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Small Price Changes and Menu Costs

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We find that while some individual price changes are indeed 'small', the average price change of different products within a store in any given month is not. Moreover, the smaller the price change of an individual product, the larger the average price change of the remaining products sold by the store. We argue that these findings are consistent with extensions of menu cost models of price-setting behavior to multiproduct firms when these firms have high average costs and low marginal costs of changing prices.

INTRODUCTION

The observation of 'small' price changes in the data is often brought up as evidence against the empirical relevance of standard 'menu costs' models of price-setting behavior (e.g., Kashyap, 1995 finds many instances of 'small' price changes in retail goods). Indeed, models that rely on a constant fixed cost of changing each price fail to account for this observation.[1] In this paper we argue that such small changes do not necessarily contradict the menu cost paradigm when many different products are sold by the same firm *and* the firm is subject to costs of adjusting prices having a firm-specific component. In this case, the optimal change in the price of a single product may indeed be small. What should *not* be observed, if store-specific costs do exist, is *all* simultaneous price changes within the store being small. Thus, the technology of changing prices is one of small marginal and high average costs.[2]

We exploit the multiproduct dimension of the price data used in Lach and Tsiddon (1992, 1996) to test the hypothesis that while some—but not all—individual price changes may be small, these small changes only show up when other price changes in the same store are large. Thus, the within-store average price change is always 'large'. These data are uniquely suited to this task since they include monthly price quotations on 26 different foodstuff products sold in grocery stores in Israel during 1978–1982. While not all goods are sold in each store, a sizable number of them are. This allows us to examine both individual price changes and average price changes within a store.

We find that the proportion of 'small' price changes is lower for the within-store average price change than for the individual price changes. Specifically, in every month, the fraction of within-store average price changes below the monthly rate of inflation is significantly smaller than the corresponding fraction for individual price changes. In fact, in many months there is not a single within-store average price change that is smaller than the monthly inflation rate.[3]

As compelling as this evidence against the 'small price change' criticism may be, this finding may be driven, in part, by the variance in the distribution of average price changes being lower—by construction—than the variance in the distribution of individual price changes. We therefore go a step further and examine the average price change

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within a store conditional on the size of the smallest individual price change within the same store. An implication of the suggested technology of changing prices is that this conditional average should be inversely related to the size of the smallest price change. We find that the *smaller* the minimal price change within the store, the *larger* is the average of price changes. In fact, a decrease in the minimal price change within a store yields a more than proportional *increase* in the average of all other contemporaneous price changes.[4]

Next section explains the reasoning behind the hypothesis advanced in this paper, while the third section presents the empirical evidence. Conclusions close the paper.

THE STORE-SPECIFIC MENU COSTS HYPOTHESIS

It is commonly believed that the existence of small price changes constitutes evidence against the menu cost proposition (Kashyap, 1995). It follows that if many small price changes are observed, the menu cost paradigm has very little—if anything—to say about actual price dynamics. This conclusion, however, is not applicable to a multi-product setting when the *marginal* cost of changing a price might be small but the *average* cost of changing prices is large.

Assume that adjustment costs are significant to the seller, in the sense that they are not to be incurred continuously, and have a store-specific component. The adjustment costs are therefore not exclusively a result of the characteristics of each product but also of the characteristics of the price-setter. The term 'menu cost' comes alive: the cost of printing a new menu is shared by all products. If such store-specific costs are indeed important, then single-product menu cost models may give a very distorted picture of price dynamics.[5]

Menu cost models for a multiproduct price-setter, however, have received little theoretical attention.[6] We therefore proceed in a heuristic fashion and develop some simple restrictions on the data by extending the logic of the single-product model. The first thing to note is that store-specific adjustment costs should induce synchronization only in the timing of price changes and do not carry precise implications as to the size of the price changes for individual products.[7] If the costs associated with the price-setter (a 'fixed' cost) dominate those costs associated with the individual product then the well-known (S, s) policy in its narrow definition is no longer optimal. While prices still change discontinuously, one should expect fairly little regularity in the size of the price change of each product.[8]

To illustrate this point, consider the polar case in which the only adjustment costs are those attached to the price-setter and the marginal cost of changing the price of an additional product is zero. If a decision is made to change prices, then the prices of all products are changed, i.e., perfect within-store synchronization in the timing of price change is the rule. As long as idiosyncratic shocks are significant relative to aggregate inflation, when a price-setter decides to change its prices the magnitude of the change in each product's price can be anything: some prices may change more than others or may change in opposite directions. The only common fact is that in all these changes, each price is set to its optimal level. In addition, it follows that, if store-specific costs are large, an appropriate weighted average of price changes within a store should also be 'large'.[9]

In the more general case, when the costs of adjustment include a component associated with each product, some prices may not change at all or may change on different dates, implying less than perfect within-store synchronization in their timing. But the rule that, conditional on the occurrence of a price change the average change should be large, still holds.

