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Commercial, industrial, and institutional discount rate estimation for efficiency standards analysis

Sector-level data 1998–2023

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Executive Summary

Underlying each of the U.S. Department of Energy's (DOE's) federal appliance and equipment energy conservation standards are a set of complex analyses of the projected costs and benefits of regulation. Any new or amended standard must be designed to achieve significant additional energy conservation, provided that it is technologically feasible and economically justified (42 U.S.C. 6295(o)(2)(A)). DOE determines economic justification based on whether the benefits exceed the burdens, considering a variety of factors, including the economic impact of the standard on consumers of the product and the savings in lifetime operating cost compared to any increase in price or maintenance expenses (42 U.S.C. 6295(o)(2)(B)).

As part of this determination, DOE conducts a life-cycle cost (LCC) analysis, which models the combined impact of appliance first cost and operating cost changes on a representative commercial building sample to identify the fraction of customers achieving LCC savings or incurring net cost at the considered efficiency levels. Thus, the commercial discount rate value(s) used to calculate the present value of energy cost savings within the LCC model implicitly plays a role in estimating the economic impact of potential standard levels.

This report provides an in-depth discussion of the commercial discount rate estimation process relying on the Capital Asset Pricing Model (CAPM) to estimate a business' cost of equity, and by adding a risk adjustment factor to the risk-free rate associated with long-term U.S. Treasury bonds to estimate their cost of debt. It is an update to previous reports on estimating commercial discount rates from firm-level and sector-level financial data (e.g., Fujita, 2021, 2016). Major topics covered in this report include the following:

- Discount rate estimation methods and rationale
- Data sources used and data limitations
- Discount rate distributions for use in standards analysis
- Discount rate estimation methods and distributions specific to the small business subgroup analysis

A version of this analysis was most recently released in 2023. Going forward, this report will be updated as data allow and analyses necessitate.

1. Introduction

The life-cycle cost (LCC) analysis of the U.S. Department of Energy's (DOE's) appliance and equipment energy conservation standard rulemaking process is used to estimate the combined impact of first cost and operating cost changes in a representative commercial building sample that could result from implementation of the rule. The LCC analysis identifies the fraction of consumers achieving LCC savings or incurring net cost, in monetary terms, at the considered efficiency levels.[1] The commercial discount rate is the rate at which future operating costs are discounted to establish their present value in the LCC analysis. The discount rate value is applied in the LCC to future year energy costs and non-energy operations and maintenance costs to calculate the estimated net LCC of products of various efficiency levels, and LCC savings as compared to the baseline for a representative sample of commercial end users. Thus, the commercial discount rate value(s) used to calculate the present value of energy cost savings within the LCC model implicitly plays a role in estimating the economic impact of potential standard levels.

The DOE's LCC analysis estimation method models the purchase of a higher efficiency appliance as an investment that yields a stream of value in the form of future energy cost savings. We derived the discount rates for the LCC analysis by estimating the cost of capital for companies in sectors that purchase appliances and energy-consuming equipment. The weighted average cost of capital (WACC) is commonly used to estimate the present value of cash flows to be derived from a typical company project or investment (Jacobs and Shivdasani, 2012). Because a given capital investment must generate at least as much value as the cost of purchasing it in order for that investment to be sound, the cost of capital approximates the relevant rate of return for businesses on future energy cost savings. For this reason, we use WACC synonymously with "discount rate."

Most companies use both debt and equity capital to fund investments, so their cost of capital is the weighted average of the cost to the firm of equity and debt financing, as estimated from financial data for publicly traded firms in a given sector.

$$WACC_{it} = k_{eit} \times w_{eit} + k_{dit} \times w_{dit}$$

Where:

$WACC_{it}$ = weighted average cost of capital for industry *i* in year *t*,
k_{eit} = cost of equity of industry *i* in year *t,*
w_{eit}= proportion of equity financing for industry *i* in year *t,*
k_{dit} = cost of debt of industry *i* in year *t,* and
w_{dit} = proportion of debt financing for industry *i* in year *t*.

We rely on the Capital Asset Pricing Model (CAPM) to estimate costs of equity (Markowitz, 1952; Modigliani and Miller, 1958). We add a risk adjustment factor to the risk-free rate associated with long-term U.S. Treasury bonds to estimate their cost of debt. We estimate

[1] For more information on the standard-setting process, please see one of the Technical Support Documents provided by DOE: https://www.energy.gov/eere/buildings/standards-and-test-procedures (last accessed March 2024).

the WACC of the following broad sectors: Education, Food Sales, Food Service, Health Care, Lodging, Mercantile, Office, Public Assembly, Service, All Commercial, Industrial, Agriculture, Federal Government, State/Local Government.

The structure of this report is as follows. The remaining subsections of the introduction provide an overview of discounting in the LCC model and a brief review of the CAPM model as described in the literature. Section 2 discusses the data sources and analytical methods used in the analysis. Section 3 presents summary results for the standard LCC analysis. Section 4 provides a brief discussion of findings. Two appendices are also provided: Appendix A provides additional information on the data sources used in the analysis; Appendix B includes the full discount rate distributions by sector as used in the LCC model.

1.1 Discounting in the Life-Cycle Cost Model

The LCC model is used to project how many and what type of businesses are likely to monetarily gain, incur a net cost, or face no net impact under a proposed standard, based on a representative building sample, typically drawn from the Commercial Building Energy Consumption Survey (CBECS) or developed using other nationally representative data for relevant sectors. A proposed standard will have differential impacts on businesses depending on many factors, including: the size and type of commercial building, intensity of product use, building age, and weatherization. A proposed standard may impact the net present value (NPV) of appliance purchases via two primary factors: the first cost of equipment and the cost of equipment use over time.

At the individual commercial building level, the LCC model addresses the question: assuming that an appliance of the proposed efficiency level is installed, what is the net monetary impact of a proposed standard on the building's resident business(es)? The commercial discount rate applied in the LCC analysis is used to estimate the value of future energy cost savings to businesses, predicated on the installation of a product of a given efficiency level.[2] It is applied to future-year energy costs and non-energy operations and maintenance costs to calculate the net present value of the appliance to a business at the time of installation. Because the time of installation defines the beginning of the analysis period, total installed cost is not discounted.

It is important to note that unlike the shipments model of the national impact analysis (NIA), the LCC analysis does not model a commercial consumer's purchase decision, so implicit discount rates are inappropriate for use in this stage of analysis. In the context of the LCC analysis, many contributing components of the implicit discount rate (e.g., transaction costs) are not relevant, as they are likely to influence a consumer's decision whether or not to purchase an appliance, but in the LCC analysis, these factors are operationally sunk costs, which are rationally excluded from calculations valuing future costs and benefits associated with the appliance or equipment. This leaves the firm's required return on investment, as defined by weighted average cost of capital, which incorporates the Capital Asset Pricing Model

[2] Note that this is a simplified description of the LCC analytical process for the ease of discussing the concept of discounting. For a more detailed discussion of the LCC model, its inputs and assumptions, and the use of the building sample to estimate savings, please see the Technical Support Document for a recent rulemaking: https://www.energy.gov/eere/buildings/appliance-and-equipment-standards-program (last accessed March 2024).

(CAPM).

2. Methods

2.1 Data Sources

Damodaran Online, the primary source of data for this analysis, is a widely used source of information about company debt and equity financing for most types of firms (Damodaran, 2024a). These datasets provide numerous annual financial details (e.g., β coefficient, standard deviation in stock, total debt, tax rate) for approximately 5,000–6,000 companies across a variety of industries. In this updated analysis, we use Damodaran Online data covering the period of 1998–2021; as each annual dataset includes approximately 80 to 100 industries, the final dataset comprises close to 2,500 observations. Appendix A.1 provides additional information on the use of these data sources to map Damodaran Online data to the building samples used in the efficiency standards analysis.

For the small business subgroup analysis, several additional data sources are used including: *Stocks, Bonds, Bills, and Inflation Valuation Yearbook, 1999–2017,* online "Cost of Capital Navigator" system (Duff & Phelps, 2024; Ibbotson, 2018a). More information on the use of these data sources and the process for mapping them to small businesses in the LCC building sample is included in Section 3.5 and Appendix A.2.

2.2 Analytical Methodology

Our methodology for estimating commercial discount rates models the purchase of a higher efficiency appliance as an investment that yields returns in the form of a stream of energy cost savings; this framing fits with the intent and methodology of the LCC analysis in which it is subsequently applied. When estimating the net present value of any investment, the discount rate represents the opportunity cost, over the life of the investment, of selecting that particular investment over other available options. The discount rate is used to calculate the value, in today's dollars, of all future year earnings (i.e., energy cost savings) and expenses (i.e., maintenance costs) associated with the purchase of an appliance of a specific efficiency level. This allows for the comparison of costs over product lifetimes between Trial Standard Levels (TSLs) of different efficiency.

Following this rationale, the commercial discount rate is estimated as the weighted average cost of capital (WACC), computed from an industry's average cost of equity (i.e., interest paid to holders of equity) and average cost of debt (i.e., expected interest rate on debt), weighted by the industry's average ratio of debt to equity, as recorded in the Damodaran Online

datasets for industry subsectors over the period of 1998–2023.[3] We tabulate binned distributions of WACC for the broad sectors defined in Table 1 by aggregating the computed WACC for each of the relevant subsectors across the 24 years of data, giving equal weight to each combination of subsector and year.

2.2.1 Cost of Equity

We estimate cost of equity using CAPM (see, e.g., Ibbotson Associates, 2009).[4] CAPM assumes that the cost of equity (k_e) for a particular company is proportional to the systematic risk faced by that company, where high risk is associated with a high cost of equity and low risk is associated with a low cost of equity. The risk facing a firm is in turn determined by several variables: the risk coefficient of the firm (β_i), the expected return on risk-free assets (R_f), and the equity risk premium (ERP). The cost of equity can be estimated at the industry level by averaging across constituent firms.

We define the expected return on risk-free assets (R_f) as the yield on long-term U.S. Treasury bonds. Treasury bonds meet three key criteria of an ideal risk-free asset: (1) investors generally perceive Treasury bonds to carry little to no risk, (2) the time horizons of Treasury bonds are compatible with the time frame of standards analysis and the expected longevity of regulated equipment, and (3) Treasury bonds are an appropriate measure for assets that produce a stream of payoffs (i.e., monthly or annual energy cost savings), rather than a lump sum payment at the end of a lengthy term (Ibbotson Associates, 2009).

The ERP and β coefficient are intended to capture the impact of undertaking systematic risk on an investment's expected payoff. The ERP is a measure of the additional return an investor expects to receive, on average, in compensation for investing in equities rather than risk-free assets. In other words, it represents the difference between the expected stock market return and the risk-free rate (Ibbotson Associates, 2009). The β coefficient of a firm or industry indicates the risk associated with that particular firm or industry relative to the price variability in the stock market. In our analysis, annual industry-level β coefficient values are taken from

[3] We note that depending on the level of detail of available data, this calculation can be performed for individual firms or entire sectors. Previously, we estimated the commercial discount rate as the weighted average cost of capital, computed from each *firm's* cost of equity (i.e., expected interest rate on equity) and cost of debt (i.e., expected interest rate on debt), weighted by the *firm's* ratio of debt to equity, as recorded in the Damodaran Online dataset. We then aggregated firms by matching to CBECS Principal Building Activities. As firm-level data are no longer available from this source, we now follow the same rationale, but use the fairly detailed industry subsector data provided by Damodaran Online and aggregate industries across years into CBECS PBAs (Cost of Capital by Industry Sector: http://pages.stern.nyu.edu/~adamodar/ [accessed February 2024]).

[4] Variants of what is now known as CAPM were developed in the 1960s by several independent researchers (Lintner, 1965; Mossin, 1966; Sharpe, 1964; Treynor, 1999). Modigliani and Miller (1958) state the basic problem as follows: "What is the 'cost of capital' to a firm in a world in which funds are used to acquire assets whose yields are uncertain; and in which capital can be obtained by many different media, ranging from pure debt instruments...to pure equity issues?" Though differing somewhat in terminology, framing, and intent, the models of Lintner, Treynor, and others were eventually demonstrated to be consistent with one another (Stone, 1970). French (2003), Perold (2004), and Sullivan (2006) provide thorough discussions of the history of CAPM as defined by these four researchers.

