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# Price changes by firms in New Zealand – some evidence from the Quarterly Survey of Business Opinion<sup>1</sup>

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In the last decade, central banks have conducted new research enhancing their understanding of firm-level price-setting behaviour. This work has revealed new information about the frequency with which firms change prices and provided explanations as to why prices are sticky. This information could potentially improve monetary policymaking and, as a result, reduce the real costs of policy changes and non-policy shocks. This article outlines the major themes and results from selected international research. It then examines price changing behaviour in New Zealand using firm-level data from the Quarterly Survey of Business Opinion (QSBO) published by the New Zealand Institute of Economic Research (NZIER). In line with international research, we find considerable diversity in the frequency of price changes by firms. Moreover, firms change prices more in response to cost changes than demand changes, and more in response to falling demand than increasing demand.

## 1 Introduction

A central focus of monetary economics is the frequency with which firms change prices. Beginning with David Hume (1752), it has long been argued that the speed that firms change prices determines the extent that fluctuations in the demand for goods and services lead to fluctuations in output rather than fluctuations in prices. When prices are inflexible, sticky or sluggish, a disproportionate fraction of the adjustment to economic shocks takes place as changes in firms' production, employment and capacity utilisation rather than in their prices. In turn, sluggish price adjustment makes the implementation of monetary policy more difficult, not only because there can be long lags between monetary policy changes and prices changes, but also because the resultant fluctuation in output levels can be costly.

In the last decade, researchers in many countries have used new data sources to examine the frequency with which firms adjust prices. Some of this research has been based on detailed surveys of firm behaviour and some has been

based on data collected by national statistical agencies. A clear picture has started to emerge. It is a picture of considerable diversity. At one extreme, a small fraction of firms appear to adjust their prices on a weekly basis. At the other extreme, a sizeable fraction of firms adjust their prices less than once every two years. In between, there are firms that adjust on a regular calendar cycle, often in January, and firms that adjust only when they are affected by a shock to their cost structure. There are firms that think nothing of having sales or specials every few weeks, and firms that agonise over every price change, often dispatching senior company personnel to customers to explain why a change was necessary (Zbaracki et al. 2004).

In conjunction with this work, there is new evidence that differences in the frequency with which firms change prices are important for monetary policy. Recent analysis of United States data has indicated that when monetary policy is tightened the size of a sector's output decline is inversely related to the frequency of price changes in that sector. Sectors that receive more sector-specific shocks tend to change prices more frequently, are faster to alter prices in response to monetary policy changes and have less output change when monetary policy is altered (Boivon, Giannoni and Mihov 2007).

In this article, we provide some evidence on the frequency with which New Zealand firms change prices. The evidence is

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<sup>1</sup> Access to the data used in this study was provided by the NZIER under conditions that maintained the full confidentiality of respondent firms. The authors are grateful to the Institute and to its Chief Executive, Dr Brent Layton, for access to this data. The authors also thank Phil Briggs, Bob Buckle and the participants at a Reserve Bank seminar. The study was supported by Bank funding and by University of Waikato Research Grant X554. The results and views presented are the work of the authors and not the Reserve Bank or NZIER.

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from the Quarterly Survey of Business Opinion (QSBO). This is a survey of firms in the manufacturing, building, merchant and service sectors published by the New Zealand Institute of Economic Research (NZIER). Since 1961, when it was first conducted, it has been an important source of information about New Zealand firms (see Box 1, overleaf). Consistent with the international evidence, we find considerable diversity in the frequency with which firms adjust prices. While many New Zealand firms adjust prices nearly every quarter, there are a significant number of firms that adjust prices infrequently, at most once every two years. In addition, the data indicate that the speed that firms adjust prices in response to demand and cost pressures is systematically related to their previous pattern of price adjustment.

The next section is a brief overview of the major themes and results on price-setting behaviour that have emerged from international research using business surveys. This is followed by a range of empirical questions regarding price changes in New Zealand using firm-level data from QSBO. The final sections contain our conclusions and directions for further research.

## 2 Major themes and international results

Recent research on the way that firms adjust prices can largely be traced to the contributions by Okun (1981), Kahneman, Knetsch and Thaler (1986), Blinder (1991) and, somewhat further back, to Hall and Hitch (1939).

Okun (1981) developed a theory of firm price adjustment based on the idea of 'costly search'. He argued that it is costly for customers to search for firms that provide good quality products at good prices on a reliable and timely basis. Once a customer finds such firms, he or she stays with them with the result that customers and firms form long-term relationships. Firms only change prices in a manner that does not harm these relationships. In particular, Okun hypothesized that firms are reluctant to raise prices in response to demand shocks for fear of alienating customers.

Kahneman et al. (1986) surveyed people about their views on when it is acceptable for firms to change prices. The

responses showed that a large majority of people thought it was fair for firms to raise prices when costs increased, although they did not mind if prices were not cut when costs declined. People also thought it was acceptable to cut prices when demand was low, although unfair for firms to raise prices above normal when demand was high. The authors argued that firms would act accordingly, so that asymmetric responses to demand and cost shocks should be observable.

