Micro Foundations of Price-setting Behaviour: Evidence from Canadian Firms

Daniel de Munnik*
Bank of Canada

Kuan Xu
Dalhousie University

Abstract

The price-setting behaviour of firms modelled in macroeconomic analysis can significantly influence how inflation dynamics unfold and how social welfare changes in response to exogenous shocks. Using the Bank of Canada's 2002–03 price-setting survey data, we employ a count data and a series of discrete-choice models to study two different but closely interrelated research questions about price-setting behaviour: (i) What explains the wide cross-sectional variation in how often firms set prices? (ii) Why are there significant differences in the importance rankings of various price-setting theories? We identify which firm and market specific characteristics can explain the observed variations, and which ones can not. We find that the patterns discernible within firms' recognition of sticky price theories are in fact strongly associated with firms' micro foundations. This chapter also presents different findings from international price-setting surveys and important lessons for macroeconomic models and future survey analysis.
JEL classification: D40, E30, L11.

* Corresponding author: dmunnik@bankofcanada.ca. The views expressed in this chapter are those of the authors. No responsibility for them should be attributed to the Bank of Canada. The authors wish to thank David Amirault, Brigid Brady, James Brox, Tiina Brox, Don Coletti, Bob Fay, Matthew Fuller, Etienne Gagnon, John Helliwell, Sharon Kozicki, Yulia Kotlyarova, Oleksiy Kryvtsov, Carolyn Kwan, Clare Levin, Eva Ortega, Lars Osberg, Lise Pichette, Kevin Reinhardt, Terence Yuen, Gordon Wilkinson, other members of the Regional Analysis Division of the Bank of Canada, the Bank of Canada seminar participants, the 2005 ACEA, 2006 CEA, and 2008 AEA conference participants for their helpful comments and feedback. The authors wish thank Yasuo Nishiyama for his support.

1. Introduction: Why Study Price-setting Behaviour? *[use as the Running Head]*

How do firms adjust prices in the marketplace? Do they tend to adjust prices infrequently in response to changes in market conditions? If so, why? These remain key questions in macroeconomics, particularly for central banks that work to keep inflation low and stable. Given the importance of these questions, it should not be surprising that many sticky-price theories have been proposed to explain sluggish price adjustment. As demonstrated in recent studies by de Walque, Smets, and Wouters (2004) and Amano, Ambler, and Rebei (2007), the price-setting behaviour modelled in macroeconomic analysis can significantly influence how inflation dynamics unfold, and can significantly influence social welfare changes in response to exogenous shocks. Therefore, it is critical to find out which sticky-price theories can best explain the actual price-setting behaviour of Canadian firms.

Following the framework of Blinder et al. (1998), the Bank of Canada designed a price-setting survey (PSS) and from 2002–03 conducted person-to-person interviews with the senior management of 170 firms. Using the PSS data, Amirault, Kwan, and Wilkinson (2006), identify two phenomena: (1) a wide variation in how often firms set prices, and (2) significant differences in the importance rankings of various price-setting theories for firms' pricing behaviour. This chapter aims to further explain these two phenomena. More specifically, we employ count data models (negative binomial regression models) to explain the wide variation in the frequency of price adjustment among Canadian firms, and use discrete-choice models (ordered probit and probit models) to evaluate the roles of, and the micro foundations for, prevailing sticky-price theories based on the Canadian PSS data. These models allow us to evaluate the marginal effects of firm-specific and market characteristics on price-adjustment behaviour, and identify the factors that motivate firms to select one or more sticky-price theories to as explanations for their price-

adjustment behaviour. This research will help us to better understand and model Canadian firms' price-setting behaviour. Finally, by identifying which factors drive the variation in price-setting behaviour, this chapter also can provides some insight for future survey research.

The remainder of this chapter is organized as follows. In section 2 we review the recent literature on price-adjustment behaviour and the existing sticky-price theories. In section 3 we describe the PSS data used in this chapter. Next, we examine the price-adjustment frequency of Canadian firms using count data models in section 4. In section 5 we analyze the different sticky-price theories using discrete-choice models. Sections 6 and 7 report the implications of our findings for monetary policy. Finally, we offer some concluding remarks in section 8.