Thus, we first explore the distribution of average price changes within the store—and compare it to the distribution of individual price changes—in order to show that the issue of small *average* price changes is empirically irrelevant. However, as mentioned in the Introduction, this analysis may be insufficient because it cannot rule out the alternative hypothesis that the only difference between the distribution of individual and average price changes is in that the latter has—by construction—a smaller variance.

To distinguish among the two alternative hypotheses we examine the relationship between the absolute value of the minimal (non-zero) price change and the average of all other contemporaneous price changes within the same store. We find that a decrease in the minimum price change is associated with a more than proportional increase

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in the average change of other prices sold in the same store.

In order to interpret this empirical finding consider the following simple example: we have two stores (A and B) facing the same demand curves for all their products (within and across stores), the inflationary process is stationary and the two stores incur the same costs when adjusting their prices. Suppose, further, that these adjustment costs are fixed and only dependent upon the store, i.e., each store incurs the same fixed cost whenever it decides to change prices and this cost is independent of the number of prices it chooses to change.

In this scenario, when a store changes prices, the average price change is a constant. Consider a month in which both stores changed prices. Because the average price change is a constant, if store A has a smaller (non-zero) minimum price change than store B, it means that it also has a larger average change in all the other prices than store B. In other words, small price changes should be accompanied by large changes in the prices of goods sold by the same store.

DATA AND EMPIRICAL FINDINGS

The data used in this work are a subsample of the data used in Lach and Tsiddon (1992), where it is described in detail. The original data set consists of nominal price quotations for 26 food products collected monthly from a sample of stores by the Central Bureau of Statistics (CBS) for the purpose of computing the consumer price index (CPI).[10]

For each store we have a (mostly incomplete) panel of prices extending over products and time. We analyze two periods separately, January 1978 to June 1979 and January 1981 to December 1982 corresponding to two inflationary steps in the Israeli inflation process. Data for 1980 were not available. The products in the sample are all homogeneous, did not change substantially either in quality or in market structure and their prices were not controlled by the government during the period of investigation.

Since our focus is on issues related to the co-movement of prices within stores, we selected 21 products that could be grouped into two broad classes: wines and meat products.[11] Each store in our data sells either wine or meat products and none of them sell both wines and meat. For the within-store average of price changes to be meaningful we select for each store those observations (months) in which there were at least three price changes.[12] For wines (meat products), this results in a total of 399 (2132) store–product–month non-zero observations on price changes in 1978–1979 and 1266 (3679) in 1981–1982.[13]

We first analyze the distribution of individual price changes. Let ΔP_{ijt} be the absolute value of the monthly rate of growth of P_{ijt}, the price of product j in store i at month t.[14] Table 1 shows location parameters and quantiles of the distribution of ΔP_{ijt} over stores, products and months.[15]

The typical price change in wines is much larger than in meat products. This is consistent with the larger duration of price quotations for the former products (Lach and Tsiddon, 1992). In both group of products—and in both periods—5% of the changes are less than 1.8–2.6%. Whatever metric one uses, these are not large price changes.

We now turn to the *average* price change. Having no information on sales or on the cross-derivatives of the profit function, we use the arithmetic average of price changes as a proxy for the correct weighted average of price changes. The average change within store i, $\Delta\bar{P}_{it}$ is $\Delta\bar{P}_{it} = (1/|G_{it}|)\sum_{j\in G_{it}}\Delta P_{ijt}$, G_{it} the set of products whose prices changed during month t in store i and $|G|$ is the number of products in set G.[16]. Table 1 also features the distribution of $\Delta\bar{P}_{it}$ over stores and months.

During the 1978–1979.6 period, the average monthly inflation rate was 4% and the median rate was 3.5% per month (the standard deviation of the monthly inflation rate was 1.9%). We find that 9.5% of the *individual* monthly price changes in wines were no larger than the median monthly inflation rate. The corresponding figure for meat products is 16.0%.[17] On the other hand, the percentage of *average* monthly price changes below the median inflation rate is only 2.4 for wines and 2.9 for meat products.

