

CHAPTER 5. MARKUPS FOR PRODUCT PRICE DETERMINATION

TABLE OF CONTENTS

5.1	INTRODUCTION	5-1
	5.1.1 Distribution Channels	5-1
5.2	MARKUP CALCULATION METHODOLOGY	5-2
5.3	APPROACH FOR CALCULATING CONTRACTOR MARKUPS	5-2
	5.3.1 Assumptions.....	5-2
	5.3.2 Approach for Mechanical Contractor Markup.....	5-3
5.4	DERIVATION OF NATIONAL MECHANICAL CONTRACTOR MARKUPS	5-4
5.5	DERIVATION OF REGIONAL MARKUPS	5-5
5.6	SALES TAX	5-5
5.7	OVERALL MARKUPS.....	5-6

LIST OF TABLES

Table 5.4.1	Mechanical Contractor Expenses and Markups Based on Census Bureau Data	5-5
Table 5.7.1	Summary of National Average Markups on CRAC Equipment.....	5-7

LIST OF FIGURES

Figure 5.1.1	Distribution Channels for CRAC Equipment.....	5-2
--------------	---	-----

CHAPTER 5. MARKUPS FOR PRODUCT PRICE DETERMINATION

5.1 INTRODUCTION

To carry out its analyses, the U.S. Department of Energy (DOE) needed to determine the cost to the consumer of baseline products and the cost of more-efficient units the consumer would purchase following the promulgation of new energy conservation standards. However, the consumer price of either baseline or higher efficiency equipment is not generally known. For this analysis, the equipment price (for either baseline or higher efficiency equipment) would be determined based on engineering estimates of manufacturing costs plus appropriate markups based on how the equipment is purchased.

DOE estimated a baseline markup and an incremental markup. DOE defined a baseline markup as a multiplier that converts the manufacturer selling price (MSP) of equipment with baseline efficiency to the consumer purchase price of equipment at the same baseline efficiency level. An incremental markup is defined as the multiplier to convert the incremental increase in MSP of higher efficiency equipment to the consumer purchase price for the same equipment. Companies mark up the price to cover business cost and profit margin, as described in section 5.3.

In this chapter, DOE first describes the market distribution channel and the methodology used to derive baseline and incremental markups. DOE then summarizes the results in two sections: (1) national markups estimation and (2) regional markups estimation. DOE differentiated markups between national and regional estimations because prices for contractors differ between regions of the country.

5.1.1 Distribution Channels

The appropriate markups for determining consumer equipment prices depend on the type of distribution channels through which products move from manufacturers to purchasers. At each point in the distribution channel, companies mark up the price of the equipment to cover their business costs and profit margin.

DOE believes that there is only one dominant distribution channel that describes how computer room air conditioning (CRAC) equipment passes from the manufacturer to the consumer. It is shown in Figure 5.1.1. This distribution channel applies to both replacements and new construction. The manufacturer or its distributor sells the equipment to a mechanical contractor, who in turns sells it to the consumer and provides installation services. The prices used in this analysis were derived from manufacturer surveys. The manufacturer price in each case is a “contractor” price, which includes the cost of delivery to the job site as well as any sales charges or commissions of distributors and manufacturer representatives. Therefore, no separate distributor or wholesaler is shown in the distribution channel. Because of the specialized nature of the equipment, general contractors typically are not involved. Thus, in this market the only distribution channel markup is that of the mechanical contractor.

Replacement and New Construction



Figure 5.1.1 Distribution Channels for CRAC Equipment

5.2 MARKUP CALCULATION METHODOLOGY

As previously discussed, mechanical contractors mark up the price of the equipment to cover their business costs and profit margins. In financial statements, gross margin is the difference between the company revenue and the company cost of sales or cost of goods sold. The gross margin includes the company expenses, including overhead costs (sales, general, and administration); research and development and interest expenses; and depreciation and taxes, as well as company profits. In order for sales of a product to contribute positively to company cash flow, the product's markup must cover the company's gross margin. Products command lower or higher markups depending on company expenses associated with the product and the degree of market competition. In all installations, sales tax applies to the final consumer cost.

