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## Understaning the Volality of Commodities Prices: The Case of Polystyrene

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## Succeeding in New Markets Through a Market Orientation (cont)

research firm in the Southern Indian city of Chennai (formerly called Madras), we collected data from 162 companies that participated in a variety of manufacturing and service industries. The sample included domestic as well as foreign companies from U.S.A., U.K., Germany, France, Japan, and Korea. In addition, the sample firms came from the private, public and the joint (part public and part government-owned) sectors. Prior to running statistical tests, we tested the questionnaires extensively for validity and reliability.

Our results consistently supported the notion that market orientation leads to superior financial performance. We used a variety of performance measures – return on sales, control of operating expenses, success of new products, ability to retain customers, and growth in revenue – and in all cases, high performing firms exhibited very high market orientation scores.

Very often, factors in a firm's external environment moderate the relationship between two variables. In other words, the positive effect of variable A on B may be tempered by one or more moderators. In this study, we looked at the effect of 3 moderators – competitive hostility, market turbulence, and supplier power – on the market orientation-performance relationship. We did not see any moderator effects. In other words, none of these factors mitigated the positive role played by market orientation to improve organizational performance.

What practical implications does this study have for West Michigan firms? India is considered an attractive market. The U.S. Department of Commerce regards India as one of the 18 "Big Emerging Markets." Its 250 million strong middle class has significant purchasing power and is clamoring for Western brands and products. Armed with their superior marketing prowess, Western firms can succeed in this market. Market orientation is a practical concept that can be operationalized as a set of 25 questions, which when implemented can give the firm a core competence to attract new buyers, hold on to existing ones and succeed in a variety of financial yardsticks.

## Understanding the Volatility of Commodities Prices: The Case of Polystyrene

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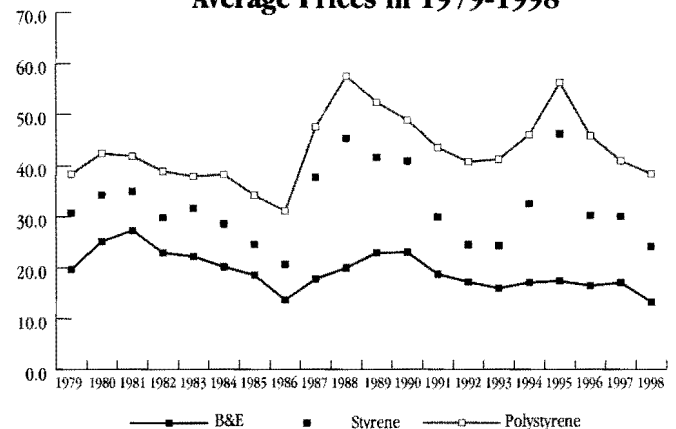
### Introduction

It's well known that construction and manufacturing make up an unusually large proportion of Grand Rapids Metropolitan area economic activity: 32% of the workforce are employed in manufacturing in the Grand Rapids area compared with 19% nationally. Most manufacturing and construction operations involve the purchase of raw materials in competitive commodities markets. Prices in these markets tend to be volatile, which presents considerable risk to companies with relatively high raw materials costs. The risk can be spread to some extent between the raw materials suppliers and their customers through futures contracts, but prices remain a concern for the purchasers of raw materials.

This paper is a case study of pricing in the market for a particular raw material: polystyrene. The prices of polystyrene and its closest substitute, polypropylene, have see-sawed at least twice in the last twelve years, and the future trend in prices for these plastics is anything but clear. Polystyrene and polypropylene make up about 28% of the enormous market in bulk thermoplastics. These plastics are used primarily in packaging and consumer disposables, but are also used extensively in office furniture, appliances, and automobiles. Figure 1 shows the recent volatility in prices: the price of general-purpose polystyrene rose from about 31 cents per pound in 1986 to over 56 cents in 1988, then back down to 41 cents in 1992, then up to 56 cents again in 1995, and price is now back under 40 cents per pound.

This price volatility is of concern to the producers of thermoplastics, their customers firms that process the bulk plastic into usable products, and these processors' customers. The Grand Rapids area contains a significant number of plastics processors. The Census Bureau reports that 114 processing facilities, employing about 9500 people, operated in Kent and Ottawa

**Figure 1**  
Average Prices in 1979-1998





Counties in 1995, up from 70 facilities and 5100 employees in 1985. These firms typically operate under relatively long-term contracts with producer office furniture, automobiles, appliances, consumer disposables, and so on. Though the terms of these contracts vary, they typically result from a competitive bidding process, and are often inflexible, committing the processors to deliver product at a fixed or often decreasing transaction price over time. Because the cost of bulk plastic represents a significant proportion of the manufacturing cost of the product, the volatility in the price of bulk plastic presents considerable risk to the processor.<sup>1</sup>

The argument presented in this paper is that price volatility has resulted from lumpy and uncoordinated investments in production capacity. This is not an atypical sequence of events in the production of commodity materials. The supply of polystyrene and polypropylene has been competitive, pushing price towards cost over the long haul. Nevertheless, the facilities to produce the plastic and its components are large and capital intensive. The higher prices that result from short supply, and continued expectations of an expanding market, encourage the producers of bulk plastics to expand capacity aggressively. Once the new capacity comes on line, the low marginal cost of production encourages the owners of that capacity to use it. The resulting substantial increase in output depresses prices, sometimes below average total production costs. The low price discourages further new investment, and the cycle continues.