Damodaran Online data archives.[5]

We estimate the cost of equity financing using the following equation, where the variables are defined as described above: [6]

$$k_{eit} = R_{ft} + \beta_{it} \times ERP_t$$

Where:
k_{eit} = cost of equity of industry *i* in year *t*,
R_{ft} = expected return on risk-free assets,
β_{it} = risk coefficient of industry *i* in year *t*, and
ERP_t = equity risk premium in year *t*.

We recognize that CAPM is a simple model used to represent a complex valuation process that varies from investor to investor and firm to firm. While potentially less accurate than more detailed models such as arbitrage pricing, multifactor, or discounted cash flow, CAPM benefits from widespread familiarity and its comparatively simple data requirements. All potential substitute models and methodologies come with their own assortment of theoretical and practical weaknesses (i.e., assumptions and data requirements). [7]

Several parameters of the cost of capital equations can vary substantially over time, and therefore the estimates can vary with the time period over which data are selected and the technical details of the data-averaging method. For guidance on the averaging method and the time period for selecting data, we used Federal Reserve methodologies. In its use of CAPM, the Federal Reserve uses a 40-year period for calculating averages, utilizes the gross domestic product (GDP) price deflator for estimating inflation, and considers the best method for determining the risk-free rate as one where the time horizon of the investor is matched with the term of the risk-free security (Board of Governors of the Federal Reserve System, 2005).

Risk-free rates for 1998–2021, presented in Table 2, are estimated by taking a 40-year geometric average of Federal Reserve data on annual nominal returns for 10-year Treasury bonds (Damodaran, 2024b). The ERP is calculated as the difference between the risk-free rate and stock market return for the same time period; we use Damodaran Online historical stock return data to calculate the ERP for the 1998-2021 time period(Damodaran, 2024b).[8]

[5] Archived Data: Cost of Capital by Industry Sector: http://pages.stern.nyu.edu/~adamodar/ (accessed February 2024).
[6] Note that CAPM can be modified to account for systematic differences in the cost of equity relating to company size as estimated via market capitalization, described to follow.
[7] For an informal yet in-depth discussion and critique of CAPM and its alternatives in discount rate estimation, see New York University's Aswath Damodaran's blog series on the topic (Damodaran, 2011).
[8] Note that annual returns to investments are not independent from each other, and thus the geometric average is more informative than the arithmetic average.

Table 1. Risk-Free Rate and Equity Risk Premium, 1998-2023

Year	Risk-Free Rate (%)	ERP (%)	Year	Risk-Free Rate (%)	ERP (%)
1998	7.15	4.76	2011	7.80	1.75
1999	6.62	5.83	2012	7.78	2.62
2000	6.98	4.52	2013	7.46	4.59
2001	6.98	4.42	2014	7.65	3.86
2002	7.32	2.80	2015	7.27	3.67
2003	7.23	3.16	2016	7.26	4.21
2004	7.33	3.02	2017	7.36	4.49
2005	7.33	3.45	2018	7.34	3.90
2006	7.43	3.16	2019	7.67	3.55
2007	7.61	2.84	2020	7.75	4.08
2008	8.25	1.15	2021	6.85	5.17
2009	7.50	2.46	2022	6.20	4.70
2010	7.47	2.51	2023	5.98	5.39

2.2.2 Cost of Debt

The cost of debt financing (k_d) represents the interest rate a firm pays to borrow money. The cost of debt for a given firm is estimated by adding a risk adjustment factor (R_a) to the risk-free rate associated with long-term U.S. Treasury bonds (R_f) described in the previous section. The risk adjustment factor depends on the variability of stock returns represented by standard deviations in a firm's stock prices (Damodaran, 2024a).[9] We note that this same calculation can alternatively be performed with industry-level data. Tax rates also affect the cost of debt financing. Using industry average tax rates provided by Damodaran Online, we incorporate the after-tax cost of debt into WACC calculations. For industry *i,* the cost of debt financing is:

$$k_{dit} = \left(R_{ft} + R_{ait}\right) \times (1 - tx_{it})$$

Where:

k_{dit} = (after-tax) cost of debt of industry *i* in year *t*,
R_{ft} = expected return on risk-free assets in year *t*,
tx_{it} = tax rate of industry *i* in year *t*, and
R_{ait} = risk adjustment factor for industry *i* in year *t*.

After estimating the cost of equity and cost of debt for each industry subsector in each year of the dataset, we calculate the WACC by industry subsector by year using the equation detailed above, in the introduction. We account for inflation using the all-items GDP deflator,

[9] Damodaran Online's archived cost of capital by industry datasets each include a table with risk adjustment factors appropriate for seven bins of standard deviation in stock price, ranging from 0% to greater than 100%. Risk adjustment factors vary by year.

averaged over a 40-year time period to align with the time period over which risk-free rates are calculated (Federal Reserve Bank of St. Louis, 2023). In Appendix B-1, we present the annual real weighted average costs of capital by subsector as binned discount rate distributions for each of the aggregate sectors listed in Section 1.

2.3 The Case of Publicly Owned Buildings

We use a distribution of bond rates to represent the discount rates for publicly owned buildings; state and local bond rates are applicable to state or local facilities, such as public schools, while federal rates are applicable to federal facilities, such as federal agency buildings (Table 4). The weighted average discount rate for federal and state/local public sector buildings, respectively is calculated from the most recent 35 years of bond data, giving equal weight to each quarter, year, or month (state and local 20-year maturity bonds and federal 10-year Treasury bonds, respectively).[10,11] Discount rate distributions appropriate to government-owned buildings are compiled from time series of bond rates (also provided in Appendix B-1).

2.4 Subgroup Analysis: Small Businesses

The LCC subgroup analysis is included in the efficiency standard analysis process to determine if there are any specific groups of consumers who may be disproportionately affected by the proposed standard. In the case of commercial appliances and equipment, small businesses are one of the most common subgroups analyzed.

Even after accounting for systematic risk through the β coefficient, CAPM underestimates the cost of equity for small firms. Characteristics of smaller firms (e.g., greater risk of market loss to competitors, fewer resources to adjust to economic shocks) generally lead investors to expect a higher rate of return when investing in small companies as compared to large companies (Grabowski, 2018). This phenomenon is known as the *size effect* (see, e.g., Fama and French, 1992; Ibbotson Associates, 2009). To account for the size effect, a size premium can be incorporated into the CAPM equation to provide an alternative estimate of the small company cost of equity, and thus, the weighted average cost of capital specific to small businesses.[12] The size effect is most pronounced for the smallest firms, in terms of market capitalization. To provide a conservative estimate of the value of discounted future energy cost savings, we focus on the size effect of "microcap" companies (i.e., companies within the smallest two deciles of the overall market as measured by market capitalization).

The additional return associated with the size effect can be accounted for by adding a

[10] Office of Management and Budget Circular A-94 Appendix C, https://obamawhitehouse.archives.gov/sites/default/files/omb/assets/a94/dischist-2016.pdf.

[11] Federal Reserve Bank of St. Louis, Federal Reserve Economic Data (https://fred.stlouisfed.org) state and local bond rate data series was discontinued in 2016. Later years of data were acquired from Bartel Associates, LLC (https://bartel-associates.com/resources/select-gasb-67-68-discount-rate-indices).

[12] Note that this section describes the process of estimating small company discount rates by sector. The process of mapping these rates to the appropriate items of the LCC model building sample is provided separately in Appendix B.

size premium (*S*) to the CAPM calculation of the industry-level cost of equity for small firms:

$$k_{eit} = R_{ft} + \beta_{it} \times ERP_t + S_t$$

Where:

k_{eit} = small business cost of equity of industry *i* in year *t*,
R_{ft} = expected return on risk-free assets in year *t*,
β_{it} = risk coefficient of industry *i* in year *t*,
ERP_t = equity risk premium in year *t*, and
S_t = size premium in year *t*.

The WACC is then estimated for each industry subsector as in Section 3.3, substituting the cost of equity including size premium for the standard CAPM cost of equity. After adjusting for the size premium, the WACC continues to be defined as a share-weighted average of the cost of debt and cost of equity for each subsector. For details on process used to map the data sources mentioned above in Sec. 2.1.2 to small businesses within the LCC building sample, see Appendix A.2.

3. Results

The following section presents the mean discount rates for the sectors we analyzed. Table 2 shows the mean WACC values for the aggregated sectors to be mapped to building samples in LCC analyses. While Table 3 provides mean values, it is important to note that firm-level and subsector-level WACC within a sector are not necessarily normally distributed; thus, we suggest using binned versions of the full distributions in subsequent analysis, rather than trying to fit coefficients of a specific distribution form. In Table 2, each observation represents an annual value for a subsector; the specific subsectors included in the dataset vary by year. "Total firms" is the sum of firms included in all subsectors in all years; the number of firms per subsector included in the dataset varies by year. While WACC values for any sector may trend higher or lower over substantial periods of time, the values presented here represent a cost of capital that is averaged over major business cycles.

Table 2. Mean WACC by Sector

Sector	Observations	Total Firms	Mean WACC (%)
Education	26	900	**7.28**
Food Sales	48	951	**5.68**
Food Service	26	2,044	**6.64**
Health Care	63	6,302	**7.04**
Lodging	26	1,822	**6.63**
Mercantile	114	6,164	**7.09**
Office	515	52,379	**6.86**
Public Assembly	52	4,186	**7.31**
Service	171	16,899	**6.21**
All Commercial	1,055	91,805	**6.77**
Industrial	1,454	87,719	**7.32**
Agriculture	11	387	**7.17**
Utilities	109	2,193	**4.20**
REIT/Property	63	5,153	**6.55**

Table 3 presents estimates of the discount rates for each sector, the small company discount rate, and the small company discount rate premium (i.e. the difference between the two). Note that size premia are not relevant to state, local, or federal operations, so a small company discount rate is not calculated for public sectors . LCC analysis using the distributions of small company discount rates for each sector suggests that relying only on the original CAPM model (without size premium) would lead to underestimation of discount rates for small companies by approximately 2%–4%, depending on the sector. Table 4 presents discount rates for government entities.

Table 3. Comparison of Small Business and Full Commercial Sample: WACC by Sector

Sector	All Company WACC (%)	Small Company WACC (%)	Small Company DR Premium (%)
Education	7.28	10.44	3.16
Food Sales	5.68	8.20	2.52
Food Service	6.64	9.56	2.92
Health Care	7.04	9.88	2.84
Lodging	6.63	8.95	2.32
Mercantile	7.09	9.93	2.84
Office	6.86	9.57	2.71
Public Assembly	7.31	10.09	2.78
Service	6.21	8.37	2.16
All Commercial	6.77	9.40	2.63
Industrial	7.32	10.21	2.89
Agriculture	7.17	9.60	2.44
Utilities	4.20	6.23	2.03
REIT/Property	6.55	8.87	2.32

Table 4. Weighted Average Cost of Capital by Government Sector

Building owner	Observations	WACC (%)
State/Local	141 quarters	2.44
Federal	420 months	2.02

4. Discussion

We derive discount rate distributions by aggregate industry sector for use in LCC analyses by calculating the weighted average cost of capital using CAPM. Using this method, we find that average discount rates by sector range from approximately 6%–7% over the analysis period, with discount rates appropriate to government buildings in the range of 2%–3%. We note that for most sectors, rates do not fit a normal distribution, so we provide entire distributions in terms of probability weights for bins of 1% increments (see Appendix B.1). By adjusting CAPM with a size premium, we derive separate discount rate distributions specific to small businesses within each sector, generally in the range of 8%–10% (see Appendix B.2).

