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THE MAGNITUDE OF MENU COSTS: DIRECT EVIDENCE FROM LARGE U.S. SUPERMARKET CHAINS*

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We use store-level data to document the exact process of changing prices and to directly measure menu costs at five multi-store supermarket chains. We show that changing prices in these establishments is a complex process, requiring dozens of steps and a nontrivial amount of resources. The menu costs average $105,887/year per store, comprising 0.70% of revenues, 35.2% of net margins, and $0.52/price change. These menu costs may be forming a barrier to price changes. Specifically, (1) a supermarket chain facing higher menu costs (due to item pricing laws which require a separate price tag on each item) changes prices 2 1/2 times less frequently than the other four chains; (2) within this chain, the prices of products exempt from the law are changed over three times more frequently than the products subject to the law.

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"In principle, fixed costs of changing prices can be observed and measured. In practice, such costs take disparate forms in different firms, and we have no data on their magnitude. So the theory can be tested at best indirectly, at worst not at all."

Alan Blinder

I. Introduction

The costs of changing nominal prices, also known as "menu costs," have important macroeconomic implications. First, menu costs can be a source of price rigidity, and thus can provide a micro-based explanation for monetary non-neutrality. Second, even small menu costs may be sufficient to generate substantial aggregate nominal rigidity and large business cycles.[1] Consequently, menu costs have received considerable attention in the theoretical macroeconomics literature as many predictions generated by traditional Keynesian and more recent new Keynesian models crucially depend on the existence of some form of price rigidity.[2]

Despite the theoretical importance of menu costs, however, little is known about their actual magnitude, as the above quotation from Blinder [1991, p. 90] succinctly reflects. Because of the practical difficulty of measuring menu costs directly, a common feature of the existing empirical studies of menu costs is that they all provide indirect evidence.[3] Yet many authors, including Blinder [1994], Kashyap [1995], and Slade [1996a], have emphasized the importance of assessing the empirical relevance of menu costs at the level of individual firms. For example, according to Slade [1996a, p. 19], "Given the large number of theoretical papers that evaluate the implications of [price] adjustment costs, obtaining direct evidence that such costs are present seems crucial."

Our primary contribution in this paper is providing direct measures of menu costs at four large U.S. retail supermarket chains. Using a unique store-level data set, we show that changing prices in these establishments is a complex process, requiring dozens of steps and a non-trivial amount of resources. The menu costs reported in this study are made up of: (1) the labor cost of changing shelf prices, (2) the costs of printing and delivering new price tags, (3) the costs of mistakes made during the price change process, and (4) the cost of in-store supervision of the price change process.[4] We find that the measurable components of menu costs for the four chains average $105,887 annually per store. In relative terms, these menu costs comprise 0.70 percent of revenues, 35.2 percent of net margins, and $0.52 per price change, on average.

Our second major contribution in this paper is providing evidence that these menu costs can form a barrier to price change activity at these chains, offering direct support for the relationship between menu costs and store-level individual price rigidity. We present three types of evidence that

these menu costs form a barrier to price change activity at these firms. First, we contrast the price change activity of an additional chain that operates in a state with an item pricing law with the first four chains which operate in states not subject to such laws. Item pricing laws require that a separate price tag be placed on each individual item sold (in addition to the shelf price tag). We show that the average menu cost per price change for the chain subject to the item pricing law is $1.33, over two and a half times the corresponding figure for the other four chains ($0.52). These larger menu costs lead to very different levels of price change activity by these chains. Specifically, the four supermarket chains which are not subject to item pricing laws, on average change prices on 15.6 percent of the products they carry each week. In contrast, the chain which is subject to the item pricing law (and therefore faces higher menu costs), changes prices on only 6.3 percent of the products it carries, which is less than half of the average of the other four chains.

Second, within the chain facing the item pricing law, there are 400 products that are exempt from this law and thereby face lower menu costs. For these products the chain each week changes the prices of 21 percent of the products on average, which is over three times more frequently than for products subject to the item pricing law. Third, we provide evidence from the supermarket chains that the menu costs they incur form a barrier to certain *cost-based* price adjustments. Specifically, we show that the chains not subject to item pricing laws each week experience cost increase on about 800–1,000 products they sell. Yet, they adjust prices of only about 70–80 percent of these products. The remaining 20–30 percent of the prices are not adjusted immediately because the existing menu costs make the necessary price adjustment unprofitable. Considering all three of these findings together, we conclude that menu costs can indeed affect price change activity at the level of the individual firm—offering direct evidence that these menu costs are relevant to marginal price change decisions. Finally, on a related macroeconomic issue, we provide empirical evidence which suggests that the price change process in these supermarket chains has a strong time-dependent element.

Relating our findings to the existing theoretical models, we conclude that the magnitude of the menu costs we find are large enough to be capable of having macroeconomic significance. First, recall that according to the studies of Akerlof and Yellen [1985], Mankiw [1985], and Parkin [1986], even small menu costs can be relevant since they may be sufficient to generate substantial aggregate nominal rigidity and thus large business cycles. Second, when considered in the context of the theoretical menu cost models of Blanchard and Kiyotaki [1987] and Ball and Romer [1990], we find that the menu cost figures we report are “non-trivial” and their relative magnitudes cross the

minimum theoretical threshold needed to form a barrier to price adjustments.

Although in this paper we provide direct measurements of the marginal costs associated with changing prices, it should be mentioned that there are still many aspects of menu costs we are unable to measure. In particular, we do not provide measurements of the marginal benefits associated with changing prices, which can be significant [Lieberman and Zilberfarb, 1985; and Sheshinski and Weiss, 1977]. At the local level this industry is extremely competitive [Calatone, et al. 1989; Progressive Grocer, 1992 and 1993; and Chevalier, 1995]. In such a competitive industry the benefits of frequently changing prices can be high, as unmatched price cuts or consumer perceptions of higher prices can lead to significant losses in sales.[5] This helps explain why, despite the magnitude of the menu costs we find, we still observe frequent weekly price change activity by the chains we study. For example, stores change an average of 15–16 percent of their prices each week. Also, they seem to adjust the prices of 70–80 percent of the products for which they experience cost increases.[6] Thus, although we have evidence that the menu costs we report in this study clearly matter in the sense that they create some barriers to price change activity at these retail supermarket outlets, they are not large enough to prevent significant share of prices to adjust.

The paper is organized as follows. In section II we describe the data. In section III we discuss the price change process in supermarket chains and report absolute measures of menu costs. In section IV we assess the effect of item pricing laws on menu costs. In section V we discuss the significance of the menu costs. We end with conclusions and suggestions for future research.

II. Data Description

The data come from a company that sells electronic shelf label (ESL) systems. These systems allow retailers to change the shelf prices electronically from a central computer (where price changes are actually done) via a wireless communication system and thus reduce the physical costs and lead times currently associated with changing shelf prices. In order to sell the product, the company needed to validate what the existing costs of changing shelf prices were in supermarket chains, i.e. the existing levels of menu costs. This company received access from corporate headquarters at each of the five chains in our sample to go to representative stores and carefully record the exact steps involved in the price change process. These studies considered the entire price change process in each chain. For this, detailed workflow schematics of each task in the price change process was developed. Observations of the process were conducted in multiple stores of the chains (at least two

representative stores for each chain) to verify its accuracy. Information received from chains' pricing systems, in-store observations, in-store counts, and in-store time measurements (with a stopwatch) were used to determine the volume of work performed in each step of the tasks, weekly frequency of each step performed, and the exact amount of time required to perform one unit of the work. After computing the total hours per task, this information was reconciled with the known total hours spent each week. This allowed for task level comparisons for the existing and test process. Each study required hundreds of man hours to create. The studies were conducted during the years 1991–1992.

Although we believe the menu costs reported in this paper are representative of menu costs in the U.S. supermarket industry, we should mention that they may be biased upward because the firm had an incentive to overestimate the magnitude of the menu costs in order to sell the ESL system. We think, however, that the menu cost measures we report in this paper are not subject to significant biases of this sort for a number of reasons. First, the ESL people measured and documented all price change activities jointly with the supermarket employees using the wage figures provided by the supermarket management. Second, time and motion measurements of the type used for measuring the menu costs we report here are routinely done by supermarket chains themselves in order to assess the efficiency of their price change processes. The supermarket managers compared their figures to the ESL company figures and found them to be similar. Further, these figures were presented to upper management of these chains and were found to be representative of their cost structures. In fact, the validity of the menu cost measures constructed by the ESL company was never disputed. If there was any disagreement between the ESL company and the supermarket chains, it was about the size of the savings the ESL system would provide, not about the accuracy of the menu cost measurements.[7] Further, we looked at these reports and searched for figures that could be biased upward. There were a few, such as loss of goodwill costs and inventory holding costs, and to be on the conservative side we did not include them in our measures of menu costs. Thus we only report figures for which we could see no upward bias. Finally, note that the menu cost figures we report are clearly biased downwards because we were unable to measure in dollar terms several components of menu costs and thus they are not included in our figures (see section III.5 for details).

Table I displays some general information about the supermarket chains we study, their pricing strategy, and information about the frequency of weekly price changes the stores undertake. The chains involved in this study are all large U.S. supermarket chains, from different regions in the

United States, ranging from the Northeast to the West Coast, and operating an average of 400 stores each. At the request of these retailers we will keep the companies in this study anonymous, but they are all large, multiple-store chains that seem reasonably representative of large supermarket chains currently selling in the United States. These chains are similar in the variety, selection, and quantity of the products they carry. Supermarket chains of this type make up $310,146,666,000 in total annual sales, which is 86.3% of total supermarket chain sales in 1992 [*Supermarket Business*, 1993], so the chains in our sample are representative of a major class of the retail grocery trade.

According to the second row in Table I, the number of weekly price changes in Chains A–D ranges from 3,223 to 4,316 for an average of 3,916 per store.[8] The variation in the number of weekly price changes across the chains is due in large part to their choice of pricing strategy: Chains A and B follow a high/low (HL) price strategy, while Chains C and D follow an every-day-low-price strategy (EDLP). Under the EDLP strategy, the retailer's prices are low for an extended periods of time and therefore it will offer less promotional sales or discounts. Under the HL pricing strategy, in contrast, the retailer's prices are higher, and the retailer tends to offer more frequent discounts through sales and promotions. The pricing strategy, therefore, will have an effect on the frequency of price changes observed. In particular, we would expect EDLP stores to have less frequent price changes in comparison to the HL stores. Indeed, according to Table I, Chains A and B tend to have higher number of weekly price changes (4,278 and 4,316 respectively) than Chains C and D (3,846 and 3,223, respectively).

