CHAPTER 7. MARKUPS FOR EQUIPMENT PRICE DETERMINATION

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CHAPTER 7. MARKUPS FOR EQUIPMENT PRICE DETERMINATION

7.1 INTRODUCTION

To carry out the engineering and life-cycle cost (LCC) analyses, DOE needed to determine the cost to the customer of a baseline product and the cost of more-efficient units. By applying multipliers called "markups" to the manufacturers' selling prices estimated in the engineering analysis, DOE estimated the end user prices for baseline models and more-efficient equipment.

7.1.1 Distribution Channels

The appropriate markups for determining the end user equipment price 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.

Because most small electric motors are used as components in larger pieces of equipment, much of the market passes through original equipment manufacturers (OEMs) who design, assemble and brand products that may contain small electric motors. OEMs in turn obtain their motors either directly from the motor manufacturers or from manufacturers via distributors.

Based on market research, DOE defined three distribution channels for small electric motors, and estimated their respective shares of shipments. Two channels exist for motors installed in new equipment: (1) from manufacturers to OEMs and then to end-users through equipment distributors or retailers—65 percent of shipments; and (2) from manufacturers to wholesale motor distributors to OEMs and then to end-users through equipment distributors or retailers—30 percent of shipments. The third channel refers to replacement or spare motors: (3) from manufacturers to wholesale motor distributors to end-users through distributors or retailers—5 percent of shipments. DOE estimates the proportion of shipments through each distribution channel based on public comments made by the National Electrical Manufacturers Association (NEMA).

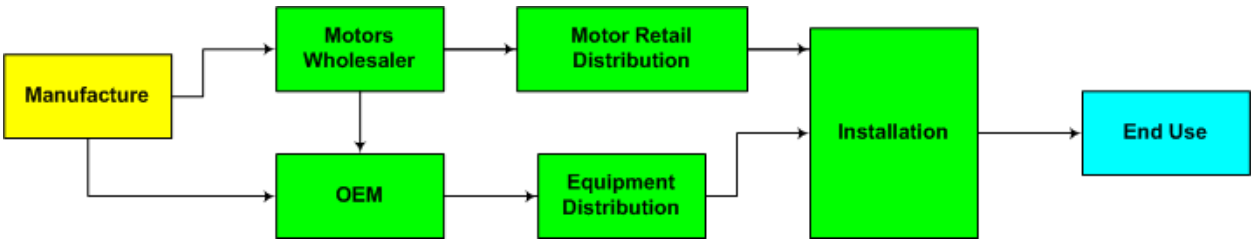

Figure 7.1.1 Distribution Channels for Small Electric Motors

In addition to these distribution chain markups, DOE estimated and added the shipping costs of the motors. This is a significant factor because more efficient motors are often larger ad heavier than less efficient motors, so this is a cost that needs to be included in an accurate cost analysis.

7.1.2 Markup Calculation Procedure

As just discussed, at each point in the distribution channel, companies mark up the price of the equipment to cover their business costs and profit margin. In financial statements, gross margin is the difference between the company revenue and the company cost of sales or cost of goods sold (*CGS*). Inputs for calculating the gross margin are all corporate costs—including overhead costs (sales, general, and administration); research and development (R&D) and interest expenses; depreciation, and taxes—and profits. In order for sales of a product to contribute positively to company cash flow, the product's markup must be greater than the corporate gross margin. Individual products may command a lower or higher markup, depending on their perceived added value and the competition they face from similar products in the market.

In developing markups for OEMs, distributors and retailers, DOE obtained data about the revenue, *CGS*, and expenses of firms that produce and sell the products of interest. DOE's approach categorizes the expenses into two categories: labor-scaling costs (*LSC*), which are fixed labor and occupancy expenses that increase in proportion to the amount of labor required to produce or sell the product, and non-labor-scaling costs (*NLSC*), which are variable operating costs that do not scale with labor and vary in proportion to *CGS*. Together, *LSC* and *NLSC* represent the gross margin.