Along with distributions for aggregate sectors (e.g., Office, Mercantile), we provide discount rate distributions for two specific industries that have been required in previous energy conservation standards analyses: (1) real estate investment trust (REIT) and property management and (2) investor-owned utilities. Future updates to this report may add

distributions for other specific sectors, depending on anticipated requirements for LCC analyses.

Previous versions of the Damodaran Online data, a key source for our analysis, were disaggregated to the level of individual companies, rather than industry subsectors. While the current subsector data are sufficient to map to a building sample defined by CBECS PBAs, company-level data have the benefit of greater flexibility in matching end use sectors that purchase specific types of energy-consuming equipment. Additionally, previous company-level data included each firm's market capitalization, a metric used to define firm size, and thus to assign an appropriate size premium. For these reasons, we aim to analyze company-level data in future updates to this report, if such data become available. In any updates to this report, we will incorporate newly released market data into the discount rate distributions.

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Appendix A. Additional Information on Data Sources

A.1 Data Sources for Analysis of All Businesses

This section provides additional information about the data sources used to estimate commercial discount rates, via a weighted average cost of capital incorporating the CAPM model, as described in detail in Section 2.

As of 2014, Damodaran Online data are now provided at the level of industries, rather than individual companies.[13] To streamline the application of Damodaran Online data to the building samples used in the efficiency standards analysis, detailed industry subsectors included in the datasets were assigned to the following aggregate sector categories that can be readily mapped to CBECS Principal Building Activities (PBAs): Education, Food Sales, Food Service, Health Care, Lodging, Mercantile, Office, Public Assembly, and Service.[14] Each of the detailed industry subsectors was also assigned to the best-matching Standard Industrial Classification (SIC) code in case a discount rate needs to be calculated for a specific sector in the future.[15] We also include an "All Commercial" sector, as represented by all firms in all commercial subsectors, for cases in which there is not a direct match between the buildings modeled in the LCC analysis and the aggregate sector categories defined above.[16] Though not included in CBECS, Damodaran Online data also includes manufacturing, utilities, and similar industries that are aggregated into the Industrial sector, as well as data on the Agricultural sector (Table A-1).

For each appliance and equipment efficiency standard under consideration, the discount rate distributions by PBA can be mapped to the building sample specific to the product. By product, the overall weighted average commercial discount rate will differ across sectors due to variation in the concentrations of types of appliances and equipment used.

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[13] Note that individual company data were available for download from Damodaran Online through early 2014, but can no longer be accessed. Damodaran Online now only provides aggregated sector-level data.

[14] EIA. 2018 Commercial Buildings Energy Consumption Survey building characteristics results. https://www.eia.gov/consumption/commercial/ (accessed March 2024).

[15] SEC. Division of Corporation Finance: Standard Industrial Classification (SIC) Code List. https://www.sec.gov/info/edgar/siccodes.htm (accessed March 2024).

[16] CBECS and Damodaran Online sector categories were mapped via NAICS and SIC codes. In response to frequently asked questions regarding CBECS, the Energy Information Administration provides a recommended mapping of its PBA codes to NAICS (https://www.eia.gov/consumption/commercial/faq.cfm#q8). Note that because CBECS PBAs are assigned based on the main activity that takes place in a building, this mapping to sectors will inevitably be imperfect. For example, a company categorized as sector 424: Nondurables Wholesalers could conceivably be mapped to three CBECS PBAs: Food Sales, Office, and Warehouse. In such cases, we rely on EIA's determination of most likely matches, as mapped in their PBA to NAICS crosswalk. Because Damodaran Online provides sectors by SIC code, while PBAs are mapped to NAICS by EIA, it was necessary to compare NAICS and SIC to bridge between SIC and PBA (SIC: https://www.osha.gov/data/sic-search; NAICS: https://www.census.gov/naics/) (all links last accessed March 2023).

Table A-1. Mapping of Sectors to CBEC Categories

Sector Name in DR Analysis	Applied to CBECS PBAs (Name and PBA number)
Education	Education (14)
Food Sales	Food Sales (6)
Food Service	Food Service (15)
Health Care	Outpatient Health Care (8); Inpatient Health Care (16); Nursing (17); Laboratory (4)
Lodging	Lodging (18)
Mercantile	Enclosed Mall (24); Strip Shopping Mall (23); Retail Other Than Mall (25)
Office	Office (2)
Public Assembly	Public Assembly (13)
Service	Service (26)
All Commercial	Any CBECS PBA
Industrial	Not in CBECS
Agriculture	Not in CBECS
Federal Government	Not in CBECS
State/Local Government	Not in CBECS

Note: CBECS only includes buildings used by firms in "commercial" sectors, so Industrial, Agriculture, Federal Government, and State/Local Government have no associated PBA identifier. However, discount rate distributions are required for these sectors because they are significant consumers of some types of appliances and energy-consuming equipment.

It is important to note that some sectors cannot be addressed with Damodaran Online data, which only includes information on publicly traded companies. Commercial companies that are privately held are represented using their publicly traded sectoral counterparts as proxies. Publicly owned buildings, such as state-owned schools or offices owned and operated by a federal agency, must be addressed separately. Government buildings are assigned a discount rate from a distribution of state and local or federal bond rates, as appropriate. For publicly owned and operated buildings, the real interest rates on 20-year state and local bonds or U.S. Treasury bonds are applied (Bartel Associates, LLC, 2022; Federal Reserve Bank of Saint Louis, 2021).

Table A-2, below provides additional information on the mapping of sectors from Damodaran Online datasets to aggregate CBECS sectors.

Table A-2. Assignment of Detailed Data to Sectors for Discount Rate Analysis

Aggregate Sector for CBECS Mapping	Detailed Sector Names as Provided in Damodaran Online Data Sets (1998–2022)
Education	Education; Educational Services
Food Sales	Food Wholesalers; Grocery; Retail (Grocery and Food); Retail/Wholesale Food
Food Service	Restaurant; Restaurant/Dining
Health Care	Healthcare Facilities; Healthcare Information; Healthcare Services; Healthcare Support Services; Healthcare Information and Technology; Hospitals/Healthcare Facilities; Medical Services
Lodging	Hotel/Gaming
Mercantile	Drugstore; Retail (Automotive); Retail (Building Supply); Retail (Distributors); Retail (General); Retail (Hardlines); Retail (Softlines); Retail (Special Lines); Retail Automotive; Retail Building Supply; Retail Store
Office	Advertising; Bank; Bank (Canadian); Bank (Midwest); Bank (Money Center); Banks (Regional); Broadcasting; Brokerage & Investment Banking; Business & Consumer Services; Cable TV; Computer Services; Computer Software; Computer Software/Svcs; Diversified; Diversified Co.; E-Commerce; Human Resources; Insurance (General); Insurance (Life); Insurance (Prop/Cas.); Internet; Investment Co.; Investment Co.(Foreign); Investment Companies; Investments & Asset Management; Property Management; Public/Private Equity; R.E.I.T.; Real Estate (Development); Real Estate (General/Diversified); Real Estate (Operations & Services); Reinsurance; Retail (Internet); Retail (Online); Securities Brokerage; Software (Entertainment); Software (Internet); Software (System & Application); Telecom. Utility; Thrift
Public Assembly	Entertainment; Recreation
Service	Financial Svcs.; Financial Svcs. (Div.); Financial Svcs. (Non-bank & Insurance); Foreign Telecom.; Funeral Services; Industrial Services; Information Services; Internet software and services; IT Services; Office Equip/Supplies; Office Equipment & Services; Oilfield Svcs/Equip.; Pharmacy Services; Telecom. Services
All Commercial	All detailed sectors included in: Education, Food Sales, Food Service, Health Care, Mercantile, Office, Public Assembly, Service
Industrial	Aerospace/Defense; Air Transport; Aluminum; Apparel; Auto & Truck; Auto Parts; Auto Parts (OEM); Auto Parts (Replacement); Automotive; Beverage; Beverage (Alcoholic); Beverage (Soft); Biotechnology; Building Materials; Cement & Aggregates; Chemical (Basic); Chemical (Diversified); Chemical (Specialty); Coal; Coal & Related Energy; Computers/Peripherals; Construction; Construction Supplies; Copper; Drug; Drugs (Biotechnology); Drugs (Pharmaceutical); Electric Util. (Central); Electric Utility (East); Electric Utility (West); Electrical Equipment; Electronics; Electronics (Consumer & Office); Electronics (General); Engineering; Engineering & Const; Engineering/Construction; Entertainment Tech; Environmental; Environmental & Waste Services; Food Processing; Foreign Electronics; Furn/Home Furnishings; Gold/Silver Mining; Green & Renewable Energy; Healthcare Equipment; Healthcare Products; Heavy Construction; Heavy Truck & Equip; Heavy Truck/Equip Makers; Home Appliance; Homebuilding; Household Products; Machinery; Manuf. Housing/RV; Maritime; Med Supp Invasive; Med Supp Non-Invasive; Medical Supplies; Metal Fabricating; Metals & Mining; Metals & Mining (Div.); Natural Gas (Div.); Natural Gas Utility; Newspaper; Oil/Gas (Integrated); Oil/Gas (Production and Exploration); Oil/Gas Distribution; Packaging & Container; Paper/Forest Products; Petroleum (Integrated); Petroleum (Producing); Pharma & Drugs; Pipeline MLPs; Power; Precious Metals; Precision Instrument; Publishing; Publishing & Newspapers; Railroad; Rubber& Tires; Semiconductor; Semiconductor Equip; Shipbuilding & Marine; Shoe; Steel; Steel (General); Steel (Integrated); Telecom (Wireless); Telecom. Equipment; Textile; Tire & Rubber; Tobacco; Toiletries/Cosmetics; Transportation; Transportation (Railroads); Trucking; Utility (Foreign); Utility (General); Utility (Water); Water Utility; Wireless Networking
Agriculture	Farming/Agriculture
Utilities	Natural Gas Utility; Utility (Foreign); Utility (General); Utility (Water); Water Utility
REIT / Property	Property Management; REIT; Real Estate (Development); Real Estate (General/Diversified); Real Estate (Operations & Services)

A.2 Mapping to Small Businesses in the LCC Building Sample

For the small business subgroup analysis, size premia for microcap companies are obtained from the *Stocks, Bonds, Bills, and Inflation Valuation Yearbook, 1999–2017* (Ibbotson Associates, 2015, e.g., 2001; Ibbotson, 2018b). For 2018–2020, size premium data were extracted from the Duff & Phelps online "Cost of Capital Navigator" system (Duff & Phelps, 2021). For 2021 and 2022, the size premium was extracted from the Kroll "Cost of Capital Navigator" (Kroll, 2023).[17] Using the above-modified CAPM equation, size premia are combined with Damodaran Online data to calculate revised WACC distributions by sector that are specifically relevant to small businesses. Within the firm-level data previously available from Damodaran Online, small companies could be identified by their market capitalization; now that only sector-level data are available, we apply the size premia to the sector average values. Size premia and the definition of small companies can vary over time, as shown in Table A-3, which includes market capitalization deciles 9 and 10 for each year of the dataset.

Table A-3. Size Premia and Decile Definitions

Year	Market Cap. of Largest Firm (Decile 10, $million)	Market Cap. of Largest Firm (Decile 9, $million)	Size Premium (Deciles 9,10 Microcap , %)
1998	--	252.0	2.60
1999	97.9	214.6	2.21
2000	84.5	192.6	2.62
2001	141.5	314.0	3.53
2002	166.4	330.6	4.01
2003	262.7	505.4	4.02
2004	264.9	586.4	3.95
2005	314.4	626.9	3.88
2006	363.5	723.3	3.65
2007	218.5	456.3	3.74
2008	214.1	431.3	3.99
2009	235.6	477.5	4.07
2010	206.8	422.8	3.89
2011	253.8	514.2	3.81
2012	253.7	514.2	3.81
2013	338.8	632.8	3.84
2014	300.7	548.8	3.74
2015	--	--	3.58
2016	--	--	3.67
2017	--	--	5.40
2018	--	--	3.39
2019	--	--	3.16
2020	189.8	451.8	3.21
2021	289.0	627.8	3.02
2022	289.0	627.8	4.80
2023	212.6	554.5	2.91

[17] Note that the source of size premium data is effectively the same for all time periods, but ownership of the company producing the data product has changed multiple times.