2 Recent Evidence on Price-setting Behaviour

How often do firms adjust their prices? Why do some firms change prices more often than others? Which sticky-price theory is best supported by the empirical evidence? These questions have been the focal point of recent empirical work.

2.1 Can we explain sticky prices?

Many sticky-price theories have been proposed in the literature to explain the infrequent adjustment of prices to economic shocks. However, these theories were tested based on the prices of individual goods and services with no reference to the behaviour of individual firms (Cecchetti 1986; Carlton 1989), until Blinder (1991) proposed and used the firm-level survey data of the United States. Blinder's work inspired more research based on firm-level PSSs involving twelve central banks around the world (Table 1). In contrast to the macroeconomic models that feature highly flexible and frequently adjusted prices, the existing firm-based PSSs and corresponding research demonstrate that prices are indeed sticky, with a varying lifespan/duration within and

across countries (Table 2). In addition to the findings from the firm-level studies, some economists have adopted the product/service-based approach to study the sticky-price phenomenon (Table 3).

Why do prices demonstrate varying degrees of stickiness? The literature suggests, although not unanimously, that these variations may reflect some common factors, such as (1) firm size, (2) firm industry or sector, (3) long-term contracts, (4) the level of competition, (5) specific events that trigger price adjustment (known as pricing triggers) and (6) the role of firm-recognized sticky-price theories (Fabiani et al. 2006; Amirault, Kwan, and Wilkinson 2006). But the literature has not addressed how firm-specific factors and market characteristics *jointly affect* firms' price-adjustment frequency. We attempt to answer this question for a better understanding of the pricing behaviour of Canadian firms.

Before describing our data (section 3) and estimating our count data model (section 4), we provide a brief summary of the existing sticky-price theories used in both our count data models and our discrete-choice models.

2.2 Which sticky-price theories are widely recognized?

Another aim of this chapter is to analyze why firms recognize some sticky-price theories but not others. Below, we review the eleven sticky-price theories evaluated in the PSS.[1]

The first theory, known as the sticky-information theory, suggests that prices adjust to economic shocks with some lag because the information used to review (and ultimately change) prices is available infrequently. The second and third theories, coordination failure theory on price

[1] In the Canadian survey, the senior management of firms were read a simple statement in non-technical language that represented each sticky-price theory, and then were asked, "Does this statement apply to your firm?" For the first six theories, firms had to answer Yes (very important, fairly important, or slightly important), or No (unimportant). For the remaining five theories, firms simply answered important or unimportant (Amirault, Kwan, and Wilkinson 2006). Because of the differences in allowable responses, in section 5 we estimate a series of both ordered probit and probit models. For reporting purposes, we divide these theories into two groups (see sections 3 and 5). Note that the answers were not mutually exclusive.

decline and coordination failure theory on price increase, respectively, suggest that firms delay price adjustments (downward or upward) because they fear that, by initiating a price change, they would initiate a price war or reduce market share (Clower 1965; Cooper and John 1988; Ball and Romer 1991). The fourth theory, cost-based pricing, suggests that prices are determined mainly by production costs and that delays in cost-push inflation in the multi-stage production processes generate aggregate price-level inertia (Gordon 1981; Blanchard 1983). The fifth and sixth theories are the explicit and implicit contract theories, respectively, which suggest that formal or informal contracts between buyers and sellers can fix nominal prices over some horizon (Okun 1981). Generally, buyers and sellers sign contracts to gain certainty, limit risk, and lower search costs that result in price stickiness. The seventh theory is the menu costs theory, which suggests that firms delay price adjustment because there is a non-negligible fixed cost for changing prices (Barro 1972).[2] The eighth theory, the non-price competition theory, argues that market clearing may take place because of factors other than prices, such as delivery time, quality, and warranty (Carlton 1989).[3] In other words, the quality of the product changes while the sticker price is unchanged which gives the allusion of sticky prices.