Supermarkets of the size we study tend to carry around 25,000 different items on a regular basis.[9] The last row in the table presents the share of the 25,000 products for which the supermarket chains change their prices in a period of one week. The average share for the four chains is 15.66 percent.

III. Absolute Measures of Menu Costs

There are four components of menu costs which we are able to measure in dollar terms.[10] These are: (1) the cost of labor required to change the shelf price tags, (2) the cost of printing and delivering new price tags, (3) the cost of mistakes made during the process of changing prices, and (4) the cost of in-store supervision time spent on implementing price changes.

III.1. Costs of the Labor Required to Change Shelf Prices

Figure I displays an overview of the steps involved in changing prices at chain A. There are three

main components in the labor costs incurred by the chains: (a) labor cost of tag change preparation, (b) labor cost of the tag change itself, and (c) labor cost of verifying whether the price changes are done correctly, which include tag change verification, in-store resolution of price mistakes, and zone and corporate resolution of price mistakes.[11] Standard price tag changes, which include the steps outlined on the left hand side of Figure I, make up the majority of price changes in these chains. Some price changes also require additional price signs to be placed at different locations in the store, such as on an end of aisle display or near the shelf.[12] These sign changes add to the menu costs, and they are outlined on the right hand side of Figure I: the sign change preparation, actual sign changes, and sign change verification boxes. The bottom two boxes in Figure I are additional menu costs related to the extra steps taken in these stores to make sure the tag and sign changes have been done correctly.[13] Table II lists each stage of the price change process, the total amount of time spent on each stage each week on average, and the number of tasks performed. In addition, the table identifies some of the main tasks performed in each stage as well as the four most time consuming tasks in each stage. To compute the total labor time used in changing prices on a weekly basis, we combine the data collected through in-store time and motion observations with information on the volume of products for which prices are changed. These weekly hours are multiplied by the wage rates (adjusted for fringe benefits) of the employees used in the price change process to get the total costs of labor required to change prices.

For the four supermarket chains in our study the total annual labor cost of changing the shelf price tags range from $40,027 to $61,414 per store, for an average of $52,084 (see the first row in Table III), making up about 49 percent of the total menu costs on average. The labor cost of changing the price signs range from $16,411 to $27,955 per store, for an average of $22,183 (see the second row in Table III), making up almost 21 percent of the menu costs on average. Thus, for the four supermarket chains the total annual menu costs associated with the labor required to change prices (shelf price tags and price signs, combined) range from $62,210 to $81,703 per store, for an annual average of $74,267. This is the single largest component of the menu costs we report in this study, making up about 70.1 percent of the total menu costs for these chains on average. This should not be surprising, given that the most significant portion of retail grocery operating expenses are labor costs [Hoch, Drèze, and Purk, 1994].[14]

III.2. Costs of Printing and Delivering New Price Tags

There are direct costs associated with printing and delivering the price and sign tags. The

order must be recorded and processed at the chain, sent to the printer, recorded and processed at the printer, printed, packaged, and then delivered to each store. The cost per tag is usually quite low, $0.017 per tag at Chain A, which includes stock costs of $0.0118 per tag, impression and data center operator costs of $0.0037 per tag, and mail room handling costs of $0.0010 per tag. There are, however, many price changes undertaken each week. In total, the costs of printing and delivering the price and sign tags range from $3,048 to $10,018, averaging $6,014, per store per year (see Table III). These costs comprise less than 6 percent of the total menu costs we report.

III.3. Costs of Mistakes Made in the Process of Changing Prices

Despite the labor put into checking to make sure that the price changes are done correctly, there are still many price mistakes that are not caught until customers discover them throughout the week, and these mistakes impose costs on the chain. Clearly, the costs associated with these errors must be considered when deciding whether to change prices or not, and therefore are a relevant dimension of menu costs. These mistakes can occur so often that they were a feature of a *Dateline* segment on U.S. supermarket chains [NBC, April, 1992] and an article in *Money* magazine [April 1993]. Both, the *Money* magazine article and Goodstein [1994] report that on average 10 percent of the products they examined had price mistakes. A more recent study by the Federal Trade Commission (1996) reports a total error rate of about 5 percent.

The menu costs associated with these mistakes include: lost cashier time to correct the errors, scan guarantee refunds, and inventory mistakes associated with incorrect price tags.[15] Lost cashier time is measured here in terms of wage payments. Scan guarantee refunds are additional price reductions beyond the error, or additional items given away for free because of the mistake. Finally, the inventory mistakes costs we report include only the cost of stockouts, which occur when shelf price is lower than intended.

The mistake costs were available at chains A, C, and D, and they range from $19,135 to $20,692 for an average of $20,140 per store annually (see Table III). These costs are the second largest component of menu costs in our study, comprising about 19 percent of the total.

III.4. Costs of In-store Supervision Time Spent on Implementing Price Changes

Managers at the store level spend time overseeing, implementing, and troubleshooting the price change process. Only chains A and B had a measure of the menu costs associated with this in-store supervision time, and both of these came from a self reported number of hours spent on

changing prices by the managers at these chains. The hours spent on changing prices were the same across the chains, approximately 5 hours per week. Thus, the menu costs for in-store supervision time came to $4,241 and $6,692 per store annually for chains A and B, respectively (see Table III). These costs comprise less than 6 percent of the total menu costs we report in this paper. Notice, however, that these measures does not include the cost of the management time spent on price change decisions made at corporate headquarters, which is discussed next.

III.5. Components of Menu Costs We Are Unable to Measure in Dollar Terms

Our data set does not contain the exact dollar measures of some menu cost components. One such component is the cost of corporate management time spent on price change decisions.[16] In the supermarket chains we study, prices are generally set at corporate headquarters in a weekly meeting where the manager in charge of setting prices looks at a variety of information including: (a) any manufacturer wholesale price changes, promotions, and other related issues, (b) past sales for this product, and (c) competitors' prices. Based on this information and on discussions with other managers, the price setting manager decides whether to change prices, and if so, by how much.

To estimate the magnitude of these managerial components of the menu costs, consider the following. In an average chain there is at least 1 executive of merchandising, who devotes most of his/her time to pricing decisions. In addition, there are up to 3 senior managers who would deal with pricing and to whom category managers report. There are also 10–12 category managers who are responsible for setting prices on all the products within their category. Additional 2–4 people spend full time handling the implementation of price changes across retail outlets, coordinating the printing and delivery of price tags, and handling pricing problems in the system. Another 5–7 workers gather the data on competitors' prices and analyse both the competitors' data and the store's own scanner data to put it in a form useable by managers making pricing decisions. Thus, in total there are about 21–27 people working at the corporate headquarters on price change decisions. Assuming $150,000 as the average annual salary of the executive of merchandising and senior managers, $100,000 for category managers, and $50,000 for the rest, the chainwide managerial cost falls in the neighborhood of $2.3–$2.9 million a year, which seems a substantial amount. Note, however, that these pricing decision are made for the entire chain and therefore, the costs per store are significantly less, especially for the larger chains. For example, using $2.9 million as the upper bound, the additional annual menu cost per store for Chains A–D, which on

average operate about 400 stores each, averages about $7,250, which is much lower than expected, and is due to the centralization of the price change decisions in the chains we study.[17]

Our menu cost measures also do not include the cost of changing prices of direct store delivery (DSD) products. These products are almost completely handled by manufacturers, including stocking, monitoring inventories, and setting and changing prices.[18] We have data on the weekly frequency of price changes of DSD products in Chain E. In an average week there are 174 price changes of DSD products, which is about 10 percent of their total weekly price changes. Using the cost of changing the price of a regular product, $1.33 (see section IV for details), the annual cost of changing prices of the DSD products in this chain roughly equals $12,034.[19] Our menu cost measures do not include these figures since we do not have similar data for the other chains.[20]

III.6. Total Menu Costs

The total annual menu costs reported for each chain per store are listed in the last row of Table III. As the table indicates, the menu costs range from $91,416 to $114,188 for an average of $105,887 per store per year.[21] Note that these menu cost measures include only the components we could accurately measure in dollar terms, which are discussed in sections III.1–III.4.

IV. Item Pricing Laws and Menu Costs

In this section we provide evidence on the menu costs for an additional chain (Chain E), which unlike the other four chains, operates in a state with an item pricing law. The most important aspect of item pricing laws is that they require a price tag on each individual item sold, not just on the shelf, which is what the other four chains in our sample do. For example, the item pricing law in Connecticut requires that the grocers "shall mark or cause to be marked each consumer commodity which bears a Universal Product Code with its retail price."[22] From a menu cost perspective, the requirement of posting prices on every item (in addition to the shelf price tag) introduces additional costs in the process of changing prices.

Although most of the steps involved in changing prices are the same for both types of chains, stores that are subject to item pricing laws have to undertake additional steps to obey this law.[23] The labor cost component of menu costs in Chain E totals $75,127 a year, of which $49,710 is the cost of the labor time spent on changing the prices of individual items, $3,234 is the cost of the labor time spent on shelf tag replacements, and $22,183 is the cost of the labor time spent on sign changes (see Table III).[24] An additional $44,168 is spent annually putting prices on new items as

they are brought to the shelves. Although we do not include this last figure in our menu cost measures because we do not have information on how much of it is due to price change activity and how much due to just pricing—these costs are clearly a direct consequence of the item pricing law. The printing and delivery cost of price tags and price signs are $7,644 and the mistake costs are $20,799. These figures along with the amount of $5,466 for the cost of in-store managerial supervision time, yield total annual menu costs of $109,036 per store.

Although the magnitude of the total annual menu costs seem similar to the other four chains, note that the average weekly frequency of price changes in chain E is only 1,578, which is only 40.3 (= 1,578/3,916) percent of the price changes made by the other four chains. Thus the average menu cost per price change for Chain E is $1.33 (see Table IV, last row). In contrast, the corresponding figures for Chains A–D average $0.52. Hence, the menu costs per price change incurred by the supermarket chain facing item pricing laws are more than two and a half times the amount incurred by chains that are not subject to this law.[25] Overall, these findings suggest that legal restrictions of the type of item pricing laws can have a significant impact on the menu costs incurred by sellers.

