Inflation, Costs of Adjustment and the Real Price Amplitude: Am Empirical Study

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Inflation, Costs of Adjustment, and the Amplitude of Real Price Changes
An Empirical Analysis

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Abstract

The menu-cost model (Sheshinski-Weiss, 1977) demonstrated that in the presence of fixed price adjustment costs, monopoly firms who face an inflationary trend in rival prices will adjust their nominal price level periodically, following an (S,s) policy in real price space. This paper tests the implications of the model on the real price amplitude and the expected frequency of price adjustments, using Israeli data. It is shown that except for the lower end of the real price cycle, the theory is supported by the data.

Key Word: Stochastic Inflation, costs of price adjustment, monopoly price, real price amplitude

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1 Introduction

It is well-known that one of the damaging consequences of rapid inflation is frequent nonsynchronized nominal price changes, leading to increased variation in relative prices and to higher price uncertainty (Parks, 1978; Jaffee and Kleiman, 1978; Vining and Elwertowsky, I976; Cagan, 1975; Cukierman and Wachtel, 1980). A less-known aspect of the same phenomenon is the increase in the amplitude of changes in the real price of each product over time. The typical firm is therefore further away from its regular profit-maximizing position and suffers a real loss. Investigating some theoretical aspects of this problem, Sheshinski and Weiss (1977, 1979) argued that the fluctuations in real prices constitute the major welfare loss associated with inflationary processes. These losses exist even if inflation is fully predicted in the aggregate as long as relative prices are allowed to vary randomly. Under such circumstances firms will find it profitable to inform customers of their specific prices; however, they will find it costly to change prices continually [see also Fischer and Modigliani (1978)].

We adopt a micro, partial equilibrium approach and consider a firm that operates under inflationiary expectations. Following Arrow (1962), we assume that the firm possesses a monopoly power that allows it to set the nominal price of its output or, alternatively, the price of one of its inputs. The firm produces a nonstorable product whose demand depends on its price relative to the price of rival commodities considered as an aggregate. The firm expects the aggregate price level and its costs of production to increase at a certain given rate. In the absence of adjustment costs the optimal policy would be to increase its own price continually at the same rate. We assume, however, that a fixed real cost is associated with each price change (Barro, 1972). Consequently, the optimal policy is characterized by a sequence of finite intervals during which the *nominal* price is held constant, followed by discrete price adjustments (Scarf, 1959). The analysis focuses on the effect of the expected rate of inflation on the frequency and the magnitude of these price changes.

Sheshinski and Weiss (1977) showed that an increase in the rate of inflation leads to an increase in the initial real price and to a decrease in the terminal real price in each period, thereby increasing the magnitude of each price change and the amplitude of fluctuations in real prices. However, the effect on the frequency of price changes was shown to be ambiguous.

The objective of this paper is to test these implications of their model empirically. We examine the effects of the accelerating rate of inflation in Israel on the nominal and real price/time patterns of two branded commodities, instant coffee and noodles, both produced by local monopolies. Our preliminary findings suggest that *ceteris paribus*, an increase in the expected rate of inflation implies a higher frequency of nominal price changes. The nominal price is set at a level that implies a higher *initial* real price, but the nominal price is not held fixed until the *final* real price is reduced. The latter aspect of the firm's price adjustment strategy appears to be inconsistent with the simple model that we propose. In part, this may be due to the omission of the real interest rate from the empirical analysis. In future work we plan to examirne additional products and to suggest some theoretical modifications of our simple price adjustment model in an attempt to resolve this discrepancy.

2 A Model of Price Adjustment

We consider a price-setting firm that operates under inflationary expectations, where costs and demand are subject to exogenous unexpected shocks. As there are real costs of adjustment associated with varying nominal prices, the firm does not change its prices immediately whenever conditions change, even if these changes are presumed to be permanent.