In 1981–1982 inflation stepped up. The average monthly inflation rate was 6.6% and the median rate was 6.1% per month. The standard deviation of the monthly inflation rate was little changed at 2.1%. In wines, 26.4% of the *individual* monthly price changes were no larger than the median monthly inflation rate for this period. The corresponding figure for meat products is 25.5%. On the other hand, the percentage of *average* monthly price changes below the median inflation

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Table 1. Individual (ΔP_{ijt}) and Average ($\Delta \bar{P}_{it}$) Price Changes

		N	MEAN	MIN	Quantiles 5%	10%	25%	50 %	75%	MAX
(A) 1978–1979.6										
WINES	ΔP_{ijt}	399	0.166	0.006	0.018 (0.004)	0.036 (0.007)	0.077 (0.011)	0.136 (0.019)	0.258 (0.032)	0.854
	$\Delta \bar{P}_{it}$	83	0.157	0.020	0.044 (0.010)	0.059 (0.008)	0.085 (0.006)	0.132 (0.016)	0.229 (0.020)	0.393
MEATS	ΔP_{ijt}	2132	0.088	0.006	0.018 (0.002)	0.026 (0.003)	0.043 (0.005)	0.072 (0.009)	0.112 (0.014)	0.549
	$\Delta \bar{P}_{it}$	475	0.088	0.025	0.041 (0.002)	0.048 (0.002)	0.062 (0.001)	0.082 (0.002)	0.105 (0.002)	0.284
(B) 1981–1982										
WINES	ΔP_{ijt}	1266	0.135	0.001	0.025 (0.003)	0.038 (0.005)	0.058 (0.008)	0.115 (0.015)	0.179 (0.022)	2.49
	$\Delta \bar{P}_{it}$	258	0.136	0.011	0.045 (0.002)	0.054 (0.006)	0.084 (0.005)	0.132 (0.006)	0.176 (0.006)	0.610
MEATS	ΔP_{ijt}	3679	0.114	0.002	0.026 (0.003)	0.037 (0.005)	0.060 (0.007)	0.094 (0.012)	0.150 (0.019)	1.001
	$\Delta \bar{P}_{it}$	787	0.113	0.024	0.048 (0.002)	0.059 (0.002)	0.080 (0.002)	0.107 (0.002)	0.137 (0.002)	0.388

Notes: The quantiles and their standard errors (in parenthesis) are bootstrap estimates from 1000 samples. The quantile estimates obtained from the order statistics are almost identical to the bootstrap estimates. The estimates of the mean of ΔP_{ijt} and of $\Delta \bar{P}_{it}$ may sometimes differ because of the unbalanced nature of the data.

rate is only 11.6 for wines and 11.4 for meat products.

We implicitly used the median monthly inflation rate to define a 'small' price change. Under this metric, small price changes are between two and four times as likely to occur in individual price changes than in within-store average price changes. In a world without menu costs, price changes would be small and so would their average.

We can also choose an arbitrary rate to divide price changes into small and large. In this approach the definition of a small price change does not vary with the inflation rate, as implied by menu cost models. Given that groceries are a high volume–low margin business, a 4% rate appears to be a reasonable choice. In 1978–1979.6, we find that 11% of the *individual* monthly price changes in wines were smaller than 4%, but only 4% of the *average* monthly price changes were smaller than 4%. The corresponding figure for meat products is 21% for *individual* price changes and 4.5% for *average* price changes. In 1981–1982, 10% of the *individual* monthly price changes in wines were smaller than 4%, but only 1.5% of the *average* monthly price changes were smaller than that. The corresponding figure for meat products is 11% for *individual* price changes and 2% for *average* price changes. Thus, under this metric too, small *average* price changes are less likely than small *individual* price changes.

These conclusions are also supported by a more disaggregated analysis of the data. Tables 2 and 3 display the percentage of price changes being less or equal to the aggregate rate of inflation on a monthly basis. According to this definition of 'smallness', in all but in three months for wines and two months for meat products, the proportion of small price changes is lower among average price changes than among individual price changes. In wines (meat products) there were no small average price changes at all in 18 (12) months, even when the monthly inflation rate was above 6% in some of these months.[18]

To some extent these results are not that surprising because the distribution of an average of the data is less spread out than the distribution of the raw data. Thus, we approach the problem from another perspective. The intuitive essence of this argument is that the presence of store-effects in the costs of adjusting prices implies that small price changes need not always exist, but when they exist, they are accompanied by large price changes.

