# The Accuracy of Supermarket Scanning Data: An Initial Investigation*

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## Problem Addressed

When optical scanners were introduced for food store use more than a decade ago a near revolution in store operations was forecast. Store management was expected to initiate automatic reordering systems using scanning as well as use the information to evaluate specialing and pricing strategies more carefully (see NGA). Economists for their part had potential access to a new and far-reaching data set on product movement at the retail level. It was becoming possible to do retail level analysis routinely which previously required special tabulations (see e.g. Marion and Walker, and Marian, et al.).

Reality has been quite different; uptake of the technology has been far slower than was originally expected. Only in the past several years have installations reached an annual average of 150 a month with a total of 8641 stores equipped by April 1984 (Nielsen, Inc., personal communication). Typically it is the larger stores which acquire scanners first so that the coverage of retail food and related product sales is becoming quite complete.

Any application of scanning data for price analysis or store management, however, necessarily assumes that files accurately reflect sales. To the extent the data are erroneous, any use of the data will lead to inaccurate conclusions. This study is an initial evaluation of the accuracy with which scanning data actually reflect disappearances. The analysis was prompted by an observation that week-to-week reported sales variability of three major supermarket companies for a range of items was very large compared to average sales. For slow movers over a 10 to 13 week period it was not uncommon for the standard deviation of sales to exceed average weekly sales. Moreover, there was no apparent pattern to the sales such as might be caused by monthly pay periods. All the firms included in these results had made special efforts to maintain the quality of scanning data so that these figures represent the best generally available data.

Large interweek sales variability does of course not prove scanning data inaccuracies. Variations may be caused by stockouts, by specialing, or simply by normal shopping habits. The variability does nonetheless raise a question about the validity of the data and

*The authors would like to thank the management of two firms, which must go unnamed, for their assistance in this project. Errors are the authors'.

their applicability for analysis. The intent of this analysis is to allay those concerns and possibly to identify the need for further investigation.

**Factors Affecting Scan Data Quality**

Scanning data misrepresent item movement if (1) the scanning file is not rigorously maintained so that an item is improperly recorded, (2) the item cannot be or is not scanned and the UPC code is not entered manually, or (3) shoplifting and other forms of stock shrink account for a significant portion of the movement of a product. With shoplifting contributing approximately one percent of supermarket sales, this factor should not be a significant issue for the vast range of products (Price Waterhouse).

One failure to scan can be caused by the manufacturer which imprints products with improper or unclear bar codes. According to industry estimates this applies to about 15 percent of bar-coded items (Supermarket News, 9/84). Key problems are truncated symbols and poorly located codes (Supermarket News, 8/84). Package type has an additional impact. Small, shiny products like gum are the most problematic. Ice-shrouded frozen foods and leaky fresh meats are similarly difficult to read. Many scanning problems are, however, the responsibility of the retailer. Insufficient attention to maintaining the file leads to missing or improperly recorded sales. At the front end the failure to clean the glass plate covering the scan reader limits scannability. In other cases, stores face a direct tradeoff between labor costs and data quality. As a labor savings effort many stores limit the checker to two or three scanning attempts before the item is entered manually. And then the 10-digit UPC code is seldom recorded from the key pad. Recording the code or attempting the scan more times would enhance the completeness of the data set but at the cost of labor time and customer service. Many stores do sell raw data files to several data service companies which require that 60 percent of store dollar sales are scanned. But within those wide limits the store has considerable discretion over the completeness of the scanning file.

**Methodology**

This study uses a straightforward approach of comparing sales recorded in scanning files with actual shelf disappearance. Disappearance is computed as weekly warehouse receipts, as listed on regular orders and verified by in-store stock checks, adjusted by shelf inventory. Inventory counts were made shortly after midnight Saturdays when weekly sales are traditionally tabulated and the scan file registers reset to zero. Comparing the disappearance with the recorded sales indicates how well the scanning reports reflect actual item movement. Periodic store visits were also made to check for outs-of-stock. Stockouts, while not necessarily affecting recorded sales, can cause the major week to week sales variability observed in scanning data.

For the analysis, two regional chains, A and B, in the upstate New York area cooperated by providing scanning records, warehouse withdrawal information, lists of specialed and couponed items and related documents and materials. Three stores, two from Chain A and one from Chain B, were included. Both of these stores had scanning systems installed within the year preceding the study. Neither chain makes specific use of the data on a regular basis, other than sales to the major food data service companies, and they do not emphasize data quality heavily. Thus, it is likely that the results from these stores reflect the current data quality situation in many scanning supermarkets throughout the country.