5.3 APPROACH FOR CALCULATING CONTRACTOR MARKUPS

For the final rule, DOE examined the manner in which markups change by efficiency level and other factors for mechanical contractors. DOE determined that markups are neither fixed-dollar nor proportional to all direct costs, which means that the selling price of a product may not be strictly proportional to the purchase price of the equipment. Based on information from the 2007 Economic Census, as discussed in section 5.4, DOE also found measurable differences between *incremental* markups on direct equipment costs and the *average* aggregate markup on direct business costs for mechanical contractors. Section 5.3.2 further discusses the differences between average and incremental markups.

The main reason that the selling price of a product may not be strictly proportional to the purchase price of the equipment is that businesses incur a wide variety of costs. When the purchase price of equipment and materials increases, only a fraction of the business expenses increase, while the remainder of the businesses' expenses stays relatively constant. For example, if the unit price of CRAC equipment increases by 30 percent, it is unlikely that the cost of secretarial support in an administrative office will increase by 30 percent also. Certain business expenses are uncorrelated with the cost of equipment or cost of goods.

5.3.1 Assumptions

DOE derived the mechanical contractor markups from three key assumptions about the costs associated with furnaces and central air conditioners and heat pumps. DOE based the mechanical contractor markups on firm-level income statement data from the 2007 Economic Census. These income statements break down the components of all costs incurred by firms that

supply and install air conditioning equipment.^a The key assumptions used to estimate markups using these financial data are as follows.

1. The firm income statements faithfully represent the various average costs incurred by firms installing CRAC equipment.
2. These costs can be divided into two categories: (1) costs that vary in proportion to the MSP of CRAC equipment (variant costs); and (2) costs that do not vary with the MSP of CRAC equipment (invariant costs).
3. Overall, contractor prices for CRAC equipment vary in proportion to contractor costs for CRAC equipment included in the income statements.

In support of the first assumption, the income statements itemize firm costs into a number of expense categories, including direct costs to purchase or install the equipment, operating labor and occupancy costs, and other operating costs and profit. Although contractors tend to handle multiple commodity lines, including room air conditioners, furnaces, central air conditioners and heat pumps, and boilers, the data provide the most accurate available indication of the expenses associated with CRAC equipment.

Information obtained from the trade literature, and from selected heating, ventilating, and air conditioning (HVAC) contractors and consultants, tends to support the second assumption; this information indicates that contractor markups vary according to the quantity of labor and materials used to distribute and install appliances and equipment. In the following discussion, DOE assumes a division of costs between those that do not scale with the manufacturer price (labor and occupancy expenses), and those that do (operating expenses and profit). This division of costs led to the estimate of contractor markups described in section 5.3.2.

In support of the third assumption, the HVAC contractor industry is competitive, and consumer demand for commercial heating and air conditioning is inelastic (*i.e.*, the demand is not expected to decrease significantly with an increase in the price of equipment). The large number of HVAC firms listed in the 2007 Economic Census indicates the competitive nature of the market. For example, there are more than 700 HVAC manufacturers¹ and 91,000 HVAC contractors² listed in the 2007 census. Following standard economic theory, competitive firms either set prices in line with costs or quickly go out of business.³

5.3.2 Approach for Mechanical Contractor Markup

To estimate mechanical contractor markups for furnaces and central air conditioners and heat pumps, DOE collected financial data from the Plumbing, Heating, and Air-Conditioning (NAICS 238220) series from the 2007 Economic Census.

The census data include the number of establishments, payroll for construction workers, value of construction, cost of materials, and cost of subcontracted work at both state and national levels. DOE calculated the baseline markup for mechanical contractors using the following equation:

^a Mechanical contractors to which these reports refer handle multiple commodity lines, including residential and commercial air conditioners and warm-air furnaces.

$$MU_{BASE} = \frac{V_{CONSTRUCT}}{Pay + MatCost + SubCost}$$

Eq. 5.1

Where:

MU_{BASE} = baseline mechanical contractor markup,

$V_{CONSTRUCT}$ = value of construction,

Pay = payroll for construction workers,

$MatCost$ = cost of materials, and

$SubCost$ = cost of subcontracted work.