To evaluate the LCC implications of higher small business discount rates, an alternative analysis can be conducted as if all buildings in the sample are small businesses or if buildings likely to contain small businesses can be identified from the LCC model building sample. To identify such buildings, Small Business Administration (SBA) size standards are used to define which business entities are 'small' (13 C.F.R. §121.201 2018). The SBA establishes size standards for types of economic activity, or industry, under the North American Industry Classification System (NAICS). The SBA defines a small business by either its annual receipts (i.e., revenues) or, rarely, its number of employees. Definitions are provided at the six-digit NAICS code level (i.e., highly detailed subsectors), and demonstrate some degree of variability within aggregate sectors as we have defined them for our discount rates analysis (Table A-4).

Table A-4. Sizes of Small Businesses by Sector (Aggregation of SBA Data)

Sector	Average Limit of Size		Range	
	2018 $mil	# of employees	2018 $mil	# of employees
Education	18.8	--	9 to 34.5	
Food Sales	18	184	9 to 40	100 to 250
Food Service	19.4	--	9 to 47	--
Health Care	24	--	9 to 47	--
Lodging	18.7	--	9 to 47	--
Mercantile	30	170	9 to 47	100 to 250
Office	39.4	1,160	11 to 47	900 to 1,500
Public Assembly	25	--	9 to 47	--
Service	21.1	1,130	8 to 47	1,000 to 1,500
All Com	23.8	661	8 to 47	100 to 1,500
Agriculture	5.8	--	2.25 to 34	--
Industrial	31.5	940	9 to 47	500 to 1,500
REIT/Property	23.6	--	9.5 to 34	--
Utilities	35.3	523	30 to 41	250 to 1,150

The LCC model building sample is typically drawn from the Commercial Building Energy Consumption Survey (CBECS), which provides the number of workers employed but not the annual revenues for each of the records in its building sample. Thus, for most sectors, we need to correlate annual revenues with the number of workers to identify the records in the building sample that potentially represent small businesses. Because some individual CBECS building records could represent businesses that are part of much larger firms, the small business subgroup identified in this way may overrepresent the actual number of small businesses. However, given that average firm-level impacts are of primary interest, the results from the analysis provide an adequate indication of whether the small business subgroup would disproportionally gain or experience a net cost under a proposed standard.

In previous appliance and equipment energy conservation standards analysis, industries occupying the following CBECS building types have been considered in the small business subgroup: public assembly, health care, lodging, food services, office, and mercantile.

In the following analysis, we provide estimates of number of employees per firm to define small businesses for each aggregate sector in case they are required for future analyses.

The Establishment and Firm Size data series from the U.S. Census Bureau 2017 Economic Census were used to define the relationship between annual revenues and the number of workers for each of the relevant business activities.[18] The Census data series provide annual receipts, the number of paid employees, and the number of establishments by categories of establishments. Establishments are binned into different 'categories' holding a range of annual receipts (e.g., establishments with receipts of $1 million to less than $2.5 million) or a range of employees (e.g., establishments with 50-99 employees). Within each establishment category, an average value for annual receipts was determined by dividing the annual receipts by the number of establishments. Similar calculations produce an average number of paid employees for each establishment category. By deriving the average revenues and numbers of employees for the establishment categories within each of our aggregate sectors, we estimate the relationship between sales (revenues) and number of employees for buildings in these sectors via simple linear regression. The parameters of the linear trendlines of Figure A-1 through Figure A-11 were then used to estimate small business definitions in terms of number of employees from the SBA size definitions in terms of revenue.

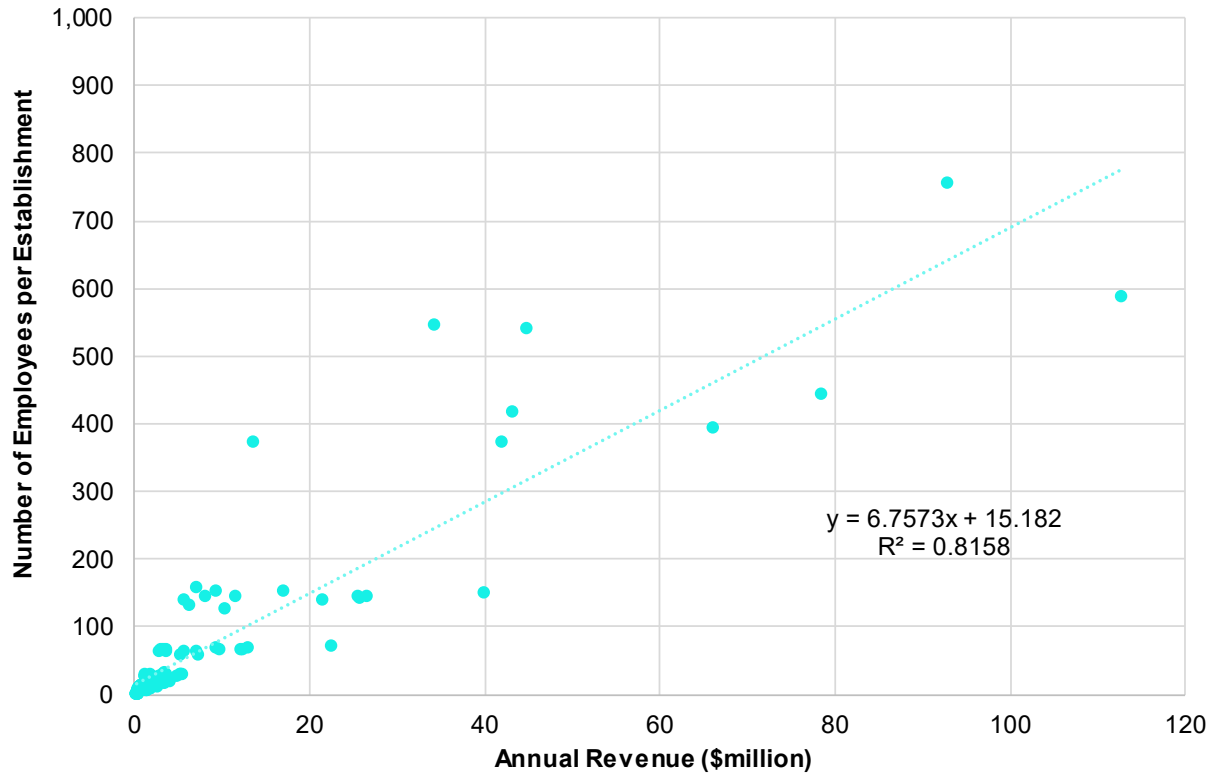

Figure A-1. Education: Relationship between Number of Employees and Value of Sales

[18] https://www2.census.gov/programs-surveys/economic-census/data/2017 (Accessed April 2024).

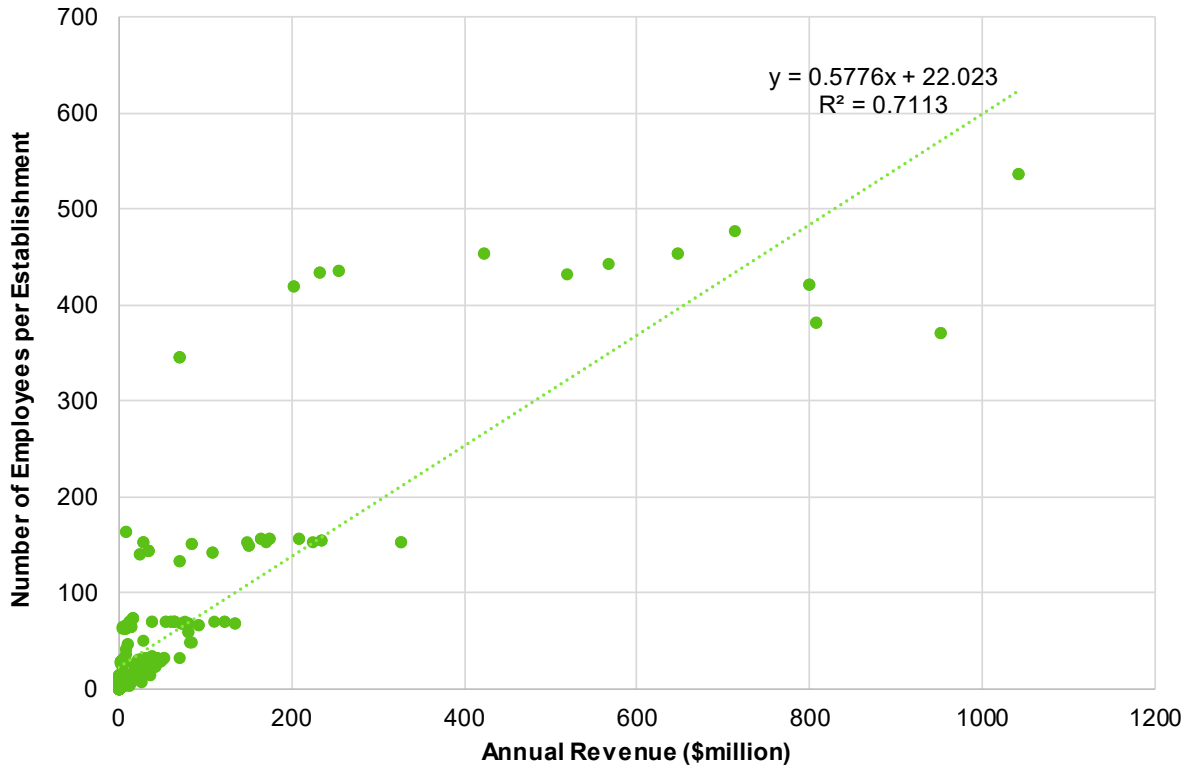

Figure A-2. Food Sales: Relationship between Number of Employees and Value of Sales

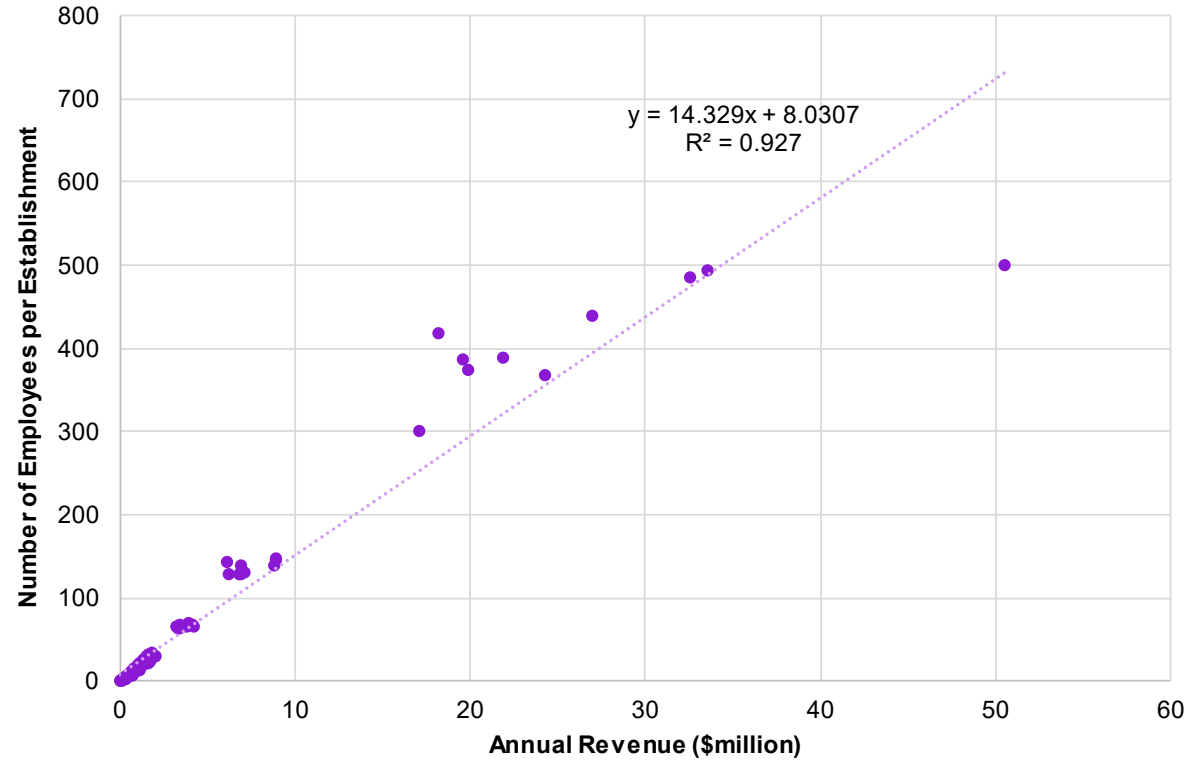

Figure A-3. Food Service: Relationship between Number of Employees and Value of Sales

