INFLATION AND ASYMMETRIC PRICE ADJUSTMENT

Robert A. Buckle and John A. Carlson*

Abstract—Using a unique micro data set, we find pervasive evidence of price asymmetry that is systematically related to inflation. An ordered probit model of pricing by manufacturing, building and merchandising firms shows that inflation: (i) increases the probability of a price increase in response to cost increases and (ii) decreases the probability of a price decrease in response to decreases in demand. Predicted inflation-induced asymmetries also show up for price responses to cost decreases and demand increases but not as overwhelmingly. Similar asymmetries are evident in firms’ expectations of price changes, with a slight optimistic bias relative to actual changes.

I. Introduction

The nature of nominal price rigidity has a crucial influence on the real effects of monetary policy and the characteristics of business cycles. Some economists have argued that these price rigidities are likely to be asymmetric (for example, Tobin (1972)) and some textbooks have captured this idea with a convex aggregate supply curve (for instance, Lipsey (1983, chapter 41)) while Ball and Mankiw (1994) have recently suggested a micro-theoretical foundation for price asymmetry in which price asymmetry depends on inflation. However, to date there has been little empirical research evaluating price asymmetry, and there has been no previous evidence that price asymmetries depend on inflation. The purpose of this paper is to fill that gap.

We make use of a unique micro data set to test for price asymmetries at the firm level and to evaluate the Ball/Mankiw proposition that price asymmetry depends on general inflation. In the conclusion to their paper, Ball and Mankiw comment that “an aspect of our model that might be examined in future empirical work is the relation between price adjustment and inflation’’ (p. 261). This is the principal objective of this paper.

The data are obtained from a survey of New Zealand firms that provide information about changes to their selling prices, costs, and demand. Each firm’s response to each question can be identified, so we can readily identify those firms that report increases and those that report decreases in prices, costs, and demand in order to compare the relative sensitivity of prices to increases and decreases in costs and demand across different inflation environments. Furthermore, firms can be identified by industry type, and the survey provides information about expected changes to prices, cost, and demand, as well as actual changes to these variables.

The remainder of the paper is structured as follows. Section II describes in more detail the Ball/Mankiw pricing model and how the interaction of menu costs and inflation can induce an asymmetric response to shocks to desired price. Section III explains the survey data used to evaluate these ideas empirically. Section IV describes the way we have arranged the survey data, the estimation procedure, and the results. Section V concludes.

II. Explanations for Price Asymmetries

Some of the most well developed ideas providing microfoundations for nominal price rigidities have followed the “menu cost” approach, as reflected in the collection of papers in Sheshinski and Weiss (1993). A feature of this approach is that, if it is costly to change price, firms will delay changes until the private benefits outweigh the private costs. If there is general inflation, a firm’s real price will automatically fall—thereby possibly offsetting a need to lower its nominal price.

Ball and Mankiw use these ideas to argue that nominal price adjustments are asymmetric. They consider a model, based on the monopolistic competition models of Blanchard and Kiyotaki (1987) and Ball and Romer (1989), which combines elements of time-contingent pricing, in which a firm adjusts prices on a regular time schedule, and state-contingent pricing, in which a firm has the option of changing prices whenever economic circumstances warrant a change. If midway between regular price changes shocks are large enough, the firm will pay a menu cost and make an additional price change. This set-up enables Ball and Mankiw to avoid the complications created by cumulative shocks over several periods and to concentrate on whether or not a firm should change price in response to a single shock.

Formally, let \( \theta \) be an exogenous shock to a firm’s desired price in the absence of any menu costs, \( \pi \) the general rate of inflation, and \( C \) the
menu cost of changing price. In the Ball/Mankiw model, firms regularly adjust prices every two periods setting the price \( \pi/2 \) above the desired price in the first period and \( \pi/2 \) below the desired price in the second period. They have an option to make an additional price adjustment between these regular changes in the event that a shock, \( \theta \), to their desired price is sufficiently large. A firm will not change its price. That is, a firm will not change price if

\[
\sqrt{\pi} - \frac{\pi}{2} < \theta < + \sqrt{\pi} - \frac{\pi}{2}.
\]

If \( \theta \) is above the upper bound, the firm will raise price, and, if \( \theta \) is below the lower bound, the firm will lower price.