V. Significance of The Menu Costs

The next natural question to ask is, how important are these costs? To address this question, we (1) provide several relative measures of the menu costs, (2) discuss the effect of the menu costs on supermarkets' price change activity, and (3) discuss macroeconomic implications by relating our findings to the existing theoretical models of menu costs. In each case, we provide additional evidence to help assess the importance of these menu costs.

V.1. Relative Measures of the Menu Costs

In order to assess the relative magnitude of the menu costs reported in section IV, we now present the menu cost figures relative to the average store-level revenues and net profit margins.[26] In addition, we present the menu cost figures per price change.

The annual average revenues of a large U.S. supermarket chain of the type and size included in our sample is $15,052,716 per store.[27] According to the second row of Table IV, the ratio of menu costs to revenues for Chains A–D ranges between 0.61–0.76 percent averaging 0.70 percent.[28] We relate the size of these figures to the existing theoretical menu cost models in section V.3.

Net profit margin, which measures the revenues minus all costs, is approximately 1–3 percent of revenues for these chains [Montgomery, 1994], so we use 2 percent as a working

average. The reason for the low profit rate in this industry is the intense competition [Calatone, et al. 1989], especially at the regional level [Chevalier, 1995], which has been increasing since the early 90's [*Progressive Grocer*, 1992 and 1993]. It follows that the average store profitability for these chains equals $301,054 per year. Therefore, the ratio of total menu cost to net margin for Chains A–D ranges between 30.4–37.9 percent for an average of 35.2 percent. Thus, the menu costs we report in this study represent a significant share of supermarkets' profits.

Another way to look at the menu cost figures we report is to express them relative to the frequency of price changes. In the last row of Table IV we present the menu cost figures per price change for each chain. As the table indicates, the cost of changing a price in chains A–D ranges between $0.46–$0.68 for an average of $0.52. For Chain E the figure is substantially larger, $1.33 per price change.[29] These figures are lower than the estimated cost of $2.00–3.00 per price change reported by Slade [1996a]. There are several possible reasons for this: (1) our menu cost figures are based on actual measurements of the resources that go into the price change process, whereas she estimates menu costs econometrically as model coefficients using a mix of store-level price and aggregate cost data; (2) we cover 25,000 products the supermarkets carry rather than a single product category; (3) our menu cost figures do not include all components of menu costs; and (4) there could be differences in wage rates which may be important given the significance of the labor cost component in menu costs.

V.2. The Effect of Menu Costs on the Price Change Activity of the Supermarkets

In this section we present evidence which suggests that these menu cost may be forming a barrier to price change activity. To begin with, consider the effect of the item pricing law on the price change activity of Chain E. The data on the weekly frequency of price changes in each chain is displayed in the last two rows of Table I. According to these figures, the average weekly frequency of price changes in Chain E is only 1,578. Thus, on average Chain E changes prices of only 6.31 percent of its products each week. In contrast, the average weekly frequency of price changes at Chains A–D ranges from 3,223 to 4,316, for the four-chain average of 3,916 price changes weekly. So, Chains A–D change prices of 12.89 to 17.26 percent of their products each week, yielding a four-chain average of 15.66 percent. Thus, Chain E, which faces the item pricing law, changes prices only about 1/3 times as frequently as do Chains A–D.[30]

Moreover, within chain E, there are 400 products which are exempt from the item pricing law,

and thereby face lower menu costs. We find that there are an average of 83 weekly price changes for these products, yielding 21 percent of these products changing prices. So within chain E, they change prices over three times as frequently for products with lower menu costs than for the products with higher menu costs. Note that this finding is on the price change activity within the same chain offering almost a natural experiment on the impact of menu costs on the chain's pricing behavior. Hence, we provide evidence both, across chains as well as across products within a chain, that as the costs of changing price go up, the frequency of price changes goes down. Thus, the menu costs we find are significant enough to affect the chain's price change practice.

We also have additional evidence from Chains A, B, and D about these menu costs being a barrier to certain price changes, and it is summarized in Table V. According to the Price Management Department of Chain A, the chain experiences cost increases on 860 products in an average week, to which it would like to react with a price increase.[31] However, on average, 22% of these price increases are not implemented immediately because the cost of changing prices for these products is too high to make it economically worthwhile. Figures of the same magnitude were reported by other chains. For example, Chain D experiences cost increases for 961 products on an average week. Out of these, the chain adjusts prices of only 633 products. The remaining 34 percent of the prices are left unadjusted because of the menu costs. Similarly, Chain B finds it economically inefficient to adjust prices of 508, i.e. 30 percent, of its products each week because of menu costs. This provides additional evidence that the menu costs incurred by these chains are preventing price adjustments to some costs changes, leading to price rigidities of the products involved.[32] Note that, although we do not have similar data for Chain E, we would expect significantly lower numbers on this measure at that chain. These figures also suggest an upper bound on the benefit of complete price flexibility under the current pricing practice of weekly price adjustments. However, if new technologies (e.g., ESL systems) and new pricing practices (e.g., a decentralization of the price change decisions) are adopted, allowing a fundamental change in the way the pricing mechanism is currently set, the managers could consider more frequent price change activity (e.g., multiple times each week) as menu costs go down.

In this paper we measure the menu costs at the chains' current level price change activity. It may be worthwhile to speculate on the shape of the cost function relating menu costs to the frequency of price changes by assessing how these costs would change if the price change activity were to increase or to decrease. It seems likely that many of the costs we report in this paper will

(approximately) change linearly with additional price changes within the current range of price changes the chains are undertaking (plus or minus, perhaps, a thousand per week). For example, the labor costs associated with changing a shelf price tag, costs of verifying price changes, and the costs of mistakes occurring during this process, all increase linearly with the frequency of price changes. This is because most of the time-consuming steps involved in the price change process must be repeated each time an additional shelf price tag is changed (see Table II). Further, we were unable to find many tasks that generated significant returns to scale. It is unclear what cost savings are available if the price change activity drops substantially below the levels it is at now. Clearly, if price changes were near zero, or done less frequently than weekly (say monthly), there could be major differences in these costs.

What is less clear is how these costs would change at more extreme levels of price change activity. With less frequent price changes the menu costs could probably be reduced significantly, although the cost of deciding what prices to set initially, and the cost of putting the initial shelf price tags would still remain as a lower bound of the menu cost. However, for achieving more price flexibility by changing prices more frequently (i.e., multiple times each week), substantial changes must be undertaken. At present, the supermarket chains are set up to make the majority of their price changes on a weekly basis, with the appropriate systems in place to make this process most efficient. For example, in order to save costs and to have higher quality price tags (e.g., with color, more details, greater clarity, glossy, etc.), the chains often send new price tag requests to a printing shop which takes three days to print and deliver the labels to each store. Then, given the large number of price changes taking place, and the goals of minimizing customer disruptions and labor costs (such as overtime pay), and coordinating with advertised price promotions, the prices are changed in the store over a two-three day period (see Table VI). The combination of these schedule and built-in lags is acceptable under the current practice of changing prices weekly, but would have to be adjusted dramatically to allow for significantly more frequent price changes on a regular basis.

Perhaps even more imposing are the costs of changing the managerial costs associated with the current weekly system of price changes. The process of pricing at this organizational level is not a self-contained process taking place in isolation from other operations of the supermarket management. Rather, it is a part of a larger system of business decisions and operations. The current process of operations (such as data collection and their analysis, management meetings, coordination of the decisions across functional areas, etc.) is set-up to function on a weekly basis.[33] Further,

these management, accounting, and logistics systems are currently built around a tremendous amount of information to be analyzed for thousands of products.[34] Accommodating more frequent price changes on a regular basis would require a radical adjustment of many managerial sub-structures and units at both corporate and store levels, which could involve costly investment in restructuring and retraining the existing labor force as well as in new physical and human capital. Thus the cost function relating the menu costs to the frequency of price changes would approximately be linear from zero to roughly about 5,000 price changes per week. With higher frequency of price changes, under the current weekly pricing practice, the menu costs are likely to increase dramatically, perhaps by as much as 10–20 times, according to the ESL executives.[35]

V.3. Relating Our Findings to the Existing Theoretical Models of Menu Costs

In order to assess the magnitude of these menu cost figures in the context of the existing theoretical menu cost literature, consider the following calculation experiments done within the framework of two theoretical menu cost models. Blanchard and Kiyotaki [1987] study a general equilibrium menu cost model with monopolistic competition and with unit elasticity of aggregate demand with respect to real money balances. According to their calculations, menu costs of the magnitude of 0.08 percent of revenues, which they consider "very small," may be sufficient to prevent adjustment of prices. Ball and Romer [1990] conduct similar calculations in the framework of a model with imperfect competition and menu costs. They find that for plausible markup and labor elasticity parameter values, menu costs needed to prevent price adjustment is 0.70 percent of revenues, which as they suggest, is non-negligible. For smaller menu costs, e.g., 0.04 percent of the revenue, which Ball and Romer consider "trivial," implausibly large values of markup and labor elasticity parameters are needed to prevent price adjustment to monetary shocks.

According to the figures in Table IV, the reported menu cost to revenues ratio for Chains A–D averages 0.70 percent, ranging from 0.61 percent to 0.76 percent. These are significantly larger than the "trivial" 0.04 or 0.08 percent figures mentioned above, suggesting that the menu cost figures we find here are non-trivial. Further, under the model and parameter values considered by Blanchard and Kiyotaki [1987], the menu cost figures we find are higher than the theoretical minimum needed to form a barrier to price adjustments. Under the model and parameter values considered by Ball and Romer [1990], the reported menu cost/revenue ratio for all but one chain reaches or crosses the theoretical threshold of 0.70 needed to form a barrier to price adjustments.

The existence of numerous unmeasured menu cost components discussed in section III.5 also raises the possibility that the actual menu costs incurred by these chains are significantly higher than that threshold. This suggests that the menu costs we report may be large enough to form a barrier to nominal price adjustments, when interpreted in the context of these models.