For each step in equipment distribution, DOE estimated both a baseline markup and an incremental markup. For small electric motors, DOE understands that no increase in distribution labor is necessary for the distribution of more efficient equipment, while the non-labor-scaling cost does increase with increasing equipment costs. This allowed DOE to estimate the incremental markup given a breakdown of distribution and manufacturing business expenses for a particular industry.

In the case of OEM manufacturing costs, DOE did not have detailed industry component costs, but it did have time series of total sales payroll and material costs for a variety of related industries. In this case, DOE performed a regression analysis to estimate incremental markups on material input costs.

7.2 DISTRIBUTOR AND RETAIL MARKUPS

DOE based its distributor and retail markups on financial data from the U.S. Census Business Expenses Survey (BES). DOE organized the financial data into balance sheets that break down cost components incurred by firms that sell equipment with small motors or

replacement motors.[a] The key assumptions that DOE used to estimate the retailer and distributor markups using these financial data were:

1. The balance sheets faithfully represent the various average costs incurred by firms distributing motors and equipment containing motors.

2. These costs can be divided into two categories:
   a. Costs that vary in proportion to the manufacturer sales price (variable costs); and
   b. Costs that do not vary with the manufacturer sales price (fixed costs).

3. Retailer and distributor sales prices vary in proportion to retailer and distributor costs that are included in the balance sheets.

In support of the first assumption, the balance sheets itemize firm costs into a number of expense categories, including *CGS*, operating labor and occupancy costs, and other operating costs and profit. Although retailers and distributors tend to handle multiple commodity lines, the data provide the most accurate available indication of distributor expenses.

In the discussion that follows, DOE uses a division of costs between those that do not scale with the manufacturer sales price (fixed costs—labor and occupancy expenses referred to above as *LSC*), and those that do scale (variable costs—operating expenses and profit referred to above as *NLSC*).

In support of the third assumption, the retailer and distributor industries are relatively competitive, and end user demand for motors and equipment with motors is relatively inelastic—i.e., the demand is not expected to decrease significantly with a relatively small increase in price. Following standard economic theory, competitive firms facing inelastic demand either set prices in line with costs or quickly go out of business.[i]

Using the above assumptions, DOE developed baseline and incremental markups and applied them in calculating end user equipment prices from manufacturer sales prices. DOE used the baseline markups, which cover all of a retailer's or distributor's costs (i.e., both *LSC* and *NLSC*), to determine the sales price of baseline models. The baseline markup relates the manufacturer sales price to the retailer sales price or distributor sales price. DOE considers baseline models to be equipment sold under existing market conditions (i.e., without new energy efficiency standards). DOE calculated the baseline markup (MU_{BASE}) for retailers and distributors using the following equation:

$$MU_{BASE} = \frac{CGS_{RTL/DIST} + GM_{RTL/DIST}}{CGS_{RTL/DIST}} = \frac{CGS_{RTL/DIST} + (LSC_{RTL/DIST} + NLSC_{RTL/DIST})}{CGS_{RTL/DIST}}$$

[a] The distributors to whom these financial data refer handle multiple commodity lines.

Where:

MU_{BASE} = baseline retailer or distributor markup,
$CGS_{RTL/DIST}$ = retailer's or distributor's cost of goods sold,
$GM_{RTL/DIST}$ = retailer's or distributor's gross margin,
$LSC_{RTL/DIST}$ = retailer's or distributor's labor-scaling costs, and
$NLSC_{RTL/DIST}$ = retailer's or distributor's non-labor-scaling costs.

Incremental markups cover only those costs that scale with a change in the manufacturer's sales price (i.e., *NLSC*). Incremental markups are coefficients that relate the change in the manufacturer sales price of higher-efficiency models to the change in the retailer or distributor sales price. DOE considers higher-efficiency models to be equipment sold under market conditions with new efficiency standards. It calculated the incremental markup (MU_{INCR}) for retailers and distributors using the following equation:

$$MU_{INCR} = \frac{CGS_{RTL/DIST} + NLSC_{RTL/DIST}}{CGS_{RTL/DIST}}$$

Where:

MU_{INCR} = incremental retailer or distributor markup,
$CGS_{RTL/DIST}$ = retailer's or distributor's cost of goods sold, and
$NLSC_{RTL/DIST}$ = retailer's or distributor's non-labor-scaling costs.