The ninth, tenth and eleventh theories are evaluated only in the Canadian price-setting survey. The ninth theory is the factor stability theory. This concept, which is technically not a 'sticky price theory', suggests that prices do not need to change more often because the firm considers the factors that determine prices to be relatively stable (Amirault, Kwan, and Wilkinson 2006). The tenth theory, the low-inflation theory, argues that firms adjust their prices less frequently because a low, stable, and predictable inflation environment makes real price

[2] Blinder et al. (1998) add the idea of the time and effort required to collect information. Amirault, Kwan, and Wilkinson (2006) and Fabiani et al. (2005) use the traditional definition of the theory. Wolman (2000) gives an excellent literature review of this theory.

[3] Non-price competition and factor stability (the next theory explained) are not actually a theory of "sticky prices". However, for simplicity we group all the theories together under this heading as was done by Amirault et al (2006).

adjustments more noticeable to customers (Engel 1993; Amirault, Kwan, and Wilkinson 2006). The eleventh theory is the customer relations theory, which suggests that firms do not respond to cost and demand shocks because of their concern for customer relations (Okun 1981; Rotemberg 2002, 2004).

Which sticky-price theories are most commonly recognized by firms? The existing literature indicates that coordination failure on a price increase or decline, cost-based pricing, and explicit and implicit contracts are the most commonly recognized theories in the United States, United Kingdom, Japan, Sweden, nine EU countries, and Canada. The U.S. study, based on regression analysis, also concludes that coordination failure and implicit contracts are important for explaining price stickiness (Blinder et al. 1998). Interestingly, five of the eleven sticky-price theories mentioned above have not been evaluated in terms of firms' micro foundations in the existing literature. No studies similar to Blinder et al. (1998) have been conducted on the recent Canadian PSS data. This chapter aims to fill that void.

3 Canadian Price-setting Survey Data

In this section, we first describe the key features of the Bank of Canada's 2002–03 PSS and we then explain the two key variables of this research: (1) the frequency of price adjustment, and (2) the importance ranking given to each sticky-price theory by the firms surveyed.

3.1 The price-setting survey

The PSS data were collected by the Bank of Canada from 170 private, for-profit, unregulated, and non-commodity-producing firms across Canada that represent the Canadian economy in terms of industry sector, firm size, and, to some extent, regional distribution. This survey provides

reasonable insight into the price-setting behaviour of Canadian firms (Amirault, Kwan, and Wilkinson 2006).

The Canadian PSS has many merits. First, its design takes advantage of the findings from the U.S. and the U.K. surveys by utilizing the previously well-received and better-defined questions (such as the theory rankings), while discarding those questions that are difficult to interpret (such as questions about marginal cost that firms have difficulty answering) (Amirault, Kwan, and Wilkinson 2006). Second, because the Canadian PSS data were collected in face-to-face interviews, surveyors were able to resolve respondents' questions and minimize misinterpretations. As a result, this data series does not contain any missing values (thereby differing from Blinder et al. 1998 and Fabiani et al. 2006); all questions were answered by small, medium, and large firms in various industries. This rich data set permits a detailed investigation that was not previously possible. But the survey method also has its limitations; it inherently has potential biases, limiting the degree to which statistical inference can be made in our analysis (see Appendix A).

The Canadian PSS data contain descriptions of each firm's price-setting behaviour, features, and business environment. The information includes the firm's cost structure, product distribution, sales under contracts, and roles in setting prices (Tables B1 and B2 in Appendix B provide variable definitions and descriptions).

Prior to introducing our models, we present the dependent variable in our count data model (the frequency of price adjustment) and the data collected on firms' rankings of the various price-setting theories used in both estimations (explained in sections 4 and 5).