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Table 2. Price Changes and the Inflation Rate Wines

(A) 1978–1979.6 Month	Inflation rate Π (%)	Individual $\Delta P_{ijt} \leqslant \Pi$ percent (N)	Average $\Delta \bar{P}_{it} \leqslant \Pi$ percent (N)
2	1.58	—	—
3	3.70	25.0 (8)	0.0 (2)
4	5.51	—	—
5	1.85	20.0 (15)	0.0 (4)
6	1.97	33.3 (3)	0.0 (1)
7	2.39	0.0 (54)	0.0 (9)
8	2.38	4.7 (43)	0.0 (9)
9	3.01	2.8 (36)	0.0 (8)
10	5.74	18.2 (11)	50.0 (2)
11	6.23	1.8 (109)	0.0 (20)
12	3.44	20.7 (29)	0.0 (6)
13	4.94	50.0 (6)	50.0 (2)
14	2.43	—	—
15	5.61	50.0 (10)	66.7 (3)
16	8.67	33.3 (6)	0.0 (2)
17	4.76	33.3 (6)	0.0 (2)
18	3.54	3.2 (63)	0.0 (13)
Total	4.00	10.8 (399)	3.6 (83)
(B) 1981–1982			
2	5.51	64.1 (64)	50.0 (12)
3	4.79	25.7 (70)	7.14 (14)
4	10.7	55.6 (63)	53.8 (13)
5	3.35	12.5 (64)	0.0 (13)
6	2.73	2.33 (43)	0.0 (8)
7	6.06	27.3 (22)	60.0 (5)
8	3.90	13.3 (30)	0.0 (6)
9	8.14	20.6 (63)	8.3 (12)
10	9.02	23.3 (43)	18.2 (11)
11	5.80	11.3 (80)	0.0 (17)
12	5.16	15.4 (52)	0.0 (11)
13	8.32	31.9 (47)	16.7 (12)
14	5.70	16.7 (54)	10.0 (10)
15	5.06	11.4 (79)	0.0 (15)
16	10.7	35.5 (31)	28.6 (7)
17	6.22	5.95 (84)	0.0 (16)
18	6.03	47.7 (44)	25.0 (8)
19	9.21	29.9 (87)	20.0 (15)
20	7.87	52.3 (44)	40.0 (10)
21	7.59	38.7 (31)	25.0 (8)
22	8.40	18.2 (66)	8.3 (12)
23	6.49	11.8 (68)	0.0 (14)
24	5.55	29.7 (37)	11.1 (9)
Total	6.62	28.1 (1266)	12.8 (258)

Notes: Entries are the percentage of observations less or equal to the monthly inflation rate. N is the number of observations for the month (the denominator). For the individual changes, N is the number of price changes across products and stores and for the average price changes, N is the number of stores during the month. The 'total' row refers to the number of price changes over all months less or equal than the average monthly inflation rate.