## The Characteristics of Demand

Two especially important characteristics of the demand for polystyrene and polypropylene present themselves. The first is that the market for these plastics, and for thermoplastics generally, has grown and is expected to continue to grow substantially. Just since 1994, total worldwide consumption of thermoplastics grew from 246 billion pounds per year to about 308 billion pounds in 1998. In part this growth follows the general growth in the production of consumer goods. But the bulk of the growth comes from the substitution of plastics for other materials, such as metal or paper, in a variety of consumer products. The relatively low cost, light weight, formability, insulating ability, appearance, as well as other characteristics of thermoplastics have encouraged steady improvements in technology and design that allow for their expanded use. Forecasters expect the demand for thermoplastics to continue to grow at about 3% per year despite the drop in demand from the continuing financial crisis in Asia.

The second important characteristic of demand is that the processors of thermoplastics can substitute among them. For example, the costs to process an engineered resin, ABS, are similar to those of polystyrene, but it has better properties once processed (e.g., better impact resistance). Nevertheless, the relatively low price of general-purpose polystyrene has encouraged product designers and processors to find ways to shift out of ABS; domestic consumption of ABS fell from 1.5 billion pounds in 1994 to 1.3 billion pounds in 1998. The cost of processing polypropylene (into components for the furniture or automotive industries, for example) is considerably higher than that of processing polystyrene due in large part to greater shrinkage during processing. As a rule of thumb, the relatively high cost of processing polypropylene allows polystyrene to withstand a ten cents per pound price premium. Domestic consumption of both polystyrene and polypropylene continues to increase: consumption of polystyrene grew from about 4.5 billion pounds in 1986 to over 6.8 billion pounds in 1998, and consumption of polypropylene grew from about 12 billion pounds in 1994 to over 14 billion pounds in 1998.

## The Characteristics of Supply

There also are two especially important characteristics of the supply of polystyrene and polypropylene. The first is the marginal cost of production. The principle component of polystyrene is styrene, a clear liquid composed of 74% benzene and 26% ethylene. Benzene and ethylene come from the processing of petroleum and natural gas, and so it's reasonable to expect their prices to follow the price of oil. Indeed, the cost of the amount of benzene and ethylene needed to produce a pound of styrene has decreased from 23 cents in 1990 to about 13 cents now. Other production costs have remained steady. Polypropylene is made from propylene, which is a gaseous hydrocarbon. As with polystyrene, the costs of production of polypropylene have remained steady or decreased over the 1990s.

The second important characteristic of supply is the scale of cost-effective production facilities. The design capacity of polystyrene facilities, for example, averages 200 to 300 million pounds of output per year, with some plants designed to produce over 500 million pounds. Importantly, styrene plants are bigger yet, averaging over a billion pounds of output annually. This has two implications. First, the construction of even a single new plant can significantly increase production capacity. Second, the entire domestic market for styrene can be supplied by a relatively small number of firms. There currently are only seven styrene producers with production over one billion pounds per year. ARCO Chemical has the largest share with 22% of total production capacity.

## The Market for Polystyrene

The characteristics of supply and demand identified above shed considerable light on how the market works to price polystyrene and its substitutes. Figure 3 suggests that the key to understanding movements in the price of polystyrene is an understanding of the price of styrene. Figure 2 shows that prior to 1985 the prices of polystyrene and styrene followed changes in the price of raw materials (benzene and ethylene). That relationship appeared to change, however, after 1985; though the price of raw materials rose, the price of styrene rose considerably more. The second big increase in the price of styrene around 1995 appears to have even less relationship to changes in production costs. Something else is at work. Figure 4 suggests that that something has to do with changes in the capacity to produce styrene. The peak in the price of styrene in 1988 corre-

*Continued on Page 15*

<sup>1</sup>Of course, the contract may shift at least some of the risk onto the purchaser of the processed product by allowing the price of the product to vary with changes in the price of bulk plastic. Some processors may also shift risk back to the producers of the plastic by agreeing to a price well before the delivery date. There has not, however, yet developed a resale market for futures contracts for bulk plastics



**Figure 2**

Year	B&E	Styrene	Polystyrene
1979	19.7	30.8	38.4
1980	25.1	34.4	42.4
1981	27.3	35.1	41.9
1982	22.9	29.9	39.0
1983	22.2	31.7	38.0
1984	20.2	28.6	38.4
1985	18.6	24.5	34.3
1986	13.8	20.7	31.2
1987	17.9	37.9	47.5
1988	20.0	45.3	57.6
1989	22.9	41.7	52.4
1990	23.0	41.0	48.9
1991	18.8	30.0	43.5
1992	17.3	24.5	40.8
1993	16.1	24.3	41.3
1994	17.2	32.7	46.0
1995	17.5	46.2	56.3
1996	16.6	30.3	45.8
1997	17.7	30.1	41.0
1998	13.4	24.1	38.5

price volatility in polystyrene appears to have resulted from lumpy investments in the capacity to produce styrene in response to the growing market for polystyrene.