3.2 How often do firms change prices?

The first key variable of interest in this research is the price-setting frequency of Canadian firms, which records how many times these firms adjusted their prices in the past twelve months. As Figure 1 shows, 8 per cent did not change prices at all in the past twelve months, 27 per cent of the firms changed prices once, 18 per cent of the firms changed prices more than 52 times, and 6 per cent of the firms changed prices 365 times. The median number of price changes is about four times a year. Unlike many other economic variables, this variable takes on integer values greater than or equal to zero, with a large number of firms making fewer than two price changes per year, and a smaller number making highly frequent price changes within the same period. The distribution of this variable is bounded at zero and stretched to the right, giving a clear sign of a non-normal distribution. Figure 1 shows that this distribution is very similar to that found by Blinder et al. (1998) for their U.S. study. The high price-adjustment frequency at the firm level indicates that the statistics on price-adjustment frequency that are based on the monthly CPI data for products/services are likely to underestimate the actual frequency of price adjustment: because the CPI data are collected monthly, they may well be incomplete or right censored.

3.3 Firms' evaluations of sticky-price theories

The second key variable of interest in this research is the importance ranking of each of the eleven sticky-price theories from the firm's point of view. According to Amirault, Kwan, and Wilkinson (2006), cost-based pricing (67 per cent) and customer relations (55 per cent) are viewed as the most important factors that influence price-setting, while explicit contracts (45 per cent), non-price competition (44 per cent), and coordination failure on a price increase (41 per cent) are ranked as considerably more important than the remaining six theories. At the other extreme, theories

pertaining to menu costs (21 per cent) and sticky information (14 per cent) appear to be less important in price-setting.[4]

In the Canadian PSS, the rankings of six of the eleven theories are recorded as ordinal multinomial responses, such as 0, 1, 2, and 3, whereas those of the remaining five theories are recorded as binary responses, such as 0, 1 (Table 4).[5,6] For example, firms were read the following statement that describes cost-based pricing: "Prices depend mainly on the costs of labour and raw materials used in producing goods and services. Therefore, prices don't change until costs change." Firms were then asked whether this statement was very, fairly, or slightly important to their company, or unimportant. For the remaining five of the eleven theories, firms were asked only to choose whether the statement was "important" or "unimportant." Amirault, Kwan, and Wilkinson (2006) note that if a firm indicated that a statement was important to the company, it was interpreted as meaning that the firm recognized the corresponding sticky-price theory as a description of the firm's behaviour.

As noted previously, the one key variable, the frequency of price adjustment, is a count data variable, while another set of key variables, the importance rankings of sticky-price theories, are either ordinal multinomial or binary responses variables. Because the classical linear regression framework cannot accommodate the count data and ordinal multinomial/binary response data, this research uses count data models for the former, and probit and ordered probit models for the latter.

[4] In particular, the highly recognized cost-based pricing theory coincides with the finding of Fabiani et al. (2005) that many firms have a markup type formula in their pricing. Blinder et al. (1998), Hall, Walsh, and Yates (2000) and Apel, Fribera, and Hallsten (2000) all have similar rankings.

[5] For practical purposes, we divide the eleven theories into two groups: the theories that have ordinal multinomial responses are referred to as group one, and the theories that have binary responses are referred to as group two.

[6] A few firms (7 of 170) found the sticky-information theory very or fairly important. To estimate the ordered probit model for the sticky-information theory would be technically possible but not desirable, since the model lacks sufficient observations for certain responses. Hence, for this theory, we convert multinomial responses to binary responses and consider the probit model rather than the ordered probit model.

4 Modelling Price-Adjustment Frequency

In the existing literature, little attention is paid to modelling the price-adjustment frequency in terms of firms' features, business environments, and the recognition of various sticky-price theories. In this chapter, we use the Canadian PSS data to determine which factors influence the price-adjustment frequency at the firm level. In this section, we provide the motivation for using the negative binomial regression model, discuss our covariate selection process, and present the estimation results. In section 5, we evaluate the rankings of the eleven sticky-price theories.