DOE used financial data from the BES for the categories "Electrical Goods Merchant Wholesalers" and "Machinery, Equipment, and Supplies Merchant Wholesalers" to calculate markups used by wholesale distributors of motors to OEMs and by distributors of equipment containing small motors or replacement motors, respectively. Table 7.2.1 shows the data from the BES and the markups DOE estimated using the procedures described above.

DOE used financial data from the BES, in the "Building materials, hardware, garden supply and mobile home dealers" category to calculate markups used by retail outlets that sell equipment containing motors or replacement motors.[ii] Table 7.2.2 shows the BES data that DOE used and the markups that DOE estimated following the procedures described above.

Table 7.2.1 Data Used to Calculate Wholesale Markups

Item	Equipment Wholesale (Million Dollars)	Motors Wholesale (Million Dollars)
Sales (revenue)	225425	205688
Cost of Goods Sold (CGS)	158097	160435
Gross Margin (GM)	67328	45253
Operating Expenses	52498	42110
Labor-Scaling Costs (LSC):		
Annual Payroll	25804	19402
Fringe benefits	4343	3233
Contract labor	750	954
Taxes and license fees	823	450
Lease and rental payments	2932	1980
Telephone and other communications	1185	958
Purchased Utilities	706	478
Contract work	151	269
Purchased repair and maintenance services	826	436
Commissions paid	963	1309
LCS Subtotal:	38483	29469
Non-Labor-Scaling Costs (NLSC):		
Depreciation and Amortization	2650	1947
Office Supplies	885	663
Packaging and Other Materials	346	425
Advertising Services	959	1842
Legal Services	277	292
Accounting, Auditing, and Bookkeeping	346	215
Computer Related Services	403	498
Other Operating Expenses	8149	6759
Net Profit Before Taxes	14830	3143
NLSC Subtotal:	28845	15784
Baseline Markup (MU_{BASE}) = (CGS+GM)/CGS	**1.43**	**1.28**
Incremental Markup (MU_{INCR}) = (CGS+NLSC)/CGS	**1.18**	**1.10**

Table 7.2.2 Data Used to Calculate Retail Markups

Item	Million Dollars
Sales (revenue)	148397
Cost of Goods Sold (CGS)	102922
Gross Margin (GM)	45475
Operating Expenses	3664
Labor-Scaling Costs (LSC)	
Annual Payroll	17740
Fringe benefits	3212
Contract labor	941
Taxes and license fees	728
Lease and rental payments	2474
Telephone and other communications	601
Purchased Utilities	918
Contract work	0
Purchased repair and maintenance services	840
Commissions paid	0
LCS Subtotal:	27454
Non-Labor-Scaling Costs (NLSC)	
Depreciation and Amortization	1783
Office Supplies	488
Packaging and Other Materials	264
Advertising Services	1321
Legal Services	159
Accounting, Auditing, and Bookkeeping	196
Computer Related Services	179
Other Operating Expenses	4820
Net Profit Before Taxes	8811
NLSC Subtotal:	18021
Baseline Markup (MU_{BASE}) = (CGS+GM)/CGS	**1.44**
Incremental Markup (MU_{INCR}) = (CGS+NLSC)/CGS	**1.18**

7.3 ORIGINAL EQUIPMENT MANUFACTURER MARKUP

DOE calculated the OEM markup as follows:

$$\frac{SALES}{PAY + MAT + CAP} = MU_{BASE}.$$

Where:

$SALES$ =	value of shipments,
PAY =	payroll expenses,
MAT =	material input expenses,
CAP =	capital expenses,
MU_{BASE} =	baseline markup.