Instead, it will allow its real price to fluctuate between some predetermined bounds and will change the nominal price by a discrete jump only if the lower or upper bounds are met. Sheshinski and Weiss (1977) describe the determination of these bounds. They show that for each permanently fixed rate of inflation, real costs, and demand, there is an optimal price program in which, starting at the first price change, nominal prices are held constant over successive time intervals of *equal* duration. That is, at calendar time μ the firm plans to change its nominal price at times $t = \mu + \xi + \tau\epsilon, \quad \tau = 0, 1, \ldots$ where $\xi \geq 0$ is the time that elapses until the first price change and ϵ is the time that elapses between all subsequent price changes. Furthermore, if g_μ is the rate of inflation expected to hold permanently from μ onward, then $p_\tau = p_{\tau-1}e^{g_\mu \epsilon}, \quad \tau = 1, 2, \ldots$. The value of the optimal program [see Eq. (2) in Sheshinski and Weiss (1977)] can be written as follows:

$$\begin{aligned} v_\mu = &\int_0^\xi F_\mu\left(\frac{p_\mu}{\overline{p}_\mu}e^{-g_\mu t}\right)e^{-rt}dt - \beta e^{-r\xi} \\ &+ \frac{e^{-r\xi}}{1-e^{-r\epsilon}}\left[\int_0^\epsilon F_\mu\left(Se^{-g_\mu t}\right)e^{-rt}dt - \beta e^{-r\epsilon}\right] \end{aligned} \tag{1}$$

where p_μ is the nominal *predetermined* price at time μ; $\overline{p}_\mu$, the general price level at time μ; S, the real price chosen at time μ for $t = \mu + \xi + \tau\epsilon, \quad \tau = 0, 1, 2, \ldots$; F_μ, real profits as a function of real price at time $t \geq \mu$; β, real costs of a nominal price adjustment; and r, real rate of interest. It is assumed that r and β are positive constants independent of calendar time. On the other hand, the expected rate of inflation g_μ and the profit function may change over time. All such changes are unexpected; however, at each μ it is assumed that the inflation rate and the profit function will remain the same for $t \geq \mu$.

The optimal values of the choice variables ξ, S and ϵ are obtained by maximizing (1). The first-order conditions are

$$F_\mu\left(\frac{p_\mu}{\overline{p}_\mu}e^{-g_\mu \xi}\right) + r\beta - \frac{r}{1-e^{-r\epsilon}}\left[\int_0^\epsilon F_\mu\left(Se^{-g_\mu t}\right)e^{-rt}dt - \beta e^{-r\epsilon}\right] \leq 0 \tag{2}$$

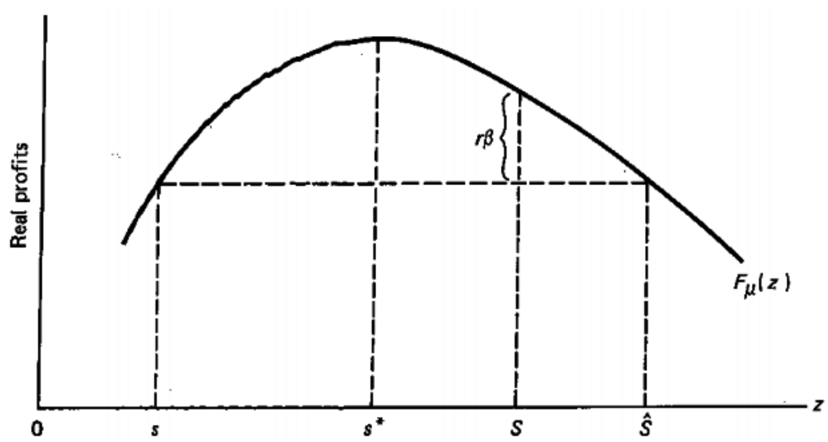

Figure 1: The profit function of the firm.

$$\int_0^{\epsilon} F_\mu^{'}\left(Se^{-g_\mu t}\right)e^{-(r+g_\mu)t}dt = 0 \tag{3}$$

$$F_\mu\left(Se^{-g_\mu\epsilon}\right) + r\beta - \frac{r}{1-e^{-r\epsilon}}\left[\int_0^{\epsilon} F_\mu\left(Se^{-g_\mu t}\right)e^{-rt}dt - \beta e^{-r\epsilon}\right] = 0 \tag{4}$$