Blinder (1991) and his team (Blinder et al. 1998) conducted intensive interviews of a large number of United States firms regarding their pricing behaviour.<sup>2</sup> The team asked a wide range of questions such as: How often do firms change their prices? How do firms respond to cost and demand changes? Do firms set prices according to the textbook theories of price stickiness? The answers were sufficiently groundbreaking that surveys into price setting behaviour have now been conducted in several other countries, often by central banks. In addition, researchers in Europe and North America have examined firm level price data provided to national statistical agencies to see how frequently firms changed retail and wholesale prices.

The results of this research have shed light on both the frequency with which firms change prices and the reasons why they change prices. Turning first to the frequency of price changes, a standard finding is that some firms change prices very frequently but a significant number only change them occasionally. Blinder found that 10 percent of United States firms changed prices once a week, but 50 percent of firms changed prices at most once a year. Subsequent research suggests that 25-30 percent of firms in the United States change prices every month, while the average duration between price changes is six or seven months (Bils and Klenow, 2004; Klenow and Kryvtsov, 2005). European consumer prices seem to be stickier. Surveys across European countries suggest approximately 15 percent of consumer prices are changed every month, while the average duration

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<sup>2</sup> Prior to Blinder, mainstream economists were skeptical at best, and hostile at worst, to the use of firm-level survey and interview data. "We are trained to study behaviour by watching what people do (usually in markets), not by listening to what they say" (Blinder 1991, p.90). Due to the success of this survey, this situation is changing rapidly.

## Box 1

The New Zealand Institute of Economics Research (NZIER) has, since 1961, published a Quarterly Survey of Business Opinion (QSBO). The survey covers firms in the manufacturing, building, merchant and service sectors (with primary industries, utilities and government services the main omissions). It has long been an important source of forecasting and monitoring information and data for economic research. (On the latter, see Buckle and Silverstone 2004).

Almost all questions in QSBO are related to the experiences and outlook of respondent firms regarding profitability,

output, employment, investment intentions, costs, prices and similar variables. Table 1 shows most of the questions common to all sectors together with the June quarter 2007 responses. These aggregated responses are published in QSBO as net balances, that is, the difference between the percentage replying 'up' and the percentage replying 'down'. In table 1, for example, a net 37 percent of respondents expect the general business situation over the six months to December 2007 to deteriorate. The net balances, in turn, are often compared in QSBO with their underlying official statistics, such as GDP and the producer and consumer price indices.

**Table 1**  
**QSBO Economy-wide Questionnaire**  
Percentage of 518 replies to Survey 185, June 2007

How many <b>employees</b> are covered by this return?								
1-20	21-50	51-100	101-200	201-500	Over 500			
27	14	9	9	24	17			
Which <b>district</b> does this return primarily relate?								
Auckland	Wellington	Canterbury	Other					
34	11	10	45					
Do you expect the <b>general business situation</b> in New Zealand during the next six months to:								
Improve	Same	Deteriorate	N/A					
9	45	46	0					
Finding the <b>skilled staff</b> you want today compared with three months ago is:								
Easier	Same	Harder	N/A					
3	48	43	6					
What <b>single factor</b> , if any, is most limiting your ability to increase your activity:								
Sales	Materials	Finance	Labour	Capacity	Other			
52	3	5	19	11	8			
Do you expect <b>new investment approvals</b> (compared with the last 12 months) to be:								
Greater	Same	Less	N/A					
29	38	26	6					
<b>Past and future trends.</b> What has been your firm's experience during the past three months and what changes do you expect in your firm during the next three months in respect of:								
Experienced				Expected				
Up	Same	Down	N/A	Up	Same	Down	N/A	
23	56	21	0	24	63	13	1	
17	58	14	11	9	60	20	11	
22	66	9	3	11	73	12	3	
53	37	8	1	52	42	4	1	
34	54	10	2	42	48	8	2	
18	42	40	1	19	48	33	1	
26	53	19	2	28	50	20	2	
				Numbers Employed				
				Overtime Worked				
				Labour Turnover				
				Average Cost				
				Selling Prices				
				Profitability				
				Output/Sales				

Note: N/A means 'not applicable' or 'no answer'.

Source: NZIER *Quarterly Survey of Business Opinion* 185, June 2007.

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between price changes was just over a year. (Dhyne et al. 2006).

Second, the research has also examined the reasons why firms change prices. Following Blinder, firms have been provided with a list of a dozen or so reasons why they do not change prices more frequently, and asked to rank their importance. The top five explanations in Blinder's survey were:

- Firms hesitate to raise prices in case their competitors will not follow (co-ordination failure).
- Firms change prices, with a lag, to changes in costs (cost-based pricing).
- Firms change non-price features, such as varying the quality of service (non-price competition).
- Firms have an implicit understanding with their customers not to increase prices when supplies are tight, unless justified by higher costs (implicit contracts).
- Firms have written contracts which usually make it difficult to change prices within the contract period (explicit contracts).