An issue of interest in this literature is time-dependent vs state-dependent pricing rules (see, for example, Caplin and Leahy [1991]). The evidence from our data set on the timing of price changes suggests that the price change decisions in these supermarkets have a strong time-dependent price setting element.[36] For example, according to Table VI, the prices in chain A are changed weekly according to the following schedule: the price changes of general merchandise that is advertised is done Saturday nights, grocery and produce prices are changed Sunday nights, the rest of the general merchandise prices are changed on Monday nights, and the prices of advertised grocery items are changed on Tuesday nights. Thus, as the figures in Table VI indicate, over 96 percent of the price changes are done during Sunday and Monday nights. However, this does not imply that state-dependent pricing rules are unimportant. Even if price changes across product categories follow a prescheduled weekly time table, the prices of which products to change is likely to be a state-dependent decision. For example, it could depend on changes in supply and demand conditions such as competitors price change decisions. Indeed, Levy, Dutta, and Bergen [1996] use retail store-level orange juice price and cost data to demonstrate that the extent of price response to cost shocks, that is, the extent of price rigidity, may depend on the persistence of supply shocks.[37]

We do not want to overstate the usefulness of our data for directly addressing the issue of monetary non-neutrality. On one hand, authors such as Caplin and Spulber [1987] have demonstrated that under certain conditions individual price rigidity may not be sufficient for aggregate price rigidity, but unfortunately our data do not speak directly to this issue.[38] On the other hand, authors such as Akerlof and Yellen [1985], Mankiw [1985], and Parkin [1986] have shown that even small menu costs can be relevant since they may be sufficient to generate substantial aggregate nominal rigidity and thus large business cycles. Therefore, as Blinder [1994], Kashyap [1995], and Slade [1996a] emphasize, it is important to search for direct evidence that such costs are indeed present at the micro level. By directly identifying, documenting, and measuring the magnitude of menu costs at the store level we are taking an important step in that direction.

VI. Conclusion and Future Research

Our main contribution is that we provide direct microeconomic evidence on the actual

magnitude of menu costs for four large U.S. retail supermarket chains. The annual menu costs per store at these chains average $114,188, comprising 0.70 percent of revenues, 35.2 percent of net profit margins, and $0.52 per price change, on average.

Further we provide evidence which suggests that these menu costs may be forming a barrier to price changes. Specifically, we show that (1) supermarket chains not subject to item pricing law change prices two and a half times more frequently than the chain that is subject to the law; (2) within the chain that is subject to the item pricing law, they change prices over three times as frequently for products that are exempt from this law than for the products which are subject to this law; and (3) we find that these chains do not adjust prices of up to one third of the products for which they face cost increases because of menu cost considerations.

When we relate these findings to the existing theoretical models of menu costs, we conclude that the magnitude of menu costs we find are large enough to be capable of having macroeconomic significance. Specifically, when considered in the context of the theoretical menu cost models of Blanchard and Kiyotaki [1987] and Ball and Romer [1990], we find that the menu cost figures we report are “non-trivial” and their relative magnitudes cross the minimum theoretical threshold needed to form a barrier to price adjustments.

Despite the high relative magnitude of the marginal cost of changing price we find, the data still indicate frequent weekly price changes. This is because of the high marginal benefit of changing price, which is due to the fierce competition found in the retail supermarket industry. That marginal benefits may outweigh the marginal costs of changing prices in this industry, however, does not rule out the possibility that menu costs of the magnitude we find here can create substantial nominal rigidity in other industries or markets. In less competitive industries and markets, menu costs of the type and magnitude we document here are likely to have a bigger impact on the frequency of price adjustment and consequently, on the degree of price rigidity.

At a minimum, the direct dollar measures of menu costs we report here can be used as a starting point for future research on measuring their magnitude in other industries and establishments. We anticipate that these menu costs will be similar in other markets which rely on posted prices (such as drug stores, department stores, etc.) because the steps involved in the price change process are likely to be similar. What may differ are the frequency of price changes and the labor wage rates at these stores. For example, since supermarket chains change thousands of prices

each week, the total annual menu costs incurred by these chains per store are likely to be high in comparison to other retail formats such as chain drug stores or department stores. There are, however, a variety of industries for which the steps involved in changing prices would be significantly different from those reported in our study. For example, business-to-business sales which often rely on a salesforce, will require changes in the list price sheets, changes in the instructions to the salesforce which may include education and discussion with the salespeople in the company, and so forth. These business-to-business prices also often have more complex pricing schemes including quantity discounts, bundling, and individually negotiated prices. As another example, the composition of the cost of changing the newsstand prices of magazines [Cecchetti, 1986] or the prices of products sold through catalogs [Kashyap, 1995], are different from many of the menu cost components we discuss here. Further, the finding that a centralization of pricing decisions makes the store-level managerial component of menu cost relatively small, suggests that the managerial menu costs likely are highest in settings where price change decisions are decentralized. Thus, future empirical work should look at menu cost and its composition in a variety of other industries, markets, and products, with both centralized as well as decentralized price change decisions, in order to see if the magnitude of these costs can be generalized and benchmarks can be established. Further, there are technological changes taking place in this and other industries that promise to alter the structure of menu costs, which deserve an attention. At the theoretical level, our findings suggest that it may be worthwhile to explore models which incorporate the idea of item pricing laws as an additional component of menu costs.

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References

Akerlof, George A., and Janet L. Yellen, "A Near-Rational Model of Business Cycle, with Wage and Price Inertia," Quarterly Journal of Economics, C (1985), 823–838.

Amano, Robert A., and R. Tiff Macklem, "Menu Costs, Relative Prices, and Inflation: Evidence for Canada," Working Paper, Research Department, Bank of Canada, 1995.

Andersen, Torben M., Price Rigidity: Causes and Macroeconomic Implications (Oxford: Clarendon Press, 1994).

Balke, Nathan S. and Mark A. Wynne, "Supply Shocks and the Distribution of Price Changes," Federal Reserve Bank of Dallas Economic Review, (1996), 10–18.

Ball, Laurence, and N. Gregory Mankiw, "A Sticky-Price Manifesto," Carnegie-Rochester Conference Series on Public Policy, (1994), 127–152.

Ball, Laurence, and N. Gregory Mankiw, "Relative Price Changes as Aggregate Supply Shocks," Quarterly Journal of Economics, CX (1995), 161–193.

Ball, Laurence, N. Gregory Mankiw, and David Romer, "The New Keynesian Economics and the Output-Inflation Trade-off," Brookings Papers on Economic Activity, 1 (1988), 1–65.

Ball, Laurence, and David Romer, "Real Rigidities and Nonneutrality of Money," Review of Economic Studies, LVII (1990), 183–203.

Bergen, Mark, Shantanu Dutta, and Steven M. Shugan, "Using Branded Variants," Journal of Marketing Research, XXXIII (1996), 9–19.

Berkowitz, Eric N., Roger A. Kerin, and William Rudelius, Marketing (St. Louis, MO: Times Mirror/Mosby College Publishing, 1986).

Blanchard Olivier J., and Nobuhiro Kiyotaki, "Monopolistic Competition and the Effects of Aggregate Demand," American Economic Review, LXXVII (1987), 647–666.

Blattberg, Robert C., and Scott A. Neslin, Sales Promotion: Concepts, Methods, and Strategies (Englewood Cliffs, NJ: Prentice Hall, 1989).

Blinder, Alan S., "Why Are Prices Sticky? Preliminary Results from an Interview Study," American Economic Review, LXXXI (1991), 89–96.

——, "On Sticky Prices: Academic Theories Meet the Real World," in Monetary Policy, N. Gregory Mankiw, ed. (NBER: University of Chicago Press, 1994).

Bryan, Michael F., and Stephen G. Cecchetti, "Inflation and the Distribution of Price Changes," National Bureau of Economic Research, Working Paper No. 5793.

Calatone, Roger J., Cornelia Droge, David Litvack, and C. Anthony DiBenedetto, "Flanking in a Price War," Interfaces, XIX (1989), 1–12.

Caplin, Andrew, "Individual Inertia and Aggregate Dynamics," in Optimal Pricing, Inflation, and the Cost of Price Adjustment, Eytan Sheshinski and Yoram Weiss, eds. (Cambridge, MA: The MIT Press, 1993).

Caplin, Andrew S., and John Leahy, "State Dependent Pricing and the Dynamics of Money and Output," Quarterly Journal of Economics, CVI (1991), 683–708.

Caplin, Andrew S., and Daniel F. Spulber, "Menu Costs and the Neutrality of Money," Quarterly Journal of Economics, CII (1987), 703–725.

Carlton, Dennis W., "The Rigidity of Prices," American Economic Review, LXXVI (1986),

637–658.

——, "The Theory and the Facts of How Markets Clear: Is Industrial Organization Valuable for Understanding Macroeconomics?" in Handbook of Industrial Organization, Volume 1, Richard Schmalensee and Robert D. Willig, eds. (Amsterdam: North Holland, 1989).

Carlton, Dennis W., and Jeffrey M. Perloff, Modern Industrial Organization (New York, NY: Harper Collins, 1994).

Cecchetti, Stephen G., "The Frequency of Price Adjustment: A Study of the Newsstand Prices of Magazines," Journal of Econometrics, XXXI (1986), 255–274.

Chevalier, Judith A., "Capital Structure and Product Market Competition: Empirical Evidence from Supermarket Industry," American Economic Review, LXXXV (1995), 415–435.

Danziger, Leif, "Price Adjustments with Stochastic Inflation," International Economic Review, XXIV (1983), 699–707.

——, "Inflation, Fixed Cost of Price Adjustments, and Measurement of Relative Price Variability," American Economic Review, LXXVII (1987), 704–713.

Dutta, Shantanu, Mark Bergen, and Daniel Levy, "Price Flexibility: Evidence From Scanner Data," Working Paper, University of Chicago and Emory University, 1995.

Eden, Benjamin, "Time Rigidities in the Adjustment of Prices to Monetary Shocks: An Analysis of Micro Data," Discussion Paper No. 94.16, Bank of Israel, 1994.

Federal Trade Commission, "Price Check: A Report on the Accuracy of Checkout Scanners," October (1966).

Goodstein, Ronald C., "UPC Scanner Pricing Systems: Are They Accurate?" Journal of Marketing, LVIII (1994), 20–30.

Gordon, Robert J., "What is New-Keynesian Economics?" Journal of Economic Literature, XXVIII (1990), 1115–1171.

Haddock, David D., and Fred S. McChesney, "Why Do Firms Contrive Shortages? The Economics of Intentional Mispricing," Economic Inquiry, XXXII (1994), 562–581.

Hoch, Stephen J., Xavier Drèze, and Mary E. Purk, "EDLP, Hi-Lo, and Margin Arithmetic," Journal of Marketing, LVIII (1994), 16–27.

