

Incremental Markups – A Critical Review of Theory and Practice

Comments on *An Analysis of Price Determination and Markups in the Air Conditioning and Heating Equipment Industry* - LBNL-52791

Summary

In the paper *An Analysis of Price Determination and Markups in the Air Conditioning and Heating Equipment Industry* (Markup Paper) the authors propose to “calculate the change in final consumer prices due to minimum efficiency standards focusing on a standard economic model.”¹ They further go on to “find that the ratio of manufacturer price to final consumer price prior to a standard tends to exceed the ratio of the change in manufacturer price to the change in final consumer price”. Or, more simply, that the markup through the distribution channel goes down following a change in appliance efficiency standards. The US Department of Energy (DOE), in setting minimum appliance efficiency standards, then uses this Incremental Markup.

This analysis relies on a model of industry behavior based on perfect competition as a normative standard, i.e. the distribution process for air conditioning and heating equipment will function in the future as predicted by the perfect competition model. For this to be credible and useful for future projections by policy makers, the proposed model must meet *all* of several conditions:

- **Applicability:** all the conditions of the perfect competition model must be met
- **Exclusivity:** no other model with different projections can be applicable
- **Sufficiency:** there is enough data for the model
- **Accuracy:** the projections from the model are demonstrated to be correct

In this paper, we will show that none of these conditions apply. There is an alternative model of industry organization that characterizes the distribution process for air conditioning, and heating equipment that better fits the actual operation of the market. This raises questions about the *applicability* and *exclusivity* of a perfect competition paradigm. In addition, the literature on industry structure and profits amply demonstrate that no model has strong predictive power and that all such models have major data flaws questioning both their *sufficiency* and *accuracy*.

¹ Dale, Larry; Millstein, Dev; Coughlin, Katie; Van Buskirk, Robert; Rosenquist, Gregory; Lekov, Alex and Bhuyan, Sanjib: *An Analysis of Price Determination and Markups in the Air Conditioning and Heating Equipment Industry*, Lawrence Berkeley National Laboratory LBNL-52791, January 2004, Abstract

As such, the proposal to use the Incremental Markup analysis fails not one, but all of the conditions and should not serve as the basis for policy projections. There is no *a priori* theoretical support for the DOE position that margins will, in fact, converge to some theoretical value. In addition, DOE proposes no evidence to show that margins or markups do, in fact, behave in this manner.

In this paper, we will develop an alternative theoretical explanation for why margins/markups need not converge and for why firms could earn profits beyond their long-term cost of capital. Second, we will show that actual pricing behavior by heating ventilating and air conditioning (HVAC) distributor/wholesaler and contractors is consistent with constant markups across all products and that these markups have remained stable over time. The combination of theoretic foundation and actual experience indicates that the use of a single, standard markup for both base equipment and incremental cost additions is the appropriate basis for forecasting future costs.

Distribution Channels and Segments for Residential Air Conditioning and Heating Products

Before delving into a discussion of the underlying economic theory, it will be helpful to understand the distribution channels and end-customer market segments for air conditioning and heating products. This is especially the case since the ultimate use by DOE of markups through the distribution channel is to project actual prices paid by end-users for air conditioning and heating equipment. There are three broad segments of the HVAC industry:

- Residential (including furnaces, air conditioners and heat pumps – there is a parallel process for boilers that is not included)
- Commercial Unitary (including single package air conditioners and heat pumps)
- Applied (including chillers and related air handlers)

While there is some overlap in channels and customers across these segments, this is a convenient breakdown that is widely used in the HVAC industry. The products in the Applied segment are largely not covered by DOE efficiency standards and are not part of this discussion. To put these segments into perspective, the Residential segment includes approximate annual production of 3-4 million air conditioners and heat pumps and 3 million gas furnaces. The Commercial Unitary segment includes approximate annual production of 200-300 thousand air conditioners and heat pumps.

Residential

The Residential segment is largely comprised of warm air furnaces (electric, gas, oil or other fuels) and split system air conditioners and heat pumps. These products are

principally used in homes, although some of these products are used in very light commercial applications. They are sold through Distributor/Wholesalers to installing HBAC contractors and then either directly to homeowners or to remodelers or homebuilders. The Residential segment includes approximately xxx million split-system condensing units and heat pumps and xxx million gas, electric and oil furnaces annually.

Distributor/Wholesaler/Contractor - Residential

Distribution of residential air conditioning and heating equipment moves through two largely distinct, but superficially similar, channels:

- Manufacturer-aligned distributors and
- Multi-manufacturer wholesalers

Most of the larger air conditioning and heating equipment manufacturers have closed distribution for their principal name brands (Carrier, Trane, York, Lennox, etc.) in the residential segment. For these name brands, the manufacturer has *distributors* who sell virtually only that name brand of equipment (plus ancillary supplies and some complimentary specialty items). Lennox goes a step further and sells residential scale equipment. These distributors advertise the name brand and have some equity in their local territory and manufacturer relationship. Most have geographic territory agreements of some form. In turn, a group of contractors align with the distributor/manufacturer pair, usually referred to as “dealers”. The dealers advertise their alliance, often as part of their name, and purchase the vast bulk of their equipment from a single distributor in this channel. While dealers can switch their alliance, this is a slow and costly process requiring re-branding the dealer, switching literature, changing credit arrangements, cleaning out inventory and retraining the installation and service staff. Based on the estimated 2008 market shares by manufacturer quoted by DOE, the companies with aligned distribution have 62-68% market shares for gas furnaces, heat pumps and central air conditioners.² This somewhat overstates the total percent of the market using aligned distribution since these manufacturers also have some brands they sell through the alternative channel.

The alternative channel is sales through multi-manufacturer *wholesalers* who carry air conditioning and heating equipment from multiple manufacturers. These wholesalers have somewhat greater flexibility in switching the manufacturer they represent or the percent of sales between several manufacturers. In turn, non-dealer affiliated contractors often purchase from these non-aligned wholesalers. These contractors have greater flexibility in selecting a manufacturer for any given project and may have more flexibility in selecting between wholesalers. This channel has the remainder of the furnace, heat pump and air conditioner market.

² US Department of Energy, Technical Support Document EERE-2011-BT-STD-0011-0012, June 2011

End User – Residential

At the residential end user level, there are three principal segments: emergency replacement, large homeowner projects and production builders (sales of air conditioning and heating equipment to the mobile home are not covered by this segment). Replacement sales are purchases by homeowners to replace existing heating or air conditioning equipment. Most often, these are for failed units where immediate replacement is necessary. Large homeowner projects include remodeling of an existing home or construction of a new home where the homeowner who will (or does) occupy the home is an integral part of the construction process. Production builders cover residential developers who build homes regularly for resale to homeowners. Each of these individual segments has a different set of decision makers and, therefore, a different mix of criteria for selecting air conditioning and heating equipment.