For the study, products were selected which varied from "low to high" sales levels and from "easy to difficult" to scan. The judgment of upper level management was used to classify products into similar groups by ease of scanning (see Table 1). Neither chain scanned fresh meat or product, hence those categories were not included.

A slightly different approach was taken in each chain. For the two stores in chain "A," items were monitored on a weekly basis for six weeks during summer 1984. Due to the labor intensity of the monitoring activity the number of items was limited to 30. In

chain "B" the analysis was run over an entire summer 1984 quarter (13 weeks). Inventory was taken at the beginning and ending date and compared to the total store receipts and recorded sales. By limiting the amount of in-store inventory taking it was possible to increase the number of items monitored to 79.

Despite the cooperation of the chain management and store managers, several data collection problems developed during the study period which prevented the inclusion of all items for every week. Specifically, the scanning data and/or warehouse withdrawal information were incomplete for some items and some weeks. A few items were discontinued or at least disappeared from the shelves during the study. In addition, the in-store inventory taking process was difficult to items with back room stocks. These include high sales level items (e.g. tuna fish on special), bulk items (e.g. paper products) and slow movers which are held in partial cartons (e.g. film). If the problem was severe the items were deleted from the study. In other instances the failure to count all inventory could introduce some error into the results for individual items. However, with the results reported as averages for several items, the impact of any individual item error becomes so small so that the results described below are considered representative of the actual quality of scanning data in the study stores.

**Major Findings and Implications**

Two figures were collected on each item included in the study. These are the (a) sales as recorded by the scanning system and (b) the "disappearances" computed as warehouse receipts adjusted for inventories. From these two measures of item movement the difference or "discrepancy" is computed as an actual number and a percentage of the scanning movement. In the reported results the scanning recorded sales and the actual discrepancy and percent discrepancy are included. Because of space limitation and possible recording errors with individual items all figures are reported as average for items in each "scanning category" as described in Table 1.

Results for Chain "A" are reported by store in Table 2. Similarly presented results for the one store in Chain "B" are in Table 3. The items included in each scanning group are not necessarily constant across chains or within stores of a chain.

The average error figures are quite acceptable for most data use purposes lying as they do between 3.5 and 5 percent of recorded sales. Thus, on an aggregate level there is no evidence of a serious discrepancy in scanning records compared to disappearance.

For individual items, however, the measured discrepancies are greater, varying from essentially nothing to over 100 percent (Tables 2 and 3, 7th column). Particularly problematic are blister-packed items, those sold with tags or cards, truncated codes, bottom marked bags and top coded items. These items are both difficult to scan and have relatively low unit sales. Thus, for them a limited number of mis-scans or other unrecorded disappearances lead to large percentage errors. Interestingly, neither the items considered "hard to scan" nor frozen foods displayed particular problems to scanning accuracy. Apparently the conventional wisdom regarding the scannability of these items is incorrect. Nor are there large errors for canned goods like coffee and pet foods despite occasional case-lot sales. Either such sales are very infrequent or the items are scanned anyway.

Categories show considerable variability across stores and even within the same chain. Based on the way the study was conducted it is not possible to distinguish among the effects of the selection of items in the category and the individual store practices. The results do nonetheless suggest substantial error is possible when examining individual items on a weekly basis. This factor should be considered where using scanning data. The study provided no evidence that stock outs are a major contribution to weekly sales fluctuations.

Overall scanning systems give evidence of providing quite accurate measures of aggregate item sales over multi-week periods. There is no apparent problem with using the

data so compiled, although replications of this analysis are needed before that conclusion can be stated definitively. For weekly sales, however, at the individual item and store level, scanning data limitations appear more severe. As a result, care must be used when sales figures on this level are used for such purposes as automatic reordering or the calculation of store-specific demand elasticities. Particular caution should be exercised when analyzing products with low unit sales levels and those sold on cards, top or bottom marked and small items with truncated codes. Additional efforts at store and manufacturer levels are required before scanning files for all items can be considered highly accurate measures of disappearance. Nevertheless, major categories, like canned goods, appear to be measured within reasonable error bounds under current practices.

