td>
<td>0.97</td>
<td>3.57</td>
<td>31.11</td>
</tr>
</tbody>
</table>


Notes: The table reports summary statistics for 2,810 unique BHCs from 2001:01 to 2012:Q4, a total of 58,217 firm-quarter observations. The column labeled “industry” reports the average industry efficiency ratio, calculated by summing across all bank holding companies each quarter, taking the ratio, and then taking the time-series mean, either over the 2001:01-2012:Q4 sample period or over calendar year 2012. The denotation “p” refers to percentiles of individual observations (for example, “p50” is the median). Variables are defined in Appendix A of the original article. RWA is risk-weighted assets.
Figure 1 plots the time series evolution of the four normalized measures of total industry NIE. Each expense measure declined between 2001 and mid-2007, a period when the revenues and assets of the banking system grew rapidly. For example, the industry efficiency ratio fell from 65.4% in first-quarter 2001 to 58.8% in second-quarter 2007, while the expense asset ratio declined from 0.96% to 0.72% over the same period. This downward trend was reversed during the 2007–09 financial crisis. Since the efficiency ratio is mechanically inversely related to net operating revenue, the reversal for that NIE measure is perhaps unsurprising. However, the expense asset ratio also increased, whether normalized by total assets or RWA. In recent years, NIE ratios have stabilized at levels higher than those prevailing prior to the onset of the crisis. The rise in the efficiency ratio in part simply reflects the decline in net operating revenue and measures of profitability for the banking industry, owing to compression of net interest margins and lower non-interest income.

Appendix B also plots the evolution of the relative shares of the five NIE sub-categories. Goodwill impairment expenses are almost entirely concentrated in 2008, with negligible levels for this expense category before and after 2008. Other NIE makes up a progressively larger fraction of total NIE over the past five years. (In 2012, this category represented 39.9% of total NIE, a share similar to that held by compensation expenses).

As a first look at the relationship between firm size and normalized NIE, the main focus of this paper, we present scatter plots of BHC size and the efficiency ratio (Figure 2). The plots are based on year-to-date 2012 expense data and assets as of the end of 2012. A striking feature of the chart is the variability in NIE across firms, particularly among smaller BHCs. This finding is also borne out in our multivariate analysis in Section 4. The variability points to the importance of adding controls for those observable differences in BHCs’ activities that are associated with different types of expenses. These controls are described in Section 3.3.

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**Figure 1: NIE ratios over time**

Notes: Income data are quarterly and are not annualized. Ratios are reported in percentages. NIE is NIE; RWA is risk-weighted assets.
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Figure 2: Scatter plots of operating cost ratios and BHC Size

Notes: Scatter plots are based on average quarterly NIEs over 2012 and total BHC assets as of the end of 2012. BHC is bank holding company.
3.2 Classifying other NIE
The category “other NIE” represents more than one-third of industry NIEs since 2001. To shed light on these costs, we examine data from the memoranda to Schedule HI. Since 2008, Schedule HI has allowed BHCs to classify other NIE into eleven standardized sub-categories; in addition, space is provided for BHCs to report additional “write-in” expense items that were not captured by the standardized fields. For the 11 standardized sub-categories, BHCs are instructed to record items for amounts greater than $25,000 that also exceed 3% of total other NIE.

Write-in items bear the additional requirement that the expense item exceed 10% of total other NIE. Since 2008, amounts in the 11 standardized categories have made up 38% of total other NIE, while the write-in fields have constituted another 28% of other NIE. The remaining 34% of other NIE is not reported in the Schedule HI memoranda, presumably because it does not meet the reporting thresholds described above.

It is particularly challenging to classify and analyze items recorded in the write-in expense fields, because these amounts are reported using non-standardized language by each BHC. For example, NIEs related to foreclosures and to properties that are “other real estate owned” are variously written in as “reo,” “ore,” “R.E.O,” “oreo,” “foreclose,” and so on, as well as various misspelled text strings, such as “oero” and “forclosuer” (sic). Overall, more than 30,000 text strings are written in by the BHCs in our sample between 2008 and 2012. Approximately, 5,500 of these strings are unique. Individual BHCs often tend to use the same text field from one quarter to the next when referring to a given data item, a practice that reduces the total number of fields to be classified.

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9 The eleven standardized memoranda categories are (a) data processing expenses, (b) advertising and marketing expenses, (c) directors’ fees, (d) printing, stationery, and supplies, (e) postage, (f) legal fees and expenses, (g) FDIC insurance assessments, (h) accounting and auditing expenses, (i) consulting and advisory expenses, (j) automated teller machine (ATM) and interchange expenses and (k) telecommunications expenses. See FR Y-9C Schedule HI Memorandum Item 7.

10 “Other real estate owned” refers to real estate owned by a bank as a result of the foreclosure of a mortgage loan.
We classify each unique text string into broad categories, proceeding in two steps. First, we classify each string into 1 of 90 sub-categories, such as “card rewards,” “custodian fees,” “affordable/low-income housing,” “servicing,” “dues/memberships/subscriptions,” and “lockbox fee.” We chose these subcategories by grouping together apparently similar items, employing our institutional knowledge where possible, as well as internet searches and our best judgment. A list of these sub-categories, along with the percentage of non-missing values, is presented in Appendix B of the original paper, not available here. This classification was in part done by hand, and in part via Stata code that conducted Boolean searches for keywords within each text string. The sub-categories include four separate “miscellaneous/other” categories, one for text strings that are well-defined but do not fit into any obvious category (for example, “cattle feed,” “livestock,” and “image processing”), one for items that we did not understand (for example, “tops expense”), one for items that are vague or otherwise unclassifiable (for example, “sundry loss”), and one for text strings that combine multiple items with values listed.