In the emergency replacement segment, the homeowner is the purchaser and selects a contractor who actually provides and installs the heating or air conditioning system. There is almost always time pressure to find and install the replacement unit, limiting the homeowner's ability to shop and to request proposals from multiple contractors. In addition, the homeowner purchases air conditioning and heating equipment infrequently so the homeowner is rarely familiar with the suppliers, the alternative heating and cooling options or the likely cost of a system. The homeowner is at a substantial disadvantage to the contractors in the degree of information about the price, quality or other matters involved. It is also typical for the homeowner to get a package price including all labor, equipment, supplies, etc., so the homeowner has no real insight into the price of equipment. The homeowner often does not select the lowest price with actual selection depending on perceived quality, speed and other factors. Incidentally, contractors in this segment also have little insight into their competitors' pricing since they only rarely see the competitors proposals. Even if they do see competitor pricing, it is typically only a total including both labor and materials.

In the large project segment, the homeowner is dealing with a homebuilder or remodeling contractor who serves as an intermediary with the air conditioning and heating subcontractor. Virtually all of the characteristics of the purchase process here are different from that of emergency replacement, other than the homeowner's general lack of knowledge and familiarity with air conditioning and heating equipment and that the purchase is for a single house/project. The homebuilder or remodeling contractor generally selects the air conditioning and heating subcontractor based on a combination of price, reliability, relationship and the like. The homeowner may or may not be given a choice between different contractors, manufacturers, efficiencies or other options. The air conditioning and heating subcontractor typically quotes a total installed price to the homebuilder or remodeling contractor.

In the production builder segment, the homebuilder is the principal decision maker. The homebuilder constructs a number of houses as part of a single project and solicits bids for the total package of homes. If the project is big enough, the manufacturer or distributor/wholesaler may become involved to quote a special equipment price. This is the only segment where there is reasonable parity of information between the purchaser (the homebuilder) and the remainder of the distribution channel (contractors, distributors, manufacturers). Each party in this process deals with the other on a regular basis and the homebuilder has the opportunity to check prices for equipment across various manufacturers and contractors.

The sizes of the segments fluctuate with the economy and the new construction cycle. On a long-term average, the emergency replacement segment is approximately 50% of air conditioning and heating shipments. Large homeowner projects represent approximately 30% of shipments and production builders represent the remaining 20%.

Commercial Unitary

The Commercial Unitary segment is largely comprised of single package air conditioners and heat pumps (commonly referred to as “rooftop” units). These use a direct expansion technology similar to Residential products and Commercial Unitary products typically have greater capacity and combine the evaporator and condenser coils, fans and compressors in a single cabinet.

Distributor/Wholesaler/Contractor – Commercial

Manufacturers of Commercial Unitary air conditioners and heat pumps use their Residential distributor/wholesaler channel for Commercial Unitary equipment. In addition, some manufacturers supplement the Residential distributor/wholesaler channel with manufacturer-owned offices and independent sales representatives who handle Applied equipment. A breakdown between the Residential distributor/wholesaler and the Applied office channels is not available although the majority of sales are to contractors specializing in packaged air conditioning equipment and sheet metal ducting rather than to contractors specializing in Applied chillers and piping.

The distributor/wholesaler makeup of the Commercial Unitary segment is almost exclusively made up of aligned distributors. Most of the residential HVAC manufacturers who use non-aligned wholesalers have a minor presence in the commercial segment. In general, because of their protected geographic territories and their alignment with specific contractors, distributors are in a position to provide more service and support to contractors than do wholesalers. This service and support is necessary for Commercial Unitary equipment because of the greater engineering requirements for many commercial projects, the inclusion of

accessories or variations in the equipment order, the complexities of job-site delivery and the greater credit exposure for larger jobs.

Smaller commercial projects tend to be done by combined residential/commercial HVAC contractors who are traditionally affiliated with a distributor and manufacturer brand. The services offered by the distributor are important to those contractors and help promote affiliation. Many of these contractors also have active service businesses doing routine maintenance and small upgrades and repairs for regular end-use customers.

Larger commercial projects (both Unitary and Applied) fall into two major segments: plan and spec and value engineered. While contractors may do both, those with the skills necessary to do value engineering try to focus their business away from plan and spec work.

In plan and spec projects, the general contractor (or, occasionally, the owner) issues a set of detailed specifications and asks multiple contractors for quotes. Typically the lowest bid sets the price for the project, although the contractor actually awarded the project may not have originally been the lowest bidder. HVAC contractors often request special quotes for equipment for these projects because of their competitive nature. It is common for the distributor (or manufacturer if the project is big enough) to put out a price for the job packaged to all affiliated contractors bidding that job. This segment is the only truly price clearing one, with visible bidding patterns and relatively visible pricing (although dissembling on the actual final price of a project is not uncommon). As a result, this segment can be highly competitive and most contractors try to avoid it when at all possible

The value engineered (sometimes referred to as design-build) segment includes contractors and projects where the HVAC contractor works with the general contractor or owner to design a system meeting the project's needs. This approach is often faster than the multi-step design, plan, bid, build process of plan and spec work. It often can result in both lower costs for the job and higher margins to the contractor because of special knowledge and construction expertise. Pricing in this segment is almost always for a total installed package where the breakdown of labor, materials, equipment and margins is obscured from the customer. The choice of contractor is usually built upon past relationships and the perception of competitive price. It is not typical to bid the project to multiple contractors, although there may be general discussion and budget ideas from several contractors before the final one is selected to do the actual design and pricing.

End customers for Commercial Unitary equipment vary from small retail companies to multi-facility owning chains and developers. Smaller end users are very similar to residential customers in that they purchase HVAC equipment rarely and have no real idea of the marketplace and the expected price or other factors for a project. They make their contractor selection on the local relationship, perception of quality, timing and perceived value. Larger customers are in the marketplace more

frequently and may have greater visibility into the expected price levels in the market. However, the actual selection of contractors is frequently based on a combination of price and a wide variety of other factors. Pricing is almost always for complete packages without separate pricing for individual items, such as equipment.

Economic Theory

In the Markup Paper, the authors base their argument on the economic theory of perfect competition: “(the) basic model assumes perfect competition and constant marginal cost curves.”³ The core implication of the argument is that there is no ability for the aggregate of firms to earn profits above the normal cost of capital. As a result, all sellers in aggregate will only be able to raise prices to incorporate their variable costs: “This model of markup determination in the case of perfect competition and constant costs implies that the increase in final price that a consumer sees will equal those changes in costs associated with the increasing cost of a good.”⁴ From there, the authors propose methods to estimate the incremental costs and compute an incremental markup.

The argument and the conclusions depend on the proposition that firms in aggregate are constrained in some manner so that they cannot earn profits above their normal cost of capital. The authors recognize this in their discussion of “Impact of Market Power on Markups”⁵ where they concede that their proposed method of calculating markups fails when a “firm faces inelastic residual demand”, i.e. when a company or group of companies can continue to increase sales and/or increase prices so that total rate of return increases beyond the normal cost of capital.