A full ranking of the explanations is shown in table 2, overleaf, along with the ranking of firms in the United Kingdom, the Euro area, Canada and Sweden. As can be seen, firms in each country had substantially similar rankings. In general, the surveys support the argument that firms change prices more in response to cost changes than demand changes.

The research has generated many other findings. The following list, based on Fabiani et al. (2007 p7-8, 47), summarises the research conducted in most of the Euro area countries by the Eurosystem central banks. These results are similar to those from other countries.

- The frequency of price changes varies considerably from firm to firm.
- The average frequency of price changes varies by sector.
- Energy sector firms change prices more frequently than other firms.
- Firms that use a lot of raw materials change prices more

frequently than firms that use few raw materials.

- Firms that are labour intensive, particularly in the service sectors, change prices less frequently than others.
- Firms in the Euro area change their prices less frequently than those in the United States.
- There is little evidence of downward price rigidity, except in the services sector.
- Price-setting responds asymmetrically to factors such as changes to cost and demand.
- The dominant approach to price setting is for firms to mark up prices over costs.

### 3 New Zealand evidence from the Quarterly Survey of Business Opinion

The analysis of the QSBO survey is presented as a series of questions and answers. Most of the analysis is based on firms' response to a question asking whether their selling price had decreased, stayed the same, or increased in the previous three months. Since firms often sell more than one item, the question is normally interpreted to refer to the selling price of the firm's main product. The firms are also asked whether their costs or sales changed over the previous three months (see box 1).

#### *Question 1: What fraction of firms change prices each quarter?*

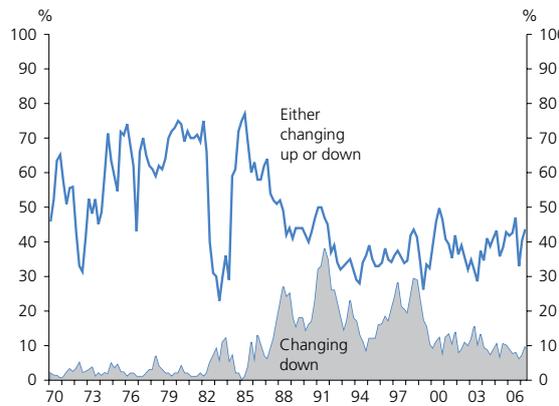
Figure 1, overleaf, shows the fraction of firms that claimed they had changed their selling prices in the previous quarter. The figure shows the fraction that either increased or decreased prices and the fraction that just decreased prices. Two points stand out. First, the fraction changing prices depends on the inflation rate. Prior to 1987, when the inflation rate was high, around two thirds of firms changed prices in a quarter. Since 1990, when the inflation rate has

**Table 2**  
**Explanations, importance and ranking of price stickiness theories**

Theory	Explanation	Country Study and Rank				
		US	UK	EA	CA	SW
Cost-based Pricing	Prices depend mainly on input costs and do not change until costs change.	2	2	3	1	2
Explicit Contracts	Written contracts make it difficult to change prices while the contract is in force.	5	1	2	3	3
Implicit Contracts	Firms have an implied understanding with customers not to increase prices in tight markets.	4	5	1	2, 7	1
Coordination Failure	Firms delay price changes because they do not want to be the first price-mover in the industry.	1	3	4	5, 8	4
Non-price Competition	Firms change non-price feature, such as delivery times and services, rather than prices.	3	8	7	4	
Pricing Thresholds	Prices may be sticky because firms are reluctant to cross pricing thresholds such as \$9.95.	8	4	10		7
Constant Marginal Cost	Factors influencing prices, such as marginal costs, do not change over the business cycle.	9	6		9	
Cost of Price Adjustments	Firms may change prices infrequently due to the costs of gathering information for pricing decisions and notifying the changes.	6 11	11	8 9	10 11	11 13
Procyclical Elasticity	Prices are sticky because firms lose customers when prices raised but gain few when lowered.	7	9			10 12
Stock Adjustment	Firms adjust stocks rather than prices to accommodate shocks to market conditions.	10	7			
Price Means Quality	Firms may be unwilling to cut prices in case customers think there is a decline in quality.	12	10	5		
Liquidity Constraints	In a recession price may need to be maintained to cover costs and to finance projects.					5, 6
Price Wars	Price wars contribute to keeping prices down during booms.					9
Temporary Shocks	If firms believe a shock affecting them is temporary, they may forego a price change.			6		
Low Inflation	Low inflation makes large price changes more noticeable.				6	

Sources: United States (US): Blinder *et al.* (1998, Table 5.2), United Kingdom (UK): Hall *et al.* (2000, Table 3), Euro Area (EA): Fabiani *et al.* (2006, Table 8), Canada (CA): Amirault *et al.* (2004, Table 4), Sweden (SW): Apel *et al.* (2005, Table 4).