Direct Store Delivery Work Group, et al., "Direct Store Delivery: An Efficient Consumer Response Best Practices Report," Joint Industry Project on Efficient Consumer Response, Industry Relations Department, Grocery Manufacturers of America, 1995.

Kashyap, Anil K., "Sticky Prices: New Evidence from Retail Catalogues," Quarterly Journal of Economics, CX (1995), 245–274.

Lach, Saul, and Daniel Tsiddon, "The Behavior of Prices and Inflation: An Empirical Analysis of Disaggregated Data," Journal of Political Economy, C (1992), 349–389.

Lach, Saul, and Daniel Tsiddon, "Staggering and Synchronization in Price-Setting: Evidence from Multiproduct Firms," American Economic Review, 1996, forthcoming.

Lattin, James M., and Gwen Ortmeyer, "A Theoretical Rationale for Everyday Low Pricing by Grocery Retailers," Working Paper, Graduate School of Business, Stanford University, 1991.

Levy, Daniel, Mark Bergen, Shantanu Dutta, and Robert Venable, "On The Magnitude of Menu Costs: Direct Evidence from Large U.S. Supermarket Chains," Working Paper, University of Minnesota and Emory University, 1996.

Levy, Daniel, Shantanu Dutta, and Mark Bergen, "Heterogeneity in Price Rigidity and Shock Persistence," working paper, University of Chicago and Emory University, 1996.

Liebermann, Yehoshua, and Ben-Zion Zilberfarb, "Price Adjustment Strategy Under Conditions of High Inflation: An Empirical Examination," Journal of Economics and Business, XXXVII (1985), 253–265.

Mankiw, N. Gregory, "Small Menu Costs and Large Business Cycles: A Macroeconomic Model of Monopoly," Quarterly Journal of Economics, C (1985), 529–539.

Mankiw, N. Gregory and David Romer, New Keynesian Economics (Cambridge, MA: MIT Press, 1991).

Meltzer, Allan H., "Information, Sticky Prices, and Macroeconomic Foundations," Federal Reserve Bank of St. Louis Review, LXXVII (1995), 101–118.

Money Magazine, "Don't get cheated by Supermarket Scanners," an article by Vanessa O'Connell, XXII (1993), 132–138.

Montgomery, Alan L., "The Impact of Micro-Marketing on Pricing Strategies," Ph.D. Dissertation, Graduate School of Business, University of Chicago, 1994.

Okun, Arthur M., "Inflation: Its Mechanics and Welfare Costs," Brookings Papers on Economic Activity, 2 (1975), 351–390.

——, Prices and Quantities: A Macroeconomic Analysis (Washington, DC: The Brookings Institution, 1981).

Parkin, Michael, "The Output-Inflation Trade-off When Prices Are Costly to Change," Journal of Political Economy, LXXXXIV (1986), 200–224.

Romer, David, Advanced Macroeconomics (New York, NY: McGraw-Hill, 1996).

Rotemberg, Julio J., "Sticky Prices in the United States," Journal of Political Economy, LXXXX (1982), 1187–1211.

Sheshinski, Eytan, A. Tishler, and Yoram Weiss, "Inflation, Costs of Price Adjustments, and the Amplitude of Real Price Changes: An Empirical Analysis," in Development in an Inflationary World, J. Flanders and Assaf Razin, eds. (New York, NY: Academic Press, 1981).

Sheshinski, Eytan, and Yoram Weiss, "Inflation and Costs of Price Adjustments," Review of Economic Studies, XXXXIV (1977), 287–303.

Sheshinski, Eytan, and Yoram Weiss, Optimal Pricing, Inflation, and the Cost of Price Adjustment (Cambridge, MA: The MIT Press, 1993).

Slade, Margaret E., "Optimal Pricing with Costly Adjustment: Evidence from Retail-Grocery Prices," The University of British Columbia, submitted, 1996a.

——, "Sticky Prices in a Dynamic Oligopoly: An Investigation of (s, S) Thresholds," The University of British Columbia, manuscript, 1996b.

Supermarket Business, "Consumer Expenditures Study," XXXXVIII (1993), 52.

Warner, Elizabeth J., "Pricing in the Retail Industry: A Case Study," manuscript, Hamilton College, 1995.

Warner, Elizabeth J. and Robert Barsky, "The Timing and Magnitude of Retail Store Markdowns: Evidence from Weekends and Holidays," Quarterly Journal of Economics, CX (1995), 321–352.

Footnotes

1. See Akerlof and Yellen [1985], Mankiw [1985], Parkin [1986], Blanchard and Kiyotaki [1987], Caplin and Leahy [1991], and Caplin [1993].

2. See, for example, Mankiw and Romer [1991], Sheshinski and Weiss [1993], Andersen [1994], Ball and Mankiw [1994], Romer [1996], and studies cited therein.

3. These studies include, Sheshinski, Tishler, and Weiss [1981], Rotemberg [1982], Lieberman and Zilberfarb [1985], Carlton [1986, 1989], Cecchetti [1986], Danziger [1987], Ball, Mankiw, and Romer [1988]; Gordon [1990], Lach and Tsiddon [1992, 1996], Blinder [1994], Eden [1994], Amano and Macklem [1995]; Ball and Mankiw [1995]; Kashyap [1995], Warner [1995], Warner and Barsky [1995], and Slade [1996a, 1996b].

4. We also discuss other components of menu costs, including the costs of making corporate level managerial price change decisions and provide some evidence on their approximate magnitude, although we do not include these figures in the measures of menu cost we report.

5. Also, changing prices frequently can make it more difficult for customers to compare prices of branded items across supermarkets because of higher search costs [Carlton, 1986], which is valuable for creating differentiation between retail outlets [Bergen, Dutta, and Shugan, 1996].

6. This level of price change activity is similar to that found in other studies of U.S. supermarket prices [Dutta, Bergen and Levy 1995], although the price reaction to cost changes can be significantly more rigid depending on the nature of the cost changes the retailer faces [Levy, Dutta and Bergen 1996].

7. Indeed, four out of the five chains included in our sample have purchased ESL systems; three of the four actually purchased multiple systems (between 2–20 systems), and Chain E is considering buying 50 more.

8. Since Chain E is subject to an item pricing law, it is discussed separately in section IV.

9. The supermarkets often have about 40,000 UPC codes in their computer database records, but internal studies undertaken by the ESL company indicate that the supermarkets usually carry no more than 25,000 products at any given time. The extra UPC codes are for seasonal and/or promotional sizes and packages of products, and for discontinued products.

10. In this paper we only report measures of the marginal cost of changing prices. The costs of putting a price tag for the first time, and other costs that would be included in the average cost, are not included in the figures we report. Only when discussing Chain E, which is the chain subject to item pricing laws, we faced the issue of cost of pricing (at the first time) vs the cost of changing a price. Since there was no clear way of separating the two types of costs, the reported cost figure ($44,168, in the second paragraph of section IV) was excluded all together from our calculations. See also footnote 13.

11. Our data include a detailed description of the entire price change process with flow-charts documenting the specific steps undertaken in this process and the exact time period spent on each step. All these data and information, plus an appendix reporting computational details, are contained in a working paper version of this paper [Levy, Dutta, Bergen, and Venable, 1996] which is available upon request.

12. These are usually related to the product being on promotion, feature advertising, display, or in-store sale such as “manager’s special,” “today’s special,” etc. The steps involved in making sign changes are similar to price changes. The main differences are that (i) the time required for each of the steps in sign changes are longer because they are in less standard locations, and (ii) there are fewer sign changes than standard shelf price tag changes.

13. The menu cost measures we report do not include the cost of changing prices in cases where items are moved from shelf to shelf, or where shelf space is reallocated by increasing the shelf space for some products at the expense of others. However, they do include the cost of pricing new products when they are first introduced. While this could bias the menu cost measures upward since it really captures the cost of pricing rather than the cost of changing price, the size of this bias is marginal due to the small number of new products. For example, according to ESL company executives, the number of new products introduced at these chains each week ranges from 20 to 60 approximately. In comparison to the number of products for which prices are changed each week (3,223–4,316), the bias is negligible.

14. Our measure of labor cost may overstate the true costs of changing prices if supermarkets hoard labor to save hiring and firing costs. However, this is not likely to be the case for several reasons. First, the labor costs of changing prices we report are based on actual measurements of the minimum amount of time and labor required to accomplish the task rather than on the number of employees hired to change prices at the store. Second, the adjustment in the amount of labor is usually done through hours worked, which makes cost of hiring and firing less relevant. And third, the workers on the floor are routinely moved from task to task according the need. These tasks include stocking, cleaning, price changing, customer service, etc. The workers employed by supermarket chains are always busy and so the opportunity cost of changing price is not zero. Therefore, labor hoarding is not likely to be an important factor in our measurements.

15. Other likely costs of price mistakes which we do not consider explicitly because we are unable to measure them in dollar terms are legal problems (when the scanner price is higher than the shelf price), loss in customer goodwill, and decreased profitability (when the scanner price is lower than the shelf price).

16. It has been suggested that the cost of managerial decisions is one of the most important components of menu cost. See, for example, Ball and Mankiw [1994], Kashyap [1995], and Meltzer [1995]. Since the ESL system was not designed to save the costs of corporate headquarter managerial time spent on price change decisions, the ESL company did not measure this component of menu costs. The estimates reported in this section are based on the information received from the ESL company executives.

17. A decentralization of the price change process, say, by allowing the store-level managers to make price change decisions, can change these figures tremendously. For example, consider the following thought experiment conducted using the average annual per store figures for Chains A–D. Suppose that the supermarket chains decentralize the price change process by hiring for each store only one quarter of the price change managing team, while, at the same time, they completely eliminate the corporate level team. The resulting annual menu cost per store would be $830,887 (= $105,887 + $725,000), which would dwarf any of the measurable menu cost figures we report in this study. Even if the average store only hired just the merchandising manager at the annual cost of $150,000, it would still incur annual managerial cost of about $255,887 (= $105,887 + $150,000). In other words, such a trivial decentralization would double the store-level menu costs. This would indeed make the cost of price change decisions, the most important component of menu cost.

18. DSD products usually are high-volume, fast-moving, and/or perishable products such as milk, soda, eggs, bread, dairy, snacks, etc. In the chains we study, about 10–20 percent of the products are of a DSD type, but that share may reach as much as 40 percent of the products carried [Direct Store Delivery Work Group, et al., 1995].