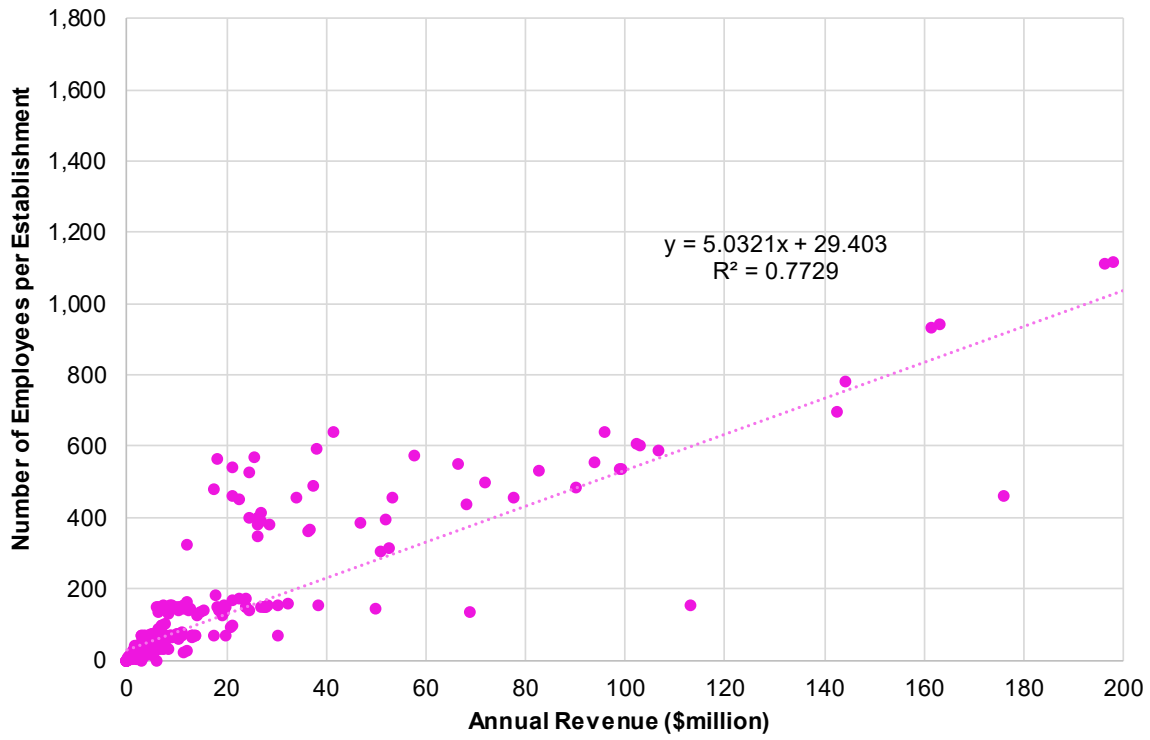

Figure A-4. Health Care: Relationship between Number of Employees and Value of Sales

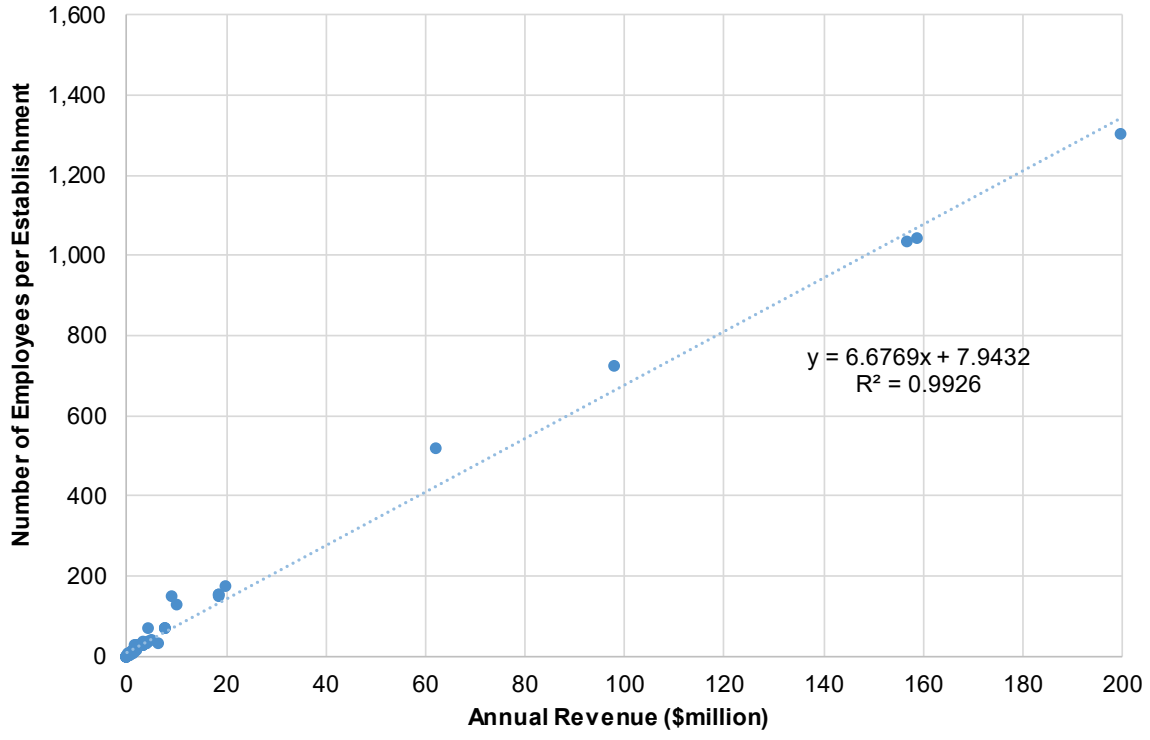

Figure A-5. Lodging: Relationship between Number of Employees and Value of Sales

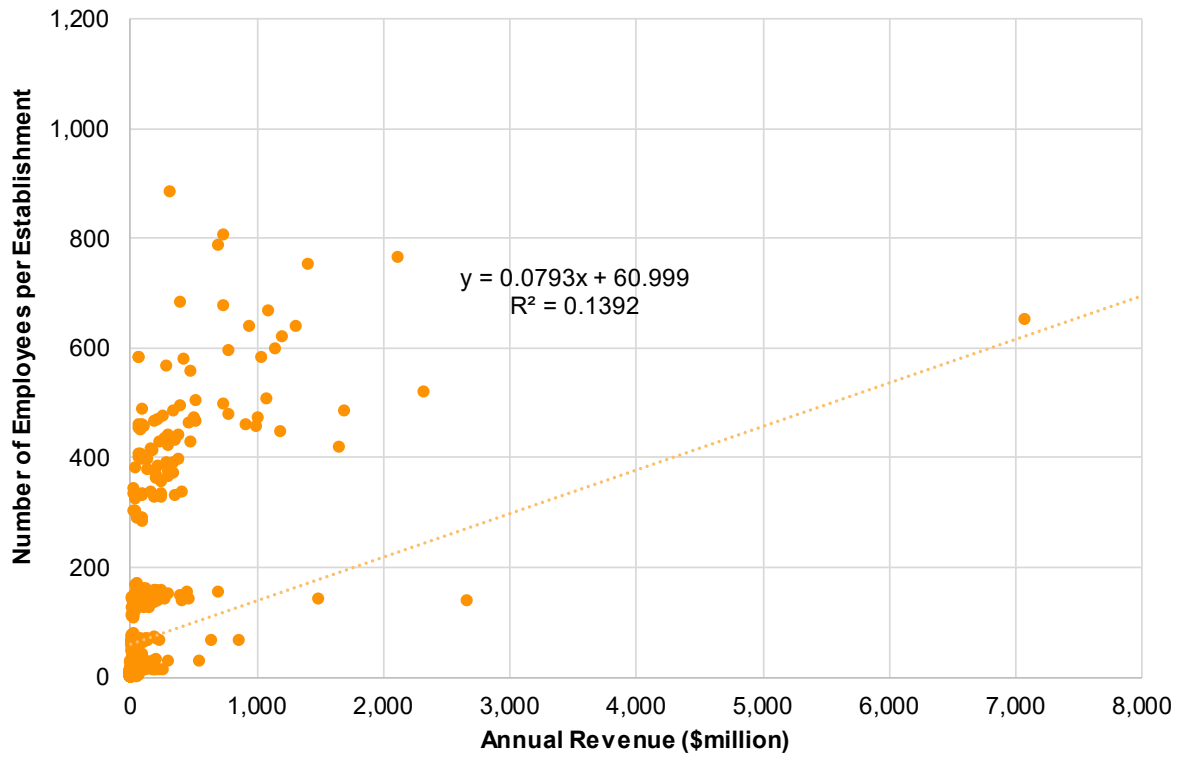

Figure A-6. Mercantile: Relationship between Number of Employees and Value of Sales