The *2002 Economic Census Manufacturing Industry Series* reports the payroll (production and total), cost of materials, capital expenditures, and total value of shipments for manufacturers of various types of machinery. Six years of data are reported for each manufacturer type. DOE collected this data for 11 types of OEMs:

- Air-conditioning and warm air heating equipment and commercial and industrial refrigeration equipment manufacturing
- All other industrial machinery manufacturing
- Farm machinery and equipment manufacturing
- Food product machinery manufacturing
- Heating equipment (except warm air furnaces) manufacturing
- Industrial and commercial fan and blower manufacturing
- Machine tool (metal cutting types) manufacturing
- Machine tool (metal forming types) manufacturing
- Other metalworking machinery manufacturing
- Sawmill and woodworking machinery manufacturing
- Textile machinery manufacturing

The markups range between 1.20 (Industrial machinery, Machine tools) and 1.56 (Heating equipment), with an average of 1.37.

DOE estimated incremental markups using a least squares regression of the value of shipments on payroll and cost of materials. Because there is a large range in the size of the OEM types, companies with value of sales greater than $10 billion were separated from those with value of sales less than $10 billion. The incremental markup for larger companies was 1.27 and the incremental markup for smaller companies was 1.33. DOE used the former value for the

channel in which OEMs purchase motors directly from motor manufacturers, and the latter value for the channel in which OEMs purchase motors from a motor distributor. This approach assumes that larger companies would be more likely to purchase motors directly from motor manufacturers.

DOE developed a modified OEM markup for the Final Rule analysis which takes into account the costs faced by OEMs which need to redesign their products in order to incorporate small motors of different sizes. Nationally, about 2.5% of U.S. gross domestic product is spent on research and development (R&D)[iii]. DOE estimates that R&D by equipment OEMs, including the design of new products, generally represents approximately 2 percent of company revenue. This percentage is slightly less than the national average to account for high technology companies that generally spend a much larger fraction of revenue on R&D than OEMs of equipment that incorporate small motors. DOE accounted for the additional costs to redesign products and incorporate differently-shaped motors by adding 2% to the OEM markup, increasing the baseline OEM markup from 1.37 to 1.39 and the incremental OEM markup from 1.27 to 1.29 for OEMs without a distributor, and 1.33 to 1.35 for OEMs that purchase motors through distributors. For sensitivity cases (based on NEMA's OEM survey) in which some OEMs are assumed to require space-constrained designs, DOE assumed that these OEMs would not face redesign costs, and therefore did not include this 2% increase in the OEM markup.

7.4 CONTRACTOR OR INSTALLER MARKUP

DOE used information from RSMeans Electrical Cost Data[iv] to estimate markups used by contractors in the installation of equipment with small motors or replacement motors. RSMeans electrical cost data estimates material expense markups for electrical contractors as 10%, leading to a markup factor of 1.10. DOE recognizes that contractors are not used in all installations, since some firms have in-house technicians who would install equipment or replace a motor. However, DOE has no information on the extent to which this occurs, so it applied a markup of 1.10 in all cases.

7.5 SALES TAXES

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

DOE derived state and local taxes from data provided by the Sales Tax Clearinghouse.[v] These data represent weighted averages that include county and city rates. DOE then derived population-weighted average tax values for each Census division and large state, as shown in Table 7.5.1 below. DOE then derived U.S. average tax values using a populated-weighted average of the Census division and large State values. This provides a national average tax rate of 6.84 percent, which DOE used for each of the distribution channels.

Table 7.5.1 Average Sales Tax Rates by Census Division and Large State

Census Division/State	Tax Rate	Population (July 1, 2007)[vi]
New England	4.98%	14,264,185
Mid Atlantic	6.07%	21,118,712
East North Central	6.56%	46,338,216
West North Central	6.65%	20,050,579
South Atlantic	5.95%	39,609,017
East South Central	7.85%	17,944,829
West South Central	8.30%	10,745,317
Mountain	6.46%	21,360,990
Pacific	4.97%	12,182,745
New York State	8.25%	19,297,729
California	7.95%	36,553,215
Texas	7.95%	23,904,380
Florida	6.70%	18,251,243

7.6 OVERALL MARKUP

The overall markup for each distribution channel is the product of the relevant markups, as well as the sales tax. DOE used the overall baseline markup to estimate the end user equipment price of baseline models, given the manufacturer selling price of the baseline models. As stated above, DOE considers baseline models to be equipment sold under existing market conditions (i.e., without new energy efficiency standards).