**Figure 1**  
**Percentage of all firms changing prices each quarter, 1970–2007**



Source: NZIER

been low, only 40 percent of firms have changed prices in a quarter.<sup>3</sup> Second, a much greater proportion of firms increased prices than decreased prices. Price decreases were rare in the high inflation period before 1987. Even when the inflation rate has been low, only a small proportion of firms have decreased prices, except during the 1991 and 1998 economic downturns. Since 2000 the average number of firms that have reduced prices has only been 10 percent per quarter, a third of the number of firms that have increased prices.

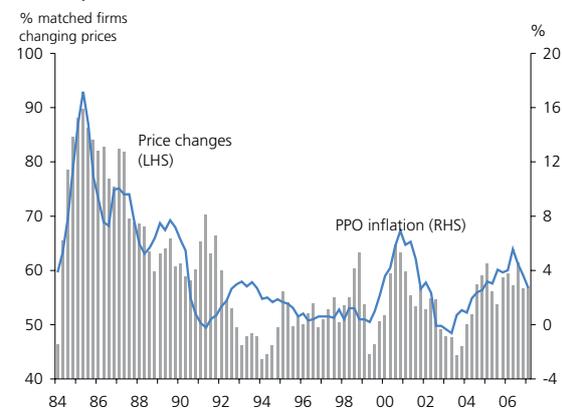
**Question 2: What fraction of firms change prices over two quarters?**

Further insight into the frequency of price changes can be gained by examining the fraction of firms that changed prices at least once over a six month period. To do this,

one needs to limit the sample to firms who respond to consecutive surveys. Table 3 presents detailed data for the 322 firms who answered both the March and June 2007 surveys. Of these firms, 43 percent said they changed prices in March and 47 percent said they changed prices in June. These outcomes are similar to the number of firms reporting a selling price change in the full sample, 44 percent (see table 1). The results in table 1, however, do not disclose the underlying dynamics seen in table 3. For example, the table shows that 37 percent of firms did not change their prices in either the March or June quarters of 2007 while 27 percent changed their prices twice. (See Silverstone 2000 for further analysis of these dynamics and related probabilities).

Figure 2 shows the proportion of firms changing prices at least once in a six month period and the producers' price index for outputs (PPO) between 1983 and 2007. The two

**Figure 2**  
**Percentage of matched firms changing prices each quarter and PPO Inflation, 1983-2007**



Source: NZIER and Statistics New Zealand

**Table 3: Price changes in March and June 2007**  
 The fraction of firms changing prices in each quarter.

March 2007	June 2007			Total
	Up	Same	Down	
Up	21.1%	12.7%	0.9%	34.8%
Same	15.8%	37.6%	4.3%	57.8%
Down	0.6%	2.8%	4.0%	7.5%
	37.6%	53.1%	9.3%	100%

Source: NZIER. Authors' calculations. 322 firms responded in both quarters.

<sup>3</sup> The mean and standard deviation for the period 1973:1-1987:4, excluding the price freeze period 1982:3-1984:1, are 64 percent and 8.5 percent, respectively. The mean and standard deviation for the period 1990:1-2007:2 are 38 percent and 5.4 percent.

**Table 4: Price changing behaviour: all firms, 1994-2006**

Distribution of the number of times firms changed prices in 8 quarters									
Mean Number 2.84									
Number	0	1	2	3	4	5	6	7	8
pdf (%)	17.4	17.8	15.4	15.2	9.9	9.0	6.1	5.1	4.1
cdf (%)	17	35	51	66	76	85	91	96	100.0

Distribution of the number of quarters since the last price change									
Number	0	1	2	3	4	5	6	7	8+
pdf (%)	34.8	16.8	7.6	8.7	4.4	4.3	2.9	3.1	17.4
cdf (%)	35	52	59	68	72	77	80	83	100.0

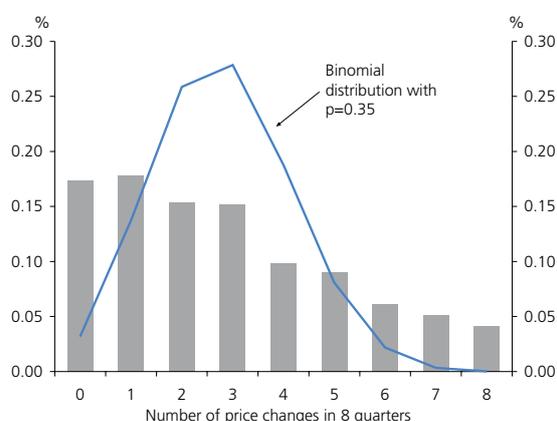
Source: NZIER. Authors' calculations. The pdf or probability function is the fraction of firms in each category. The cdf or cumulative distribution function is the cumulative sum of the probability distribution function.

series track each other very closely: the correlation over the period 1983-2007 is 0.81. The high correlation between these two series is consistent with European evidence that the number of firms changing prices is a good predictor of changes in the producer price index.