We note that the optimal solution of S and ϵ is determined from (3) and (4) alone. Whenever there is a price change it will always be chosen so as to set the real price at S. The nominal price will then be held fixed until the real price drops to $s = Se^{-g_\mu\epsilon}$. Therefore, if the basic conditions remain unchanged, the real price will repeatedly fluctuate between S and s. If $\xi > 0$, that is, if the firm does not change its price immediately, then (2) and (4) imply that $F_\mu\left[\left({}^{p_\mu}/_{\overline{p}_\mu}\right)e^{-g_\mu}\right] = F_\mu(s)$. A corner solution with an immediate price change, that is, with $\xi = 0$, will occur if $F_\mu\left({}^{p_\mu}/_{\overline{p}_\mu}\right) < F_\mu(s)$. While the optimal values of s, S, and ξ depend on the expectations held at μ concerning the rate of inflation and the shape of the real profit function (Fig. 1) , the actual nominal price at time μ is predetermined by previous conditions. If the firm finds itself with a real price $\left({}^{p_\mu}/_{\overline{p}_\mu}\right) < s$ then it will increase its real price immediately to S. If $\left({}^{p_\mu}/_{\overline{p}_\mu}\right) < \hat{S}$, where by definition $F_\mu\left(\hat{S}\right) = F_\mu(s)$, then the firm will reduce its real price immediately to S. If, however, $\hat{S} > \left({}^{p_\mu}/_{\overline{p}_\mu}\right) > s$, the firm will *not* change its nominal price at time μ. Sheshinski and Weiss (1977) proved that an increase in the expected rate of inflation will lead to an increase in S and to a reduction in s, which implies that $\hat{S}$ must increase. One purpose of our work is to test this implication empirically.

The model outlined above, which is based on Sheshinski and Weiss (1977), is built upon a number of assumptions that may limit its empirical applicability. Consumers are assumed to act exclusively on the basis of current data, and substitution over time and the possibility of carrying inventories are ignored. Such assumptions may be justified in the case of some perishable commodities like newspapers and consumer services, whose consumption cannot be postponed, but when the typical period between price adjustments is relatively short, these assumptions may not be appropriate. A second limiting aspect is that the firm's optimal plans are chosen under the assumption of a *fixed* aggregate rate of inflation. Finally, we do not analyze the potential effects of price controls. In future work we intend to extend the model to incorporate the above elements.

3 Statistical Formulation

3.1 Methodology

Assume that the firm contemplates the possibility of a price change only at some discrete equally spaced points in time, say, every month. At such points the firm gathers information on the (continuously changing) aggregate price level, costs, and demand conditions. It forms expectations and determines the optimal values of s, S, and $\hat{S}$. Let p_t be the nominal price chosen by the firm at time t, and let $\overline{p}_t$ be the aggregate price level at time t, $t = 1, 2, 3, \ldots$. The firm's decision can be formulated as follows: If $p_{t-1}/\overline{p}_t < s_t$ the firm will increase its nominal price so as to raise the real price to S_t. Similarly, if $p_{t-1}/\overline{p}_t > \hat{S}_t$, the firm will reduce its nominal price and again set the real price at S_t. Finally if $s_t \leq p_{t-1}/\overline{p}_t \leq \hat{S}_t$, the firm will not change its nominal price and will set $p_t = p_{t-1}$.

The optimal levels of s, S: and $\hat{S}$ are determined by the first-order conditions (2)-(4) as functions of the exogenous variables. The linear approximations of these functions are

$$S_t = b_1^{'} x_t + v_t, \quad s_t = b_2^{'} x_t + \gamma_2 v_t, \quad \hat{S}_t = b_3^{'} x_t + \gamma_3 v_t \tag{5}$$

where the vector x_t includes the measured effects of inflationary expectations and costs of production, and b_1, b_2, and b_3 are vectors of parameters. The random variable v_t represents shifts in the profit function due to changes in the costs of unobserved inputs and changes in demand conditions. It is assumed that

$$v_t \sim h\left(0, \sigma^2\right) \tag{6}$$

The values of S, s, and $\hat{S}$ are potentially observable only when a price change occurs. For observations in which the nominal price is held constant we can only estimate the probability that the observed real price falls between the bounds $\hat{S}$ and s. Furthermore when a price change occurs we directly observe S, but not s and $\hat{S}$. We only know that the real price exceeds $\hat{S}$ when a price reduction occurs and is below s when the price is increased. This is due to the discrete nature of our observations on the price process.