As one would expect of a fundamental concept in economics, there has been considerable discussion in the literature over the theory, the applicability and the calculation of supply and demand functions. The swinging pendulum between the belief that markets are mostly competitive or not is currently swinging away from perfect competition with the recent Nobel award to Jean Tirole for the influx of game theory into the operation of markets.⁶

The basic notion behind perfect competition is that there is a stable price/volume point where consumers are purchasing as much as they want and suppliers are maximizing their profits. No purchaser or supplier gains an advantage by deviating from this point because the purchaser cannot buy for less or the supplier cannot sell for more. From the suppliers’ standpoint, any supplier would lose all its business if it raised prices beyond this stable level. In concept the conditions for such a market

³ Dale *et. alia*. p 1

⁴ *ibid.* p 3

⁵ *ibid.* pp 6-8

⁶ For a discussion of the rise, fall and rise of non-market based ideas in theoretical economics, see: www.economicprincipals.com/issues/2014.10.19/1658.html

include:⁷

- Many firms, each small in relation to the market, and with long-run average costs that begin to increase at a scale small enough to ensure the preservation of competition among many firms;
- No barriers to entry or exit; ☒
- Many buyers, each accounting for a small share of demand; ☒
- Perfect information; ☒
- Homogeneous products; ☒
- Single-product firms only; ☒
- No indivisibilities or immobilities in the factors of production; ☒
- Easy substitutability among factors of production; ☒
- No externalities in production or consumption.

The questions facing the Markup Paper are, thus:

- Question 1: Under what circumstances does the perfect competition paradigm apply in real settings?
- Question 2: How many or which of the conditions for perfect competition must exist for the conclusions about the inability to raise prices above variable costs⁸ to hold?
- Question 3: Do the necessary conditions apply in the case of any specific industry under analysis?
- Question 4: In what circumstances (if any) is there evidence that firms can achieve profits in excess of their variable costs?
- Question 5: Do any of the conditions where there is evidence of pricing above variable costs apply to a specific industry?

Clearly to draw any normative conclusions or make any predications, question number 3 above must be true and question number 5 must be false.

Example of Perfect Competition and Its Limits

An example may be helpful to provide some context on what a market arguably meeting the perfect competition conditions is and how restrictive those conditions are. The market for stocks traded on major exchanges is about as close to a perfectly competitive market as one can imagine. The products, shares of stock, are essentially commodities, there are huge numbers of buyers and sellers, there are essentially no barriers to entry or exit and there are rules designed to ensure perfect information. In addition, modern financial theory has developed tools and concepts

⁷ This particular list comes from Peter F. Fisher; *The Strange Career of Marginal Cost Pricing*, Journal of Economic Issues, Vol. XXIV No. 4 December 1990, although there are multiple similar versions.

⁸ All discussions of variable cost use the economic definition including the cost of capital, not a common language definition

to measure the precise value of interest: financial return.⁹ All available empirical evidence supports the conclusion that perfect competition or something very close to it occurs. There is essentially no evidence that investors in widely traded common stocks can earn returns above that individual investor's risk weighted cost of capital.¹⁰

However, it takes only a small step away from the public stock market before the conclusion on excess returns disintegrates. Empirical studies of hedge funds, not just individually but even in aggregate, have shown positive excess returns (or positive alphas).¹¹ Statistical studies of hedge fund managers show positive alphas of 3.7% per year up to 1.25% per month and that positive alphas persist over time. These are substantial returns relative to the 5-6% annual return measured for the US stock market as a whole. Economic theory says that an influx of new entrants will arbitrage away these returns, but so far there is no evidence that this is happening (the returns do not, however, go to investors – most are captured by fund manager fees).

What this demonstrates is the brittle nature of the assumptions behind perfect competition and the notion that profit above costs of capital are not possible. The fact that one financial market may exhibit the expected characteristics from competition does not immediately extend to a related one. Applicability in one financial market does not extend to another. The power of analogy is weak. Any claim that perfect competition exists must, therefore, be proven in the specific marketplace in question. Analogy is not enough.

Empirical Support for the Model of Perfect Competition

One critical test of any theory is whether it yields testable hypotheses and whether those hypotheses are, in fact, true. Like the financial market situation, the prediction from the perfect competition hypothesis is that firms both individually and in aggregate will not be able to earn profits beyond their cost of capital over any extended period of time. The data on this topic is highly equivocal for two reasons. First, there is significant question about the availability and accuracy of the data necessary to perform the analyses. Second, the results show that there appear to be numerous conditions where firms do, in fact, earn consistent profits above the cost

⁹ The Capital Asset Pricing Model (CAPM) and its successor variants define return in relation to variability versus a market composite (Beta) and excess return generated by investor skill (Alpha). This is something of a simplification but is reasonable for the discussion here. The literature on this topic is vast.

¹⁰ Again, the empirical literature on the absence of excess returns in broadly traded stock markets is voluminous. This paper will take that conclusion as given.

¹¹ Stultz, René M.; *Hedge Funds: Past, Present and Future*, Ohio State Fisher College of Business, Fisher College of Business Working Paper Series, February 2007, provides a literature review of studies on hedge fund returns. The data in this study precede the financial crash of 2008. The continued profitability of the trading operations at firms like Goldman Sachs and the continued existence of some large hedge funds in the face of Darwinian focus on performance provide at least anecdotal evidence that superior performance continues.

of capital. At best, the available evidence says that there might be some circumstances where the perfect competition hypothesis holds true but that the data certainly does not support a statement that the hypothesis will necessarily hold true in all, or even most, situations.

The first consideration is the data question. The complete approach to test the perfect competition economic return hypothesis would be to take rate of return on capital data from all firms within an industry and analyze those returns over an extended period of time. As a practical matter, this approach has not been possible. First, real companies often have multiple lines of business and both the perfect competition theory and the example from capital markets show that the definition of an industry needs to be very narrow. So it is not at all clear that relevant data exists, even in principle, to test the hypothesis. Analysts have generally resorted to various government data sets at widely varying levels of industry and firm aggregation, all with significant limitations.

The second consideration is the actual results of the studies on profitability. Studies for firm and industry profitability have investigated whether firm size, industry concentration, effects of scale independent of firm size, effects of advertising and other factors lead to differences in profitability. In addition, many of the studies seek to understand whether industry conditions or firm specific elements have the greatest effects on profitability.