Since most of the sub-categories are fairly sparsely populated we then aggregate them into nine categories that are better suited to statistical analysis. We also assign each of the 11 standardized memoranda items to one of the same nine author-defined categories. By doing this, we are able to classify 66.2% of other NIE into the nine high-level categories, which are listed below:

- **Corporate overhead** (18.6% of other NIE) is intended to measure general corporate expenses and includes four standardized Y-9C items: “accounting and auditing,” “printing, stationery, and supplies,” “postage,” and “advertising and marketing.” It also includes write-in expenses related to corporate overhead costs, such as travel, business development, recruitment, professional memberships and subscriptions, and charitable contributions.
- **Information technology and data processing** (12.6% of other NIE) covers the standardized Y-9C item “data processing expenses,” as well as write-in expenses related to information technology, software, and internet banking.
- **Consulting and advisory** (11.1% of other NIE) is the standardized Y-9C item “consulting and advisory expenses.” It does not include any write-in expenses.
Legal (6.7% of other NIE) includes the standardized Y-9C item “legal fees and expenses,” as well as write-in line items related to “litigation,” “settlement,” “records retention,” “legal reserve,” and similar items.11

Retail banking (6.4% of other NIE) is intended to reflect operating costs related to lending and deposit-taking and includes the standardized NIE category “ATM and interchange expenses,” as well as write-in items related to loans, retail banking or credit cards (for example, costs related to real estate owned properties, credit reports, credit card rewards, branch closing costs, lockbox fees, check fraud, and so on).

Federal Deposit Insurance Corporation (FDIC) assessments and other government-related expenses (5.8% of other NIE) includes the standardized Y-9C item “FDIC deposit insurance assessments” and write-in expenses related to the Community Reinvestment Act, compliance with regulation and other items. In practice, deposit insurance fees make up the bulk of these expenses.

Other financial services (3.0% of other NIE) embraces written-in expense items for financial activities other than traditional lending and depository services – in particular, asset management, insurance, and miscellaneous derivatives- and trading-related expenses.

Directors’ fees and other compensation (0.3% of other NIE) includes the standardized Y-9C category “directors’ fees,” as well as write-in fields related to director compensation or other compensation costs.

Miscellaneous (1.8% of other NIE) reflects the four types of miscellaneous categories described above – that is, items that cannot be easily classified or are not understood by us based on the content of the write-in field.

In a small minority of cases, the write-in field content suggests an expense item that may have been classified as other NIE by mistake (for example, costs related to employee compensation). We did not attempt to reclassify these expenses, given the limited context and detail in the write-in fields.

---

11 The standardized “legal fees and expenses” other NIE category includes fees and retainers paid for legal services obtained, but excludes legal settlements and legal expenses associated with owned real estate. Legal settlements and legal reserves established against expected future settlements are recorded in the write-in text fields, if separately reported.
Do big banks have lower operating costs?

Descriptive statistics for these nine author-defined categories of other NIE are presented in Panel B of Table 2. Note that the individual percentiles and standard deviations reported in the table are based on annual expenses, rather than quarterly values. We adopt this approach because of the significant number of zero values reported for even these nine aggregated categories. Our analysis of the other NIE subcategories is based on these year-end cumulative expenses.

The variation across BHCs in the relative size of different components of other NIE is striking. For example, the category “other financial services,” which includes NIE related to insurance and other nonbanking financial services, has a median value of zero, but at the 99.5th percentile, it is 15.9% of total other NIE. This varied distribution of expenses is consistent with the dispersion in products and services offered by BHCs.
Do big banks have lower operating costs?

Table 2: Components of other NIE

<table>
<thead>
<tr>
<th>Panel A: FR Y-9C classification of other NIE: 2008-12</th>
</tr>
</thead>
<tbody>
<tr>
<td>Category</td>
</tr>
<tr>
<td>In Y-9C</td>
</tr>
<tr>
<td>Text classified</td>
</tr>
<tr>
<td>Unclassified</td>
</tr>
<tr>
<td>Total</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Panel B: Components of other NIE, as a percentage of total other NIE: 2008-12</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Component (author-defined)</strong></td>
</tr>
<tr>
<td>Corporate overhead</td>
</tr>
<tr>
<td>Information technology and data processing</td>
</tr>
<tr>
<td>Consulting and advisory</td>
</tr>
<tr>
<td>Legal</td>
</tr>
<tr>
<td>Retail banking</td>
</tr>
<tr>
<td>FDIC assessments and other government</td>
</tr>
<tr>
<td>Other financial services</td>
</tr>
<tr>
<td>Directors’ fees and other compensation</td>
</tr>
<tr>
<td>Miscellaneous</td>
</tr>
<tr>
<td>Total classified</td>
</tr>
<tr>
<td>Unclassified</td>
</tr>
</tbody>
</table>


Notes: The table reports summary statistics for 2,810 unique BHCs from 2008 to 2012. Annual data are as of year-end, for a total of 4,999 firm-year observations. Panel A summarizes information on the following types of NIE: (i) FR Y-9C line items: eleven standardized other NIE items reported in FR Y-9C Schedule HI: Memoranda, (ii) text classified: other NIE items reported in Schedule HI: Memoranda as text fields, and (iii) unclassified: other NIE items not classified in Schedule HI (for example, because the amounts do not exceed the reporting threshold). Panel B includes summary statistics for the nine author-defined other NIE categories, which are constructed from the FR Y-9C line items and the text fields. These data are described in Section 3.2. FDIC is Federal Deposit Insurance Corporation.
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Table 3: Summary statistics for control variables