The probabilities of prices increasing, remaining constant, and decreasing, are, respectively,

$$\begin{aligned}
\mathrm{pr}\,(p_t > p_{t-1}) &= \mathrm{pr}\,({}^{p_{t-1}}/_{\overline{p}_t} \leq s_t) = \mathrm{pr}\left[\left({}^{p_{t-1}}/_{\overline{p}_t} - b_2^{'}x_t\right)\gamma_2^{-1} \leq v_t\right] \\
\mathrm{pr}\,(p_t = p_{t-1}) &= \mathrm{pr}\left(s_t < {}^{p_{t-1}}/_{\overline{p}_t} < \hat{S}_t\right) \\
&= \mathrm{pr}\left[\left({}^{p_{t-1}}/_{\overline{p}_t} - b_3^{'}x_t\right)\gamma_3^{-1} < v_t < \left({}^{p_{t-1}}/_{\overline{p}_t} - b_2^{'}x_t\right)\gamma_2^{-1}\right] \\
\mathrm{pr}\,(p_t < p_{t-1}) &= \mathrm{pr}\left({}^{p_{t-1}}/_{\overline{p}_t} \geq \hat{S}_t\right) = \mathrm{pr}\left[\left({}^{p_{t-1}}/_{\overline{p}_t} - b_3^{'}x_t\right)\gamma_3^{-1} \geq v_t\right]
\end{aligned} \tag{7}$$

Estimates of the coefficient vectors $b_2^{'}$ and $b_3^{'}$, and of $\gamma_2\sigma$ and $\gamma_3\sigma$ can be obtained by maximizing the likelihood function

$$\begin{aligned}
L = &\prod_{t\in I_1} \Phi\left[\left(-\frac{p_{t-1}}{\overline{p}_t} + b_2^{'}x_t\right)\frac{1}{\gamma_2\sigma}\right] \\
&\prod_{t\in I_2} \left\{\Phi\left[\left(\frac{p_{t-1}}{\overline{p}_t} - b_2^{'}x_t\right)\frac{1}{\gamma_2\sigma}\right] - \Phi\left[\left(\frac{p_{t-1}}{\overline{p}_t} - b_3^{'}x_t\right)\frac{1}{\gamma_3\sigma}\right]\right\} \\
&\prod_{t\in I_3} \Phi\left[\left(\frac{p_{t-1}}{\overline{p}_t} - b_3^{'}x_t\right)\frac{1}{\gamma_3\sigma}\right]
\end{aligned} \tag{8}$$

where Φ is the standard normal distribution function and I_1, I_2, I_3 denote the set of indices for which p_t has increased, is unchanged, or has decreased, respectively.

Recalling that $S_t = {}^{p_t}/_{\overline{p}_t}$ whenever a price change occurs, we can obtain consistent estimates of the coefficients of $b_1^{'}$ from the regression

$${}^{p_t}/_{\overline{p}_t} = b_1^{'}x_t + \sigma\lambda_t + w_t, \quad t \in I_1 \cup I_3 \tag{9}$$

The variable λ_t is added to eliminate the sample selection bias (Heckman, 1979) and is defined by:

$$\lambda_t = \begin{cases}
\frac{1}{\sigma}E\left[v_t \mid v_t \geq \left(\frac{p_{t-1}}{\overline{p}_t} - b_2^{'}x_t\right)\frac{1}{\gamma_2}\right] = \frac{\phi\left[\left({}^{p_{t-1}}/_{\overline{p}_t} - b_2^{'}x_t\right)(\gamma_2\sigma)^{-1}\right]}{\Phi\left[\left(-{}^{p_{t-1}}/_{\overline{p}_t} + b_2^{'}x_t\right)(\gamma_2\sigma)^{-1}\right]} & t \in I_1 \\
\frac{1}{\sigma}E\left[v_t \mid v_t \leq \left(\frac{p_{t-1}}{\overline{p}_t} - b_3^{'}x_t\right)\frac{1}{\gamma_3}\right] = \frac{-\phi\left[\left({}^{p_{t-1}}/_{\overline{p}_t} - b_3^{'}x_t\right)(\gamma_3\sigma)^{-1}\right]}{\Phi\left[\left({}^{p_{t-1}}/_{\overline{p}_t} - b_2^{'}x_t\right)(\gamma_3\sigma)^{-1}\right]} & t \in I_3
\end{cases} \tag{10}$$

where ϕ and Φ are the standard normal density and distribution functions, respectively. With this definitionn the residual w_t has an expectation equal to zero.