Analogously, DOE estimated the incremental mechanical contractor markups by only marking up those costs that scale with a change in the manufacturer's sales price (variant costs, VC) for higher energy efficiency products. DOE assumes a division of costs between those that do not scale with the manufacturer price (labor and occupancy expenses), and those that do (other operating expenses and profit). Hence, DOE categorized the census cost data in each major cost category and estimated markups using the following equation:

$$MU_{INCR} = \frac{CGS_{CONT} + VC_{CONT}}{CGS_{CONT}}$$

Eq. 5.2

Where:

MU_{INCR} = incremental contractor markup,

CGS_{CONT} = contractor cost of goods sold, and

VC_{CONT} = contractor variant costs.

5.4 DERIVATION OF NATIONAL MECHANICAL CONTRACTOR MARKUPS

The HVAC contractors, defined here as mechanical contractors, are covered by data from the 2007 Economic Census. Aggregate data are shown in Table 5.4.1. DOE converted expenses per dollar sales into revenue per dollar cost of goods sold by dividing each figure in the first data column by \$0.678. For every \$1.00 the mechanical contractor spends on equipment costs, the mechanical contractor earns \$1.00 in sales revenue to cover the equipment cost, and \$0.474 to cover the other costs. This totals \$1.474 in sales revenue earned for every \$1.00 spent on equipment costs, for a baseline markup ($MU_{MECHCONTBASE}$) of 1.474 for mechanical contractors, because the contractor earns \$1.474 in sales revenue for every \$1.00 spent to purchase the equipment. This is the beginning point for the determination of mechanical contractor markups.

Calculation of the incremental markups for each market type required separation of the invariant and variant costs. DOE used detailed 2007 Census Bureau data for all plumbing, heating, and air-conditioning contractors. The Census Bureau data were used to calculate the baseline and incremental markups as shown in Table 5.4.1. (Appendix 5A.1 contains the full set of data used to calculate the incremental markup.)

Table 5.4.1 Mechanical Contractor Expenses and Markups Based on Census Bureau Data

Description	Contractor Expenses or Revenue	
	Per Dollar Sales Revenue \$	Per Dollar Cost of Goods \$
Direct Cost of Equipment Sales: Cost of goods sold	0.678	1.000
Labor Expenses: Salaries (indirect) and benefits	0.175	0.258
Occupancy Expense: Rent, maintenance, and utilities	0.023	0.032
Other Operating Expenses: Depreciation, advertising, and insurance.	0.040	0.058
Net Profit Before Taxes	0.086	0.127
Baseline Markup (<i>MUMECH BASE</i>): Revenue per dollar cost of goods		1.474
Incremental Markup (<i>MUMECH INCR</i>): Increased revenue per dollar increase cost of goods sold		1.184

Source: U.S. Census Bureau. 2007. Plumbing, Heating, and Air-Conditioning Contractors. Sector 23: 238220. Construction: Industry Series, Detailed Statistics for Establishments, 2007.

Using the data in Table 5.4.1, the incremental markup is 20 percent lower than the baseline markup. DOE assumed that this deviation applies equally to the baseline markups calculated for the replacement and new construction markets.

5.5 DERIVATION OF REGIONAL MARKUPS

The 2007 Economic Census provides Geographic Area Series for the Plumbing, Heating, and Air-Conditioning (NAICS 23820) sector, which contains state-level sales and cost data, including value of construction, cost of subcontract work, cost of materials, and payroll for construction workers. By using Eq. 5.1, DOE estimated baseline markups for each state.

DOE then calculated a state-level relative baseline markup, which equals the quotient of each state's baseline markup and national average markup. A relative mechanical contractor markup value was calculated for each state. The relative values are multiplied by the national markups for both baseline and incremental markups. For example, as shown in Appendix 5A, the relative mechanical contractor markup value for California is 1.043, which would be multiplied by the mean markup factor of 1.474, yielding a mechanical contractor baseline markup of 1.537. If instead the incremental markup were needed, the 1.043 relative markup value would be multiplied by the mean incremental markup factor of 1.184, yielding a mechanical contractor markup value of 1.235.

5.6 SALES TAX

The sales tax represents state and local sales taxes that are applied to the consumer price of the equipment. The sales tax is a multiplicative factor that increases the consumer equipment price.