At zero inflation, the range is symmetric and bounded by \( \pm \sqrt{\pi} \). The range becomes asymmetric if the inflation rate \( \pi \) is not zero. For a given distribution of shocks, the larger the inflation rate, the more likely the firm is to make a price increase and the less likely it is to make a price decrease. Ball and Mankiw therefore predict that there will be greater asymmetry in price responses to shocks at higher rates of inflation.

### III. Micro Firm Data

Over time, a number of economists have collected and analyzed data on individual prices, and these data have provided useful answers to a variety of questions. For example, Cecchetti (1986), Carlton (1986), and Kashyap (1995) provide information on the frequency and size of price changes of different products. Lach and Tsiddon (1992) have looked at how inflation affects the distribution of real prices, and have also examined the extent to which price changes are staggered or synchronized (1996). None of these, however, have matching observations of inflation-induced asymmetries in response to cost or demand changes.

One notable source of individual firm data on changes not only in prices but also in associated costs and demand is the Quarterly Survey of Business Opinion (QSBO), which is managed by the New Zealand Institute of Economic Research (NZIER). The data have been collected over a large number of years in which average inflation rates have been quite different. In addition, the questions have remained the same, and, to a large extent, the same firms have been sampled every quarter. A great advantage of these features is that we can analyze the effects of inflation on how firms’ price-change decisions are related to cost and demand changes with most other things equal. Furthermore, having data from individual firms over many quarters aids in statistical inference by providing a substantial number of observations.

The data are qualitative in nature (up, same, down). Business surveys of this type have become one of the most intensive methods of data collection during the post-WWII years. (See for example, Kohler (1995).) The data available from these surveys have sparked a growing body of microeconometric research that, as Zimmerman (1997, p. 409) remarks in his recent survey article, “offers a unique source for investigating the statistical adequacy of macro modeling and microeconomic theories.”

The NZIER survey involves the distribution to business executives of a standard questionnaire that identifies the firm, its principal activity, location, and size; a series of questions about the firm’s operating environment; and a standard question asking executives to report their perceptions of the actual and expected changes in a number of variables. This paper utilizes responses to the following questions, which have been unchanged throughout the entire sample period:

- “What has been your firm’s experience during the past three months and what changes do you expect during the next three months in respect of the following?"

<table>
<thead>
<tr>
<th>Expected Change</th>
<th>Expected Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>past three months</td>
<td>next three months</td>
</tr>
<tr>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Up</td>
<td>Same</td>
</tr>
<tr>
<td>“Average selling prices”</td>
<td>“Average costs”</td>
</tr>
</tbody>
</table>

Responses provide individual firm data on both actual and expected changes in selling prices, costs, and demand, respectively. The individual respondent data are available for manufacturers and builders in every quarter since 1963:3 and for merchants in every quarter since 1974:3. For this reason and because pricing behavior might vary across industries, we present separate results for manufacturers, builders, and merchants.

### IV. Ordered-Probit Analysis of Price Changes

Our sample consists of firms that report the direction of expected and actual change (‘up’, ‘same’ or ‘down’) in their price \( p \), cost \( c \), and demand \( d \). We have coded all responses so that any variable has the value of +1 for up, 0 for same, and −1 for down.