For the perfect competition model to be true as a matter of requirement for future behavior, all of these studies would need to find that there was no variation in the risk-adjusted rate of return under any circumstances. Each individual company and the industry as a whole should all earn the risk-adjusted rate of return. On the contrary, the bulk of the studies find the opposite. A wide range of factors can cause individual firms to diverge from expected norm. For example:

- Collins and Preston establish, in a study of 418 four digit SIC codes in the US Census of Manufacturers for 1958 and 1963, that industry concentration bears on price-cost margins and also find that there are substantial variations in results between consumer and producer goods manufacturers and between high and low differentiation consumer goods. In addition, concentration, geographic dispersion and capital-output ratio have only limited explanatory power for profitability, implying that there is a variation in price-cost ratio and that this variation remains unexplained.¹²
- Gort and Singamsetti find that there is essentially no relationship between the industry a firm is in and/or the level of concentration in the industry on profitability for 507 manufacturing companies.¹³

¹² Collins, Norman R. and Preston, Lee E. Price-Cost Margins and Industry Structure, *The Review of Economics and Statistics*, Vol. 51, No. 3 (August, 1969) pp. 271-286

¹³ Gort, Michael and Singamsetti, Rao; Concentration and Profit Rates: New Evidence on an Old Issue, Explanations in Economic Research, Volume 3, Number 1, National Bureau of Economic Research, 1976

- Porter finds, in a study of 42 consumer goods industries that profitability of firms in an industry can vary significantly depending upon the strategic group a firm belongs to. This study defines groups as leaders and followers, although Porter recognizes that there could be many other factors that could create a group.¹⁴
- Ravenscraft finds that profitability by line of business is not related to industry concentration and is related to firm market share for a sample of 3186 lines of business in manufacturing firms in 1975. The multivariable model for profitability at the line of business level has low explanatory power, with an R² of 20% or lower.¹⁵
- Schmalense tests for firm, industry and market share effects on profitability and concludes that industry structure (concentration) has the greatest effect although this accounts for only approximately 20% of the total profit effect. The sample includes line of business results for US manufacturing companies.¹⁶
- Schmalense also tests the notion of industry concentration (characteristic of the industry matters) versus firm efficiency (market share of the firm matters) and finds that industry matters more than share although neither explains much of profit behavior. The sample covers two years and the statistical results differ greatly between the years. In addition, the range of profits are large in the data sample, with one standard deviation at $\pm 30\%$ plus, indicating large differences in profitability across firms.¹⁷
- Cubbin and Geroski find that “most firms’ profitability experience differs considerably from those of their closest rivals” based on a sample of 217 large UK firms over the period of 1951-1977. In addition they find that there are firms within industries that seem “to inhabit market niches better protected than those on average in their industry” and that there is “evidence pointing towards the notion that returns are not equalized across all firms and sectors even in the long run.”¹⁸ They also note that their findings are not entirely consistent with Schmalense’s.
- Robert Hall measures the “markup ratio” of value added and concludes that the “hypothesis of competition is rejected”.¹⁹ Stefan Norrbin questions these findings for manufacturing industries but does find several industries with

¹⁴ Porter, Michael E.; The Structure within Industries and Companies’ Performance, *The Review of Economics and Statistics*, Vol. 61, No. 2 (May 1979) pp 214-227

¹⁵ Ravenscraft, David J.; Structure-Profit Relationships at the Line of Business and Industry Level, *The Review of Economics and Statistics*, Vol. 65, No.1 (February 1983), pp 22-31

¹⁶ Schmalense, Richard; Do Markets Differ Much?, *The American Economic Review*, Vol. 75, No. 3 (June 1985) pp 341-351

¹⁷ Schmalense, Richard; Collusion Versus Efficiency: Testing Alternative Hypotheses, *The Journal of Industrial Economics*, Vol. 35, No. 4 pp 399-425

¹⁸ Cubbin, J. and Geroski, P.; The Convergence of Profits in the Long Run: Inter-Firm and Inter-Industry Comparisons, *The Journal of Industrial Economics*, Vol. 35, No. 4, June 1987, p 427 and p 436

¹⁹ Hall, Robert E.; The Relation between Price and Marginal Cost in U.S. Industry, *Journal of Political Economy* Vol. 96. No. 5 (October 1988), p 939

positive markup ratios, at the two digit SIC level, such as for Machinery and Stone, Clay and Glass. There is also substantial variation in markup ratio across industries implying that not each industry earns only economic rates of return.²⁰

- Bhuyan and Lopez demonstrate that oligopoly conditions prevail in various food and tobacco industries at the four digit SIC level in terms of “welfare losses” relative to perfect competition.²¹
- Holian and Reza investigate the different effects of accounting versus economic profit data on profitability for 331 firms in a Stern Stewart database for the years 1989-2003. They find that firm effects are more important than industry ones although neither has very strong correlation for accounting profits (adj $R^2 = .168$) while economic profit data has considerably greater explanatory value (adj $R^2 = .504$).²²

This is only a smattering of the empirical work on determinants on industry and firm profitability.

Based on the empirical evidence, it is not possible to say with any confidence that an industry, collection of firms or line of business with structure A will have profit characteristics B. Attempts to create general principles across any or all forms of A, B remain ill defined.

Implications for Assessment of Competition in a Specific Situation

Returning to the Questions posed above, the answer to Question 1, the general applicability of the perfect competition paradigm, is that such applicability is not generally supported by the empirical data. In addition, the answer to Question 2, under what circumstances is it applicable (or how can it be modified to become applicable), is that we do not know, again based on the empirical evidence. Several hypotheses remain in effect on what determines profitability and none has very strong explanatory power.

Michael Spence summarizes the dilemma in discussing contestable market theory:

As students of microeconomic theory know, the conditions under which perfectly competitive outcomes are likely or possible are rather stringent. The conditions include constant or diminishing returns to scale, or scale

²⁰ Norrbin, Stefan C.; The Relation between Price and Marginal Cost in U.S. Industry: A Contradiction, *Journal of Political Economy* Vol. 101. No. 6 (December 1991), p 1162

²¹ Bhuyan Sanjib and Lopez, Rogoberto A.; Welfare Loses Under Alternative Oligopoly Regimes: The U.S. Food and Tobacco Manufacturing Industries, *Journal of Agriculture and Applied Economics*, 27 (2), December. 1995, p 582

²² Holian, Matt and Reza, Ali; Firm and Industry Effects in Accounting versus Economic Profit Data, *Economics Bulletin*, vol. 30 (3) pp 2189-2196, 2010. Note: Stern Stewart is a commercial company advocating the use of economic value analysis. The author participated in training for a competing system in the late 1980s and can attest that the conversion from accounting profit is cumbersome and not amenable to general use despite the greater accuracy found in this study.

economies that are small in relation to the size of the market. For normative purposes, the absence of externalities at the level of costs is also essential.

Perfect competition theory serves two functions in economics. It is sometimes a reasonable approximation to reality in the descriptive sense, and perhaps more importantly it is a welfare standard. In the absence of externalities, perfectly competitive equilibria are Pareto optimal. The problem is that such equilibria do not exist in certain market environments. And even when they do, it is sometimes hard to believe that the competitive model accurately describes what is taking place.²³

Any attempt to apply perfect competition theory to a specific situation needs to demonstrate, for each and every situation, that *all* of the underlying assumptions hold. There is very little to no evidence that this occurs in the real world. A resort to analogy has no empirical and limited theoretical support as a means of predicating profitability from one industry to another.