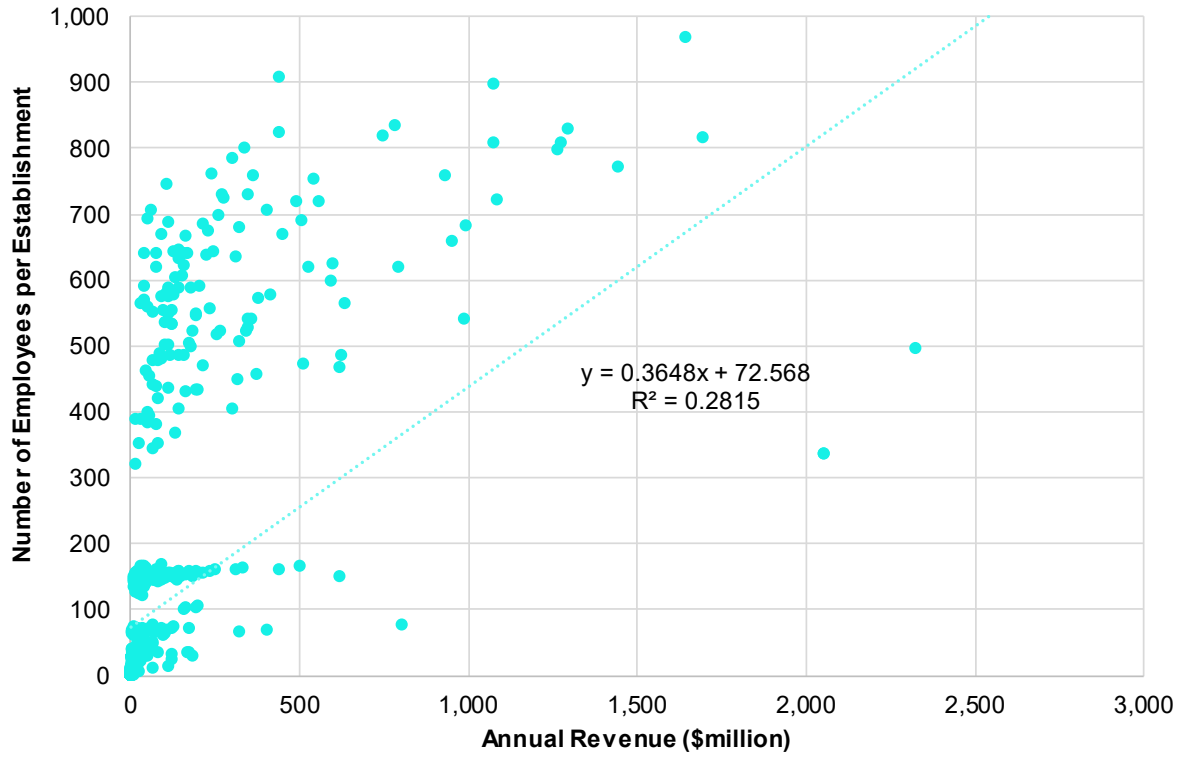

Figure A-7. Office: Relationship between Number of Employees and Value of Sales

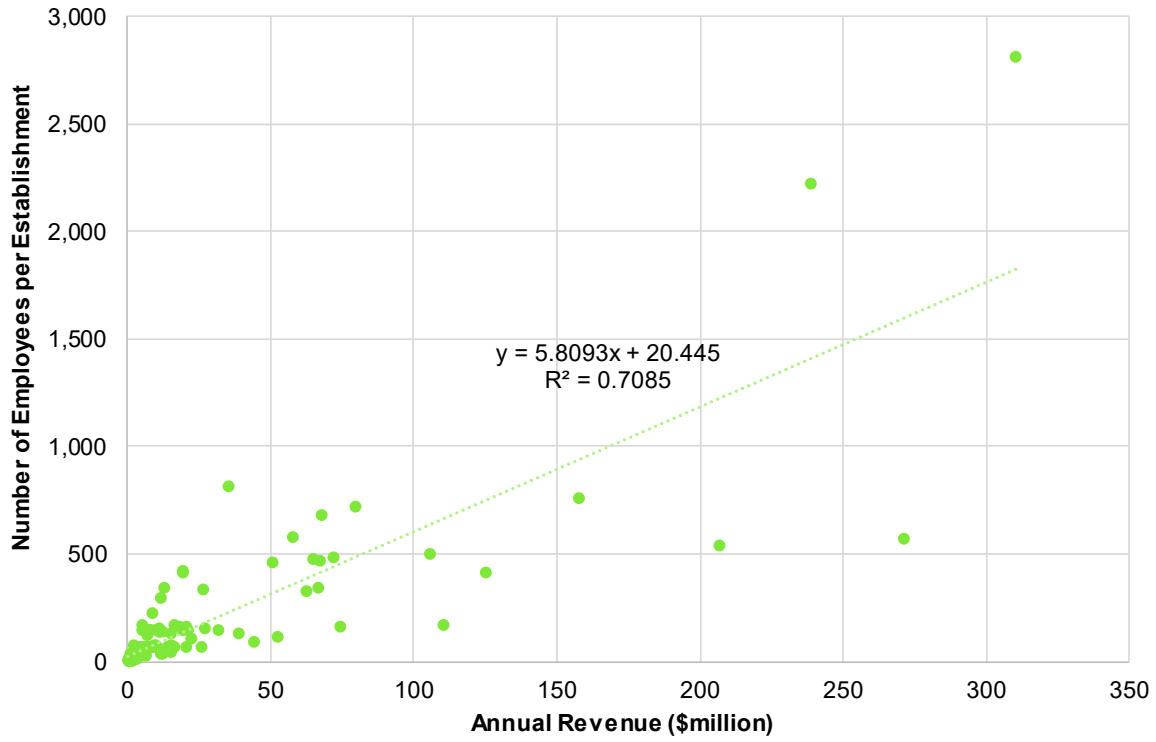

Figure A-8. Public Assembly: Relationship between Number of Employees and Value of Sales

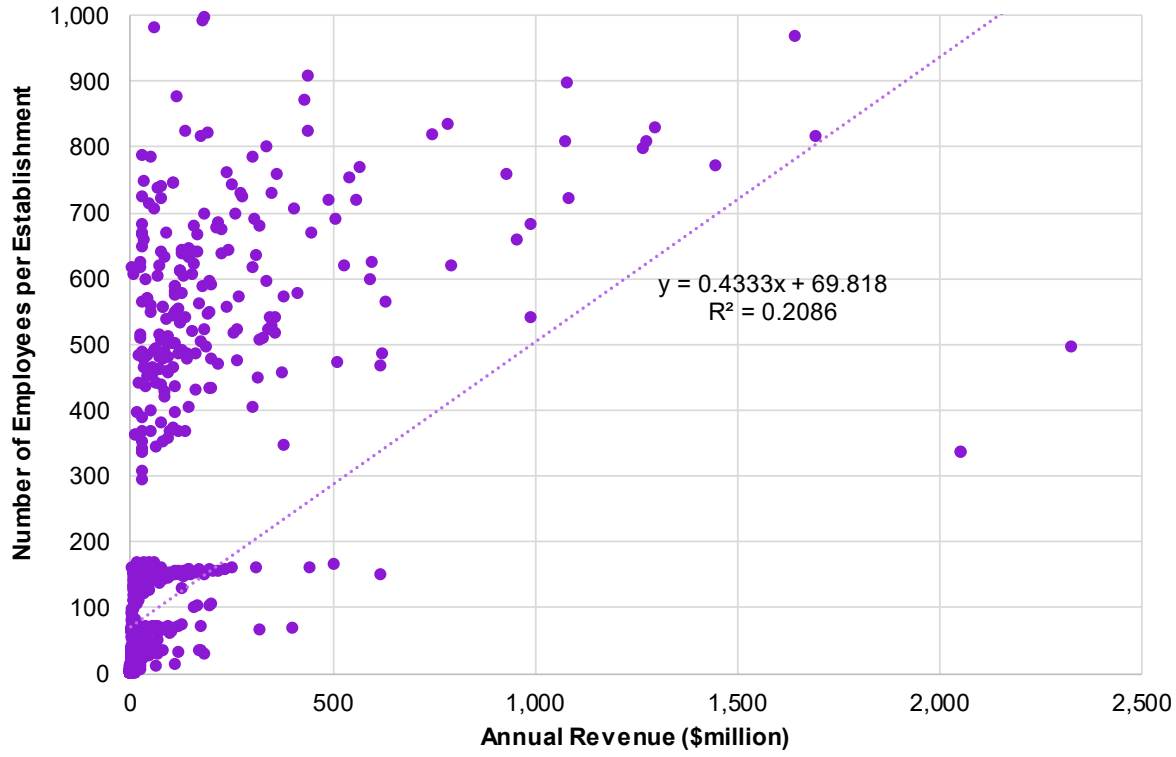

Figure A-9. Service: Relationship between Number of Employees and Value of Sales

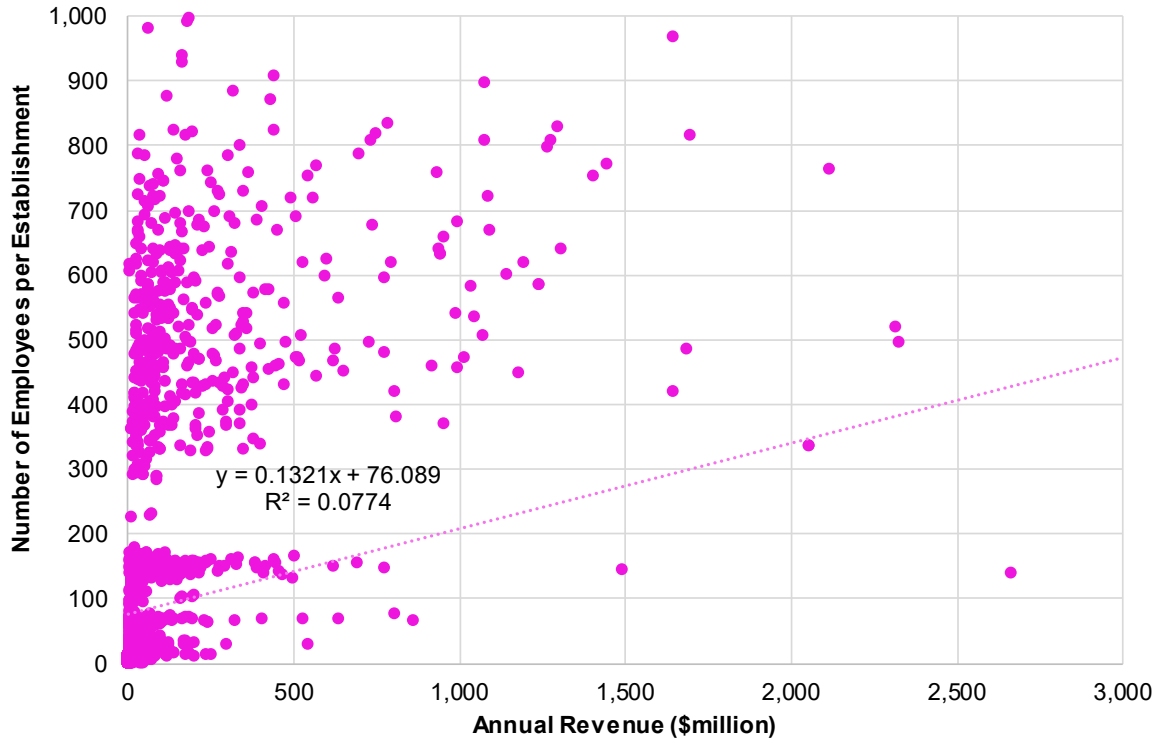

Figure A-10. All Commercial: Relationship between Number of Employees and Value of Sales

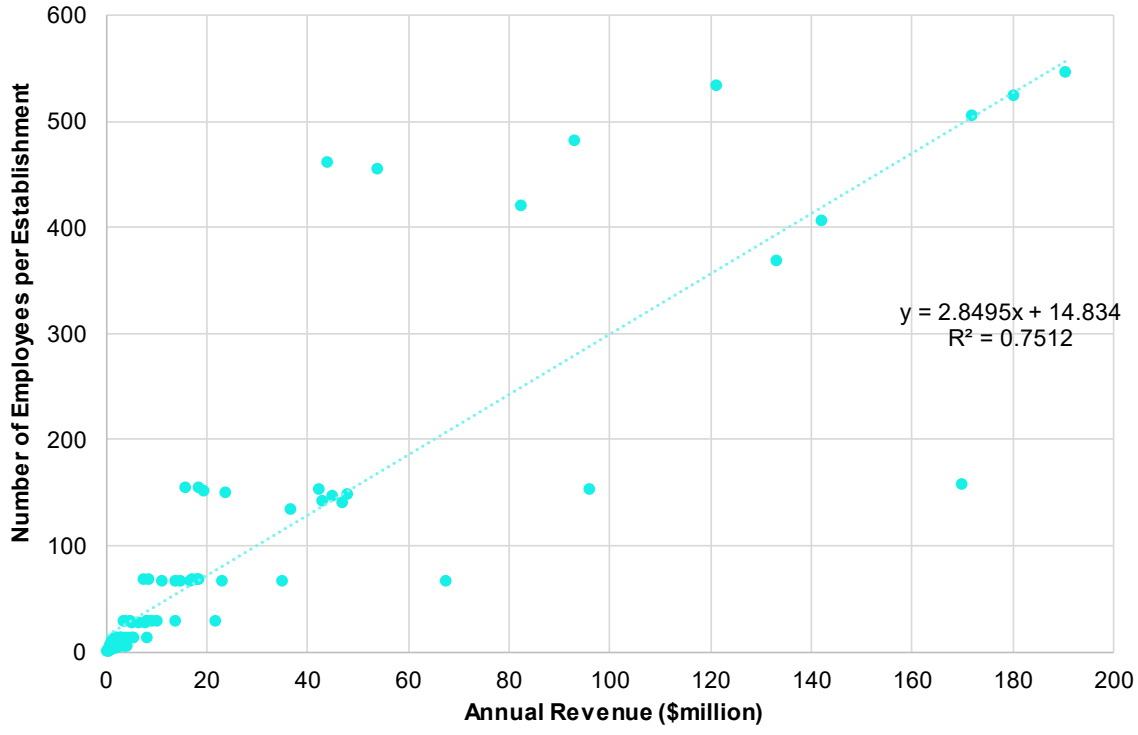

Figure A-11. REIT/Property Management: Relationship between Number of Employees and Value of Sales