DOE derived state and local taxes from data provided by the Sales Tax Clearinghouse.⁴ These data represent weighted averages that include county and city rates. Detailed sales tax data by each state can be found in Appendix 5A.

5.7 OVERALL MARKUPS

The overall markup for each distribution channel is the product of the appropriate markups, as well as sales tax (Table 5.7.1).

DOE used the overall baseline markup to estimate the consumer product price of baseline models, given the manufacturer cost of the baseline models. As previously stated, DOE considers baseline models to be products sold under existing market conditions (*i.e.*, without new energy conservation standards). The following equation shows how DOE used the overall baseline markup to determine the product price for baseline models.

$$CPP_{BASE} = PRICE_{MFG} \times (MU_{BASE} \times Tax_{SALES}) = PRICE_{MFG} \times MU_{OVERALL_BASE} \quad \text{Eq. 5.3}$$

Where:

CPP_{BASE} = consumer product price for baseline models,
 $PRICE_{MFG}$ = manufacturer sales price (distributor delivered price) for baseline models,
 MU_{BASE} = baseline mechanical contractor markup,
 Tax_{SALES} = sales tax, and
 $MU_{OVERALL_BASE}$ = baseline overall markup.

Similarly, DOE used the overall incremental markup to estimate changes in the consumer product price, given changes in the manufacturer cost from the baseline model cost resulting from an energy conservation standard to raise product energy efficiency. The total consumer product price for more energy efficient models is composed of two components: (1) the consumer product price of the baseline model and (2) the change in consumer product price associated with the increase in manufacturer cost to meet the new energy conservation standard. The following equation shows how DOE used the overall incremental markup to determine the consumer product price for more energy efficient models (*i.e.*, models meeting new energy conservation standards).

$$\begin{aligned} CPP_{STD} &= PRICE_{MFG} \times MU_{OVERALL_BASE} + \Delta PRICE_{MFG} \times (MU_{INCR} \times Tax_{SALES}) \\ &= CPP_{BASE} + \Delta PRICE_{MFG} \times MU_{OVERALL_INCR} \end{aligned} \quad \text{Eq. 5.4}$$

Where:

CPP_{STD} = consumer product price for models meeting new energy conservation standards,
 CPP_{BASE} = consumer product price for baseline models,
 $PRICE_{MFG}$ = manufacturer sales price for baseline models,
 $\Delta PRICE_{MFG}$ = change in manufacturer sales price for higher energy efficient models,
 MU_{INCR} = incremental markup,
 Tax_{SALES} = sales tax,
 $MU_{OVERALL_BASE}$ = baseline overall markup (product of mechanical contractor markup and sales tax), and
 $MU_{OVERALL_INCR}$ = incremental overall markup.

National average baseline and incremental markups for each market participant are summarized in Table 5.7.1.

Table 5.7.1 Summary of National Average Markups on CRAC Equipment

	Baseline Markup	Incremental Markup
Mechanical Contractor	1.474	1.184
Sales tax (National population-weighted average)	1.071	1.071
Overall Markup	1.579	1.269

REFERENCES

1. U.S. Census Bureau. *2007 Economic Census, Table EC073111: Detailed Statistics by Industry for the United States: 2007*. Air-Conditioning and Warm Air Heating Equipment and Commercial and Industrial Refrigeration Equipment Manufacturing. (Last accessed April 25, 2012.) Data can be accessed by searching for the Table EC073111 at <http://factfinder2.census.gov/faces/nav/jsf/pages/searchresults.xhtml?refresh=t#none>.
2. U.S. Census Bureau. *2007 Economic Census, Construction Geographic Area Series: Table EC0723A1: Detailed Statistics for Establishments: 2007*. Plumbing, Heating, and Air-Conditioning Contractors. (Last accessed April 25, 2012.) Data can be accessed by searching for the Table EC0723A1 at <http://factfinder2.census.gov/faces/nav/jsf/pages/searchresults.xhtml?refresh=t#none>.
3. Pindyck, R. and Rubinfeld, D. 2000. *Microeconomics: Fifth Edition*. Prentice Hall: Upper Saddle River, NJ.
4. The Sales Tax Clearinghouse. (Last accessed January 11, 2012.) <https://thestc.com/STRates.stm>