**Question 3: Are firms equally likely to change prices?**

To explore the frequency with which different firms change prices, we examined the responses of firms that replied to eight consecutive surveys in the periods ending in the fourth quarter of 1994, 1996, 1998, 2000, 2002, 2004 and 2006. Since firms often miss responding to a survey, this sampling procedure substantially reduces the sample size to 1013 observations.

**Figure 3**  
Distribution of the number of price changes over eight quarters, 1994-2006



Source: NZIER

Figure 3, and the upper part of table 4, shows the number of times firms changed prices during an eight quarter period. The mean number of price changes was 2.8 changes every eight quarters, or one change every eight and a half months. This average, however, disguises a very wide distribution. At one end of the distribution, 35 percent of firms recorded one change or fewer every eight quarters, of which half recorded no changes. At the other end, 15 percent of firms recorded at least six changes in the eight quarters.

It is of interest to know whether this distribution is consistent with the hypothesis that every firm was equally likely to change prices. The simple answer is no. If every firm were equally likely to change prices each quarter, the number of price changes made over eight quarters would follow a binomial distribution. Figure 3 shows this binomial distribution together with the actual distribution of the number of changes made by firms.<sup>4</sup> The two distributions are clearly very different. Compared to the binomial distribution, the actual distribution has more firms changing prices very frequently and many more firms changing prices very infrequently. The hypothesis that the two distributions are the same can be formally rejected at the five percent significance level using a Wilcoxon-Mann-Whitney non-parametric test.<sup>5</sup> In broad terms, this distribution is similar to results found internationally.

<sup>4</sup> The binomial distribution is calculated using a probability of change equal to the fraction of firms that change prices each quarter, in this case 35 percent.

<sup>5</sup> The Wilcoxon-Mann-Whitney test tests whether the cumulative distribution functions of two distributions lie above each other. The test statistic has a standard normal asymptotic distribution. The test statistics comparing the two distributions is 2.41, significant at the 1 percent level.

The lower part of table 4 shows the length of time since a firm last changed its prices. The table indicates that 35 percent of firms changed prices in the previous quarter and another 17 percent reported that they last changed prices in the quarter before that. In total, 68 percent of firms reported they had changed prices at least once in the previous four quarters. Of the remaining 32 percent, 17 percent had not reported any price changes in the previous eight quarters.

It is natural to ask two questions about these latter results. First, is it likely that the 17 percent of firms that reported that they had not changed prices in the previous eight quarters were simply misreporting? This could be the case. We think it unlikely for two reasons. First, if one extends the period of analysis from eight quarters to ten quarters, one finds that a quarter of these firms (4 percent out of 17 percent) changed their prices in the additional two quarters. This fraction is similar to the fraction of respondents that reported they last changed seven or eight quarters ago, suggesting a natural decay process. Secondly, only 10 percent of the firms that reported no price changes in the previous eight quarters also reported no demand changes over the same period. Since these two questions are adjacent in the survey, it seems unlikely that the respondent firms were simply choosing to tick the 'no change' boxes in the questionnaire.

**Question 4: Are differences in the frequency with which firms change prices related to the size and sector of firms?**

To answer this question, table 5 shows aspects of the distribution of price changes for firms in three different size categories in the manufacturing and building, merchant

and service sectors. The three size categories are firms with fewer than 50 employees, firms with 50-200 employees, and firms with more than 200 employees.

Three results are immediately apparent. First, merchants change prices more frequently than either manufacturing or service firms. This result holds for firms of all sizes and therefore does not reflect differences in the size composition of sectors. Second, small firms change prices less frequently than medium sized firms, who change prices less frequently than large firms. This result holds in each sector, although, as discussed below, the differences between medium and large firms are not statistically significant. On average, large firms changed prices one more time during every two year period than small firms. Third, there are significant differences in price setting behaviour within each size-sector category. At least nine percent of each category changed prices very frequently and at least another 16 percent changed prices very infrequently.

Closer inspection of the data shows that large firms are twice as likely as small firms to change prices very frequently (at least six times in eight quarters), but much less likely to change prices very infrequently (at most once in eight quarters). A quarter of large firms changed prices nearly every quarter. In contrast, over 40 percent of small manufacturing and service sector firms, and a third of small merchant firms, changed prices at most once in a two year period, of which more than half reported no changes. The tendency of small firms to change prices less frequently than large firms is found in most international studies. Amirault et al. (2004, p.34) offer the following explanation. Because many senior staff at small firms have numerous tasks in addition to reviewing

**Table 5: Distribution of the number of times firms changed prices in eight quarters**  
Disaggregated by size and sector, 1994-2006

	Small	Medium Mean	Large	Small	Medium Sample Size	Large
Manufacturers	2.31	2.90	3.57	144	137	69
Services	2.36	2.87	3.40	250	126	77
Merchants	2.79	3.70	3.90	104	63	43
	Percent with 0 or 1 Changes			Percent with 6 to 8 Changes		
Manufacturers	41	35	28	9	17	23
Services	45	37	19	10	17	22
Merchants	34	21	16	13	22	28

Source: NZIER. Authors' calculations.