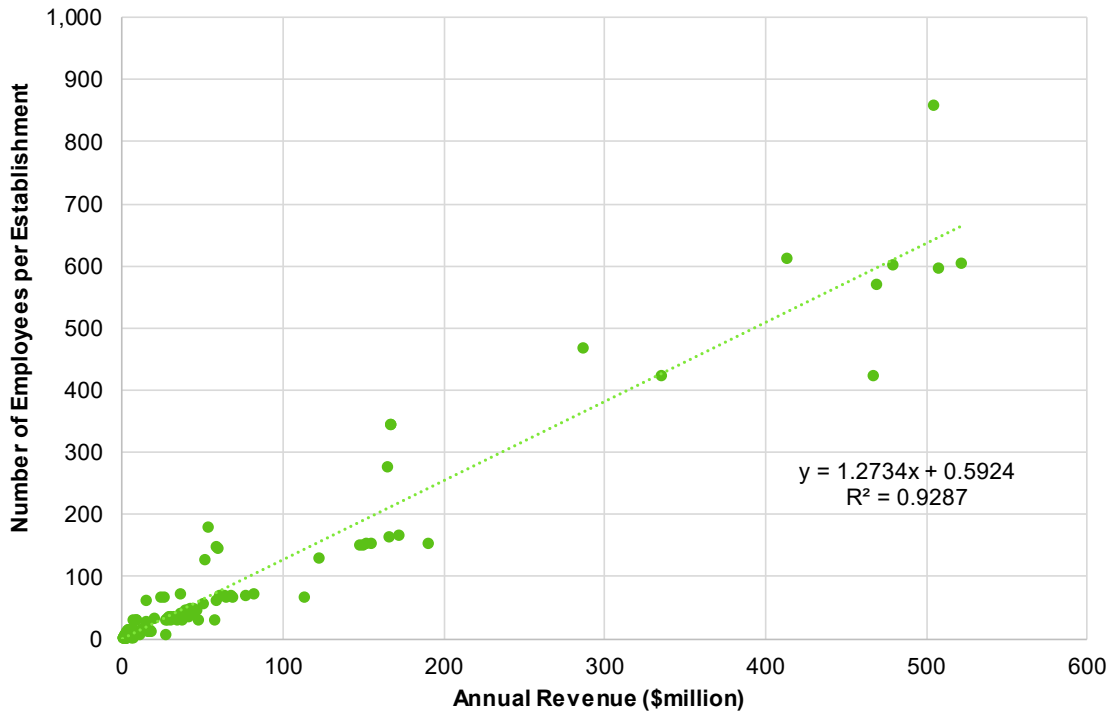

Figure A-12. Utilities: Relationship between Number of Employees and Value of Sales

Based on the regression parameters shown in Figures A-1 through A-12, we then estimated the number of employees for each of the building types associated with annual sales at the upper limit of the SBA definition of a small business (Table A-5).

Table A-5. Estimated Maximum Number of Employees in Small Business by Sector

Aggregate Sector	Identifying Small Businesses		
	Estimated Maximum Annual Revenue	Estimated Maximum Number of Employees	SBA definition in terms of Number of Employees
Education	18.8	140	--
Food Sales	18	50	100
Food Service	19.4	290	--
Health Care	24	150	--
Lodging	18.7	130	--
Mercantile	30	60	100
Office	39.4	90	900
Public Assembly	25	170	--
Service	21.1	80	1000
All Commercial	23.8	80	100 to 1000
Agriculture	5.8	30 to 290 *	--
Industrial	31.5	80	500
REIT/Property	23.6	80	--
Utilities	35.3	50	250

The maximum employee numbers from Table A-5 can be used to guide the identification from the full building sample of which buildings could potentially be occupied by

small businesses. Where possible, we recommend using the SBA definitions in terms of number of employees; approximation based on revenue may be used in instances where the SBA does not provide this value.

We reiterate that this methodology may overestimate the proportion of the total building sample composed of small businesses, as any small building will be flagged as a small business, even if it is in fact part of a major chain. However, of primary interest are the average firm-level impacts, and the results from the analysis provide an adequate indication of any differential impact on the small business subgroup following a proposed standard.

Appendix B. Discount Rate Distributions by Sector

B.1 Discount Rate Distributions for the Life-Cycle Cost Analysis

Table B-1. Education Discount Rate Distribution

Bin	Bin Range (%)	Bin Average Discount Rate (%)	Weight (% of companies)	# of Companies
1	<0			
2	≥0 to <1			
3	1-2			
4	2-3			
5	3-4			
6	4-5			
7	5-6	5.33	15.7	141
8	6-7	6.62	35.6	320
9	7-8	7.39	14.9	134
10	8-9	8.41	18.4	166
11	9-10	9.30	15.4	139
12	10-11			
13	11-12			
14	12-13			
15	≥13			
Weighted Average		**7.28**		

Table B-2. Food Sales Discount Rate Distribution

Bin	Bin Range (%)	Bin Average Discount Rate (%)	Weight (% of companies)	# of Companies
1	<0			
2	0-1			
3	1-2			
4	2-3			
5	3-4	3.79	2.6	25
6	4-5	4.63	44.4	422
7	5-6	5.57	24.2	230
8	6-7	6.34	13.6	129
9	7-8	7.44	4.9	47
10	8-9	8.76	5.3	50
11	9-10	9.53	3.5	33
12	10-11	10.33	1.6	15
13	11-12			
14	12-13			
15	≥13			
Weighted Average		**5.68**		

Table B-3. Food Service Discount Rate Distribution

Bin	Bin Range (%)	Bin Average Discount Rate (%)	Weight (% of companies)	# of Companies
1	<0			
2	0-1			
3	1-2			
4	2-3			
5	3-4			
6	4-5	4.87	8.8	180
7	5-6	5.58	31.1	635
8	6-7	6.62	30.0	614
9	7-8	7.24	16.2	332
10	8-9	8.45	6.6	134
11	9-10	9.79	3.9	79
12	10-11			
13	11-12	11.10	3.4	70
14	12-13			
15	≥13			
Weighted Average		**6.64**		

Table B-4. Health Care Discount Rate Distribution

Bin	Bin Range (%)	Bin Average Discount Rate (%)	Weight (% of companies)	# of Companies
1	<0			
2	0-1			
3	1-2			
4	2-3			
5	3-4			
6	4-5			
7	5-6	5.60	28.2	1776
8	6-7	6.47	22.7	1428
9	7-8	7.47	23.4	1472
10	8-9	8.35	14.7	927
11	9-10	9.25	11.1	699
12	10-11			
13	11-12			
14	12-13			
15	≥13			
Weighted Average		**7.04**		

Table B-5. Lodging Discount Rate Distribution

Bin	Bin Range (%)	Bin Average Discount Rate (%)	Weight (% of companies)	# of Companies
1	<0			
2	0-1			
3	1-2			
4	2-3			
5	3-4			
6	4-5	4.78	21.4	389
7	5-6	5.48	15.0	274
8	6-7	6.47	21.1	385
9	7-8	7.26	26.6	485
10	8-9	8.32	8.6	157
11	9-10	9.99	3.6	66
12	10-11			
13	11-12	11.31	3.6	66
14	12-13			
15	≥13			
Weighted Average		**6.63**		

Table B-6. Mercantile Discount Rate Distribution

Bin	Bin Range (%)	Bin Average Discount Rate (%)	Weight (% of companies)	# of Companies
1	<0			
2	0-1			
3	1-2			
4	2-3			
5	3-4			
6	4-5	4.74	0.8	50
7	5-6	5.59	15.4	949
8	6-7	6.50	31.8	1961
9	7-8	7.45	33.2	2045
10	8-9	8.20	12.4	764
11	9-10	9.45	4.2	257
12	10-11	10.29	1.7	106
13	11-12	11.50	0.3	16
14	12-13			
15	≥13			
Weighted Average		**7.09**		

Table B-7. Office Discount Rate Distribution

Bin	Bin Range (%)	Bin Average Discount Rate (%)	Weight (% of companies)	# of Companies
1	<0			
2	0-1			
3	1-2			
4	2-3			
5	3-4	3.77	5.6	2909
6	4-5	4.54	17.2	8998
7	5-6	5.46	21.3	11166
8	6-7	6.44	13.3	6943
9	7-8	7.44	10.1	5268
10	8-9	8.59	14.7	7690
11	9-10	9.40	10.2	5318
12	10-11	10.34	4.0	2096
13	11-12	11.36	1.5	811
14	12-13	12.81	1.6	838
15	≥13	14.37	0.7	342
Weighted Average		**6.86**		

Table B-8. Public Assembly Discount Rate Distribution

Bin	Bin Range (%)	Bin Average Discount Rate (%)	Weight (% of companies)	# of Companies
1	<0			
2	0-1			
3	1-2			
4	2-3			
5	3-4			
6	4-5	4.98	1.7	73
7	5-6	5.77	8.8	369
8	6-7	6.54	33.5	1403
9	7-8	7.46	29.6	1241
10	8-9	8.50	15.2	635
11	9-10	9.22	11.1	465
12	10-11			
13	11-12			
14	12-13			
15	≥13			
Weighted Average		**7.31**		

Table B-9. Service Discount Rate Distribution

Bin	Bin Range (%)	Bin Average Discount Rate (%)	Weight (% of companies)	# of Companies
1	<0			
2	0-1			
3	1-2			
4	2-3	2.29	1.3	223
5	3-4	3.86	4.8	818
6	4-5	4.45	14.0	2374
7	5-6	5.55	30.3	5120
8	6-7	6.40	21.7	3661
9	7-8	7.54	12.4	2103
10	8-9	8.55	9.8	1650
11	9-10	9.18	4.6	771
12	10-11	10.24	1.1	179
13	11-12			
14	12-13			
15	≥13			
Weighted Average		**6.21**		

Table B-10. All Commercial Discount Rate Distribution

Bin	Bin Range (%)	Bin Average Discount Rate (%)	Weight (% of companies)	# of Companies
1	<0			
2	0-1			
3	1-2			
4	2-3	2.29	0.2	223
5	3-4	3.79	4.1	3752
6	4-5	4.54	13.7	12565
7	5-6	5.51	22.6	20717
8	6-7	6.46	18.3	16845
9	7-8	7.45	14.3	13148
10	8-9	8.53	13.3	12173
11	9-10	9.37	8.5	7827
12	10-11	10.33	2.6	2396
13	11-12	11.34	1.0	963
14	12-13	12.80	0.9	854
15	≥13	14.37	0.4	342
Weighted Average		**6.77**		

Table B-11. Industrial Discount Rate Distribution

Bin	Bin Range (%)	Bin Average Discount Rate (%)	Weight (% of companies)	# of Companies
1	<0			
2	0-1			
3	1-2	1.61	0.0	13
4	2-3	2.62	0.1	59
5	3-4	3.67	1.5	1284
6	4-5	4.62	6.2	5437
7	5-6	5.55	17.8	15606
8	6-7	6.47	18.9	16580
9	7-8	7.52	16.0	14048
10	8-9	8.50	24.9	21851
11	9-10	9.43	10.1	8856
12	10-11	10.46	3.5	3093
13	11-12	11.46	0.6	486
14	12-13	12.52	0.3	285
15	≥13	13.05	0.1	121
Weighted Average		**7.32**		