To estimate the influence of changes in costs, demand, and inflation on changes in price, we use ordered-probit regressions. The idea is to assign a value \( v \) to each observation. In our particular application, let

\[
v_{jt} = \left( b_1 + b_3 \pi \right) c_{jdjt} + \left( b_5 + b_7 \pi \right) d_{jdjt} + \left( b_9 + b_{11} \pi \right) cdn_{jdt} + \left( b_7 + b_9 \pi \right) ddn_{jdt}.
\]

where \( c_{jdjt} = cost \text{ increase (1 if } c = 1, \text{ 0 otherwise)} \), \( d_{jdjt} = demand \text{ increase (1 if } d = 1, \text{ 0 otherwise)} \), \( cdn = cost \text{ decrease (1 if } c = -1, \text{ 0 otherwise)} \), \( ddn = demand \text{ decrease (1 if } d = -1, \text{ 0 otherwise)} \) experienced by firm \( j \) in quarter \( t \) and \( \pi = \text{ the average annual rate of consumer price (CPI) inflation that prevailed at the time of each observation.} \)

Let \( u \) be a standard normal variable (with zero mean and variance of one), and define three probabilities:

\[
Pr[p = -1|c, d, \pi] = Pr[v + u < k_1] = Pr[u < k_1 - v] \quad (3)
\]
\[
Pr[p = 0|c, d, \pi] = Pr[k_1 < v + u < k_2] = Pr[k_1 - v < u < k_2 - v] \quad (4)
\]
\[
Pr[p = 1|c, d, \pi] = Pr[k_2 < v + u] = Pr[k_2 - v < u] \quad (5)
\]

An ordered-probit regression procedure estimates the eight coefficients \( b_1, \ldots, b_9 \) and the two additional “cut-point” parameters \( k_1 \) and \( k_2 \) that maximize the likelihood of observing the actual sample of reported price changes. For more details about the ordered-probit procedure, see Greene (1993) and Stata Corporation (1995).

The \( b \) and \( k \) estimates using our samples are reported in table 1 separately for manufacturers, builders, and merchants. The columns
Table 1.—Ordered-Probit Estimates of Influences on Expected and Actual Price Changes

<table>
<thead>
<tr>
<th>Line</th>
<th>Pr [p = 1 \mid c, d, \pi]</th>
<th>Pr [\mu &gt; 0.950 - 0.434(10)]</th>
<th>Pr [\mu &lt; -0.174] = 0.57.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Pr [p = 1 \mid c = 0, d = 0, \pi]</td>
<td>0.17</td>
<td>0.24</td>
</tr>
<tr>
<td>2</td>
<td>Pr [p = 1 \mid c = 0, d = 0, \pi]</td>
<td>0.40</td>
<td>0.46</td>
</tr>
<tr>
<td>3</td>
<td>Pr [p = 1 \mid c = 1, d = 0, \pi]</td>
<td>0.63</td>
<td>0.79</td>
</tr>
<tr>
<td>4</td>
<td>Pr [p = 1 \mid d = 1, c = 0, \pi]</td>
<td>0.18</td>
<td>0.26</td>
</tr>
<tr>
<td>5</td>
<td>Pr [p = 1 \mid d = 1, c = 0, \pi]</td>
<td>0.23</td>
<td>0.26</td>
</tr>
<tr>
<td>6</td>
<td>Pr [p = 1 \mid c = 0, d = 0, \pi]</td>
<td>0.10</td>
<td>0.21</td>
</tr>
<tr>
<td>7</td>
<td>Pr [p = 1 \mid c = 1, d = 0, \pi]</td>
<td>0.17</td>
<td>0.30</td>
</tr>
<tr>
<td>8</td>
<td>Pr [p = 1 \mid d = 1, c = 0, \pi]</td>
<td>0.14</td>
<td>0.33</td>
</tr>
<tr>
<td>9</td>
<td>Pr [p = 1 \mid d = 1, c = 0, \pi]</td>
<td>0.24</td>
<td>0.38</td>
</tr>
<tr>
<td>10</td>
<td>Pr [p = 1 \mid d = 1, c = 0, \pi]</td>
<td>0.11</td>
<td>0.29</td>
</tr>
</tbody>
</table>

The second equality comes from a table for the distribution of a standard normal variable. In some estimates across all samples are the price responses to cost increases \((b_1)\), the interaction between cost increases and inflation \((b_2)\), cost decreases \((b_3)\), demand decreases \((b_4)\), and the interaction between demand decreases and inflation \((b_5)\). Firms appear to be much more likely to increase price in response to a cost increase and much less likely to decrease price in response to a demand decrease when inflation is higher.