4.1 Model and specification

4.1.1 Factors affecting the price-adjustment frequency

Some of the potential explanatory variables for price-adjustment frequency that we use are common in the literature – variable cost, firm size (number of employees), industry type, competition, contract utilization, customer types, and product destinations – but other explanatory variables are unique in this research. First, we include in our model pricing triggers (variables to trigger a price change by the firm), which are regular price changes (time-dependent pricing); wage changes; price changes of domestic inputs; changes in taxes, fees, or other costs; competitors' price changes; exchange rate changes; changes in demand conditions; and changes in economic forecasts, sales campaigns, and parent company directives/incentives. Second, we add to our model the variables that capture the relevancy of the eleven price-setting theories to firms' price-setting behaviour. Third, we consider a set of unique market structure variables found only in the Canadian PSS, such as information lags in price-setting information, price leadership, price

leadership in the industry, and buyer concentration (Tables B1 and B2 in Appendix B provide variable definitions and descriptions).[7]

As a preliminary step in our analysis, we evaluate the pairwise correlations between our variable of interest and each of the potential explanatory variables. The descriptive statistics show that region, industry type, firm size, contract utilization, competition, price leadership, sales destination, and state-dependent pricing are correlated with price-adjustment frequency. In addition, price-adjustment frequency is significantly correlated with some sticky-price theories. While it is useful to explore the pairwise relationship between the price-adjustment frequency and each of its plausible determinants, as in Amirault, Kwan, and Wilkinson (2006), it is more desirable to consider how a large set of covariates jointly affect the price-adjustment frequency jointly.

4.1.2 Count data models

Because the price-adjustment frequency takes on non-negative integers and demonstrates the properties of a count process, we use count data models that can accommodate the non-negativity and non-normality of frequency data, and link the data to a set of covariates.

The simplest count data model is the Poisson regression. Let y_i be a draw from the Poisson distributed random variable, Y_i. Let $\boldsymbol{x}_i$ be a $k \times 1$ column vector of i th observations of k independent variables. In this case, the probability of Y_i given $\boldsymbol{x}_i$ follows the Poisson distribution with parameter μ_i; that is,

[7] Several other variables are used in Bils and Klenow (2004) (raw vs. processed products, and import share), Dhyne et al. (2004) (seasonality, outlet type, taxes, and product-specific inflation), and Blinder et al. (1998) (hierarchical delays theory recognition, judging quality by price theory recognition, and cycle sensitivity), but are not available in the Canadian PSS.

$$\Pr[Y_i = y_i \mid \boldsymbol{x}_i] = P_i = \frac{e^{-\mu_i}\mu_i^{y_i}}{y_i!}, \tag{1}$$

for $i = 0,1,2,\ldots$. Here, $\mu_i = \mu_i(\boldsymbol{x}_i, \beta)$, the most-used functional form of which is

$$\mu_i = \exp(\boldsymbol{x}_i'\beta), \tag{2}$$

or

$$\ln \mu_i = \boldsymbol{x}_i'\beta, \tag{3}$$

where β is a k *x* 1 column vector of parameters. It can be shown that the expected number of counts per period is

$$E(y_i \mid \boldsymbol{x}_i) = \exp(\boldsymbol{x}_i'\beta), \tag{4}$$

which is identical to the variance of the number of counts per period:

$$Var(y_i \mid \boldsymbol{x}_i) = \exp(\boldsymbol{x}_i'\beta). \tag{5}$$

The equal dispersion imposes a strong restriction to the Poisson regression model. The Poisson regression model can be estimated by the maximum-likelihood method, assuming that the observations are identically, independently distributed and the model is correctly specified. The marginal impact of $\boldsymbol{x}_i$ is not β but

$$\frac{\partial E(y_i \mid \boldsymbol{x}_i)}{\partial \boldsymbol{x}_i} = \exp(\boldsymbol{x}_i'\beta)\beta = \mu_i\beta. \tag{6a}$$