<table>
<thead>
<tr>
<th>Asset shares (percentage of total assets)</th>
<th>Industry, by size cohort</th>
<th>Individual observations</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Top 1%</td>
<td>95%-99%</td>
</tr>
<tr>
<td>Total loans</td>
<td>42.08</td>
<td>59.58</td>
</tr>
<tr>
<td>Residential real estate loans</td>
<td>14.94</td>
<td>16.63</td>
</tr>
<tr>
<td>Commercial real estate loans</td>
<td>4.26</td>
<td>15.65</td>
</tr>
<tr>
<td>Commercial and industrial loans</td>
<td>8.64</td>
<td>12.54</td>
</tr>
<tr>
<td>Credit card loans</td>
<td>3.53</td>
<td>2.33</td>
</tr>
<tr>
<td>Other consumer loans</td>
<td>4.68</td>
<td>6.11</td>
</tr>
<tr>
<td>All other loans</td>
<td>6.03</td>
<td>6.32</td>
</tr>
<tr>
<td>Trading assets</td>
<td>15.52</td>
<td>1.45</td>
</tr>
<tr>
<td>Federal funds and repurchase agreements</td>
<td>13.67</td>
<td>2.20</td>
</tr>
<tr>
<td>Cash</td>
<td>5.49</td>
<td>5.76</td>
</tr>
<tr>
<td>Investment securities</td>
<td>12.65</td>
<td>20.60</td>
</tr>
<tr>
<td>Other real estate owned</td>
<td>0.11</td>
<td>0.12</td>
</tr>
<tr>
<td>Fixed assets</td>
<td>0.70</td>
<td>1.24</td>
</tr>
<tr>
<td>Investments in unconsolidated subsidiaries</td>
<td>0.33</td>
<td>0.18</td>
</tr>
<tr>
<td>Investments in real estate ventures</td>
<td>0.08</td>
<td>0.05</td>
</tr>
<tr>
<td>Intangible and other assets</td>
<td>8.02</td>
<td>6.77</td>
</tr>
<tr>
<td>Risk</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Risk-weighted assets (percentage of total assets)</td>
<td>63.85</td>
<td>75.08</td>
</tr>
<tr>
<td>Nonperforming loans (percentage of total loans)</td>
<td>2.94</td>
<td>1.85</td>
</tr>
<tr>
<td>HHI income</td>
<td>0.53</td>
<td>0.56</td>
</tr>
</tbody>
</table>
3.3 Controls

Operating costs are likely to vary significantly across BHCs engaged in different business activities. While the decision to enter different businesses is endogenous, and may be related to size, we are primarily interested in understanding how size is related to operating expenses on an apples-to-apples basis. For this reason, our regression analysis controls for a variety of BHC characteristics reported in the FR Y-9C. Summary statistics for these controls are presented in Table 3.

Do big banks have lower operating costs?

<table>
<thead>
<tr>
<th>Revenue composition (percentage of net operating revenue)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interest income</td>
</tr>
<tr>
<td>Trading income</td>
</tr>
<tr>
<td>Non-interest non-trading income</td>
</tr>
<tr>
<td>Fiduciary income</td>
</tr>
<tr>
<td>Investment banking fees</td>
</tr>
<tr>
<td>Service charges on deposits</td>
</tr>
<tr>
<td>Net servicing fees</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Funding structure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deposits/assets (percent)</td>
</tr>
<tr>
<td>Publicly traded (percentage of sample)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Business concentration</th>
</tr>
</thead>
<tbody>
<tr>
<td>HHI assets</td>
</tr>
<tr>
<td>HHI income</td>
</tr>
</tbody>
</table>


Notes: The table reports summary statistics for 2,810 unique BHCs from 2001:Q1 to 2012:Q4, a total of 58,217 firm-quarter observations. The first six columns are industry ratios (computed by first summing numerator and denominator across all firms in the relevant size class), or are statistics weighted by firm size, except for the two indicator variables “publicly traded” and “BHC is foreign-owned.” Size cohorts are recalculated in each quarter. The last two columns are unweighted statistics across all firms. Note that the sample period for the regression analysis begins in 2002:Q1, not 2001:Q1, because specifications include lagged income variables from the previous four quarters. See Appendix A of the original article for variable definitions. HHI is Herfindahl-Hirschman Index; BHC is bank holding company.
In order to show how these controls are related to bank size, we also present industry averages for the following size cohorts: largest 1%, 95% to 99%, 75% to 95%, 50% to 75%, and smallest 50%. Differences in BHC characteristics by size are clear from differences in sample means within the cohorts. However, there is substantial variation in business models apparent within size cohorts as well.

The controls in Table 3 are grouped into six categories, as follows:

- **Asset shares**: our asset composition control variables measure the fraction of balance sheet assets held in various types of loans and other assets (for example, trading assets, securities, cash and fixed assets). As shown in Table 3, small firms hold a higher fraction of total assets in the form of loans, while trading assets are a significantly higher share of total assets for the largest BHCs than for any other group.

- **Risk**: we control for two additional measures of asset risk – RWA as a percentage of total assets and nonperforming loans (NPLs) as a percentage of total loans. The relationship between firm size and risk is non-monotonic for both risk measures, although we note that the largest firms have significantly higher nonperforming loan ratios than other BHCs.

- **Revenue composition**: this variable refers to the percentage of net operating revenue (the sum of interest and non-interest income) that is earned from different sources: (i) interest income, (ii) trading income and (iii) five different components of non-interest nontrading income. Since these components can be volatile, we include these variables in the regressions, in the form of a four-quarter rolling average lagged value. (The standard deviation reported in the table is based on this four-quarter rolling average.) It is notable that large BHCs earn a significantly higher percentage of revenue from non-interest income.