3.2 THE DATA

The products chosen for analysis were instant coffee and noodles, both of which are produced by local monopolies. Monthly data on the price of these commodities is available for the period 1965-1978. Monthly data on wages in the food-processing industry and on raw materials were used to construct an index of the variable costs of production; weightings of wages and raw materials were derived from data on the costs structure of the respective firms.[1]

The expected monthly rate of inflation was assumed to depend on past trends and on relevant macroeconomic variables. After some experimentation, a forecasting equation was chosen in which price changes in the previous 12 months and the rate of change in the foreign eXchange rate were used as explanatory variables.[2] (Other macroeconomic variables such as money supply and wage rates were found to have negligible additional explanatory power.) This equation was used to produce estimates of the expected aggregate rate of inflation in each month.

Data on the nominal price profiles of the two commodities are to be found in the appendices, together with the values of the real price, real costs, and expected rate of inflation at the points at which price changes occurred. (To save space, we do not report the values of real variables at other dates. These data can be obtained from the authors upon request.)

In describing the data we may divide the sample into three distinct periods. Between August 1965 and August 1970 the average rate of inflation was only 0.25% per month. Despite some significant changes in the price of coffee beans, the nominal price of instant coffee was changed only twice, and at moderate rates. The price of noodles was changed more frequently but again at moderate rates. Between August 1970 and October 1973, the average rate of inflation accelerated to 1.1% per month. We do not find a marked increase in the frequency of nominal price changes, but rather an increase in the size of the jumps. Between October 1973 and December 1978 the rate of inflation accelerated further to an average of 2.9% per month. We now observe a higher frequency of nominal price changes as well as larger jumps in the prices of both products. The relative gap between real prices just before and just after the nominal price change is increased. There is thus an increase in real price variation. The overall variation in the real price of coffee is much larger than that of noodles, reflecting the sharp swings in the international price of raw coffee beans; in fact, for coffee we observe six cases of price *reduction*. In the case of noodles, prices only increase.

The two firms under discussion are subject to price control, meaning that they must submit applications for price changes to a supervising agency. If approved, the new price becomes the official price and cannot be changed without permissionn. While the presence of such controls entails certain costs, their effectiveness during the sample period was probably quite low.[3] There are nev-

[1] Wages and raw materials account for 55% of the total production costs for noodles and 80% for instant coffee. For noodles the relative share of wages is 38% and of flour 62%. For instant coffee the relative share of wages is 25% and of coffee beans 75%.

[2] It may be argued that exchange rate changes are not exogenous variables; in alternative specifications we introduced dummy variables for the two major devaluations (instead of exchange rate changes) and a time trend, but obtained similar results.

[3] All price-increase requests appear to have been approved; moreover in several cases actual price increases were below time maximum approved by the authorities. In late 1977, a further restriction was introduced whereby changes were approved at most once every three months;

Table 1: Profit Estimates of the Effect of Expected Inflation and Real Costs on s and $\hat{S}$.[a]

Sample and dependent variable	Constant	Expected inflation	Real cost	Standard deviation σ_i
		Instant Coffee		
All price changes				
s	−0.49 (−3.26)	7.48 (3.68)	0.62 (7.04)	0.42
$\hat{S}$	4.00 (4.67)	−19.61 (−1.14)	−0.75 (−1.13)	1.1
Price increases				
s	−0.51 (−5.93)	7.33 (5.55)	0.66 (8.99)	0.40
		Noodles		
s	0.29 (5.39)	3.26 (5.19)	0.33 (6.55)	0.25

[a] Asymptotic t values in parentheses.

ertheless some indications that price controls had some effect on the timing of price increases, in that the periods after the Six Day War and the Yom Kippur War were both characterized by long periods of nominal price stability. It is difficult to obtain data on Israeli branded commodities that are *not* subject to formal price controls. In future work special effort will be mnade to obtain such data, possibly from other countries.