Table 3. Price Changes and the Inflation Rate Meat Products

(A) 1978–1979.6 Month	Inflation rate Π (%)	Individual $\Delta P_{ijt} \leqslant \Pi$ percent (N)	Average $\Delta \bar{P}_{it} \leqslant \Pi$ percent (N)
2	1.58	0.72 (138)	0.0 (31)
3	3.70	32.4 (114)	12.0 (25)
4	5.51	36.5 (137)	24.1 (29)
5	1.85	4.2 (119)	0.0 (27)
6	1.97	5.1 (99)	0.0 (24)
7	2.39	9.6 (94)	0.0 (22)
8	2.38	12.1 (141)	0.0 (31)
9	3.01	8.9 (189)	0.0 (40)
10	5.74	44.8 (143)	15.2 (33)
11	6.23	30.3 (175)	2.9 (35)
12	3.44	17.8 (90)	0.0 (20)
13	4.94	35.6 (73)	16.7 (18)
14	2.43	10.9 (101)	0.0 (24)
15	5.61	47.2 (144)	32.4 (34)
16	8.67	60.4 (134)	70.4 (27)
17	4.76	36.7 (128)	6.7 (30)
18	3.54	10.6 (113)	4.0 (25)
Total	4.00	21.5 (2132)	4.5 (475)
(B) 1981–1982			
2	5.51	29.5 (190)	6.67 (45)
3	4.79	9.6 (229)	2.17 (46)
4	10.7	73.9 (138)	69.7 (33)
5	3.35	10.6 (141)	0.0 (33)
6	2.73	11.1 (153)	5.9 (34)
7	6.06	41.9 (105)	26.9 (26)
8	3.90	13.2 (106)	0.0 (26)
9	8.14	35.0 (160)	17.6 (34)
10	9.02	44.7 (150)	32.3 (31)
11	5.80	19.9 (161)	3.13 (32)
12	5.16	19.1 (94)	0.0 (22)
13	8.32	35.3 (167)	21.1 (38)
14	5.70	13.9 (144)	3.57 (28)
15	5.06	16.5 (127)	0.0 (24)
16	10.7	57.1 (182)	44.7 (38)
17	6.22	10.1 (198)	0.0 (38)
18	6.03	15.1 (166)	2.86 (35)
19	9.21	23.7 (190)	10.5 (38)
20	7.87	21.9 (215)	4.65 (43)
21	7.59	31.3 (182)	15.8 (38)
22	8.40	57.1 (105)	63.6 (22)
23	6.49	57.1 (177)	45.0 (40)
24	5.55	37.2 (199)	11.6 (43)
Total	6.62	28.5 (3679)	14.2 (787)

Notes: Entries are the percentage of observations less or equal to the monthly inflation rate. N is the number of observations for the month (the denominator). For the individual changes, N is the number of price changes across products and stores and for the average price changes, N is the number of stores during the month. The 'total' row refers to the number of price changes over all months less or equal than the average monthly inflation rate.

In order to check this proposition directly we conducted the following exercise. For each store-month observation we selected the minimum price change, ΔP_{it}^{Min}, and computed the mean of the changes in the remaining prices (excluding ΔP_{it}^{Min}). Denote this mean price by $\Delta \bar{P}_{it/Min}$. We then sorted all store-month observations according to its minimum price change and plotted the ratio of the mean price change excluding the minimum price to the minimum

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price, $\tau_{it} = \Delta\bar{P}_{it/Min}/\Delta P_{it/Min}$, against the minimum price change, ΔP_{it}^{Min}.[19]

Our argument says that this plot should be downward sloping: the smaller the minimum price change, the larger the change in the accompanying prices relative to this price. In other words, the expected price change conditional on the smallest price change observed in the store should vary less than proportionally with the minimal price change.

Figures 1–4 plot the log of the τ_{it} ratios for wines and meat products and Table 4 shows estimated slopes of an exponential curve fit to these data (which fits the data better than a linear model). The estimated slopes are indeed negative and statistically significant. This means that the average of the remaining prices increases proportionally less than the lowest price.

Because the evidence of a negative slope is more relevant at the lower range of the values of ΔP_{it}^{Min}, panel B, in Table 4 presents estimates of the slope for the left-hand side portion of the plot.[20] We chose to use data in the first quartile of the distribution of ΔP_{it}^{Min} representing price changes less than 4.3–7.7% depending on the product and period (Table 1). As predicted by the presence of store-specific adjustment costs, 'small' price changes are accompanied by 'large' price changes in the other products.

Lastly, we address the legitimate concern that this last result is driven by the presence of heterogeneity in the distribution of price changes across stores and months. Note, first, that $\Delta P_{it/Min}$ is an increasing function of ΔP_{it}^{Min} in an expected sense. This is still true even if each store-month has a different distribution of price changes.

But whether $\Delta P_{it/Min}$ increases proportionally more or less than ΔP_{it}^{Min} depends on the relationship between higher moments of the distribution of price changes and ΔP_{it}^{Min}. For example, suppose that every store-month observation is a sample of price changes drawn from a distribution differing only in that its variance decreases as ΔP_{it}^{Min} increases. Then sorting by the minimum

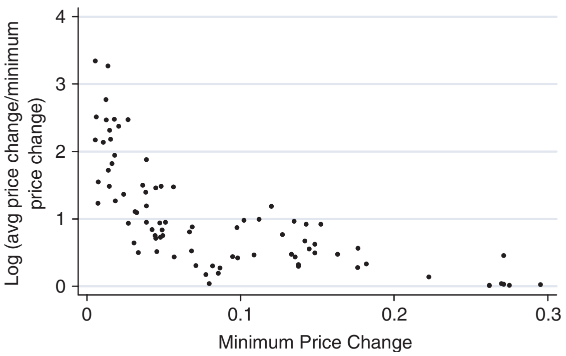

Figure 1. Average price change/minimum price change (in logs) wines 1978–1979.6.