**Table 6**  
**Seasonal Distribution of Price Changes 1992-2007**  
 Percentage of Total Price Notifications

Prices	March	June	September	December	Totals
Up	6	6	6	5	23
Same	17	16	15	15	63
Down	4	4	3	3	14
<b>Totals</b>	<b>27</b>	<b>26</b>	<b>24</b>	<b>23</b>	<b>100</b>

Source: NZIER. Authors' calculations.

and adjusting prices, the administrative and management costs associated with the price-setting process are particularly onerous and so prices are changed less frequently.

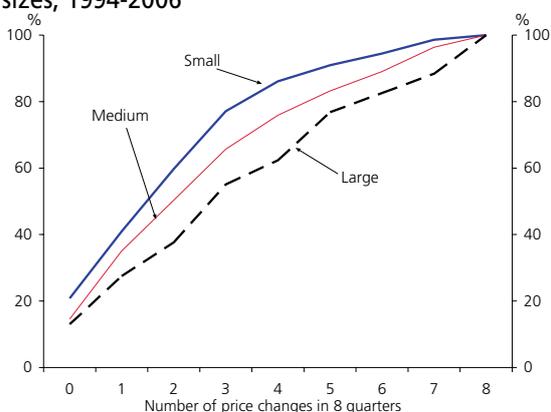
Figure 4 shows the cumulative distribution function of the number of price changes made by small, medium and large manufacturing firms. It shows that large firms are much more likely to change prices than small or medium firms. For example, 38 percent of large firms change prices at most twice every two years, whereas 50 percent of medium firms and 60 percent of small firms change prices at that frequency. The hypothesis that small manufacturing firms have the same distribution of price changes as either medium or large manufacturing firms can be rejected at the five percent significance level using a Wilcoxon-Mann-Whitney test.<sup>6</sup> In contrast, it is not possible to reject the hypothesis that medium and large manufacturing firms have different

distributions at the five percent level. A similar pattern of results is found for the merchant and service sectors, namely that small firms change prices less frequently than medium or large firms, but the differences between medium and large firms are smaller and not statistically significant.<sup>7</sup>

**Question 5: Is there seasonality in the frequency of price changes?**

Table 6 shows the seasonal distribution of price changes using the 35,600 responses given between 1992 and 2007. There is little evidence of a seasonal pattern in the data. The number of price changes, expressed as a percentage of total replies, is about the same in each quarter, at between eight and 10 percent. This result is also found when the data are disaggregated by sector. This outcome could be explained partly by the questionnaire which asks respondents to exclude seasonal variations in their replies.

**Figure 4**  
 Cumulative distribution of the number of price changes, manufacturing sector, all employment sizes, 1994-2006



<sup>6</sup> The test statistics comparing the small and medium size firms is 2.01, significant at the 5 percent level. The test statistic for the small and large firms is 3.32, significant at the 1 percent level. The test statistic for the medium and large firms is 1.73, significant at the 10 percent level.

**Question 6: Do firms change prices when costs and demand change?**

The above results show the frequency with which firms change prices but do not explain why firms change prices. The QSBO data cannot be used to answer question 6 directly as firms are not asked why they change prices. The data can be used indirectly, however, as firms are asked whether or not they have faced cost or demand changes. We apply regression analysis to determine if firms change prices when they experience demand or cost changes.

The approach adopted here was first used by Buckle and Carlson (2000a, b) in their analysis of the QSBO data. Like

<sup>7</sup> The Wilcoxon-Mann-Whitney statistics for merchants are: small-medium 2.67, small large 2.70 and medium large 0.54. The statistics for service firms are small-medium 2.10, small large 3.59 and medium large 1.73.

them, we estimate an ordered probit model that relates a firm's likelihood of changing prices in a particular quarter to changes in cost and demand conditions. We assume that a firm has a desired or target price. The firm adjusts its actual price to this value whenever the gap between its actual price and its target price becomes too large or, to put differently, whenever this gap exceeds a certain threshold. The price gap of the  $i^{\text{th}}$  firm, denoted,  $p_i^*$  depends on various factors facing the firm including changes in its cost structure and demand conditions and an additional idiosyncratic term  $e_i$ :

$$(1) p_i^* = \alpha^{c+} D_i^{c+} + \alpha^{c-} D_i^{c-} + \alpha^{d+} D_i^{d+} + \alpha^{d-} D_i^{d-} + e_i$$

$D_i^{c+}$  and  $D_i^{c-}$  are dummy variables indicating whether or not a firm had a positive or negative cost change, and  $D_i^{d+}$  and  $D_i^{d-}$  are dummy variables indicating whether or not a firm had a positive or negative demand change. The coefficients  $(\alpha^{c+}, \alpha^{c-}, \alpha^{d+}, \alpha^{d-})$  indicate how firms respond to the cost and demand changes. Firms are assumed to increase prices whenever  $p^*$  exceeds an upper threshold  $k^+$  and to decrease prices whenever  $p^*$  is less than a lower threshold  $k^-$ .