---

12 To compute the industry average for the asset and income ratios, we sum the numerator and denominator of the ratio across all firms in the size cohort, and then take the ratio of the two sums. In contrast, the mean and standard deviation reported in the first two columns represent the unweighted mean and standard deviation of the individual observations in the sample. Of course, the mean of the individual observations may differ substantially from the industry mean if the ratio in question is correlated with firm size.
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- **Funding structure:** in some specifications, we include two controls for funding structure, the ratio of deposits to assets and a dummy for whether the BHC is a publicly traded company (firms with foreign parents are coded as private, regardless of whether their ultimate parent is public). Large firms fund less of their assets with deposits, on average.

- **Business concentration:** research in organizational economics has found that diversified firms tend to be less efficient and less profitable than focused firms. In studies that are most relevant to our analysis, Goetz et al. (2013) find that geographically diversified commercial banks have lower valuations, while Laeven and Levine (2007) find a diversification discount (based on the firm’s activity mix) in an international cross section of banks. In the spirit of these studies, we include Herfindahl-Hirschman Index (HHI)-style measures of asset and income concentration, computed as the sum of squared asset weights and income weights, respectively, based on the categories presented in Table 3. Higher values of these measures indicate greater concentration. As Table 3 shows, large firms have more diversified assets and activities (lower HHI), reflecting their greater reliance on financial activities outside of traditional lending and deposit-taking.

- **Organizational complexity:** organizationally complex firms may also have higher operating costs, because of various internal inefficiencies (for example, duplication of efforts across different subsidiaries or divisions within the same firm). It is important to attempt to disentangle the effects of size and structure, given that large firms are likely to be organizationally complex. Our analysis includes three measures of organizational structure, the log number of subsidiaries [following Avraham et al. (2012)], the percentage of subsidiaries domiciled overseas and a dummy for whether the BHC has a foreign parent. As shown by the sample means across size cohorts, large firms have more complex organizational structures than small firms on each of these dimensions. The differences are striking: the largest BHCs (those in the top 1% of the size distribution) have 962 subsidiaries on average, 22.7% of which are domiciled overseas. BHCs below the sample median in size, however, have only four subsidiaries on average, and only 4.8% of these subsidiaries are domiciled outside the U.S.
4. Analysis

In this section, we study the relationship between BHC size and measures of total NIE scaled by revenue or assets, examining how this relationship is affected by controlling for differences in firms’ business models and by the normalization of NIE used. Our analysis progressively adds controls for a wide range of measures of the composition of BHC assets and sources of income, on the presumption that some types of assets or activities are likely to be more complex and time-consuming to manage than others. For example, a BHC with a large portfolio of other real estate owned assets will likely incur significant property maintenance and management expenses associated with these assets, compared with an otherwise similar banking firm that has liquidated such properties in return for cash, government securities or other simple assets. Similarly, a portfolio of consumer loans is likely to have different screening and monitoring costs than a portfolio of commercial loans. Including these controls seems particularly important given that asset composition varies significantly by firm size, as documented in Section 3.

4.1 Total NIE

We undertook an ordinary least squares estimate of the relationship between the efficiency ratio and BHC size measured by the log of total assets.\(^{13}\) We find a statistically and economically significant inverse relationship between size and the efficiency ratio in each regression specification. That is, NIEs per dollar of net operating revenue are lower for large BHCs.

We began our analysis with a regression that controls only for time-series variation in the efficiency ratio, through the inclusion of quarter fixed effects. Each subsequent regression specification successively adds more explanatory variables associated with differences in BHCs’ business activities. We begin with simple controls for the composition of BHC assets and add more detailed measures of the risk of those assets, the composition of revenue, funding structure, business concentration, organizational complexity and geography.

\(^{13}\) The findings are provided in Table 4 of the original article. The table has been removed here due to space constraints.
We find that the inclusion of additional controls tends to steepen the inverse relationship between BHC size and the efficiency ratio. Including controls for BHC asset composition (for example, the percentage of assets in fixed assets, residential real estate loans, trading assets, and so on) increases the magnitude of the coefficient on bank size by 54% (from -1.32 in specification 1 to -1.96 in specification 3), and increases the explanatory power of the model by 13 percentage points. Controlling for the percentage of income generated by different activities (for example, trading, investment banking and deposit service charges) shifts the coefficient to -2.63 (specification 6). The inclusion of controls for organizational complexity further steepens the association between BHC size and the efficiency ratio; the coefficient increases in magnitude from -2.98 to -4.13.

For the model including all controls but excluding firm fixed effects, the coefficient on size of -4.151 implies that a 10% increase in size is associated with a 42 basis point decrease in the efficiency ratio, equivalent to 0.6% of the sample average efficiency ratio. In dollar terms, the coefficient implies that for a BHC at the mean of the data (U.S.$9.1 billion in assets), an increase in size of U.S.$1 billion is associated with a reduction in operating expenses of U.S.$437,000 per quarter, relative to a counterfactual in which the efficiency ratio is not associated with size. The corresponding calculation for the smaller coefficient from column 2 implies a reduction in operating expenses of U.S.$199,000 per quarter. The final specification includes BHC fixed effects, and thus examines only changes in size within bank holding companies. This within-firm analysis includes both size changes from organic growth and size changes from mergers. While still statistically significant, this coefficient is somewhat smaller in magnitude than that which includes all controls but firm fixed effects (-2.47 compared with -4.15). There is some evidence that NIEs after mergers are inflated by one-time merger related costs [Kwan and Wilcox (2002)], which may account for this difference. The standard error of the size coefficient estimate from final specification is much larger than in the other specifications; in other words, the coefficients are estimated with lower power, owing to the smaller residual variation in the efficiency ratio not absorbed or accounted for by the fixed effects and other controls.
As expected, observable differences among BHCs explain a significant fraction of the variation in NIEs. Simple asset controls alone more than double the adjusted R2 of the initial specification. However, even the fixed effects specification in final regression has an R2 of only 54.9%, implying a large amount of residual variation in operating costs. Furthermore, the inclusion of BHC fixed effects nearly doubles the R2 relative to the specification that excludes firm fixed effects but includes all other controls, a result suggestive of large persistent differences in operating costs across observably similar firms. This finding seems consistent with prior literature on X-inefficiency, which shows that many banking firms operate significantly inside the efficient production frontier [see, for example, Berger et al. (1993)]. It is worth noting that BHC size alone explains only a very small fraction (less than 1%) of the total variation in NIE in the data, as illustrated graphically in Figure 2.