That is, to interpret the estimation results, the sign of the parameters can be interpreted in terms of the direction of the impacts of the independent variables. But, to give quantitative information on the marginal impact of one particular independent variable within $\boldsymbol{x}_i$ on the expected value of counts, y_i , the corresponding beta estimate must be multiplied by the expected counts per period

for y_i . However, it is more convenient to examine factor change in $E(y_i \mid \boldsymbol{x}_i)$. Let x_{ik} be the *k*th variable in $\boldsymbol{x}_i$ and let δ be a small change (say, $\delta = 1$); then, the factor change is given by

$$\frac{E(y_i \mid \boldsymbol{x}_i, x_{ik} + \delta)}{E(y_i \mid \boldsymbol{x}_i, x_{ik})} = e^{\beta_k \delta}. \qquad (6b)$$

When $\delta = 1$, $\frac{E(y_i \mid \boldsymbol{x}_i, x_{ik} + \delta)}{E(y_i \mid \boldsymbol{x}_i, x_{ik})} = e^{\beta_k}$. In our analysis, we use equation (6b) to interpret our count model results.

The equal dispersion is considered the major restriction of the Poisson regression model. The negative binomial regression model – the most common alternative count data model – is more general than the Poisson regression model, and can accommodate cross-section heterogeneity. The key change from the Poisson regression model to the negative binomial model is to add a term, ε_i , to $\boldsymbol{x}_i'\beta$, so that

$$\ln \mu_i = \boldsymbol{x}_i'\beta + \varepsilon_i , \qquad (7)$$

where $\ln \mu_i' = \boldsymbol{x}_i'\beta$ ($\ln \mu_i'$ was defined as $\ln \mu_i$ in the Poisson regression model) and $\ln u_i = \varepsilon_i$. With this additional structure, the distribution of y_i conditional on $\boldsymbol{x}_i$ and u_i is also the Poisson distribution with conditional mean and variance μ_i :

$$f(y_i \mid \boldsymbol{x}_i,\ u_i) = \frac{e^{-\mu_i' u_i}(\mu_i' u_i)^{y_i}}{y_i!}. \qquad (8)$$

However, the distribution of u_i must be specified. The most common practice is to assume that the distribution is the gamma distribution with an additional dispersion parameter α for $u_i = \exp(\varepsilon_i)$. The variance of $\exp(\varepsilon_i)$ is normalized to 1, $Var[\exp(\varepsilon_i)] = 1$, to make the model identified. It can be shown that, with this normalization and the gamma distribution for u_i , $f(y_i \mid \boldsymbol{x}_i,\ u_i)$ becomes

the negative binomial distribution with dispersion parameter α. If $\alpha = 0$, the negative binomial regression model becomes the Poisson regression model. The larger the value of α, the greater the dispersion of y. The negative binomial regression model can be estimated by the maximum-likelihood method. It provides the estimates for β and α, and standard errors of these estimates. It is possible to use the likelihood-ratio test to verify whether α is equal to zero.

To model the price-adjustment frequency, we must consider which explanatory variables should be included in our model. Guided by the preliminary statistical analysis and existing findings in the literature, we include the following variables: region, industry type, the number of employees, variable cost, firm size, number of competitors, contract utilization, price leadership, and information delays. Although buyer concentration, product destination, and consumer type are largely insignificant in the preliminary statistical analysis, we still consider them in our model on a theoretical basis. In addition, we include the dummy variables for the "very important" response for all ordinal response theories in the first group and all pricing triggers. Lastly, we include the binary variables for the five theories in the second group in our model.

In addition, because there are a large number of categorical explanatory variables in the model, we need to select a baseline case against which the estimated coefficients of the model can be interpreted as marginal effects. The baseline case chosen is a firm in British Columbia's service sector; it has an average number of employees (about 2,800), operates in an industry without a price leader, has about half of its sales contracted, and has about 30 direct competitors. This firm also has no information delays (less than 24 hours), and about 60 per cent of its sales are to other businesses in its home region. The firm indicated that regular price adjustments are very important, and that they are therefore a time-dependent price-setter. Lastly, less than 10 per cent of this

baseline firm's sales are to its top five buyers, and the firm believes that neither a sticky-price theory nor a pricing trigger is very important.