The model can be written as:

$$(2) \quad \text{Prob}(\text{price increase}) \\ = \text{Prob}(\alpha^{c+} D_i^{c+} + \alpha^{c-} D_i^{c-} + \alpha^{d+} D_i^{d+} + \alpha^{d-} D_i^{d-} + e_i > k^+) \\ = \text{Prob}(e_i > k^+ - (\alpha^{c+} D_i^{c+} + \alpha^{c-} D_i^{c-} + \alpha^{d+} D_i^{d+} + \alpha^{d-} D_i^{d-}))$$

$$(3) \quad \text{Prob}(\text{price decrease}) \\ = \text{Prob}(\alpha^{c+} D_i^{c+} + \alpha^{c-} D_i^{c-} + \alpha^{d+} D_i^{d+} + \alpha^{d-} D_i^{d-} + e_i < k^-) \\ = \text{Prob}(e_i < k^- - (\alpha^{c+} D_i^{c+} + \alpha^{c-} D_i^{c-} + \alpha^{d+} D_i^{d+} + \alpha^{d-} D_i^{d-}))$$

The ordered probit regression estimates the parameters  $(\alpha^{c+}, \alpha^{c-}, \alpha^{d+}, \alpha^{d-}, k^+, k^-)$  given the observed pattern of cost, demand and price changes and the assumption that  $e$  is normally distributed.

We estimate four separate models. First, we estimate the model using all firms that responded to any survey between 1992 and 2007. There are 36,255 observations in this regression. In the second, we restrict the sample to firms that responded to eight consecutive surveys ending in the December quarters of 1994, 1996, 1998, 2000, 2002, 2004

and 2006. There are 1,003 observations in this regression, as we only use the December observations. The last two regressions are estimated using two subsets of these data. The first subset contains the firms that frequently adjusted prices, defined as those firms that changed prices at least five times in the previous seven quarters. There are 185 firms in this group. The second subset contains the firms that infrequently adjusted prices, defined as those firms that changed prices at most once in the previous seven quarters. There are 394 firms in this group. This split was made as firms differ in their tendency to change prices.

Table 7, overleaf, shows the regression results. The coefficient estimates and associated standard errors are shown, together with a "marginal probability" measure indicating how a cost or demand change increases the likelihood that prices will be changed in the same direction. The "marginal probability" measures are best interpreted by considering an example from the first regression. The coefficient on the increase cost dummy  $D^{c+}$  is 0.74 and the upper threshold  $k^+$  is 0.98. If there was no change in costs, the firm would increase prices whenever the term  $e$  exceeded 0.98, that is, 16 percent of the time. If there was an increase in costs, the firm would increase prices whenever  $e$  exceeded 0.24, that is, 41 percent of the time. A cost increase, therefore, increases the probability of increasing prices by  $41 - 16 = 24$  percent (these percentages have been rounded).

The results in table 7 are consistent with the main findings of international surveys and the earlier work of Buckle and Carlson (2000b). Firms are more likely to increase prices when costs increase than to reduce them when costs decrease. Firms are also more likely to reduce prices when demand decreases than to increase prices when demand increases. The latter asymmetry is large. In the first regression, analysing the behaviour of all firms, an increase in demand only increased the probability of increasing prices by four percent, whereas a decrease in demand increased the probability of reducing prices by 16 percent. In the remaining regressions, an increase in demand was estimated to slightly reduce the probability of increasing prices, although these estimates were not statistically significant. In these last cases, however, a decrease in demand was estimated to increase the probability of reducing prices by between 13

**Table 7: Ordered Probit Models**

	$D^{c+}$ <i>cost+</i>	$D^{c-}$ <i>cost-</i>	$D^{d+}$ <i>demand+</i>	$D^{d-}$ <i>demand-</i>	$k^-$	$k^+$	Log Ratio (4)
Firms responding to the survey in any quarter.							
Coefficient	0.74	-0.52	0.14	-0.28	-0.98	0.98	4897**
(se)	(0.013)**	(0.020)**	(0.014)**	(0.016)**	(0.011)**	(0.012)**	
probability	24%	16%	4%	8%	16%	16%	N=36255
Firms with responses to eight consecutive quarters ending December 1994 – 2006							
All Firms							
Coefficient	0.78	-0.56	-0.04	-0.48	-1.13	0.96	147**
(se)	(0.08)**	(0.14)**	(0.08)	(0.11)**	(0.07)**	(0.07)**	
probability	26%	13%	-1%	13%	13%	17%	N=1003
Firms with responses to eight consecutive quarters ending December 1994 – 2006							
Firms that frequently change prices							
Coefficient	0.94	-0.85	-0.14	-0.66	-0.69	0.29	58**
(se)	(0.19)**	(0.29)**	(0.20)	(0.24)**	(0.19)**	(0.18)**	
probability	36%	32%	-5%	24%	25%	39%	N=185
Firms with responses to eight consecutive quarters ending December 1994 – 2006							
Firms that infrequently change prices							
Coefficient	0.57	-0.51	-0.05	-0.73	-1.63	1.44	29**
(se)	(0.17)**	(0.29)	(0.16)	(0.20)**	(0.14)**	(0.13)**	
probability	12%	8%	-1%	13%	7%	5%	N=394