In sum, we find consistent evidence that large BHCs have lower operating costs as measured by the efficiency ratio, although the strength of the relationship is sensitive to the set of controls used. Instead of taking a strong stance on the “appropriate” set of controls, throughout the paper we present results for specifications using controls from 3 of the regressions used in the original table, namely columns 1, 2, and 10 from Table 4 in the original article. A comparison of the results across these specifications enables the reader to observe how the relationship between NIEs and size is influenced by the inclusion or exclusion of controls for the mix of BHC assets and business activities.

Although our main focus is on the relationship between operating costs and firm size, estimates for several of the controls examined are also of independent interest. In particular, BHC organizational complexity, measured by the log number of subsidiaries, is associated with higher NIE ratios. BHCs with a foreign parent also have higher expenses. Proxies for greater organizational focus are associated with lower NIE: BHCs that have more concentrated asset portfolios and more concentrated sources of non-interest income have lower expenses, all else equal, although the marginal explanatory power of additional concentration is relatively low. Each of these relationships is robust to the inclusion of BHC fixed effects. Although not presented here, these relationships are also robust to specification changes that allow for a more flexible linkage between size and the efficiency ratio. This finding suggests that our results are not likely to be driven only by the largest BHCs.
Caution should be exercised in applying a causal interpretation to these associations, given that we do not have a convincing econometric instrument for organizational complexity or focus. But taken at face value, each of these estimates implies that complex, diversified firms have higher operating expenses than focused or organizationally simple firms, consistent with the conclusions of prior literature on the diversification discount in banking [Goetz et al. (2013); Laeven and Levine (2007)].

4.2 Other functional forms
The specifications so far assume a log-linear relationship between BHC size and the efficiency ratio. Next, we allow for a more flexible functional form by estimating fractional polynomial specifications that permit the data to determine the shape of the relationship between size and the NIE ratio. An alternative to regular polynomials, fractional polynomials provide flexible parameterization for continuous variables. We use the Stata function fracpoly to determine an optimal polynomial specification (optimal polynomial) and also estimate a specification with exponents ranging from -2 to 2 — that is, log assets raised to the -2, -1, 0, 1, and 2 power (flex polynomial). These best-fit polynomials are shown in Figure 3 along with the ordinary least squares line of best fit.

Overall, the log-linear functional form assumed in the analysis appears to be a good approximation, although we note that, based on point estimates, the point-estimated relationship between log assets and the efficiency ratio is somewhat concave at the tails. Specifically, the relationship between BHC size and the NIE ratio is relatively flat among small BHCs (those with assets below U.S.$150 million), while the relationship is steeper among the largest BHCs (those with assets above U.S.$750 billion). For the vast range of asset sizes, the relationship between log size and efficiency ratio is close to linear, and the 95% confidence interval of the alternative forms is very similar. Thus, we use a log-linear specification for the remainder of the analysis.

In addition to investigating flexible polynomial specifications, we separate the sample into different size cohorts, re-sorted in each quarter, and estimate separate specifications for each cohort. This approach allows the relationship between NIE and control variables, as well as size, to vary by BHC size class. (In the fractional polynomial approach, the coefficients on explanatory variables other than size are unrelated to size.)
Do big banks have lower operating costs?

Figure 3: Efficiency ratio and BHC size, flexible functional forms

Source: Authors’ calculations, based on statistical analysis of FR Y-9C data.
Note: Functional forms are partial predictions based on varying log of assets ($000s), holding other covariates fixed at their sample means. The efficiency ratio is normalized to be equal to zero for a BHC with $10 billion in assets.

Each column of Table 4 represents specifications 1, 2, and 10 of Table 4 in the original article estimated on a subset of the BHCs sorted by size in each year. The first column replicates the results on the entire sample, for comparison. Without including controls for BHC asset mix, it appears that much of the coefficient on size is driven by BHCs below the median asset size (column 6).
As additional controls are included, economies of scale become apparent in many of the size cohorts. In the specification including all controls, the estimated coefficient on size is negative in all cohorts and statistically significant. As suggested by the flexible polynomial specifications, the point estimate coefficient on size is largest in the top 1% of the sample. What do these findings imply for the policy debate around size limits for the largest BHCs? We find no evidence that the inverse relationship between size and operating costs disappears above any particular size threshold; indeed, our point estimates suggest that, if anything, the relationship is steeper among the largest firms. This result is consistent with scale economies from sources other than bargaining power to the extent that we believe that differences in bargaining power may be small within the top 1% of BHCs. The statistical precision of our estimates is limited, however, given the small number of observations for the largest BHCs.