The current excess capacity and the rocky recent performance of styrene producers has led to some restructuring in the industry. First, the production of styrene has trended away from petrochemical firms toward the producers of commodity plastics. Amoco, Arco, Mobil, and Monsanto are now out of the styrene business. This makes sense to the extent that the producers of raw plastics have a better sense of the growth in their market than do firms that are less specialized in the production of petrochemicals. Second, the excess capacity has led to some consolidation among the bigger producers of styrenics. Nova recently purchased Huntsman to become the biggest of the now largest producers of polystyrene, which collectively supply nearly 90% of the market. One would expect these changes in the market not only to reduce price volatility, but also to help the five largest firms coordinate pricing sufficiently to increase margins, at least incrementally.

Working against them, however, is the hot competition in the supply of polypropylene. Figure 5 shows how closely polypropylene tracks polystyrene, even though fluctuations in the price of styrene do not affect the costs of producing polypropylene. Rather, as the price of polystyrene rises, some of the processors of polystyrene switch to polypropylene. The short-run limits in production capacity allow the increased demand for

polypropylene to drive up its price. The reverse occurs as the price of polystyrene falls. There currently are 16 large suppliers in the relatively large polypropylene market, and competition among them for the available business is intense. Capacity expansions underway or announced will leave capacity in 2000 at a level 50% higher than in 1996. Though consolidations may also occur in this industry, we expect that the heavy competition among polypropylene producers will limit the upward mobility of polystyrene prices.

Of course, the contract may shift at least some of the risk onto the purchaser of the processed product by allowing the price of the product to vary with changes in the price of bulk plastic. Some processors may also shift risk back to the producers of the plastic by agreeing to a price well before the delivery date. There has not, however, yet developed a resale market for futures contracts for bulk plastics

sponds to a time when consumption was considerably greater than production capacity. Indeed, it was not until around 1985 that the market for thermoplastics really began to grow. The high prices generated by strong demand in the late 1980s, and the expectations of continued expansion in the market, encouraged producers to increase capacity. Production capacity increased dramatically in the years after 1990. Relatively low marginal production costs encouraged styrene suppliers to operate the new capacity despite the impact the greater supply of product would have on the market price.

Fortunately for these aggressive suppliers, the low prices and the growing economy encouraged a sustained increase in the consumption of

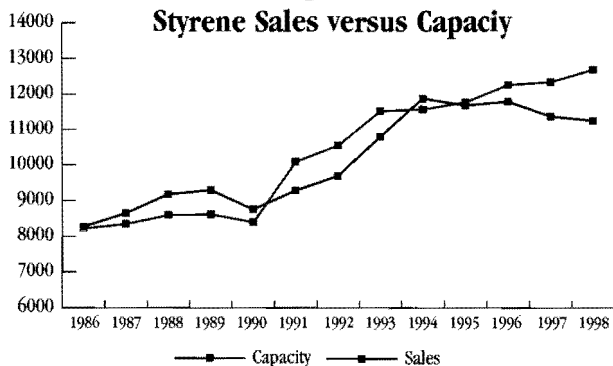
polystyrene during the same period. By 1994, production capacity had again fallen below current consumption, again driving prices upward. Again, the higher prices attracted more investment in capacity, which has resulted in the current relatively low prices. Thus, the

**Figure 3**

Year	Price	Excess Capacity	Consumption	Capacity	Supply
1986	\$0.21	-47	8,272	8,225	8,207
1987	\$0.38	-310	8,645	8,335	8,439
1988	\$0.45	-576	9,176	8,600	9,058
1989	\$0.42	326	8,294	8,620	8,768
1990	\$0.41	-354	8,754	8,400	8,711
1991	\$0.30	814	9,280	10,094	9,579
1992	\$0.25	868	9,689	10,557	9,552
1993	\$0.24	762	10,769	11,531	10,729
1994	\$0.33	-304	11,880	11,576	11,896
1995	\$0.46	95	11,685	11,780	11,910
1996	\$0.30	473	11,797	12,270	12,465
1997	\$0.30	973	11,377	12,350	12,057
1998	\$0.24	1,442	11,256	12,698	11,275

**Figure 4**

### Styrene Sales versus Capacity



**Figure 5**  
Average Annual Sale Price