Alternative to Perfect Competition Theory

The stringent form of perfect competition requires a binary answer to the underlying assumptions. Either these assumptions are true, in which case the perfect competition model holds, or they are not and it fails. As a practical matter, as Spence points out, the situation is rarely that black and white. One response has been the Porter Five Forces Model that looks at the factors affecting competition and profitability as continuums.²⁴ The conceptual explanatory power of this concept is well recognized and aids in the understanding that competition is not binary. However, these forces are not continuous variables. It is not possible to build a metric evaluating each of these forces and then calculate the degree to which an industry is or is not competitive.²⁵ The implications of the Porter approach partially explain the difficulty in finding empirical relationships in actual industry data.

²³ Spence, Michael; Contestable Markets and the Theory of Industry Structure: A Review Article
Contestable Markets and the Theory of Industry Structure by William. J. Baumol, John C. Panzar,
Robert D. Willig, *Journal of Economic Literature*, Vol. 21, No. 3 (September 1983), pp 981-982

²⁴ Porter, Michael E.; How Competitive Forces Shape Strategy, *Harvard Business Review*, March, 1979

²⁵ A colleague of the author's attempted such an exercise in the late 1980s as a part of a strategy methodology and abandoned the attempt as both questionable in theory and unrealistically complex in practice.

Application of Markup Theory in the Air Conditioning and Heating Industry

The authors of the Markup Paper contend that the perfect competition (low market power) model applies in the case of the distribution channels for air conditioning and heating equipment. Their support for this is:

1. The large number of participants at the wholesale and contractor levels²⁶
2. Reference to the Norrbin study (above)²⁷ – note the Norrbin study nowhere mentions any industries other than manufacturing so its applicability in this situation is not obvious and the Norrbin study does not actually claim that industries can be presumed competitive
3. Unsupported statement that wholesale and retail appliance (sic) markets have low barriers to entry²⁸
4. Analysis of wholesaler markups across states where they find a constant markup of 1.39²⁹

Nowhere do the authors perform any actual empirical analysis of competitive conditions, profit or margin trends in either the wholesale or the contracting sectors. As discussed later, the state-by-state analysis is actually more compatible with alternative theories.

So the authors are resorting to elements of economic theory that have no empirical support as actual determinants of profit levels in industry. As we have seen, there is little or no evidence that industry structure characteristics such as number of participants or entry barriers actually correlate with profitability. Their response to Question 3, applicability of theory, is simply assertion. This is hardly sufficient in the face of theory and data questioning the perfect competition hypotheses to demonstrate in any convincing fashion that their concepts apply.

Alternative Explanation in HVAC

Since the empirical conditions do not allow abstract, *a priori* application of empirical theory in specific situations, any process of estimating markups in an industry must look at the facts for that situation. Questions 4 & 5 above become relevant: Are there conditions that could imply the opportunity for firms to price above risk adjusted economic profit and are those conditions more or less likely to apply in this situation than are the assumptions for perfect competition?

In the case of the distribution channel for air conditioning and heating equipment, Porter's concept of strategic group makes sense, providing a theoretical foundation

²⁶ Dale *et. al.* p 1

²⁷ *ibid.* p 9

²⁸ *ibid.* p 9, note that the markets in question are for air conditioning and heating equipment not appliances, although this may simply be a matter of inadvertent usage

²⁹ *ibid.* p 10

for predicting profit patterns. Analysis of actual pricing practices by industry participants shows that they are not consistent with a concept of incremental markups. The actual data on margins is incomplete, with the data that exists suggesting that firms manage to maintain consistent margins over time and across business cycles.

The combination of the theoretical foundation and the empirical data indicates that the future pricing behavior throughout the air conditioning and heating distribution channel is not likely to follow incremental markups, as posited in the Markup Paper, and is more likely to continue following past patterns, in this case consistent average markups.

At the level of theory, the two distinct segments at the wholesale level: manufacturer-aligned distributors and multi-manufacturer wholesalers are strategic groups as defined by Porter. The basic concept is that the competitive conditions under the Porter five forces are distinct between the groups. Therefore, there may be circumstances where the conditions do not require a reversion to the profit results expected under perfect competition.³⁰ Porter specifically discusses mobility barriers which prevent firms from entering a group either from outside the industry or from within the industry but outside the group. Porter goes on to posit that the presence of mobility barriers provide “an explanation for why some firms in an industry persistently earn higher profits than others”³¹ Porter also discusses inter-firm rivalry noting that market interdependence will tend to promote rivalry but to the extent that firms are competing for customers in different segments, this will tend to diminish rivalry.³²

It is apparent that the manufacturer-aligned channel of distributors and their associated contractors form a strategic group in the Porter sense inside the broader air conditioning and heating distribution process. Moreover, the local nature of the air conditioning and heating distribution process (contractors have very small geographic range and aligned distributors have assigned territories) effectively create myriad local groups of aligned distributors and contractors. The apparent lack of concentration in the channel, implied by the large number of firms is, in fact, a chimera and misses the more concentrated nature of the localized groups.

In order to establish that the manufacturer aligned strategic group can have the opportunity to earn “consistently higher profits”, it must be clear that the overall competitive intensity of the group is lower than for the remaining industry:

1. Mobility barriers

³⁰ While not discussed here, there is ample evidence that profit results above levels predicted under perfect competition can occur without collusion. Nothing in this discussion should be taken to imply that collusion or other similar activities take place at any stage of the air conditioning and heating industries.

³¹ Porter, *Structure Within Industry and Performance*, p 216

³² *ibid.* p 218

2. Threat of substitutes
3. Power of customers
4. Power of suppliers
5. Internal rivalry

First mobility barriers into and within the manufacturer-aligned group are relatively high. Distributors have distribution agreements with the manufacturer to which they are aligned that limit the ability of new distributors to come into a local market. Similarly, both residential and commercial contractors have more and less formal relationships with a single aligned distributor. It is not in a manufacturer's interest to flood an effective distributor's territory with a new distribution entrant. While this might increase total sales, the investment to enroll, train and support a distributor is high. Encroachment on a distributor's territory also produces loud, vigorous complaints from all the manufacturer's distributors who believe they have an equity interest in their territory. Similarly, there are limits to the number of contractors an aligned distributor will choose to support. Each contractor requires training, certification and other investment. The distributor will attempt to manage its portfolio of contractors so that there is effective but not excessive coverage of the territory.

The threat of substitutes in the air conditioning and heating industry is, essentially, nil. The channel for air conditioning and heating equipment carries virtually all the products that typically meet the comfort conditioning need. In small regions of the country, there is some substitution between warm air heating and boilers, which use a separate channel, but this is insignificant on a national scale.