DOE used the overall incremental markup to estimate changes in the end user equipment price, given changes in the manufacturer cost above the baseline model cost resulting from a standard to raise equipment efficiency. The total end user equipment price for higher-efficiency models is composed of two components: the end user equipment price of the baseline model and the change in end user equipment price associated with the increase in manufacturer cost to meet the new efficiency standard. The following equation shows how DOE used the overall incremental markup to determine the end user equipment price for higher-efficiency models (i.e., models meeting new efficiency standards).

$$EQP_{STD} = MSP_{MFG} \times MU_{OVERALL\_BASE} + \Delta COST_{MFG} \times \left(MU_{INCR} \times Tax_{SALES}\right)$$
$$= EQP_{BASE} + \Delta COST_{MFG} \times MU_{OVERALL\_INCR}$$

Where:

EQP_{STD} = end user equipment price for models meeting new efficiency standards,
EQP_{BASE} = end user equipment price for baseline models,
MSP_{MFG} = manufacturer selling price for baseline models,
ΔMSP_{MFG} = change in manufacturer selling price for higher-efficiency models,
MU_{INCR} = incremental OEM or distributor markup,
Tax_{SALES} = sales tax,
$MU_{OVERALL\_BASE}$ = baseline overall markup (product of manufacturer markup, baseline OEM or distributor markup, and sales tax), and
$MU_{OVERALL\_INCR}$ = incremental overall markup (product of manufacturer markup, incremental OEM or distributor markup, and sales tax).

Table 7.6.1 summarizes the markups and the overall baseline and incremental markups for each of the three identified channels. Weighting the values by the respective shares of each channel yields an average overall baseline markup of 2.42 and an overall incremental markup of 1.75.

Table 7.6.1 Summary of Markups for Small Motors

	Direct to OEMs (65%)		**Via Distributors to OEMs (30%)**		**Via Distributors to End-Users (5%)**	
	Baseline	**Incremental**	**Baseline**	**Incremental**	**Baseline**	**Incremental**
Motor Wholesale Distributor	-	-	1.28	1.10	1.28	1.10
Equipment Manufacturer (OEM)	1.39	1.29	1.39	1.35	-	-
Equipment or Motor Distributor or Retailer	1.43	1.18	1.43	1.18	1.44	1.18
Contractor or Installer	1.10	1.10	1.10	1.10	1.10	1.10
Sales Tax	1.0684		1.0684		1.0684	
Overall	2.34	1.79	2.99	2.06	2.17	1.53

The example provided below illustrates how DOE used the baseline and incremental markups to derive an end user equipment price. Assuming the baseline manufacturer selling price is $93.46 and the change in manufacturer price to meet a given energy efficiency standard is $10, the resulting baseline end user equipment price (EQP_{BASE}) and higher-efficiency equipment price (EQP_{STD}) are:

$$EQP_{BASE} = MSP_{MFG} \times MU_{OVERALL\_BASE}$$
$$= \$93.46 \times 2.35 = \$219.63$$

$$EQP_{STD} = EQP_{BASE} + (\Delta MSP_{MFG} \times (MU_{OVERALL\_INCR}))$$
$$= \$219.63 + (\$10 \times 1.75) = \$219.63 + \$17.50 = \$237.13$$

7.7 SHIPPING COSTS

DOE examined freight shipping costs to evaluate the impact of increased motor weight on installed cost. The Department collected quoted shipping costs from 8 freight shipment companies for single shipments by "less than truckload" (LTL) ground service weighing between 50 and 1,200 pounds and over shipping distances between 350 and 3,000 miles. Marginal shipment costs per pound varied from 10.5 cents to $1.52, depending on the total weight, distance shipped, and guaranteed delivery times. In addition, marginal costs can be zero for small shipments whose cost is determined by size rather than weight. DOE used a median marginal shipment cost of 50 cents per pound.

According to the engineering analysis, DOE estimates that the weight of a 1 hp small electric motor can vary from 31 to 55 pounds while the manufacturer selling price varies from $98 to $235. Shipping costs therefore are potentially significant tend to be less than 10% of the manufacturer selling price increase of more efficient motors.

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