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**Table 1.**

| Category | Name/Type | Example of Products |
|---|---|---|
| A | baby food | Gerber Bananas |
| B | box-bottom marked | Cheerios |
| C | truncated codes | Rolaids |
| D | bottles & jars | peanut butter |
| F | large sized containers | gallon vinegar |
| G | canned goods | tomato soup |
| H | bottom-marked bags* | store brand bread |
| I | paper products | paper towels |
| J | hicone (beverage six packs) | Coke |
| K | envelope container | soup mix |
| L | two sided container | shampoo, potato chips |
| M | hard to scan | private label colas |
| N | top code | cookies |
| O | box-end marked | Band-aids |
| P | frozen foods | orange juice |
| Q | milk & dairy | margarine |
| R | containers-bottom marked | baby powder |
| S | blister pack | batteries |
| T | tags & carded items | film, patent medicines |

* For this study this category does not include large (25 and 50 pound) bags of pet food, charcoal, rock sale, etc. Those items are difficult to handle and frequently are not scanned.

Table 2: Discrepancies between scanned sales and disappearance by scanning groups for Chain A stores, New York, summer 1984

| Scanning Group | Description | Number Items | Average Weekly Scanning Sales | Average Discrepancy | Average Difference | Maximum Weekly Percentage Difference for Individual Products |
|---|---|---|---|---|---|---|
| **Store #1** | | | | | | |
| B | box, bottom-marked | 5 | 51 | 8 | 15% | 2-80% |
| D | bottles and jars | 4 | 74 | 7 | 9% | 0-73% |
| G | canned goods | 1 | 206 | 16 | 8% | - |
| H | bagged, bottom-marked | 3 | 20 | 6 | 29% | 0-113% |
| I | paper products | 1 | 205 | 12 | 6% | - |
| M | hard to scan | 1 | 402 | 10 | 2.5% | - |
| P | frozen food | 1 | 494 | 12 | 2.5% | - |
| Q | milk and dairy | 1 | 547 | 17 | 3% | - |
| Average | | | 250 | 11 | 4.5% | |
| **Store #2** | | | | | | |
| B | box, bottom-marked | 3 | 31 | 9 | 28% | 0-105% |
| C | truncated | 2 | 48 | 13 | 26.5% | 4-150% |
| D | bottles and jars | 3 | 106 | 5 | 5% | 0-67% |
| G | canned goods | 1 | 1097 | 13 | 1% | - |
| H | bagged, bottom-marked | 3 | 8 | 5 | 62% | 0-200% |
| M | hard to scan | 1 | 273 | 10 | 3.5% | - |
| Q | milk and dairy | 1 | 482 | 17 | 3.5% | - |
| Average | | | 292 | 10 | 3.5% | |

Source: Store records and surveys

Table 3: Discrepancies between scanned sales and disappearance by scanning group for Chain "B" store, New York, summer quarter, 1984

| Scanning Group | Description | Number Items | Average 13 week Scanning Sales | Average Discrepancy | Average Difference | Maximum Percentage Difference for Individual Products (Qtrly) |
|---|---|---|---|---|---|---|
| A | baby food | 1 | 61 | 1 | 2% | - |
| B | box, bottom-marked | 6 | 307 | 12 | 4% | 1-17% |
| C | truncated codes | 2 | 140 | 4.5 | 3% | 0-4% |
| D | bottles and jars | 7 | 746 | 6 | .7% | 0 -39% |
| F | large sized containers | 3 | 327 | 8 | 2% | 0 -7% |
| G | canned goods | 3 | 1541 | 14 | .9% | 0 -3% |
| H | bottom- marked bags | 4 | 266 | 9 | 3% | 2.2-12% |
| J | hicone (6-packs) | 6 | 2125 | 267 | 12.5% | 10-27% |
| K | envelope container | 3 | 219 | 15 | 7% | 6-8% |
| L | two sided container | 2 | 40 | 8.5 | 21% | 11-29% |
| M | hard to scan | 4 | 1610 | 12 | 1% | 0-4% |
| N | top code | 2 | 73 | 14.5 | 20% | 14-33% |
| O | box, end-marked | 2 | 315 | 6.5 | 2% | 2-4% |
| P | frozen foods | 5 | 351 | 9 | 2.5% | 1-5% |
| Q | milk and dairy | 3 | 1289 | 7 | .5% | 0-2% |
| S | blister pack | 4 | 79 | 33.5 | 42% | 34-66% |
| T | tags and carded | 4 | 26 | 30 | 115% | 14-194% |
| Average | | | 560 | 27 | 5% | - |

Source: Store records and surveys