Table 4: Coefficient on log assets, by size cohort

<table>
<thead>
<tr>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
<th>(6)</th>
<th>Controls</th>
</tr>
</thead>
<tbody>
<tr>
<td>Table 4, Specification (1)</td>
<td>-1.320* (0.235)</td>
<td>1.860 (1.647)</td>
<td>1.273 (1.164)</td>
<td>-1.790* (0.687)</td>
<td>-0.768 (1.509)</td>
<td>-6.140* (1.633)</td>
</tr>
<tr>
<td>Table 4, Specification (2)</td>
<td>-1.892* (0.228)</td>
<td>-2.864 (2.020)</td>
<td>-0.379 (1.278)</td>
<td>-1.888* (0.674)</td>
<td>-1.914 (1.352)</td>
<td>-3.195* (1.334)</td>
</tr>
<tr>
<td>Table 4, Specification (10)</td>
<td>-4.151* (0.326)</td>
<td>-8.018c (3.931)</td>
<td>-5.138* (1.442)</td>
<td>-4.132* (0.696)</td>
<td>-4.238* (1.204)</td>
<td>-5.055* (1.311)</td>
</tr>
<tr>
<td>N</td>
<td>58,217</td>
<td>604</td>
<td>2,405</td>
<td>12,197</td>
<td>15,181</td>
<td>27,830</td>
</tr>
</tbody>
</table>

Source: Authors’ calculations.
Notes: The table presents an analysis of the relationship between size, measured by the log of total assets (lagged by one quarter), and efficiency ratio, defined as total NIE as a percentage of net operating revenue. Each row represents the coefficient on size for specifications (1), (2), and (10) of Table 4 in the original article, estimated on a subset of bank holding companies sorted by size in each quarter. Specification (1) includes time fixed effects. Specification (2) includes time fixed effects as well as controls for the percentage of assets in each broad category (asset shares). Specification (10) includes the controls from specification (2) as well as controls for types of loans, revenue composition, funding structure, business concentration, organizational complexity and headquarters state fixed effects. Robust standard errors reported in parentheses are clustered by BHC and quarter. a: p<0.01; b: p<0.05 and c: p<0.1

As additional controls are included, economies of scale become apparent in many of the size cohorts. In the specification including all controls, the estimated coefficient on size is negative in all cohorts and statistically significant. As suggested by the flexible polynomial specifications, the point estimate coefficient on size is largest in the top 1% of the sample. What do these findings imply for the policy debate around size limits for the largest BHCs? We find no evidence that the inverse relationship between size and operating costs disappears above any particular size threshold; indeed, our point estimates suggest that, if anything, the relationship is steeper among the largest firms. This result is consistent with scale economies from sources other than bargaining power to the extent that we believe that differences in bargaining power may be small within the top 1% of BHCs. The statistical precision of our estimates is limited, however, given the small number of observations for the largest BHCs.
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4.3 Alternative measures of operating costs

The efficiency ratio may be distorted in periods when net operating income is temporarily low.\textsuperscript{14} Next, we test the sensitivity of our results to other normalizations of NIE: the expense asset ratio discussed in Section 3 (NIE/total assets), NIE/RWA, and a “cash” efficiency ratio, which excludes noncash expenses such as goodwill amortization in the numerator.

\textsuperscript{14} During the 2007-08 financial crisis, trading losses and other losses brought net operating income close to zero for several large BHCs.

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Table 5: Alternative measures of operating costs

<table>
<thead>
<tr>
<th></th>
<th>NIE/risk-weighted assets</th>
<th>NIE/assets</th>
<th>Cash NIE/net revenue (cash efficiency ratio)</th>
<th>Log NIE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Original specification:</td>
<td>-1</td>
<td>-2</td>
<td>-10</td>
<td>-1</td>
</tr>
<tr>
<td>Log assets</td>
<td>0.007</td>
<td>-0.044*</td>
<td>-0.115*</td>
<td>0.003</td>
</tr>
<tr>
<td></td>
<td>(0.01)</td>
<td>(0.011)</td>
<td>(0.013)</td>
<td>(0.006)</td>
</tr>
<tr>
<td></td>
<td>0.018*</td>
<td>-0.083*</td>
<td>-1.686*</td>
<td>-1.686*</td>
</tr>
<tr>
<td></td>
<td>(0.007)</td>
<td>(0.009)</td>
<td>(0.231)</td>
<td>(0.231)</td>
</tr>
<tr>
<td></td>
<td>-2.239*</td>
<td>-4.339*</td>
<td>0.993*</td>
<td>0.993*</td>
</tr>
<tr>
<td></td>
<td>(0.021)</td>
<td>(0.030)</td>
<td>(0.007)</td>
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<tr>
<td></td>
<td>0.003</td>
<td>0.018</td>
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<tr>
<td></td>
<td>(0.021)</td>
<td>(0.030)</td>
<td>(0.007)</td>
<td>(0.007)</td>
</tr>
</tbody>
</table>

Asset share controls   | Yes | Yes | Yes | Yes | Yes | Yes |
All controls           | Yes | Yes | Yes | Yes | Yes | Yes |
R\textsuperscript{2}     | 0.016 | 0.231 | 0.487 | 0.007 | 0.171 | 0.43 |
|                       | 0.078 | 0.208 | 0.325 | 0.935 | 0.949 | 0.968 |
N                      | 58,217 | 58,217 | 58,217 | 58,217 | 58,217 | 58,217 | 58,217 | 58,217 | 58,192 | 58,192 | 58,192 |

Source: Authors' calculations.

Note: The table presents an analysis of the relationship between size, measured by the log of total assets (lagged by one quarter), and different measures of efficiency. The dependent variables in the first three specifications are cash efficiency ratio, defined as total NIE less goodwill impairment and amortization expense over net operating revenue; in the next three specifications, NIE/assets ratio, defined as total NIE over total assets; and in the final three specifications, NIE/RWA ratio, defined as total NIE over total RWA. For each alternative measure of efficiency ratio, specifications (1), (2) and (10) of Table 4 in the original article are presented. Specification (1) includes controls for quarter fixed effects. Specification (2) includes the controls from specification (1) as well as controls for the percentage of assets in each broad category. Specification (10) includes the controls from specification (2) as well as controls for types of loans, revenue composition, funding structure, business concentration, organizational complexity, and headquarters state fixed effects. Models are estimated with robust standard errors and two-way clustering by firm and quarter. a: p<0.01; b: p<0.05 and c: p<0.1.
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We do this because noncash expenses are often associated with one-time costs relating to mergers and acquisitions that are not likely to persist, and may be associated with size. We also estimate a specification using the log of NIE as an alternative measure of operating costs.