4 Some Preliminary Findings

The estimates of the effects of inflation and real costs on the price policies of the two firms are obtained in two stages. In the first stage we estimate these effects on the lower bound s, and when price reduction occurs, on $\hat{S}$ [see Eq. (8)]. These estimates also yield the inverse Mill's ratio (10), which is used in the second stage in (9) to estimate the upper bound S. The probit estimates for the first stage are presented in Table 1 . The main finding is that an increase in the expected rate of inflation leads to a higher value of the lower bound on real price variation s. That is, the firm increases the nominal price whenever the real price falls below a critical value; the higher the expected rates of inflation, the higher

however, this latter restriction appears to have been effective only during the second half of 1978.

Table 2: The Effect of Expected Inflation and Real Costs on Initial Real Price.[a]

Sample and estimation method	Constant	Expected inflation	Real cost	λ	Sample Size	DW	R^2
			Instant coffee				
All price changes							
OLS	0.11	1.21	0.55	_	27	0.41	0.55
	(0.85)	(0.86)	(5.26)				
Two-stage	−0.02	1.76	0.60	0.03	27	0.43	0.61
	(−0.14)	(1.28)	(5.81)	(1.85)			
Price increases							
OLS	0.17	1.17	0.50	_	21	0.28	0.48
	(1.08)	(0.76)	(3.93)				
Two-stage	−0.97	7.21	0.82	0.19	21	1.30	0.96
	(−11.07)	(12.52)	(20.25)	(15.15)			
			Noodles				
OLS	0.57	−0.56	0.39	_	31	0.57	0.48
	(6.49)	(−0.99)	(5.00)				
Two-stage	0.21	1.96	0.42	0.05	31	1.51	0.84
	(3.07)	(4.22)	(9.28)	(7.46)			

[a] Asymptotic t values in parentheses.

the critical value. This result is obtained for both instant coffee and noodles whether price reductions are included or not. We find that the effect on $\hat{S}$ (the critical bound for price reductions) is not significant. This is not surprising as there are few price reductions in our sample. As expected, an increase in the real cost of production leads to an increase in the lower bound on real price variation. The larger coefficient of real costs in the case of instant coffee reflects the fact that the production cost index represents a larger part of total costs (88%, versus 55% for noodles).

The second-stage estimates are presented in Table 2 . For purposes of comparison we also present the (inconsistent) ordinary least squares (OLS) estimates. As one would expect, sample selection is important. This is reflected by the significant effect of the inverse Mill's ratio λ and its marked effect on the size of the coefficient of the expected rate of inflation. For both products we find that, correcting for sample selection, an increase in the expected rate of inflation leads to an *increase* in the upper bound on real price variation. That is, when the nominal price is increased, it is set at a level that implies a higher *initial* real price.

The findings that the effects of inflation on S and s are both positive and of similar magnitude imply that the relative gap between S and s tends to decrease as the rate of inflation increases.

Recalling the definition of s, we have the relation $\epsilon = (\ln S - \ln s)/g$. The results suggest that ϵ is reduced as the expected rate of inflation g is increased; in other words, the frequency of price changes increases.

Our finding that expected inflation has a positive effect on s may be due to missing explanatory variables, in particular, the real interest rate. Sheshinski and Weiss (1977, p. 296) show that an increase in the real interest rate should have a negative effect on both S and s. Since we do not have consistent unified data on the nominal interest rate we are unable to incorporate it in the estimation. However, from the partial data in our possession it appears that the real interest rate is negatively correlated with expected inflation, which brings about a positive bias in the parameter of the expected inflation in both s and S. We conjecture that this effect may be stronger in the case of s, since s is estimated for the entire sample period and not just for points at which price changes occurred.

For several reasons we view the above results as very preliminary: the results for the two specific commodities that we analyzed may not be applicable to other products. Differences may arise because of different storage possibilities, substitution over time, costs of price adjustment, degree of competition, and price controls. Other factors affecting the firm's price policy were only partially controlled; not all cost variables were available, and demand factors were ignored. Our statistical method did not incorporate all the restrictions of the theoretical model (for example, $S > s$) and is not the most efficient method. A separate test (outside the model) is necessary to determine whether or not our forecasting equation adequately represents the inflationary expectations.

In future work we plan to overcome some of these difficulties and to obtain a more precise estimate of the effects of inflation in price adjustment strategies.