The power of customers for the manufacturer-aligned channel is also relatively low since much of the residential market is in emergency replacement segment. Here the customer is the homeowner who is at a very distinct disadvantage relative to the contractor. Purchases are infrequent, pricing is opaque, time pressure is high to make a decision, and quality is hard to discern. All of these combine to give the contractor considerable power relative to the homeowner. Little of the commercial market is in plan and spec work where customer power is relatively high. Customer power remains weak in the other commercial segments.

Conversely, the power of the manufacturer at least appears to be relatively high since the aligned distributors have no real options. In practice, the need to keep the total channel satisfied tends to limit the manufacturer's power. From a game theory perspective, these relationships are ones which continue and where the "game" is played repeatedly. This tends to produce a solution that is satisfactory to all parties rather than encouraging the manufacturer to exercise power and extract all of the value.³³

³³ The author has observed and participated in manufacturer/distributor negotiations in the air conditioning and heating industry and in similar ones from the perspective of both sides. In

Finally, the rivalry between firms is moderate. Contractors complain bitterly and often about how highly competitive their market is. This is very true in the production builder and plan and spec segments where demand fluctuates greatly and the homebuilder, general contractor or large commercial owner have considerable power. However, the objective level of internal rivalry between contractors declines in the other segments. Contractors rarely know the comparative price level offered by their competitors and price is rarely the deciding factor in the sense that low price does not necessarily win a job. The critical activity for a contractor in this segment is to get invited to propose. So rivalry is more likely to take the form of advertising and promotion than price competition.

All of this contrasts the manufacturer-aligned segment with the general one. In the broader market at the contractor level, entry barriers are low and the power of the customer starts to increase. However the threat of substitutes is still low and the power of the manufacturer declines since the contractor often has choice between brands at a single wholesaler and has more flexibility to choose between multiple wholesalers. At the wholesaler level, customer power is relatively weak as there are a large number of contractors and very few make up a significant portion of the wholesaler's business. The power of the supplier is moderate since wholesalers have considerable investment in inventory and sales literature, etc. so switching is possible but not easy. There remains no effective threat of substitutes (in fact the threat from boilers is lowest here as many carry boilers). Internal rivalry is relatively high as the Internet and other factors have tended to make pricing more transparent increasing the potential for competition between wholesalers.

In sum, the distribution process for air conditioning and heating equipment contains two strategic groups: the manufacturer-aligned distributors plus their associated contractors and the multi-line wholesalers and the remaining contractors. The competitive intensities of the two segments are different leading to a likely inference that the manufacturer-aligned channel has the potential to earn consistently higher profits – economic profits that would not be expected to be at or go to zero as required under the perfect competition model. The answers to Questions 4&5 are yes and yes.

Actual Pricing and Markup Practices

Shorey Consulting conducted a survey of HVAC distributor/wholesalers and HVAC contractors in November 2014 to determine the actual pricing practices of both groups. The purpose was to ascertain whether pricing was for a package of products and services where air conditioners and heat pumps might be a small component of the total price and how the distributor/wholesalers and HVAC contractors actually determined their margin structure.

general, each side in the negotiation has ascribed significant bargaining power to the other irrespective of the actual situation.

The results of that survey can best be summarized by one distributor, who replied when presented with the DOE concept of incremental markups as a description of actual practice: “that is the stupidest idea I have ever heard.” Both distributor/wholesalers and HVAC contractors manage to constant target margin percentages across their whole businesses and do not vary margins for individual products. They all respond that manufacturer price increases (or rare decreases) are passed through with their traditional markups.

Distributor/Wholesaler

For distributor/wholesalers, the common practice is to work off a list price sheet and then give a standard discount to a contractor. The amount of the discount may vary between contractors depending on historical purchasing volume or other factors, with the discount is consistent across all products. There may be circumstances where individual projects get special pricing, often with concessions from the manufacturer, but this is in exceptional situations. The distributor/wholesaler then manages the business to preserve margin percentage.

Whenever the distributor/wholesaler sees a price increase, this increase is passed through to customers with the standard margin: “Anytime we have a pricing increase, we absolutely pass it on to the dealer. All day long, we pass the cost onto the consumer. When we see a 30/40% increase, so do they.”

“We always look at margin percentage, never absolute dollars. Manufacturers come to us all the time with price increases. Once we agree on a price from the manufacturer we put it in our price sheet at a level that will preserve our % margin. If we have the sense that the manufacturers are all raising their prices together because of government regulations or whatever, we simply mark up the increase to hold our margin and pass it on to our dealers. The dealers are all margin driven, too. That’s all they care about. So, in the end, the consumer pays for all increases.”

“Our software system publishes our margin every day. We live and breathe margin. Our sales reps are incented around dollars of revenue, but our top management team is incented around gross margins.”

Thus the pricing process (list prices with standard discounts), management behavior (focus on maintaining percentage margin) and past practices (passing through price increases while maintaining historic percentage margin) are consistent with a constant margin for both base equipment and for increased costs due to efficiency improvements. There is no indication or support for the notion that future margin percentages will decline with increased equipment prices to maintain constant economic profit. Rather, management information systems and perceived firm economics are aligned with maintaining a stable average margin over time.

Contractor

The management processes for HVAC contractors are somewhat different from distributor/wholesalers, yet the actual stability of margins is the same. The typical contractor process is to estimate all the costs of a job and then add a standard margin. This may or may not be the actual bid price for the project, which is based on what the contractor thinks the job will sell for or on a final price negotiation. There is no differential markup for each piece of the project (equipment, sheet metal/piping, additional supplies, buy-out items, labor, etc.).

One large commercial HVAC contractor commented: “We add up all of our costs and hope that they come out below the price needed to win. If we can, we value-engineer the project to lower the total cost. Our margin is what is left over. Hopefully it is positive. The goal in contracting is to find niches and projects where you can make your target margin.”

Commercial HVAC contractors have absorbed significant cost increases in the past, yet have maintained consistent margins. Estimated total installed cost of a commercial HVAC project depends upon whether ductwork is included. For most projects (new construction and remodeling), ductwork is an integral part of the project. Only in direct replacement of a failed unit is ductwork excluded. The incremental costs for a 7.5 ton air conditioner at the proposed standard level are between 12% (including ductwork) and 26% (excluding ductwork). The cost including ductwork for a 7.5 ton project is approximately \$15,000 (2003)³⁴ while DOE estimates the total installed cost of approximately \$8,000 (2013) excluding ductwork and an increased installed cost of approximately \$2200.³⁵

The cost of sheet metal, the major component of the cost of ductwork has undergone significant price variations, often in short periods of time, increasing 13% during the construction season of 2004 and 9% during the season of 2008.³⁶ The contractors interviewed for this study had no change in their pricing or margin practices as a result of this ductwork price fluctuation.