4.2 Empirical findings

Table 5 reports the estimation results of the count data models. The unrestricted negative binomial regression model is shown in column 3, the restricted model[8] in column 4, and the marginal effect of a unit change (see equation (6b)) on the number of yearly price adjustments in column 5. Overdispersion in each model is indicated by the level of significance of the constant alpha term at the bottom of the table. An alpha significantly different from zero indicates overdispersion. This occurs in all cases and, therefore, we can conclude that the negative binomial regression model is the most appropriate choice.

In our unrestricted model, we find that a firm's size, region, industry type, customer type, and product destination are all highly significant. Other significant variables include several theories and pricing triggers, and state-dependent price-setters. Cost structure, buyer concentration, competitors, and contracted sales are less significant.

The restricted model (Table 5, column 4) keeps many explanatory variables that are statistically significant in the unrestricted model. Akaike's information criterion (denoted "aic" in Table 5, column 2) for the restricted model is lower than that for the unrestricted model. The likelihood-ratio test between the restricted and the unrestricted model does not reject the specification of the restricted model.

[8] The restricted model is selected by eliminating all insignificant variables from the unrestricted model.

4.2.1 Marginal effects

Based on the estimation results of the restricted model, we report the marginal effects associated with the parameter estimates in column 5 of Table 5. The marginal effect associated with each coefficient estimate has an intuitive interpretation. If an explanatory variable changes by a unit, the marginal effect gives the additional number of adjustments per year in prices; in other words, the marginal effect is the change in the estimated counts triggered by a change in the features or behaviour of firms from our baseline case. In this estimation, our baseline case would adjust prices four or five times per year, close to the Canadian PSS sample mean of four. In the restricted model, the variables for variable costs, product destination, consumer type, contract utilization, and competitors are standardized. [9] Hence, when these variables have a one-standard-deviation change, the marginal effect represents the additional price-adjustment count. For example, an increase of one standard deviation (about 26 per cent) in a firm's variable cost as a proportion of their total cost would increase the count by twice a year, relative to our baseline case of four or five times a year. The summary statistics for these variables are reported in Table 6.

The estimation results of the count model indicate that a wide range of factors influence the price-adjustment frequency by Canadian firms. The estimation results also provide quantitative evidence of the substantial role played by most important factors in Canada. In Table 5, the variables highlighted in dark grey have a marginal effect greater than three additional adjustments per year, and the variables highlighted in light grey have a marginal effect of between one and three additional adjustments per year. The remaining variables in column 5 are still statistically important, but to a lesser extent. We make the following detailed observations about the estimated marginal effects.

[9] Scale variables have been standardized to make the model a better fit.

First, if a firm is involved in retail or wholesale trade, is located in Ontario or Quebec, uses contracts, or is a state-dependent price adjustor, it tends to adjust prices about five times more per year than our baseline case; that is, these firms change prices twice as often as the baseline case. Second, supplier type (sellers to other domestic customers and exporters), wage and input costs changes, information delays, price leadership, and several sticky-price theories (menu costs, factor stability, customer relations, sticky information, and coordination failure on a price increase) all have a moderate impact of less than three additional price adjustments per year in response to a marginal change. Third, the market structure affects firms' price-adjustment frequency. The largest impact comes from the number of competitors: if this number rises by one standard deviation around the mean, then the price-adjustment frequency increases by more than thirty times a year. This translates roughly into three additional adjustments per year for every ten additional direct competitors.[10]

5 Evaluations of Sticky-Price Theories

In this section, we first analyze the relationship among importance rankings assigned to various sticky-price theories and then examine how the ranking of each theory is related to microeconomic foundations at the firm level.

[10] Since the marginal effects presented in the count model are the estimated effects of a change from our baseline case, we provide the results from an alternative model in Appendix C. This alternative model uses a different baseline case as a robustness check to our interpretation of the estimated coefficients' direction and magnitude.

