

An Industry-Specific Extension to an INFORUM Model

LORRAINE SULLIVAN MONACO

ABSTRACT Relative to aggregate models, multisectoral models of the INFORUM type have rich product detail. But relative to the forecasting needs of a firm, they generally have far too little product detail for the firm's own line of products, though the detail on customers industries is often quite satisfactory. This paper describes how an industry specific extension of the overall model can be created to give forecasts in the product detail needed by the firm. The method is illustrated with an actual application to forecasting a particular plastic resin.

Business forecasters are faced with two questions: what is the outlook for a detailed set of products, and how will that outlook change if the economic environment is altered? Interindustry macro models provide answers to those questions for a number of detailed industries. Often, however, forecasters are interested in specific products that may not be explicitly identified in a large model. The DOM model of the U.S. economy forecasts a sector called "Plastics and synthetic resins," for example.¹ It does not, however, specifically model the plastic resins that are included in that sector. To forecast such detailed products, a tool for linking product data to a larger model is needed.

An Industry-Specific Extension (INSPEX) links detailed product data to an industry-based model to provide a specialized forecasting and simulation tool. Links in an INSPEX are formed by identifying markets for detailed products that are included in an interindustry macro model. Some plastic resins are used in making cars, for example, so their outlook will depend in part on the outlook for the auto industry. In addition, an INSPEX considers the market penetration of each detailed product. Plastic has replaced steel in many automotive applications, for example. The increasing use of plastic per auto has a positive effect on the outlook for some resins. This paper describes the structure of an INSPEX with an application to the plastics industry as an example.²

¹ DOM, the Detailed Output Model, is a 420-sector model of the American economy. It expands the detail of the LIFT model, the Long-term Interindustry Forecast Tool. Both models were developed at INFORUM.

² A plastics model was built for a subscriber to INFORUM's LIFT model. The specific results from that model are proprietary, so a generic example is used throughout this paper.

Defining the Problem: Setting Up Data

The first task in developing an INSPEX is selecting detailed products and defining markets for each of them. These choices are often strongly influenced by available data and by the way people in the industry think about their products and markets. In forecasting plastics, for example, several practical problems arose in assembling a useable data set for building a model. Two of these problems, and their solutions, are described in greater detail in the Appendix. The results of setting up the data are shown in Table 1. The table contains the data necessary for building an INSPEX: a time-series of the sales of a detailed product, "A-Resin," to specific markets. (Table 1 shows only four years of data; the plastics model uses data from 1975-1989.)

Market Indicators

The second task in developing an INSPEX is defining each product's markets in terms of sectors in an interindustry macro model. In forecasting plastics, for example, data existed that showed the sales of plastic resins to thirty markets, such as Transportation, Toys, and Packaging. (See Table 1.) These markets were then defined in terms of sectors from the LIFT model. "Transportation," for example, corresponds to the sectors for Motor vehicles, Trucks, and All other transportation equipment. One way of defining the plastics market for Transportation is simply to add together the output of the corresponding industries. A more specific definition of the market uses input-output coefficients to weight the output of each sector by its total plastic use per unit of output. Since the input-output coefficients in LIFT are not static, but are forecast based on past trends, the market definition is based on dynamic coefficients that capture the changing use of plastic in each application. The market for a specific plastic is then defined as the plastics-weighted sum of the output of corresponding industries. This so-called Dynamic Coefficient Indicator (DCI) of each market measures the size of the overall demand for plastics from each market. Forecasts for the indicators are determined by LIFT and DOM and reflect interindustry relationships, monetary policy, foreign trade, and so on.

Market Quotients

After defining market indicators for each product application, a link between the detailed data and the indicators is needed. An INSPEX is based on a market quotient, which is the ratio of detailed product sales to the overall market indicator for that application.³ For example, the quotient for A-Resin sold to the Transportation market is defined:

$$MQ = \frac{\text{Sales of A-Resin to Transportation}}{\text{Dynamic Coefficient Indicator of Transportation Market}}$$

³ The market quotient approach has been compared to adding a sub-model, or 'skirt', to the bottom of an input-output table. The detail of the input-output model is extended, but there is no feedback from the detail to the rest of the input-output model. See 1985: *Interindustry Forecasts of the American Economy*, Clopper Almon et al.