One of the key reasons for the stability of margins in HVAC contracting is that the estimating a pricing procedures are based on tools that have only a single margin for an entire project. For example, the major estimating and proposal program sponsored by the contractors’ trade association has only a single, standard markup field.³⁷ It would be incredibly difficult to create and imbedded a differential markup for HVAC equipment relative to all other aspects of a project with a single markup field in the estimating and bidding process. Contractors and the developers of the

³⁴ State of Michigan, State Tax Commission, *2003 STC Assessor’s Manual*, Volume 2, UIP3, Page 4

³⁵ DOE TSD EERE-2013-BT-STD-0007-0027, Table 8.2.11, Volume 8 p. 15 (note: the DOE cost increases are based on the disputed markups and, thus, understate the actual cost increase)

³⁶ US Bureau of Labor Statistics, Producer Price Index WPU1073

³⁷ Right-Suite™ sponsored by the Air Conditioning Contractors of America (ACCA), www.wrightsoft.com

estimating program also report that the margin field tends to be populated when the program is installed so that the margin percentage is never varied.

Incremental margins that varied from standard practice would require major, complex and unlikely changes in contractor behavior.

Empirical Evidence for Consistent Margins

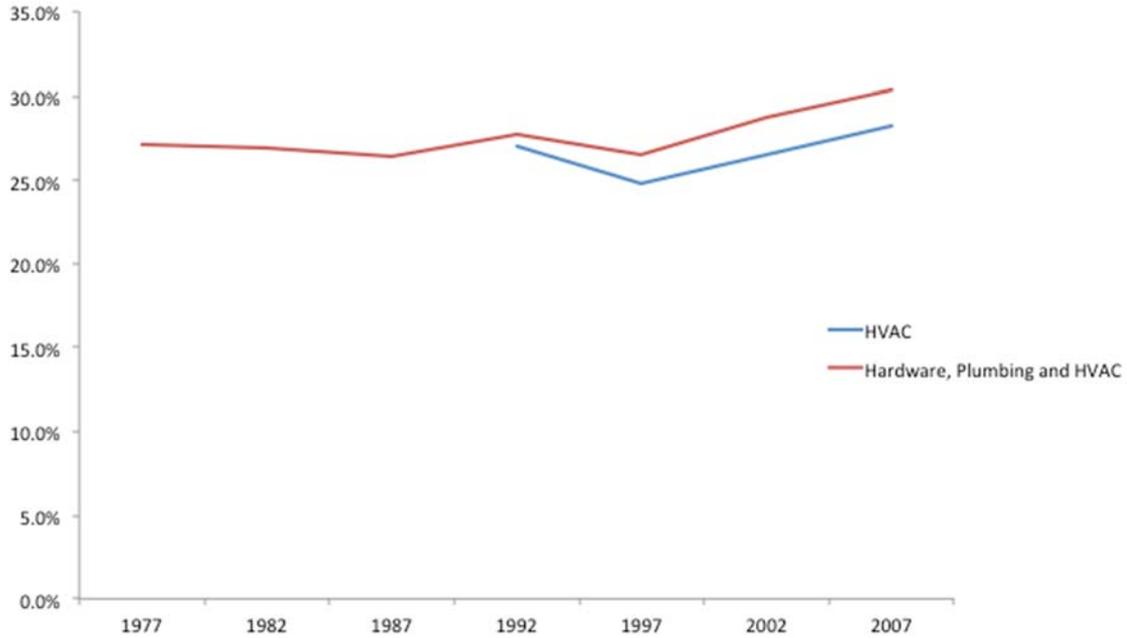
The empirical evidence on margins at both the distributor/wholesales and contractor levels in the air conditioning and heating channel is limited both in time series and in coverage. What evidence there is indicates that gross margins remain remarkably steady over time.

An ideal analysis of margin behavior would include longitudinal data on margins by product line for wholesalers and by labor versus equipment for contractors. Nothing close to this level of data exists. There is some US Census Bureau data that provides and indication of contractor and wholesaler margins over time in five-year intervals. In addition, there are publicly traded wholesalers in plumbing and related fields that can provide some proxy information. Unfortunately, none of the data is available in a disaggregated form that corresponds to the two strategic groups.

The Census data for wholesalers and contractors is contained in the Economic Census of Wholesale Trade and of Construction conducted every five years in the years ending in 2 and 7. This data contains gross margins for wholesalers and value added margins for contractors. The Census data for wholesalers is available for air conditioning and heating wholesalers (NAICS 42373, SIC 5075) from 1992 on and, at a higher level of aggregation, for NAICS Hardware, Plumbing, Air Conditioning and Heating (NAICS 4237, SIC 507) from 1977. The Census data for Plumbing, Air Conditioning and Heating contractors (NAICS 23820, SIC 1711) is available through 1977. It is also possible to create a proxy for contractor gross margin by subtracting labor from value added to get a gross margin over labor and materials.

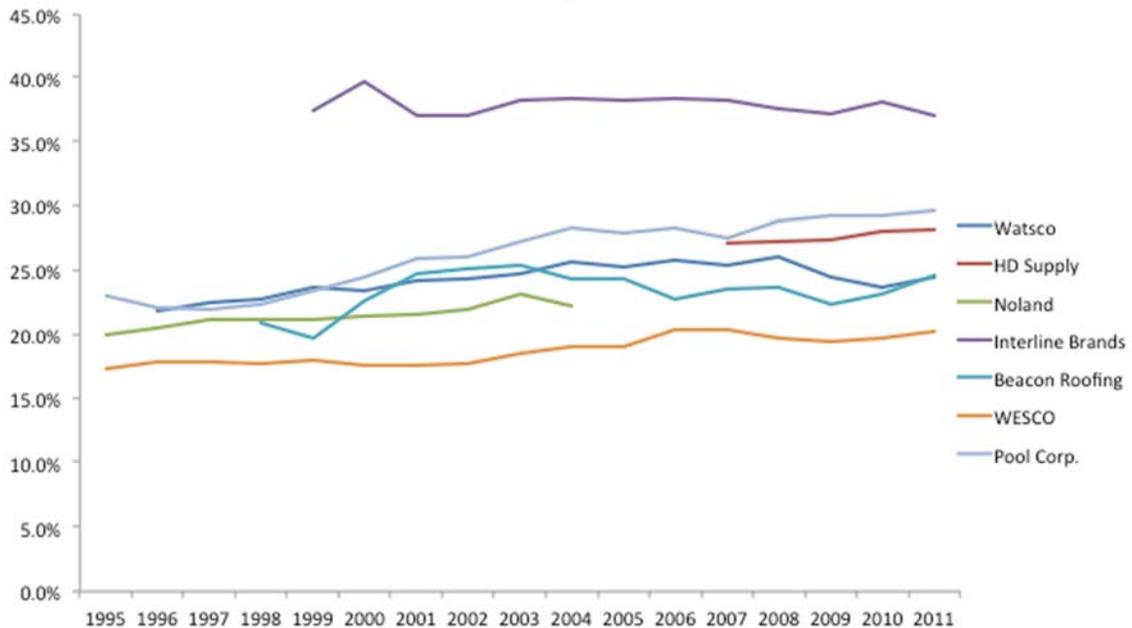
All of the data show patterns of consistent gross margins over time. The Census data for wholesalers shows stable margins across the five-year periods except for the slight dip in 1997 (Figure 1). The composite of publicly traded Industrial and Building Materials Wholesalers shows a similar set of patterns (Figure 2). Further the Markup Paper considers gross margins for wholesalers in 1977 across states and finds them to be quite constant. Since wholesalers tend to operate in limited geographic territories and do not compete with one another, the consistency across states provides additional indication of a common set of pricing practices. These margins hold true across economic cycles (1982 was a very weak year for housing, 1977 and 2002 were strong ones and 1998, 1992, 1997 and 2007 were about average.) All of this data supports the proposition that there is a stable pattern of gross margins. The model proposed in the Markup Paper would have predicted that margins declined in 2006 with the advent of the latest residential air conditioner standards and, clearly, that has not happened.