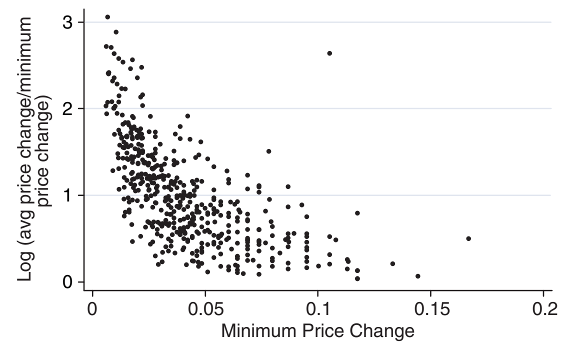

Figure 3. Average price change/minimum price change (in logs) meats 1978–1979.6.

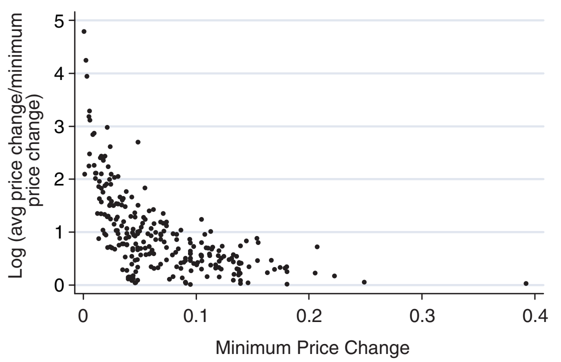

Figure 2. Average price change/minimum price change (in logs) wines 1981–1982.

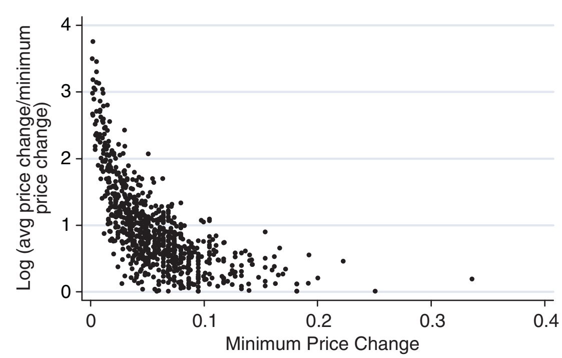

Figure 4. Average price change/minimum price change (in logs) meats 1981–1982.

Table 4. OLS Estimates of $\log(\Delta\bar{P}_{it/Min}/\Delta P_{it}^{Min}) = \alpha + \beta\Delta P_{it}^{Min} + error$

	Wines 1978–1979.6	Wines 1981–1982	Meat products 1978–1979.6	Meat products 1981–1982
Panel A: Full sample				
α	1.6 (0.10)	1.6 (0.07)	1.6 (0.04)	1.6 (0.03)
β	−7.1 (0.84)	−9.0 (0.75)	−14.4 (0.79)	−11.3 (0.47)
R^2	0.46	0.36	0.41	0.42
N	83	258	476	787
Panel B: First quartile				
α	1.7 (0.18)	2.1 (0.14)	1.5 (0.10)	1.4 (0.06)
β	−7.1 (1.75)	−14.8 (1.9)	−11.6 (1.8)	−8.2 (0.80)
R^2	0.48	0.49	0.26	0.35
N	20	64	119	196

Note: Standard errors in parentheses. The data in these regressions are plotted in Figures 1–4.

price change generates a negative correlation between τ_{it} and ΔP_{it}^{Min} as τ_{it} tends to its lower bound of one. This does not mean that the negative slope result is a built-in statistical property of the data; such a relationship reflects the workings of an economic model of pricing behavior. Thus, the presence of heterogeneity *per se* does not invalidate the above results nor our conclusions. In any case, as this discussion highlights, our focus on the left-hand side of the plot becomes all the more important.