Table 1: Sample Data for INSPEX

Sales of A-RESIN 1983-1986
(in millions of pounds)

MARKET	1983	1984	1985	1986	MRKT
1 TRANSPORTATION	0	0	0	0	1
2 Motor Vehicles,	0	0	0	0	2
3 Ships,Boats,R.V's.	0	0	0	0	3
4 All Other Transportation	0	0	0	0	4
5 PACKAGING	5702	5835	6007	6218	5
6 Bottles,Jars, and Vials	32	23	19	59	6
7 Food Containers	299	370	421	545	7
8 Flexible Packaging	4647	4718	4835	4903	8
9 All Other Packaging	723	722	730	708	9
10 BUILDING & CONSTRUCTION	240	331	347	235	10
11 Pipe,Conduit, and Fittings	63	39	51	34	11
12 Materials for Structures	57	102	137	75	12
13 All Other Build & Construct	119	189	159	108	13
14 ELECTRICAL/ELECTRONICS	393	455	431	452	14
15 Appliances, home & indust.	0	0	0	0	15
16 Communications Equipment	0	0	0	0	16
17 Industrial Equip, Batteries	363	420	357	382	17
18 FURNITURE, FURNISHINGS	0	0	0	0	18
19 Furniture	0	0	0	0	19
20 Carpet and Textiles	0	0	0	0	20
21 CONSUMER AND INSTITUTIONAL	574	684	488	529	21
22 Dinner, Table, & Kitchenware	185	209	182	214	22
23 Health and Medical Products	139	122	86	41	23
24 Toys, Sports, and Hobbies	49	89	49	40	24
25 All Other Consumer & Instit	200	263	170	233	25
26 INDUSTRIAL/MACHINERY	0	0	0	0	26
27 ADHESIVES, INKS, & COATINGS	0	0	0	0	27
28 RESELLERS AND COMPOUNDERS	428	429	566	519	28
29 UNCLASSIFIED SALES	96	119	272	249	29
30 EXPORTS	919	974	1131	939	30
31 TOTAL COMPLETE SALES	8354	8830	9245	9143	31
32 RESIDUAL MARKET	70	99	161	354	32
33 TOTAL	8424	8929	9406	9497	33

The market quotients are formed for each year of historical data for the detailed products. Once a time-series is available, each market quotient is forecast based on any trend in the series over time. In the plastics model, market quotients are forecast using a non-linear logistic curve. Logistic curves follow an S-shaped path and allow the quotients to grow at different rates over time. In most cases, an initial period of slow growth is followed by faster growth and rapid expansion of the quotient. Eventually, the rate of growth slows, and the series flattens out and approaches an asymptote.

A Forecast: Combining Market Quotients and Market Indicators

The forecast for each detailed product combines the forecast of the market indicator with projected market quotients. The outlook for a product depends not only on the overall size of its market, but also on the share of the market it captures, as measured by the market quotient. The importance of both factors is illustrated in Figure 1. The first panel shows the market indicator for A-Resin sold to the Transportation market. The outlook for this market, which is based on the forecast of transportation sectors from LIFT, is optimistic and shows strong growth. In the second panel, the market quotient for A-Resin is shown. The quotient has fluctuated over the last ten years, but

has been on a downward trend that is forecast to continue. The combination of a healthy market but a falling market quotient results in the cautious outlook for A-Resin in the last panel. Sales are projected to grow slowly over the entire forecast period.

Conclusion

The dual structure of the INSPEX, market indicators plus market quotients, clearly identifies the source of growth for each product. In the example in Figure 1, the sluggish outlook for A-Resin is clearly due to its own market penetration and not the overall strength of the Transportation market.

The dual structure of the INSPEX also allows two types of simulations to be designed. The first asks "what if" questions about the overall economy and how plastics markets are affected. An oil-price scenario, for instance, would use LIFT to examine the economy-wide effects of a lower world price of oil. The effect of lower oil prices on the Transportation market could then be used to determine the effect on A-Resin's sales. In addition, an INSPEX can be used to analyze changes in the market quotients. It may be possible to expand the use of A-Resin in cars and therefore increase its market quotient. The INSPEX can analyze the effect on total sales of changes in the market quotient.

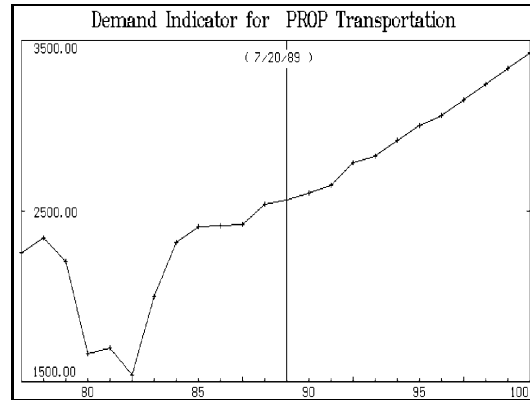
References

- Almon, Clopper, Margaret Buckler, Lawrence Horowitz, Thomas Reimbold, 1985: *Interindustry Forecasts of the American Economy*, Lexington Books, 1974.
- Monaco, Lorraine Sullivan, "An Industry-Specific Extension to an Interindustry Macroeconomic Model," paper for completion of Masters Degree, Department of Economics, University of Maryland, 1989.