19. The process of changing prices of DSD and regular products are similar. But with DSD products there are additional costs of the time spent on driving to store, parking, and setting up the price change process at each store.

20. Our measures of menu cost also do not incorporate the cost of informing consumers about price changes, which can take variety of forms such as newspaper ads and inserts, TV and radio ads, in-store promotion signs, etc. Finally, we have no data on lost customer goodwill and damaged reputation caused by discrepancies between price tag and cash register [Okun, 1981; Carlton and Perloff, 1994; Haddock and McChesney, 1994].

21. The variation in the menu costs across the chains is mostly due to wage rate and labor-efficiency variations. Also note that since the supermarket chains in our sample are similar in the size of their stores, carry similar sets of products, and follow a similar processes of price change and price change decisions, it is reasonable to believe that the chains incur similar types of costs. Therefore, as noted underneath Table III, these menu cost measures are computed by replacing the unreported figures by the averages of the available values from the other chains.

22. Public Act No. 75-391: An Act Concerning Pricing of Consumer Merchandise [Public Acts of the State of Connecticut, 1975, Vol. 1, p. 390].

23. These steps, which are in addition to the regular steps undertaken to replace price tags on the shelves, include: (1) obtaining item price tags, (2) setting up work-stations, (3) locating the product, (4) removing an item from the shelf, (5) removing old price tag, (6) setting marking gun, (7) applying new price tag, and (8) returning the item back to the shelf.

24. Since we do not have a measure of the cost of labor time spent on sign changes and the cost of in-store managerial supervision time for this chain, we use the average of the chains that

report them (A and D). Note also that the hourly wage rate of $9.07 paid by Chain E is lower than the hourly wage of about $14.00–$20.00 paid by Chains A–D.

25. Further, note that the chains with smaller menu costs are likely to change their prices more frequently which suggests that the figures of the total annual menu costs understate the differences between Chain E and the other chains. Indeed, despite the large difference in the menu cost per price change, the total annual menu costs per store for Chain E ($109,036) are more comparable to those of Chains A–D ($105,887).

26. In calculations that follow, we use industry averages because: (1) the chains did not share this proprietary information with us, and (2) we were required to keep the identity of these chains confidential, as some of these numbers are detailed enough to enable some readers to identify the chains under study.

27. This is the average of two different estimates, $12,945,432 and $17,160,000. The source of the first figure is internal record of a supermarket chain of the type and size studied here. The second figure comes from *Supermarket Business*, 1993, page 52.

28. We also measured the menu costs in terms of controllable operating expenses (which are the portion of costs that the retailer has direct control over and therefore are often the costs that the retailer is most focused on managing), and gross margins (which measure the supermarket revenues minus direct cost of the products it sells). We find that the menu costs comprise 3.13 percent of controllable operating expenses and 2.81 percent of gross margins at these chains, on average. Finally, if we measure the menu costs relative to the number of products carried per store (about 25,000), then we find that the menu costs per product average $4.23 for Chains A–D. See Table IV and the notes underneath it for details.

29. We can also try and express the menu cost figures relative to the number of individual items sold by these chains each year. (Note the difference between no. of <u>products</u> carried and no. of <u>items</u> sold. As an example, a *Tartar Control Crest, 8oz* would be considered a product carried and 300 units of them sold per year would be considered no. of items sold.) Using $1.70 as the average price of *all* the products sold, we find that the menu cost per item sold for the four chains is in the range of $0.0103–$0.0129 for an average of $0.0119 (see Table IV, second last row). To see the relative magnitude of these figures, note that according to Berkowitz, Kerin, and Rudelius [1986, p. 319], the goal of the supermarket chains of the type we study, "... is to make 1 penny of profit on each dollar of sales." Thus, menu cost per item sold, when adjusted for the average price, roughly equals one half of their target net profit per item, which seems substantial.

30. Note, however, that our comparison of the two types of chains may not be completely ceteris paribus because these stores are located in different states and therefore there may be other chain-specific factors (in addition to item pricing laws) that distinguish these stores. We do not have any specific information on these differences. We do know, however, that the stores in these chains are similar in size and carry similar sets of products.

31. Our data contain information only on the frequency of cost increases. Although it is

more than likely that the supermarkets are experiencing cost decreases as well, our data set contained no information on such decreases.

32. Menu costs may even be playing a role in the observed movement toward pricing strategies which rely on fewer price changes, such as EDLP [Blattberg and Neslin, 1989; Lattin and Ortmeyer, 1991; and *Marketing News* of April 13, 1992, p. 8]. According to *Progressive Grocer* [November, 1992, p. 50], "A growing number of operators say they have switched from high-low pricing [to EDLP]. They cite the inefficiencies of making frequent price changes ..." Similarly, Hoch, Drèze, and Purk [1994, p. 16], state that EDLP lowers operating costs by lowering "... in-store labor costs because of less frequent changeovers in special displays."

33. For example, the data is analyzed and presented to managers on Monday and Tuesday, with meetings set for Thursday and Friday to make pricing decisions for the next week in coordination them with all other business functions of the chain.

34. For example, under the current system, a chainwide category manager operating at the corporate headquarters needs to study and assess numerous detailed information such as competitors' price and sale information from the last week, the past weeks sales at the own chain, manufacturer/supplier promotions, wholesale price reductions, coop allowances, new product offerings, shelf space decisions, coordination with newspaper advertising, logistics at the warehouses as well as at each store, store differences in terms of customer characteristic and competitive environments, product/shelf selection and layout, etc.

35. If the supermarket chains indeed restructure the entire price change process and begin to change prices much more frequently (say 2–3 times a week) on a regular basis, then the shape of this cost function could change in an unpredictable way.

36. Danziger [1983], Caballero [1989], and Ball and Mankiw [1994] suggest that time-dependent price adjustment of the type documented here can be optimal if the cost of gathering information about the state exceeds the cost of making the price adjustment itself.

37. We also considered the possibility of convexities in the cost of changing prices. Our data do not suggest many convexities since the labor time spent in price tag change process, the cost of printing and delivering price tags, and in-store supervision time do not change with the size of a price change. The only measurable component of menu costs that could be convex is the cost of mistakes made: the larger the price change, the higher the probability of a customer noticing the mistake and the larger the amount required to be refunded as compensation. Among the unmeasured components of menu cost, the cost of corporate managerial time may increase with the size of a price change because larger price changes require more serious consideration.

38. See also Balke and Wynne [1996] and Bryan and Cecchetti [1996]. Since we do not have measures of how menu costs change over time, our data also have little to say about time variation in menu costs or about the relationship between menu costs and inflation, which during the period of the data collection (1991–92) averaged about 3 percent annually.

Appendix

In this appendix we provide a description of the calculations we performed to compute the menu cost figures reported in Table 1b for each chain. For a detailed description of the process of changing prices in Chains A–D, see section 4, Figures 1–11, and Tables 2–11. For distinguishing features of the price change process in the chain facing an item pricing law, see Chain E below.

Chain A

Summary of the menu costs reported for this chain: labor costs of $77,825, price tag printing and delivering costs of $4,110, mistake costs of $19,135, and in-store supervision costs of $4,241 for total menu costs of $105,311 (see Table 1b).

The labor costs are made up of: shelf price tag change costs of $61,414 and sign change costs of $16,411. The shelf price tag change costs of $61,414 are based on: (a) 45.5 weekly hours spent on changing the shelf price tags at the hourly wage rate of $7.35 adjusted for an additional 40.88 percent fringe benefits, which yields total annual cost of $24,499; and (b) 59.7 weekly hours spent on price tag verification, in-store resolution of price mistakes, and corporate resolution of price mistakes, at the hourly wage rate of $8.44 adjusted for an additional 40.88 percent fringe benefits, which yields total annual cost of $36,912.

The price tag printing and delivering costs are based on actual usage of price tags for this chain during 8 weeks of 1991. The cost consists of stock costs ($0.0118 per tag), impression and data center operator cost ($0.0037 per tag) and mail room handling cost ($0.001 per tag), yielding a total of $0.0165.

The reported mistake costs of $19,135 include: cashier time spent on error correction with customers, $1,345; reduction of scan guarantee refunds, $10,065, where the refunds were determined through analysis of price discrepancy forms for the period of June 17, 1991 to July 8, 1991 and information provided by the service manager of the store; and an estimate out of stocks due to pricing mistakes, $7,725.

In-store supervision costs of $4,241 were made up of 4.75 hours per week broken down to 0.75 hours for the store manager, 1.5 hours for the grocery manager, 1 hour per week for the general merchandise manager, and 1.5 hours per week for the service manager (as reported by store managers). Their wage rates were $20.00, $10.91, $10.61, and $10.61, respectively, with an additional 40.88% added as benefits, as reported by human resources.

Chain B

Summary of the menu costs reported for this chain: labor costs of $75,332, price tag printing and delivering costs of $10,018, mistake costs of $20,593, and in-store supervision costs of $6,692 for total menu costs of $112,635 (see Table 1b).

Labor cost include: 8 weekly hours spent on price tag preparation at $20.73 average hourly wage (including benefits) for an annual cost of $8,626, and 47.9 weekly hours spent on the shelf price tag change process at an hourly wage rate of $17.88 (including benefits) for an annual cost of $44,523. Since our data do not contain information on the labor cost of changing signs, we replace it by the average of the chains (A and D) that report this component, which equals $22,183.

Price tag printing and delivering costs are $10,018, and are taken from total chain-wide invoices divided by the number of stores.

Mistake costs include 2 hours a week spent on retail corrections at the hourly wage of $20.74 for an annual cost of $2,156. Additional 2 hours a week are spent on making these changes at secondary locations throughout the store at an hourly wage of $20.74 for a total annual cost of $2,156. They also include 5 hours spent a week on sign and ad verification at the hourly wage of $20.74 for a total annual cost of $5,391. As well as 10.1 weekly hours spent on commodity price checks at the same hourly wage of $20.74 for a total annual cost of $10,890.

In-store supervision cost includes 5 hours weekly at the hourly wage of $25.74 (including benefits), for a total annual cost of $6,692.

Chain C

Summary of the menu costs reported for this chain: labor costs of $62,210, price tag printing and delivering costs of $3,048, mistake costs of $20,692, and in-store supervision cost of $5,466 (estimated by averaging the costs reported by Chains A and B) for total annual menu costs of $91,416 (see Table 1b).