As before, for each normalization of NIE, we re-estimate specifications with the set of right-hand-side variables from columns 1, 2, and 10 of Table 4 in the original article and present the coefficient on asset size. Results are presented in Table 5. Regardless of the normalization used, the coefficient on size is negative and statistically significant once BHC controls are included. In the specification including all controls, the estimated coefficient on size is approximately 7% to 10% of the average expense ratio.

For the specifications using the log of NIE as the dependent variable, the coefficient on log assets can be directly interpreted as the elasticity of operating costs with respect to size. In line with our other results, this elasticity is less than unity — in other words, a 10% change in BHC size is associated with a less than 10% change in NIE operating costs, a finding consistent with the presence of scale economies in operating costs. For the specification including all controls, the operating cost elasticity is 0.899, much smaller than one, although it is significantly closer to one for the specification just including asset controls (0.979). Both these estimates are statistically significantly smaller than unity.

5. Decomposition of NIE
This section examines the relationship between BHC size and components of NIE. First, we consider the five major components of NIE reported in the Y-9C income statement. Probing more deeply, we then analyze the nine sub-components of “other NIE,” using our manual classification of these expenses as described in Section 3.

One goal of this disaggregated analysis is to shed additional light on the sources of the lower operating costs enjoyed by large BHCs. Although these lower costs could be due to scale economies or other efficiency benefits of size, they could also reflect implicit government guarantees for large BHCs, or the greater bargaining power of these firms. For example, large banks may endogenously select riskier activities, but invest less in risk management because of implicit insurance associated with being “too big to fail.”
Alternatively, large banks may simply take advantage of greater bargaining power to reduce expenses. These different explanations have very different normative welfare implications. Efficiency benefits of size imply that limiting size would impose deadweight economic costs, while explanations relating to bargaining power and TBTF primarily relate to the allocation of economic rents. Although the breakdown of expenses in the Y-9C does not allow us to fully disentangle these different explanations, we are able to draw some suggestive conclusions.

5.1 Major components of NIE

We begin by studying the five expense categories reported on Schedule HI: compensation (49.4% of NIE), premises and fixed assets expense (11.6%), goodwill impairment (1.8%), amortization (1.9%) and other (35.0%). As before, we normalize each expense by net operating revenue, and for parsimony, focus on the coefficient on log assets for specifications 1, 2, and 10 from Table 4 in the original article.

Each of the three largest categories of NIE declines as a percentage of net revenue as size increases, all else equal, with or without the inclusion of controls for BHC characteristics. Focusing on the specifications including these controls (either for asset composition alone or for all controls), we find that the inverse relationship between BHC size and scaled NIE is steepest for compensation, followed by other NIE, based on this calculated elasticity. For the specifications including all controls, a 10% increase in size is associated with a 0.735% decline in compensation scaled by net operating revenue and a 0.683% decline in the corresponding ratio for other NIE. The result for employee compensation is perhaps surprising, given that large BHCs have more employees in highly compensated roles such as investment banking and trading. However, the higher productivity and additional revenue earned by these employees (the denominator of the efficiency ratio) appears to offset this higher compensation.

Expenses related to premises and fixed assets may represent a category of operating costs for which scale efficiencies are lower (for example, building lease costs are roughly proportionate to the size of the leased space, at least within a specific geographic area).

15 The results are presented in Table 7 of the original article. The table has been removed here due to space constraints.
Given this, it is perhaps unsurprising that estimated economies of scale are smaller for premises and fixed assets expense: for this category, our point estimate implies that a 10% increase in size is associated with a 0.478% decline in expenses scaled by operating revenue.

Significantly, expenses related to the impairment and amortization of goodwill and other intangible assets are actually proportionately higher for large firms – a fact that distinguishes these expenses from the other categories. We estimate a positive, statistically significant (in most specifications) coefficient on these expenses. The likely key reason for this finding is that large BHCs often have grown by way of acquisitions, which will sometimes result in goodwill when the acquisition purchase price exceeds the tangible book value of assets purchased. Consequently, these firms report higher expenses related to the amortization or impairment of these assets. Although the positive slope for these two expense categories is economically significant, the two categories together make up only a relatively small proportion (3.7%) of total industry NIE.

5.2 Sub-components of other NIE
In this section, we examine the nine sub-components of “other NIE” identified in Section 3.2. (Recall that these categories reflect both standardized memoranda items reported on the Y-9C since 2008 and “write-in” text strings classified by us.) Previous work estimating scale curves for these disaggregated categories has been based on case studies or has had limited sample size (for example, Clearing House Association [2012]).

Overall, we find evidence that scaled expense falls with size for most, but not all, components of other NIE, especially after including controls for BHC asset and income composition. When controls for the composition of assets and income sources are included in the specification, large BHCs exhibit lower expenses in categories in which a fixed cost can be spread across an expanded scale of operations, such as corporate overhead, information technology and data processing.
When we look at the results for the other NIE components, we find that corporate overhead is the largest component of other NIE, and a component for which we estimate significant scale efficiencies (a high estimated coefficient on size relative to mean level of expense). Corporate overhead includes expenses, such as accounting and auditing, advertising and marketing, treasury expenses, travel and business development, charitable donations, insurance and utilities. These expenses appear to have significant operational leverage; the estimated coefficient on size is $-0.33$, approximately $7\%$ of the mean level of corporate overhead expenses. Similar scale economies are observed for expenses associated with information technology and data processing, with an estimated coefficient on size that is $-6.6\%$ of mean IT expense. This finding is consistent with the view that spreading overhead expenses associated with technology may be one source of cost advantage for large banking firms.