FIGURE 1: Forecast of A-Resin sold to Transportation Equipment Market

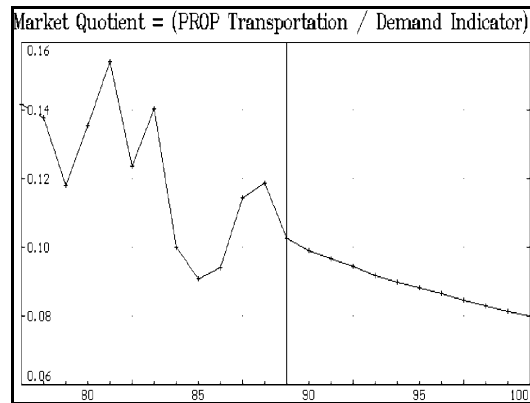
Strong Demand from Transportation

- o Outlook based on INFORUM May 1989 Forecast
- o Transportation market includes Motor vehicles, Trucks, Ships, and other transportation equipment
- o Strong export growth in U.S. implies healthy growth of transportation industry



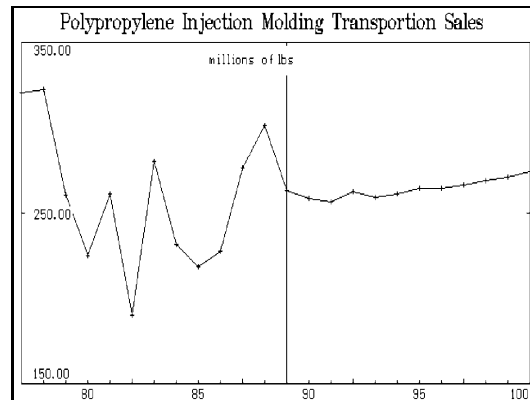
Market share on declining trend

- o Market quotient has fluctuated over last ten years
- o Overall trend has been downward
- o Forecast shows gradual continued decline



Cautious outlook for A-Resin

- o Optimistic outlook for market
- o Plus declining market quotient
- o Implies relatively modest outlook for A-Resin sales to Transportation



APPENDIX: PLASTICS DATA

Constructing a data base with a time-series of detailed product sales can be the prohibitive step in crossing the bridge between the theoretical INSPEX and a practical application. In building a plastics data base, two specific problems were encountered. First, a special procedure was needed to compensate for gaps in the original data.

The survey data from the Society of the Plastics Industry (SPI) was incomplete in many instances due to gaps in the data. These gaps arose mainly from disclosure problems: if a firm is a single producer of a resin, its sales are not reported on the aggregate survey so the firm may conceal its performance from competitors. In each year of data, then, the total *reported* sales are less than the actual total sales. In other words, there exists a 'residual' sales in each year. The residual is not consistently defined over time, however, since the gaps in the data differ from year to year. In order to solve this problem, the time-series of each resin's sales was examined. If data for that series was available in each historical year, then the series was labeled 'complete.' All incomplete series were set to zero in each year of data. In other words, if the series was incomplete, it became part of the 'residual' series. Because the incomplete series are set to zero in each year, the residual sales are defined consistently over time. Table 1 in the text shows the time-series of sales for A-Resin.

The second major data problem concerned the choice of data for building the model. Two types of data were available from the Society of the Plastics Industry. One type showed the sales of plastic resins to different markets, such as Transportation and Packaging. This data classification was attractive from a modeling point of view, since the markets were similar to sectors in the LIFT and DOM models. On the other hand, a second data source identified the sales of plastic resins by so-called 'end-uses,' such as Blow molding and Injection molding. These end-uses corresponded closely to technological differences in how resins are produced, and the end-use classification was therefore attractive to the plastic producer. To build a model that linked to DOM *markets* and that produced answers to the plastic producer's questions in terms of *end-uses*, the data sources had to be reconciled. Table A.1 illustrates the format of the bridge tables that were used to translate the end-use and market data for each plastic resin. The two SPI data sources identified the row and column totals for each resin. By using industry sources and matrix balancing, the rest of the bridge was filled in by hand. The table distributes the sales of each end-use, such as Film, to different markets, such as Packaging. The plastics INSPEX then forecasts each cell of the bridge tables, by linking the series to markets in LIFT and DOM.

Table A.1 Bridge Table for End-use/Major-Market Data
Sales of No-Resin Millions of Pounds 1986

END-USES \	MAJOR MARKETS:			TOTAL
	Transportation	Packaging	Construction	
Film	100	50	0	150
Blow Molding	20	80	10	110
Injection	80	10	90	180
Wire & cable	0	0	65	65
Other	30	50	10	90
TOTAL	230	190	175	595