Labor costs include: 5 weekly hours of labor for price tag preparation at the cost of $4,550 for 3,846 tags per week, at a wage of $17.53 for a grocery food clerk; labor for the shelf price tag change: $35,477, from an average weekly volume of 3,284 price tag changes using 13.1 hours of labor (this number of changes is based on the volume averages for a 14 week period between May 5, 1992 and August 6, 1992. They were validated against 3 weeks of price tag change data, 2 weeks of physical count, and tabulation of one week's price book.). The labor cost is 8 hours at $17.53 and 5.1 hours at $15.20 for an average wage of $16.62. So the total shelf price tag change costs are 3,284 tags at 0.75 minutes per tag (provided by the store) yielding $35,477. Since our data do not contain information on the labor cost of changing signs, we replace it by the average of the chains (A and D) that report this component, which equals $22,183.

Materials for price tag printing of $3,048 includes price tag stock $2,498; printer supplies and maintenance, $238; and labor cost of printing the price tags $312.

Mistake costs include an integrity audit at a cost of $14,585. The current practice is to perform a full check of changed prices on the day following the change, which requires 16 hours at a wage of $17.53, for an annual cost of $14,585. There are additional price checks at a cost of $6,107. With 208,860 items sold per week and a 3% tag scanner discrepancy, there are on average 6,266 mispriced items in the store. On average, 5% of these mistakes are detected by the customer which implies an average of 313 price checks required weekly, each price check taking 1.29 minutes on average. This suggests that 6.7 hours are spent per week at an hourly wage of $17.53, yielding costs of $6,107.

In-store supervision costs were not reported by this chain and therefore we estimated them by averaging the costs reported by Chains A and B, which equal $5,466.

Chain D

Summary of the menu costs reported for this chain are: labor costs of $81,703, price tag printing and delivering costs of $6,879, mistake costs of $20,140 (estimated by averaging the

costs reported for Chains A, B, and C), and in-store supervision cost of $5,466 (estimated by averaging the costs reported for Chains A and B), for total menu costs of $114,188 (see Table 1b).

The labor costs are based on the hours per week spent on the following tasks: (a) price tag preparation, 30 hours/week; (b) sign change preparation and installation, 32 hours/week (which consists of hand writing signs, 14 hours, preparing all for changes, 5 hours, and actual changes, 13 hours); and (c) actual shelf price tag changes, 31.1 hours/week. This yields total weekly hours of 93.1.

Wages range from $21.78 to $14.55 per hour depending on worker classification. The wage rate we used for each task depended on which workers undertook the task. For example, the sign preparation uses 1/3 of the labor at the hourly wage of $21.78 and 2/3 at the hourly wage of $14.55 for an average hourly wage rate of $16.8, which yields total annual labor costs of $27,955. The shelf price tag change uses 2/3 of the labor at the hourly wage rate of $21.78 and 1/3 at the hourly wage rate of $14.55, so the average wage rate is $19.20, which for 31.1 weekly hours yields total annual labor costs of $31,050. The price tag preparation costs are based on an hourly wage rate of $14.55, which with 30 weekly hours yields total annual labor costs of $22,698.

Labor used in printing and delivering price tags costs $6,879 and consists of price tag stock and printing, $3,707; printer supplies; $304; and sign printing, $2,868.

The mistake costs were not reported for this chain and therefore we estimate them by averaging the costs reported for Chains A, B, and C, which equal of $20,140.

In-store supervision costs were not reported by this chain and therefore we estimated them by averaging the costs reported by Chains A and B, which equal $5,466.

Chain E (Item Pricing Law)

Summary of the menu costs reported for this chain: labor costs of $75,127, price tag printing and delivering costs of $7,644, mistake costs of $20,799, and in-store supervision cost of $5,466 (estimated by averaging the costs reported by Chains A and B) for total reported menu costs of $109,036 (see Table 1b).

Labor costs include: 6.86 weekly hours spent on shelf tag replacements times hourly wage rate of $9.07 times 52, which yields a total of $3,234. Additional $49,710 come from 105.4 weekly hours of labor spent on marking individual items for price changes, times $9.07, the wage rate, multiplied by 52. Since our data do not contain information on the labor cost of changing signs, we replace it by the average of the chains (A and D) that report this component, which equals $22,183.

Note that the need to change prices on individual items introduces additional steps in the price change process (in comparison to Chains A–D, as discussed in section 4.1.). These steps, which are in addition to the regular steps taken to replace price tags on the shelves, include: (1) obtaining item price tags, (2) setting up work-stations, (3) locating the product, (4) removing an item from the shelf, (5) removing old price tag, (6) setting marking gun, (7) applying new price tag, and (8) returning the item back to the shelf. Additional costs are incurred to clear jammed marking guns and to reload them.

Our measure of menu cost does not include an additional $44,168 spent on putting prices on new items as they are brought to shelves. Although many of these prices are new and thus

should be measured as part of the menu costs, our data does not contain information about what fraction of these prices are new. Therefore, since we do not have a way of knowing how much of this cost is due to price change activity and how much due to just pricing, and in order to err on the conservative side, we choose to completely exclude this figure from our measurements. For similar reasons we do not include here the cost of marking guns although the amount involved is relatively small (25 guns used annually at the cost of $32.50 per gun, at 80% reduction, for the total of $650). This is because these guns are used for pricing in addition to price changing. The steps followed in first-time pricing of individual items include: (1) conclude last case, (2) get next case, (3) open case, (4) position for labeling, (5) set label gun, (6) mark items, usually 12 items per case, (7) and shelve items. Additional cost are incurred when there is a need to: (5a) reload gun, (5b) verify price discrepancy, (6a) remark missed items, (6b) clear gun jams, (6c) item packaging, and (6d) dual level case.

The total costs of printing and delivering shelf and item price tags in the amount of $7,644 include: (1) the cost of printing and delivering shelf price tags which include: $1,230 for paper shelf labels which is based on the cost of actual materials at $299, plus $931 for preparing paper labels which is based on 1.4 weekly hours times 52 time the hourly wage rate of $12.78; (2) the cost of printing and delivering item price marks which are the price tags that go on each individual item: average weekly movement of marked items is 143,819, which at a cost of $0.0006 per mark yields $4,487 in production costs for these labels; and (3) the material cost of preparing signs is $1,927 which is based on 2.9 weekly hours per week times 52 times hourly wage of $12.78.

Mistake costs: $20,799 based on 44.1 weekly hours of cashier time at the hourly wage rate of $9.07, multiplied by 52. The steps undertaken here are similar to those undertaken in the other four chains.

In-store supervision costs were not reported by this chain and therefore we estimated them by averaging the costs reported by Chains A and B, which equal $5,466.

TABLE I

General Information on Each Supermarket Chain and Their Price Change Activity

	Chain A	Chain B	Chain C	Chain D	Average of chains A–D	Chain E (item pricing law)
General pricing strategy[a]	HL	HL	EDLP	EDLP		HL
Number of price changes per store per week	**4,278**	**4,316**	**3,846**	**3,223**	**3,916**	**1,578**
% of products for which prices change in an average week[b]	**17.11**	**17.26**	**15.38**	**12.89**	**15.66**	**6.31**

a. HL (High/Low) and EDLP (Every Day Low Price) refer to the general pricing strategy followed by the retail chain. Under the EDLP strategy, the retailer's prices are low for an extended periods of time and therefore it will offer less promotional sales or discounts. Under the HL pricing strategy, in contrast, the retailer's prices are higher, and the retailer tends to offer more frequent discounts through sales and promotions. See the text for more details.

b. The share of products for which prices change on an average week is the ratio of number of price changes per store per week to 25,000. The latter is the average number of products carried per store each week.

TABLE II

Stages of Price Change Process, Time Spent on Each Stage Each Week, and the Main Tasks Performed at Each Stage at Chain A

Stage	Time spent on each stage (in seconds) and its share in the total	Number of tasks in stage	Main tasks performed in each stage	Most time consuming tasks and their share in the total time spent on the stage (in percents)	
Shelf price tag change preparation	21, 682.4 4.63%	11	Receive tags, sort by grocery/produce/general merchandise, distribute to departments for night crew, sort by effective date, sort by aisle, separate by aisle	Sort by department Distribute to departments Sort by effective date Sort and separate by aisle	29.39 6.89 10.63 39.18
Price tag change process	142,492.8 30.44%	32	Select and locate aisles, sort by subcommodities, select and locate subcommodities, select and read tags, locate items, compare UPC info (code, quantity, size, price), note all mismatches, remove old tag, put new tag, repeat the process for all products at all locations	Locate item Compare item UPC Code Remove old price tag Install new price tag	48.33 15.97 6.71 8.72
Price tag change verification	142,737.3 30.49%	26	Sort by aisle and subcommodity, go to aisle, read item from report, locate item on the shelf, locate price tag, compare prices, compare effective dates, check off on report, note mismatches (printed, handwritten, or DSD tags), mark report to order missing tags	Read item from report Locate item on shelf Locate the price tag Compare prices	10.57 53.37 5.89 14.88
Price sign change preparation	1,422.9 0.30%	10	Receive signs, sort by grocery/produce/general merchandise, distribute to departments for night crew, sort by effective data, sort by aisle, separate by aisle	Sort by department Distribute to departments Sort by effective date Sort and separate by aisle	48.07 8.01 8.18 14.32
Hand made price sign change process	75,171.6 16.06%	20	Go to end of aisle, note items on display and price, go to aisle where display item is shelved, locate item, compare the tag and display price, note mismatch, remove sign with wrong price, prepare new sign and discard old, install new sign, repeat	Note items on display and price Go to aisle with display items Locate item on the shelf Prepare new signs and discard old	18.11 13.61 18.11 26.44
Pre-printed price sign change process	32,385.6 6.92%	20	Get signs, go to aisle, locate existing sign, check effective date, compare tag and sign price, remove old sing (tear in half), install new sign, compare tag and sign price, locate item with new sign, note items not found, repeat, get copy of ad, compare ad and shelf prices, note mismatches, repeat	Locate existing signs Locate other old sings Install new signs Compare ad and shelf price tag	10.23 9.40 45.32 9.14
Price sign change verification	16,194.0 3.46%	16	Get weekly advertisement insert, go to item displays, check whether they are advertised, compare prices, correct mismatches, go to the aisle where product is shelved, locate item, compare tag and display prices, remove wrong sign, prepare new sign, install new sign, repeat	Note items on display and price Compare ad and display prices Locate item on the shelf Compare tag and display price	42.27 5.80 21.82 5.37
In-store resolution of problems occurring in the price change process	26,181.8 5.59%	29	look up on system, check authorization/tag/sign, discard wrong tag/sing, find/make and install correct tag/sign, email to CSC/ZSC, make corrections (Specifics depend on the type of problem, e.g., missing items/tags, mismatch between shelf and sign prices or between UPC info and shelf tag.)	Look up on system Locate tag and/or sign Install tag and/or sign Make corrections as needed	12.03 22.69 11.34 14.09
Zone and corporate resolution of problems occurring in the price change process	820.5 0.17%	20	Determine whether it is a store error, communicate to ZSC via email, consolidate from all zones, communicate to SSC and price integrity via email, determine whether it is zone error, determine the required correction, communicate to SCS and ZSC, resolve the problem.	Email from SSC and corrections Consolidate from zone Communicate to SSC via email Inform SSC about the corrections	43.88 43.88 7.50 2.93
Price discrepancy and scan guarantee/refund process	9,007.6 1.92%	12	Customer notes price mistake, cashier verifies the mistake and offers the lower price (or one item free if the lower price is not accepted by the customer), cashier completes price discrepancy form, SSC researches and corrects the mistake (on the shelf and/or scanner data base)	Customer tells cashier tag price Cashier offers one item free Cashier fills price discrepancy form SSC researches and corrects	17.41 7.84 13.06 52.10