Table B-12. Agriculture Discount Rate Distribution

Bin	Bin Range (%)	Bin Average Discount Rate (%)	Weight (% of companies)	# of Companies
1	<0			
2	0-1			
3	1-2			
4	2-3			
5	3-4			
6	4-5			
7	5-6			
8	6-7	6.69	53.5	207
9	7-8	7.28	28.9	112
10	8-9	8.46	17.6	68
11	9-10			
12	10-11			
13	11-12			
14	12-13			
15	≥13			
Weighted Average		**7.17**		

Table B-13. REIT/Property Discount Rate Distribution

Bin	Bin Range (%)	Bin Average Discount Rate (%)	Weight (% of companies)	# of Companies
1	<0			
2	0-1			
3	1-2			
4	2-3			
5	3-4			
6	4-5	4.90	9.0	466
7	5-6	5.49	21.9	1128
8	6-7	6.32	40.6	2092
9	7-8	7.44	12.7	657
10	8-9	8.49	9.7	502
11	9-10	9.43	6.0	308
12	10-11			
13	11-12			
14	12-13			
15	≥13			
Weighted Average		**6.55**		

Table B-14. Investor-Owned Utility Discount Rate Distribution

Bin	Bin Range (%)	Bin Average Discount Rate (%)	Weight (% of companies)	# of Companies
1	<0			
2	0-1			
3	1-2	1.61	0.6	13
4	2-3	2.50	0.7	16
5	3-4	3.67	49.6	1088
6	4-5	4.32	37.5	823
7	5-6	5.43	4.1	91
8	6-7	6.55	4.5	99
9	7-8	7.37	2.9	63
10	8-9			
11	9-10			
12	10-11			
13	11-12			
14	12-13			
15	≥13			
Weighted Average		**4.20**		

Table B-15. State/Local Government Discount Rate Distribution

Bin	Bin Range (%)	Bin Average Discount Rate (%)	Weight (% of quarters)	# of Quarters
1	<0	-2.0	7.1	10
2	0-1	0.8	2.8	4
3	1-2	1.5	22.7	32
4	2-3	2.5	24.1	34
5	3-4	3.5	33.3	47
6	4-5	4.2	9.9	14
7	5-6			
8	6-7			
9	7-8			
10	8-9			
11	9-10			
12	10-11			
13	11-12			
14	12-13			
15	≥13			
Weighted Average		**2.44**		

Table B-16. Federal Government Discount Rate Distribution

Bin	Bin Range (%)	Bin Average Discount Rate (%)	Weight (% of months)	# of Months
1	<0	-0.6	10.7	45
2	0-1	0.5	22.1	93
3	1-2	1.6	17.9	75
4	2-3	2.5	17.9	75
5	3-4	3.5	17.1	72
6	4-5	4.3	11.4	48
7	5-6	5.8	2.9	12
8	6-7			
9	7-8			
10	8-9			
11	9-10			
12	10-11			
13	11-12			
14	12-13			
15	≥13			
Weighted Average		**2.02**		

B.2 Small Business Discount Rate Distributions by Sector

We here present discount rate distributions by sector for use in the context of small businesses (Table B-17 to Table B-30).

Table B-17. Education Small Business Discount Rate Distribution

Bin	Bin Range (%)	Bin Average Discount Rate (%)	Weight (% of companies)	# of Companies
1	<0			
2	≥0 to <1			
3	1-2			
4	2-3			
5	3-4			
6	4-5			
7	5-6			
8	6-7			
9	7-8			
10	8-9	8.84	7.8	70
11	9-10	9.24	21.3	192
12	10-11	10.53	43.3	390
13	11-12	11.59	23.8	214
14	12-13	12.21	3.8	34
15	≥13			
Weighted Average		**10.44**		

Table B-18. Food Sales Small Business Discount Rate Distribution

Bin	Bin Range (%)	Bin Average Discount Rate (%)	Weight (% of companies)	# of Companies
1	<0			
2	0-1			
3	1-2			
4	2-3			
5	3-4			
6	4-5			
7	5-6	6.00	2.6	25
8	6-7	6.69	9.8	93
9	7-8	7.44	45.7	435
10	8-9	8.37	23.7	225
11	9-10	9.24	4.7	45
12	10-11	10.50	5.0	48
13	11-12	11.80	4.9	47
14	12-13	12.04	1.9	18
15	≥13	14.25	1.6	15
Weighted Average		**8.20**		

Table B-19. Food Service Small Business Discount Rate Distribution

Bin	Bin Range (%)	Bin Average Discount Rate (%)	Weight (% of companies)	# of Companies
1	<0			
2	0-1			
3	1-2			
4	2-3			
5	3-4			
6	4-5			
7	5-6			
8	6-7			
9	7-8	7.98	4.6	95
10	8-9	8.50	33.2	679
11	9-10	9.45	37.0	757
12	10-11	10.34	10.4	213
13	11-12	11.39	4.0	81
14	12-13	12.12	7.3	149
15	≥13	13.47	3.4	70
Weighted Average		**9.56**		

Table B-20. Health Care Small Business Discount Rate Distribution

Bin	Bin Range (%)	Bin Average Discount Rate (%)	Weight (% of companies)	# of Companies
1	<0			
2	0-1			
3	1-2			
4	2-3			
5	3-4			
6	4-5			
7	5-6			
8	6-7			
9	7-8	7.59	4.0	250
10	8-9	8.56	31.8	2007
11	9-10	9.44	20.8	1310
12	10-11	10.46	20.0	1263
13	11-12	11.68	19.4	1222
14	12-13	12.74	1.8	112
15	≥13	13.82	2.2	138
Weighted Average		**9.88**		

Table B-21. Lodging Small Business Discount Rate Distribution

Bin	Bin Range (%)	Bin Average Discount Rate (%)	Weight (% of companies)	# of Companies
1	<0			
2	0-1			
3	1-2			
4	2-3			
5	3-4			
6	4-5			
7	5-6			
8	6-7	6.57	15.9	290
9	7-8	7.53	15.4	280
10	8-9	8.45	15.6	284
11	9-10	9.47	33.4	609
12	10-11	10.59	8.6	157
13	11-12	11.32	3.8	70
14	12-13	12.03	3.6	66
15	≥13	13.37	3.6	66
Weighted Average		**8.95**		

Table B-22. Mercantile Small Business Discount Rate Distribution

Bin	Bin Range (%)	Bin Average Discount Rate (%)	Weight (% of companies)	# of Companies
1	<0			
2	0-1			
3	1-2			
4	2-3			
5	3-4			
6	4-5			
7	5-6			
8	6-7	6.90	0.2	15
9	7-8	7.74	0.7	43
10	8-9	8.73	12.5	769
11	9-10	9.54	44.9	2768
12	10-11	10.29	28.8	1775
13	11-12	11.47	9.1	559
14	12-1	12.29	2.8	173
15	≥13	14.14	1.0	62
Weighted Average		**9.93**		

Table B-23. Office Small Business Discount Rate Distribution

Bin	Bin Range (%)	Bin Average Discount Rate (%)	Weight (% of companies)	# of Companies
1	<0			
2	0-1			
3	1-2			
4	2-3			
5	3-4			
6	4-5	4.23	0.8	433
7	5-6	5.67	4.8	2502
8	6-7	6.37	10.4	5464
9	7-8	7.47	17.4	9127
10	8-9	8.55	14.8	7737
11	9-10	9.47	11.5	6005
12	10-11	10.42	9.6	5046
13	11-12	11.55	10.5	5513
14	12-13	12.47	10.0	5253
15	≥13	14.60	10.1	5299
Weighted Average		**9.57**		

Table B-24. Public Assembly Small Business Discount Rate Distribution

Bin	Bin Range (%)	Bin Average Discount Rate (%)	Weight (% of companies)	# of Companies
1	<0			
2	0-1			
3	1-2			
4	2-3			
5	3-4			
6	4-5			
7	5-6			
8	6-7			
9	7-8			
10	8-9	8.56	20.2	847
11	9-10	9.57	37.2	1556
12	10-11	10.52	18.3	766
13	11-12	11.70	16.4	687
14	12-13	12.19	7.9	330
15	≥13			
Weighted Average		**10.09**		

Table B-25. Service Small Business Discount Rate Distribution

Bin	Bin Range (%)	Bin Average Discount Rate (%)	Weight (% of companies)	# of Companies
1	<0			
2	0-1			
3	1-2			
4	2-3	2.70	1.3	223
5	3-4			
6	4-5	4.34	7.9	1341
7	5-6	5.60	7.0	1185
8	6-7	6.38	13.6	2301
9	7-8	7.14	4.8	808
10	8-9	8.54	21.6	3643
11	9-10	9.45	22.4	3780
12	10-11	10.49	9.7	1643
13	11-12	11.54	5.7	962
14	12-13	12.30	4.3	731
15	≥13	13.26	1.7	282
Weighted Average		**8.37**		

Table B-26. All Commercial Small Business Discount Rate Distribution

Bin	Bin Range (%)	Bin Average Discount Rate (%)	Weight (% of companies)	# of Companies
1	<0			
2	0-1			
3	1-2			
4	2-3	2.70	0.3	223
5	3-4			
6	4-5	4.31	1.9	1774
7	5-6	5.65	4.0	3712
8	6-7	6.38	8.9	8196
9	7-8	7.45	12.1	11095
10	8-9	8.55	17.8	16328
11	9-10	9.48	18.5	17022
12	10-11	10.43	12.3	11302
13	11-12	11.57	10.2	9355
14	12-13	12.42	7.5	6866
15	≥13	14.49	6.5	5932
Weighted Average		**9.40**		

Table B-27. Industrial Small Business Discount Rate Distribution

Bin	Bin Range (%)	Bin Average Discount Rate (%)	Weight (% of companies)	# of Companies
1	<0			
2	0-1			
3	1-2			
4	2-3	3.48	0.0	29
5	3-4	4.66	0.3	281
6	4-5	5.59	1.7	1475
7	5-6	6.54	3.0	2630
8	6-7	7.55	8.5	7474
9	7-8	8.49	13.3	11666
10	8-9	9.51	17.3	15157
11	9-10	10.51	19.6	17213
12	10-11	11.45	18.9	16563
13	11-12	12.51	11.5	10096
14	12-13	14.09	5.9	5135
15	≥13			
Weighted Average		**10.21**		

Table B-28. Agriculture Small Business Discount Rate Distribution

Bin	Bin Range (%)	Bin Average Discount Rate (%)	Weight (% of companies)	# of Companies
1	<0			
2	0-1			
3	1-2			
4	2-3			
5	3-4			
6	4-5			
7	5-6			
8	6-7			
9	7-8			
10	8-9	8.65	27.6	107
11	9-10	9.28	35.9	139
12	10-11	10.65	36.4	141
13	11-12			
14	12-13			
15	≥13			
Weighted Average		**9.60**		

Table B-29. REIT/Property Small Business Discount Rate Distribution

Bin	Bin Range (%)	Bin Average Discount Rate (%)	Weight (% of companies)	# of Companies
1	<0			
2	0-1			
3	1-2			
4	2-3			
5	3-4			
6	4-5			
7	5-6	5.74	0.3	16
8	6-7	6.47	2.2	114
9	7-8	7.69	22.0	1132
10	8-9	8.37	36.9	1899
11	9-10	9.52	20.5	1058
12	10-11	10.45	10.1	523
13	11-12	11.44	7.8	400
14	12-13	12.61	0.2	11
15	≥13			
Weighted Average		**8.87**		

Table B-30. Investor-Owned Utility Small Business Discount Rate Distribution

Bin	Bin Range (%)	Bin Average Discount Rate (%)	Weight (% of companies)	# of Companies
1	<0			
2	0-1			
3	1-2			
4	2-3	3.48	1.3	29
5	3-4	4.72	9.8	216
6	4-5	5.61	36.6	802
7	5-6	6.42	35.6	781
8	6-7	7.27	7.3	161
9	7-8	8.56	3.5	77
10	8-9	9.43	5.1	111
11	9-10	10.29	0.7	16
12	10-11	3.48	1.3	29
13	11-12			
14	12-13			
15	≥13			
Weighted Average		**6.23**		