Figure 1: Gross Margins - Wholesalers



Source: US Department of Commerce, Economic Census of Wholesale Trade

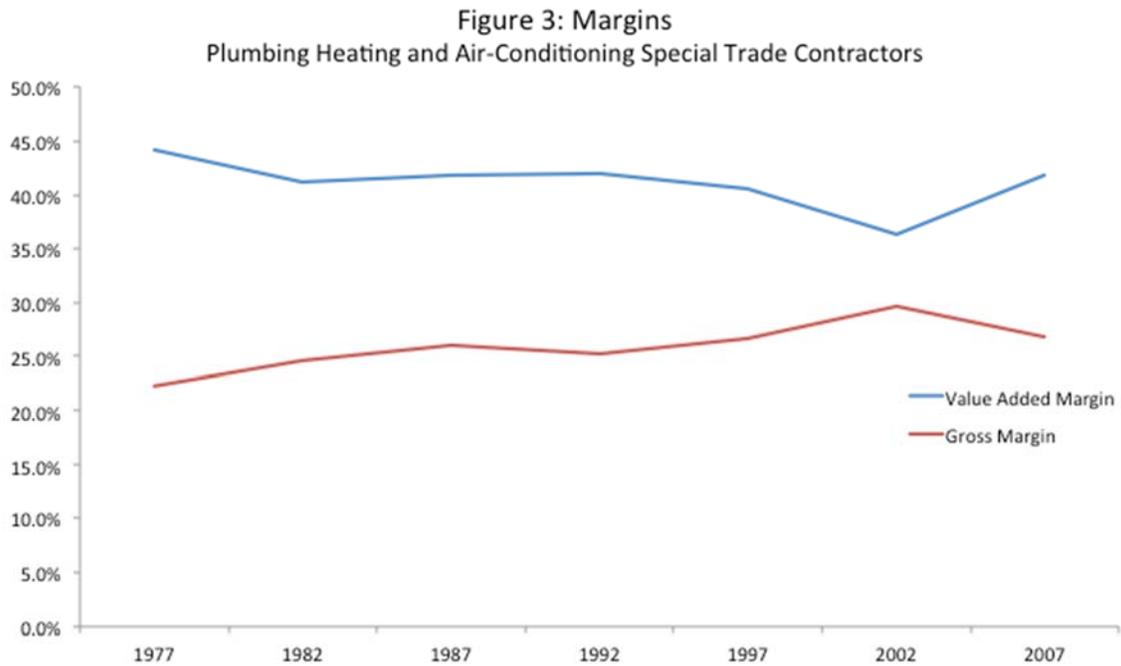
Figure 2: Gross Margins Industrial and Building Materials Wholesalers



Source: Company Annual Reports

Margins for contractors show similar consistency. The value added margin (Revenue less Value Added ÷ Revenue, where Value Added is Revenue less

purchases, essentially labor and profit) remains stable over the 30-year period except for the anomaly in 2002 (Figure 3).



Source: US Department of Census, Economic Census of Construction Industries

The most recent (2005) study of the air conditioning contracting industry initially quoted by DOE³⁸ also supports the existence of stable gross margins over time. The Gross Margin for Residential/Light Commercial and Commercial/Industrial contractors (the closest proxy to installing, not service contractors) was 32.32% in 1994 and 33.73% in 2004.³⁹

Conclusions

The US Department of Energy uses markups in order to determine the final cost to consumers of new, more energy efficient products that result from minimum efficiency standards. The Markup Paper proposes to convert from an average markup to an incremental one for the higher costs of the efficiency improvements. The support for this decision is an appeal to microeconomic theory and an observation on the number of air conditioning and heating wholesalers and contractors. However, the Markup Paper takes a theoretical model of perfect competition, with substantial limits on its applicability, and with no empirical

³⁸ Dale *et. al.* B-6

³⁹ Air Conditioning Contractors of America (ACCA), Financial analysis for the HVACR Contracting Industry, 2005 Edition, 2005. Washington, DC

support in the particular case of air conditioning and heating wholesalers and contractors (or any empirical data outside of manufacturers) and claims applicability.

Question	Incremental Margin Concept	Average Margin Concept
Question 1: Under what circumstances does the perfect competition paradigm apply in real settings?	General applicability not supported by empirical data. Applicability must be proved in each specific situation.	Applicability of perfect competition not necessary. Historical experience is a substitute.
Question 2: How many or which of the conditions for perfect competition must exist for the conclusions about the inability to raise prices above variable costs to hold?	Rules for when and under what circumstances perfect competition model applies have not been developed or demonstrated empirically. Applicability must be demonstrated case by case.	Not necessary
Question 3: Do the necessary conditions apply in the case of any specific industry under analysis?	Empirical proof of convergence of actual profits to economic cost of capital not provided by DOE. Simple resort to industry concentration has been demonstrated empirically not to correlate with profit convergence.	Not necessary
Question 4: In what circumstances (if any) is there evidence that firms can achieve profits in excess of their variable costs?	Not necessary	Theory of Strategic Groups provides alternative explanation of behavior, positing circumstances where profits above the cost of capital can be sustained.
Question 5: Do any of the conditions where there is evidence of pricing above variable costs apply to a specific industry?	Actual pricing behavior not analyzed.	Empirical data shows stable margins over time. Actual pricing practices as reported by distributor/shoelsaers and contractors consistent with average margins.

This paper demonstrates the limitations of the perfect competition model and the empirical evidence that perfect competition can not be assumed to occur in practice so that an *a priori* assumption of perfect competition is unwarranted. In addition, this paper provides an alternative theory, Strategic Groups, that fits the actual operating conditions at both the wholesale and contractor level. The empirical evidence for both wholesalers and contractors shows that they maintain average markups consistently across 30-year time horizons, implying consistency in pricing practices. The actual pricing and estimating behavior in both industries supports a conclusion that incremental markups are an unlikely result.

Therefore, the Markup Paper does not support the use of incremental markups in the face of more compelling theory and actual empirical behavioral and financial results. Continuing to use incremental markups in DOE analyses of the HVAC industry now flies in the face of both theory and empirical evidence.