In contrast to these two categories, we find that expenses associated with consulting and advisory services are proportionately higher for large BHCs. Prior to adding controls for BHC characteristics, our estimates show that the coefficient on size and consulting expenses is positive and statistically significant. This coefficient remains significant when asset composition controls are included, although once all controls are included the coefficient is positive but no longer statistically significant. This suggests that consulting and advisory services may be related to non-interest income, rather than to the composition of BHC assets. Despite recent publicity surrounding large BHCs' legal issues and large-dollar-value settlements, over the 2008–12 period, legal expenses also increase less than proportionately with BHC size, particularly in the specification including the full set of controls [specification (10)]. This expense category includes both legal fees and retainers paid for legal services performed, as well as expenses associated with legal settlements and reserves, to the extent we can identify these expenses from the write-in text fields. Some part of this finding may reflect the fact that small banks may lack internal legal departments, for which expenses would be recorded as part of compensation, and thus have higher external legal fees.

The assignment of write-in fields to retail banking requires perhaps the most judgment on our part. This category includes collection expenses, credit reports, mortgage-related expenses such as appraisal and title fees, branch expenses, checks, lockboxes and robbery, among many others.
After including asset composition controls, the estimated coefficient remains negative although not statistically significant. This result may reflect the wide variation in the types of retail banking businesses that are not well captured by our BHC characteristics. Alternatively, economies of scale may be limited or not present for branch banking (at least among the set of expenses classified in this category), since many costs only scale until the next branch is opened.

Similarly, we find a negative but statistically insignificant relationship between size and normalized FDIC assessments and other government-related expenses after including the full complement of BHC characteristics. The majority of the expenses in this line item are due to deposit insurance, and thus it would be surprising to uncover economies of scale once we control for the amount of deposit financing. This coefficient would likely shrink further if our regression specification included a control for the fraction of insured deposits, rather than total deposits.

The category “other financial services” represents the sum of expenses associated with BHCs’ non-banking businesses, such as asset management, trust and custody services, and insurance. Given the likely differences in the NIEs of these businesses, it is not surprising that the estimated coefficient changes sign from positive to negative once we control for the composition of BHCs’ assets and non-interest income. Banking firms that earn a high percentage of income from fee income should naturally have higher expenses. But holding all else equal and controlling for income composition, we find that larger BHCs have lower scaled expenses in this category: we estimate a coefficient of 7.4% of the mean value. This result is consistent with cost economies of scale in non-compensation expenses associated with businesses such as insurance and asset management.

The component of other NIE for which scale economies are largest in percentage terms is directors’ fees and other compensation. For this category, the coefficient on size is almost three times as large as the sample mean. This makes intuitive sense; even though directors of large BHCs have higher compensation, board size does not increase dramatically with firm size. This coefficient is negative and significant regardless of the set of controls used.
Miscellaneous expenses include items as varied as expenditures for cattle feed and reducing gold to market. It also includes nonspecific write-in text fields such as “miscellaneous expense,” “miscellaneous fee” and “other expense.” Regardless of the controls for bank businesses used, we do not see economies of scale in these varied expenses, although some economies may exist in the residual category “other expenses,” which includes all NIEs not otherwise classified.

6. Conclusion
We find a robust inverse relationship between the size of BHCs and scaled measures of operating costs. Quantitatively, a 10% increase in assets is associated with a 0.3% to 0.6% decline in NIE scaled by income or assets, depending on the specification. In dollar terms, our estimates imply that for a BHC of mean size in our sample, an additional U.S.$1 billion in assets reduces NIE by U.S.$1 million to U.S.$2 million per year, relative to a base case where operating cost ratios are unrelated to size. This inverse relationship is robust to various changes in model specification, although the magnitude of the relationship is sensitive to the set of controls used.

Unpacking our results, we find that while size is associated with lower scaled operating costs for most components of NIE, the largest contributions in dollar terms come from employee compensation, premises and fixed assets, corporate overhead, and information technology and data processing. While not a large component of total NIE, directors’ fees and other compensation account for the largest proportionate savings, presumably a reflection of the fact that corporate boards do not expand with firm size, even if their members are better paid on average.

Our results likely reflect a combination of three factors: first, large BHCs benefit from “operational leverage” or economies of scale, whereby they effectively spread costs over a higher revenue or asset base. Second, “X-efficiency” – a factor closely related to operational leverage – may be higher for large BHCs; that is, these firms may operate closer to the production frontier on average. Third, large BHCs may have greater bargaining power than smaller firms with suppliers or employees. We are not able to pin down with confidence the relative contribution of these three factors.
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We emphasize, however, that the inverse relationship between BHC size and scaled measures of NIE is not limited to particular components of expense or particular segments of the BHC size distribution.

Consistent with recent research that identifies the presence of scale economies in banking, our results suggest that imposing size limits on banking firms would be likely to involve real economic costs. Although the limitations of our econometric methodology must be borne in mind, a back-of-the-envelope calculation applied to our estimates implies that limiting BHC size to be no larger than 4% of GDP would increase total NIE by U.S.$2 billion to U.S.$4 billion per quarter. These costs should be weighed against the potential benefits of size limits as policymakers address the “too-big-to-fail” problem.
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References
Benston, G., 1972, “Economies of scale of financial institutions,” Journal of Money, Credit, and Banking 4, 312-41
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Niepmann, F., 2013, “Banking across borders with heterogeneous banks,” Federal Reserve Bank of New York Staff Reports, no. 609, April
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