CONCLUSIONS

We set out to show that it is incorrect to argue that menu-cost based models are irrelevant because of the occurrence of many small price changes. The reason is that in a multiproduct setting, when the cost of adjusting prices has a store-specific component, such small changes are consistent with menu-costs model. A natural restriction imposed by a multiproduct menu cost model is that an average price change within the store is not small and that small price changes in one product are accompanied by large price changes in the remaining products sold in the same store. The data show that small average price changes are infrequent and, furthermore, that the smaller the individual price change in a store the larger the price change in the remaining products sold by the same store.

NOTES

1. Theoretical extensions allowing for time-varying costs of adjustment (Caballero and Engel, 1994) or varying demand conditions (Benabou, 1992) may help to address this problem.
2. Levy *et al.* (1997), using a different methodology, arrive at a similar conclusion in their analysis of price data from large US supermarket chains.
3. The average price change exhibits a pattern consistent with the menu cost theory increasing with expected inflation and with its variance (see Lach and Tsiddon, 1992, for details).
4. In the empirical part we analyze the average change in the prices of the other products *relative* to the minimal price change in the store. Henceforth, a variation in the average change in prices of the remaining products refers to this *relative* variation.
5. In some cases, as in Cecchetti's (1986) study of the frequency of price adjustments in newsstand prices of magazines in the United States, using the single-product framework may indeed be appropriate. In other cases, as in studies of prices in grocery stores, this assumption is more problematic.
6. See Sulem (1986) and Sheshinski and Weiss (1992) for notable exceptions.
7. Evidence on the synchronization in the within-store timing of price changes is in Lach and Tsiddon (1996).
8. This contradicts the conclusion of the single-product case. In that case, the (S, s) boundaries are fixed as long as the characteristics of inflation are fixed. Thus, with a (stochastically) stable inflation one expects a constant proportional change in price.
9. The appropriate weight is the weight that accounts not only for the sales of the product but also for the effect of the change in the product's price on total revenues (Sheshinski and Weiss, 1992). When menu costs are important, this average of price changes is, of course, not independent of the characteristics of the inflationary process. We return to this point later on.
10. These are grocery or liquor stores; supermarkets and chain stores are not included in the sample.
11. Wine products consist of nine wines and liquors: arrack (anise); white vermouth; liquor; champagne; vodka; red wine; rosé wine; hock wine and sweet red

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wine. The 12 meat products, including three types of fish, are: fresh beef; frozen goulash; frozen beef liver; fresh beef liver; chicken breast; chicken liver; turkey breast; beefsteak; drumsticks; fish fillet; buri fish and codfish.

12. Stores sell dozens of different goods but only a small fraction of them are sampled. Thus, we cannot analyze the price change when a *single* product changes price because it is most likely that other products—not included in the sample—experience price changes during the same month. We can only hope to characterize the typical price change when *many* products change price on the basis of the sample of products at hand. The selection of observations with at least three price changes was motivated by our concern with producing a reasonable good estimate of the mean price change.
13. Roughly decomposed as 28 (58) different wine (meat) stores appearing on average in 3–4 (8–9) months with an average of 4.5 price changes per store in 1978–1979. In 1981–1982, we have 27 (65) different wine (meat) stores appearing on average in 10 (11–12) months with an average of 4.8 price changes per store.
14. The incidence of negative price changes in wines (meat products) is 4.1 (3.9)% in 1978–1979 and 3.2 (2.6)% in 1981–1982.
15. We are not very concerned with the presence of store, product or period effects in the data. First, we analyze price changes—not price levels—and, second, we are interested in comparing the lower tail of the distribution(s) to an hypothetical 'small' menu cost and not relative to some group norm. In any case, in Lach and Tsiddon (1992) we could not reject the hypothesis that the time-average of price changes is the same across stores and our analysis of the data on a monthly basis (see Tables 2 and 3) reaches the same conclusions as the aggregate analysis.
16. Recall that we restrict our analysis to stores having at least three price changes, $|G_{it}| \geqslant 3$.
17. This is probably an underestimate since more than one price change might have occurred during the month.
18. Because of the small number of observations per month, these results should be viewed as complementary to the aggregate analysis.
19. We use the ratio in order to neutralize the presence of store and time effects in the data so that all the observations can be pooled together. Time effects, in particular, should be controlled for because the monthly rate of inflation varied considerably across the sample period.
20. If the distributions of price changes are *uniformly* bounded above, then as the minimum price increases, the ratio τ_{it} tends to one, its lower bound.

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