CSC, ZSC, and SSC stand for Corporate Scan Coordinator, Zone Scan Coordinator, and Store Scan Coordinator, respectively.
For a more detailed discussion of the price change process, see the working paper version of this study, Levy, Bergen, Dutta, and Venable (1996).

TABLE III

Estimates of the Annual Menu Costs Per Store for Each Chain (in 1991–92 dollars)

Menu cost component	Chain A	Chain B	Chain C	Chain D	Average of chains A–D	Chain E (item pricing law)
Labor cost of price changes	61,414	53,149	40,027	53,748	52,084 (49.2%)	52,944
Labor cost of sign changes[a]	16,411	22,183	22,183	27,955	22,183 (20.9%)	22,183
Costs of printing and delivering price tags	4,110	10,018	3,048	6,879	6,014 (5.7%)	7,644
Mistake costs[b]	19,135	20,593	20,692	20,140	20,140 (19.0%)	20,799
In-store supervision costs[c]	4,241	6,692	5,466	5,466	5,466 (5.2%)	5,466
Total annual menu cost per store	**105,311**	**112,635**	**91,416**	**114,188**	**105,887 (100%)**	**109,036**

a. The labor costs of sign changes were not reported for Chains B, C, and E and so we use instead the average of Chains A and D.

b. The mistake costs were not reported for Chain D and so we use instead the average mistake costs of Chains A, B, and C.

c. The in-store supervision costs were not reported for Chains C, D, and E and so we use instead the average of Chains A and B.

TABLE IV

Relative Measures of Menu Costs per Store for Each Chain (in 1991–92 dollars or in percents)

Relative measure of menu costs	Chain A	Chain B	Chain C	Chain D	Average of chains A–D	Chain E (item pricing law)
Total annual menu cost ($)	105,311	112,635	91,416	114,188	105,887	109,036
MC/revenues[a] (%)	**0.70**	**0.75**	**0.61**	**0.76**	**0.70**	**0.72**
MC/operating expenses[b] (%)	3.11	3.32	2.70	3.37	3.13	3.22
MC/gross margin[c] (%)	2.80	2.99	2.43	3.03	2.81	2.90
MC/net margin[d] (%)	**35.0**	**37.4**	**30.4**	**37.9**	**35.2**	**36.2**
MC per product carried[e] ($)	4.21	4.50	3.66	4.57	4.23	4.36
MC per item sold[f] ($)	0.0119	0.0127	0.0103	0.0129	0.0119	0.0123
MC per price change[g] ($)	**0.47**	**0.50**	**0.46**	**0.68**	**0.52**	**1.33**

The notes below provide the figures used in computations. MC stands for total annual menu cost. See text for more details.

a. The annual revenues are $15,052,716 per store on average (*Supermarket Business*, 1993, p. 52).

b. The annual operating expenses are $3,386,861 per store on average, based on 22.5 percent of revenues (Hoch, Drèze, and Purk, 1994).

c. The annual gross margin is $3,763,179 per store on average, based on 25 percent of revenues (Hoch, Drèze, and Purk, 1994; and *Supermarket Business*, 1993).

d. The annual net margin is $301,054 per store on average, based on 2 percent of revenues (Montgomery, 1994).

e. MC per product carried is computed as a ratio of MC to the average no. of products carried per store (25,000).

f. MC per item sold is computed as the ratio of MC/(revenue/average price per item sold). The average price per item sold is $1.70. See note 1 above for revenue information. Note the difference between no. of products carried and no. of items sold. As an example, a *Tartar Control Crest, 8oz* would be considered a product carried and 300 units of them sold per year would be considered no. of items sold.

g. MC per price change is computed as (MC/52)/(no. of price changes/week), where no. of price changes/week is taken from Table 1.

TABLE V

Weekly Frequency of Cost-Based Price Adjustments Not Implemented because of Menu Costs

	Chain A	Chain B	Chain D
No. of products for which costs increase in an average week	860	1,693	961
No. of price adjustments implemented	671 (78%)	1,185 (70%)	633 (66%)
No. of price adjustments not implemented because of menu costs	**189 (22%)**	**508 (30%)**	**328 (34%)**

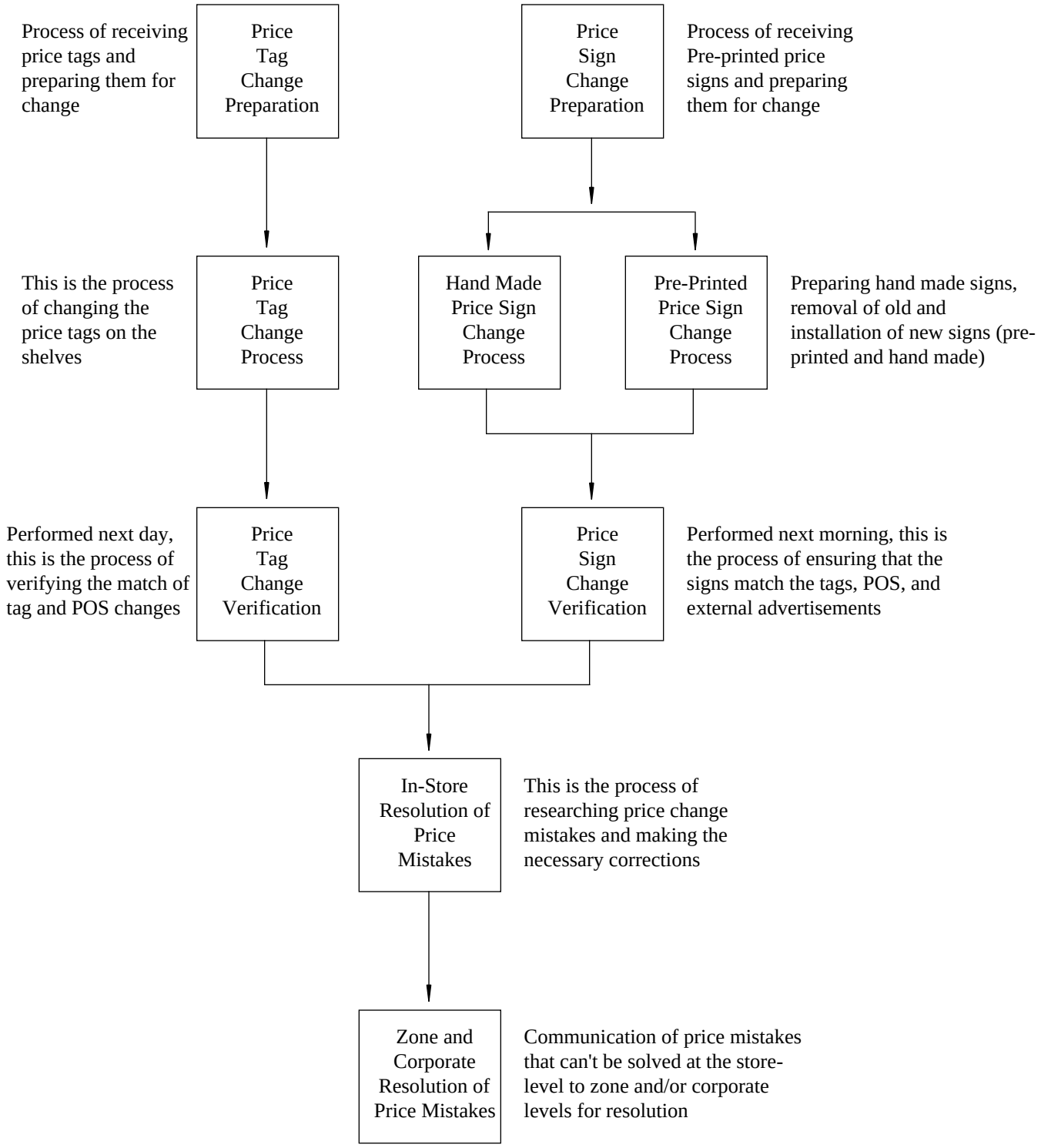
Chains C and E did not report these data.

TABLE VI

Weekly Schedule of Price Changes by Type of Merchandise in Chain A

Type of merchandise	Number of products for which prices change	Time of the week when the prices are changed
General merchandise advertised	72 (1.7%)	Saturday night
Grocery	**2,100 (49.1%)**	**Sunday night**
Market (produce)	171 (4.0%)	Sunday night
General merchandise	**1,853 (43.3%)**	**Monday night**
Grocery, advertised	82 (1.9%)	Tuesday night
Total number of weekly price changes	4, 278 (100%)	

Figure 1. Overview of the Price Change Process



Note: POS denotes Point of Sale and refers to the cash register or the database it is connected to or both. For information on the various steps undertaken in each stage of the price change process and the amount of the labor time spent on each one of these steps, see Figures 2–11 and Tables 2–11.

Source: Levy, et al. (1997a).