One of the difficulties in interpreting the size of coefficients in these ordered-probit regressions is that their importance in influencing the probability of price responses also depends on the location of the cut points, \(k_1\) and \(k_2\). We have therefore prepared table 2 to show how different conditions alter the probabilities of price increases or decreases. The probabilities shown in table 2 are based on the point estimates reported in table 1 and are calculated for different possible values of \(c, d, \pi\). For example, consider the case for manufacturers of a positive change in costs \((\text{cup} = 1)\), inflation of 10%, and no change in demand (third line and second column in table 2). The probability of an increase in price is then given by

\[
\Pr[\mu > 0.930 - 0.434(10)] = \Pr[\mu < -0.174] = 0.57.
\]

The second equality comes from a table for the distribution of a standard normal variable.

When there are no cost or demand shocks \((c = 0, d = 0)\), we can see by a comparison of lines 1 and 6 in table 2 that the probability of a price increase is only slightly more than the probability of a price decrease. So, despite high inflation over parts of our sample, there is only a slight asymmetry in the absence of cost or demand shocks.

The second line in table 2 indicates that, even without inflation, the probability that a firm will raise price when its costs are higher is between 31% and 38%. When inflation is 10%, as on line 3, the probability that a firm will raise price when its costs are higher is considerably larger (between 57% and 76%). Thus, higher inflation has a substantial effect on firms’ decision to raise prices when costs are higher.

By contrast, the probability of a price increase is not increased much by a demand increase relative to the probability when there is neither a cost nor a demand increase. Compare lines 1 and 4 of table 2. Also, an inflation rate of 10% has a relatively small effect on the probability that a firm will increase price in response to a demand increase. See lines 4 and 5 of table 2.

When demand is down, there is a fairly high probability of a price decrease, especially for builders (line 9). Inflation also has a notable effect in lowering the probability of a price decrease in the face of a demand decrease (line 10).

Thus, there are clear asymmetries in price responses to cost and demand changes induced by inflation. These estimates are of interest in their own right in giving evidence about the effects of inflation on price asymmetries, but they are not a strong test of the Ball/Mankiw hypothesis. For one thing, in their model, Ball and Mankiw concentrate on what happens between regular price changes. A sample of firms every quarter cannot isolate those periods and must of necessity consider all price changes. Furthermore, in the Ball/Mankiw model, the shocks for individual firms are optimal price changes relative to the general level of inflation. With qualitative data, we cannot quantify the distribution of the desired price changes for different firms that report the same qualitative changes. Our evidence combines two effects of higher inflation: the tendency for more firms to increase prices more
CONGLOMERATE MERGERS AS DEFENSE AGAINST THE RISK OF RELATIVE PRICE VARIABILITY

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I. Introduction

The conglomerate merger boom, exemplified by such firms as LTV, Litton, and Gulf and Western in the 1960s and by the oil companies in the 1970s, was widely attributed to accounting cosmetics, fashions, and other less-rational motives. The trend reversed itself in the 1980s, when managements typically explained this restructuring with “focusing” and “synergies”—that is, economies of scale and scope.

Recently, Weston et al. (1990) explain real conglomerate mergers during the period 1957–1977 with the three-year moving sums of the growth rate of the real GNP, the ten-year real rate of interest, and the spread between the four-to-six-month commercial paper and bond rates, and the premium of the BAA over the AAA long-term corporate bond rate. They find the parameter on their risk variable, or the premium of the BAA over the AAA rate to be positive and significant both for conglomerate and product extension mergers.

The purpose of this paper is to study the effect of relative price risk on merger behavior, based on the following notion: When the risk of

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