Appendix 1

Nominal Price Changes and the Real Cost of Noodles						
Date of price change	No. of months since last change	Rate of nominal price change (%)	Real unit cost	Expected monthly rate of inflation (%)	Real price after price change	Real price prior to price change
8.56	_	4.6	1.02	0.71	1.04	1.00
2.66	6	2.2	1.00	0.91	1.01	0.99
4.66	2	2.2	0.98	1.04	1.00	0.98
7.66	3	6.4	0.95	0.59	1.06	0.99
10.66	3	2.0	0.95	0.82	1.07	1.05
4.67	6	2.0	0.97	0.60	1.08	1.06
7.71	51	3.8	0.89	0.77	0.93	0.89
10.71	3	7.4	0.98	0.14	0.94	0.88
1.72	3	1.7	0.93	0.74	0.92	0.90
5.72	4	1.7	0.96	0.74	0.90	0.88
2.73	9	10.1	0.92	1.08	0.90	0.82
4.73	2	7.6	0.97	1.26	0.91	0.85
11.73	7	1.4	0.94	1.15	0.82	0.81
2.74	3	27.8	1.04	2.16	0.91	0.71
6.74	4	12.0	1.19	1.55	0.94	0.84
9.74	3	14.6	1.22	1.78	1.04	0.91
11.74	3	31.4	1.34	8.67	1.19	0.91
3.75	4	15.5	1.46	1.89	1.20	1.08
10.75	7	4.5	1.41	5.05	1.12	1.07
2.76	4	4.8	1.30	1.58	1.11	1.05
4.76	2	10.2	1.38	2.28	1.11	1.01
6.76	2	10.7	1.44	1.24	1.20	1.09
8.76	2	1.7	1.44	2.88	1.15	1.13
10.76	2	6.2	1.41	3.11	1.15	1.09
5.77	7	5.0	1.34	2.14	1.05	1.00
8.77	3	5.9	1.30	2.58	1.03	0.97
11.77	3	16.4	1.24	13.73	1.00	0.86
2.78	3	3.9	1.25	3.07	0.98	0.94
5.78	3	9.5	1.22	3.50	0.96	0.88
8.78	3	3.7	1.26	3.14	0.93	0.90
11.78	3	12.4	1.24	4.51	0.91	0.81

Appendix 1

Nominal Price Changes and the Real Cost of Noodles

Date of price change	No. of months since last change	Rate of nominal price change (%)	Real unit cost	Expected monthly rate of inflation (%)	Real price after price change	Real price prior to price change
1.66	_	2.2	1.00	0.44	1.00	0.98
7.67	18	0.5	0.92	0.28	0.95	0.95
8.70	37	14.5	1.13	0.45	0.99	0.86
10.71	14	9.8	1.07	1.39	0.93	0.84
1.72	3	1.8	1.01	0.74	0.90	0.88
8.74	31	13.8	0.83	1.83	0.59	0.52
11.74	3	15.5	0.79	8.67	0.58	0.50
2.75	3	8.2	0.76	2.88	0.57	0.52
6.75[a]	4	-1.4	0.77	1.85	0.53	0.54
7375	1	1.4	0.77	1.52	0.54	0.53
10.75	3	13.9	0.96	5.05	0.56	0.49
1.76[a]	3	-4.4	0.98	1.77	0.51	0.53
3.76	2	8.2	1.05	1.91	0.53	0.49
5.76	2	8.7	1.14	2.71	0.53	0.49
7.76	2	8.3	1.27	2.18	0.55	0.50
8.6	1	4.4	1.27	2.88	0.57	0.54
11.76	3	28.7	1.30	2.44	0.65	0.51
1.77	2	35.9	1.46	2.08	0.87	0.64
2.77[a]	1	-1.3	1.58	2.04	0.85	0.86
4.77	2	40.5	2.08	2.50	1.16	0.81
6.77	2	23.4	2.07	2.04	1.36	1.11
9.77[a]	3	-6.5	1.56	3.06	1.17	1.25
11.77	2	34.7	1.47	13.73	1.36	1.01
1.78[a]	2	-10.8	1.57	1.79	1.17	1.31
3.78[a]	2	-2.4	1.58	2.18	1.09	1.12
5.78	2	0.5	1.45	3.50	1.02	1.02
8.78	3	4.9	1.37	3.14	1.00	0.96

[a] Price decrease

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