Results of an ordered probit model regressing a firm's decision to increase, not change or decrease prices against dummy variables indicating cost and demand changes. The sample is split according to whether firms had 5 or more or 1 or fewer price changes in the previous seven quarters.

percent (for firms that changed prices infrequently) and 24 percent (for firms that changed prices frequently).

A comparison of the first two regressions shows that the results for the firms that only answered eight consecutive quarters are broadly consistent with the results for the firms that answered any survey. In both cases, a positive cost change increased the probability of an increase in prices by approximately a quarter, while a negative demand change increased the probability of reducing prices by approximately 15 percent. In addition, they both have a small response to positive demand changes and a somewhat larger response to negative demand changes. Since these results are so similar, there is no obvious reason to suspect that the small sample results for the firms that frequently or infrequently adjust prices are not representative of the results for all firms.

## 4 Conclusions

The results of this exploration of price-setting behaviour in New Zealand are in line with the results of recent international studies. Four aspects stand out. First, there

is considerable diversity in the frequency with which firms adjust prices. About a sixth of firms in the sample adjusted prices nearly every quarter, while a third had adjusted prices at most once every two years. Small firms are more reluctant to change prices than others. Second, firms change prices more in response to cost changes than demand changes. Third, firms seem to respond more to negative demand changes than to positive demand changes. In this regard, it is noticeable that the two episodes of widespread price reduction that occurred in the last twenty years occurred during economic downturns. Fourth, firms are more likely to have reported price increases rather than price decreases. Since 2000, for example, firms were three times as likely to report price increases as price decreases.

The most original finding of the article relates the propensity to change prices in response to cost and demand changes to a firm's prior history of price changes. Not surprisingly, firms that have a history of changing prices are much more likely to respond quickly to changes in cost and demand conditions than firms that only occasionally change prices. Previously, findings of this type have been indirect, based

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on the tendency of large firms or firms in the distribution sector to change prices more often than other firms. This paper has been able to exploit the longitudinal nature of the QSBO data to make the link explicit. It seems that some firms of all sizes and in all sectors adjust prices infrequently and these firms are slow to adjust prices in response to changing economic conditions.

For a long time, central banks have understood that the speed that firms adjust prices is a crucial factor behind the effectiveness of and costliness of monetary policy. The growing body of international research has shed new light on aspects of the transmission mechanisms of monetary policy, particularly the length of time it can take before changes in monetary policy affect the inflation rate. So far, this research has not provided central banks with a blueprint to “fine-tune” monetary policy to take account of the differential speed that different firms adjust prices. Nonetheless, there is growing recognition that greater knowledge of the reasons why firms change prices could assist central banks as they implement monetary policy. For instance, a better understanding of the asymmetric adjustment by firms to positive and negative demand shocks may provide a better guide to the operation of monetary policy in economic downturns.

### Directions for further research

Internationally, it is becoming clear that better use could be made of firm-level survey data to analyse behaviour. This is due partly to software and econometric advances and partly to those researchers, such as Blinder et al. (1991, 1998), who have urged economists to include surveys and interviews in their analysis. While the Bank monitors the QSBO survey and also conducts regular interviews with New Zealand businesses as part of its monitoring of the economy, there has been relatively little attempt to build and use statistical models using firm-level responses from these surveys.

In this article, we have attempted to show that the firm-level responses in the QSBO can provide important insights into price-setting behaviour in New Zealand. Our initial conclusions have been based on the survey responses

of manufacturers, builders, merchants and services to the questions about selling prices, costs, demand and employment. We have not used the responses to any of the other survey questions relating, for example, to profit, business confidence, recruitment, investment approvals and constraints. Neither have we used the responses from the QSBO sector-specific questionnaires relating to principal activity, capacity utilisation, productivity, stocks, export sales and overseas orders.

The responses to these other survey questions should enable us not only to test the robustness of our initial conclusions but also to allow us to consider a wide range of questions. For example: Are firms backward or forward-looking regarding their own price-setting behaviour? Do they respond to cost and demand changes with a delay? What is the relationship, if any, between price changes and profitability, output, employment and business confidence? Can our understanding of the changes in the inflation process in New Zealand as described, for example, in Hodgetts (2006), be enhanced by an understanding of firm-level price changes? The answers to these questions and others may help us better understand how firms respond and thus how monetary policy may be implemented optimally.

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