5.1 Patterns of sticky-price theory evaluation

We first consider correlations and tests of independence among the various rankings of the theories, to gain some insight into whether the rankings are necessarily mutually exclusive. For example, firms might indicate that they hold back on a price increase prior to any action of their competitors (coordination failure) because they fear antagonizing customers (customer relations).

Firms were asked whether any of the eleven sticky-price theories applied to their business, and, if so, how important it was to their pricing behaviour (Table 4); we divide the responses into two groups of theories: the four possible ordinal multinomial responses (from very important to unimportant) are group one, and the binary responses (important or unimportant) are group two. To calculate the correlations between all eleven theories, we adopt two methods. First, we use the Goodman-Kruskal gamma correlation coefficients[11] to measure the correlations between every pair of theories in the first group, and between first and second group theories. Second, we tabulate the Pearson chi-squared tests of independence between every pair of theories in the second group. Below, we highlight the main results from this exercise.

We find that many of the Goodman-Kruskal gamma correlations are relatively small in value, and that all but one of the significant correlation coefficients are positive. This suggests that many of these theories recognized by the Canadian firms are possible complements, or at least not mutually exclusive. Coordination failure on a price increase and explicit contracts are the only negatively correlated theories, and implicit contracts and customer relations are highly correlated theories.

[11] This method is suggested and used by Blinder et al. (1998). This correlation coefficient takes into account the ordinal nature of the data. We can interpret it roughly as a regular correlation coefficient, since its value is bounded between zero and one; see Goodman and Kruskal (1954). We also have used Spearman's non-parametric rank test for independence – the results are almost identical.

In addition, we find that the correlation between coordination failure on a price decline and coordination failure on a price increase is positive and strong. We note a near-zero correlation between explicit and implicit contracts, which differs from Blinder et al.'s (1998) finding that the two theories are net substitutes. We find that, among the theories in the second group, the recognition of customer relations and factor stability are strong complements to other theories, suggesting that they are used by firms in combination with other practices. The interdependent relations among low inflation, factor stability, and non-price competition point to the difficulty in changing sticky prices, because price changes are more noticeable (either because of low inflation, economic stability, or competition), which may disturb customer relations. We also note that non-price competition and factor stability are not significantly correlated with any first-group theories.

Overall, we find that many price-setting theories are complementary rather than mutually exclusive. Our findings suggest that customer relations and cost-based pricing are perhaps the most complementary among all sticky-price theories.

5.2 Model and specification

In this section, we identify firm and industry characteristics that explain the relative importance of sticky-price theories to the firm. To do so, we identify and evaluate potential explanatory variables that can explain the rankings of sticky-price theories using probit and ordered probit models.

5.2.1 Factors affecting the importance rankings

We consider the following variables that may influence a firm's ranking of a given sticky-price theory: firm size, industry type, variable cost, state-dependent pricing, competition, sales destinations, contract utilization (per cent of sales under contract), recognition of other sticky-price

theories,[12] pricing triggers, buyer concentration, information delay, price leadership, and region (Tables B1 and B2).

5.2.2 Probit and ordered probit models

In addition to probit models that can be made from binary choices, the ordered probit model is suitable to where there are two or more ordered choices represented by integers. For simplicity, we let the number of the ordered integer choices be three. This model can be derived from the following latent variable model:

$$Y_i^* = \boldsymbol{x}_i'\beta + u_i, \quad u_i \overset{iid}{\sim} N(0,\ 1). \tag{9}$$

Here, we cannot observe Y_i^*. Instead, we can observe Y_i, which takes on values according to the following decision rules:

$$\begin{aligned} Y_i &= 0 \quad \text{if} \quad Y_i^* < a_1, \\ Y_i &= 1 \quad \text{if} \quad a_1 \le Y_i^* < a_2, \\ Y_i &= 2 \quad \text{if} \quad Y_i^* \ge a_2, \end{aligned} \tag{10}$$

where $a_1 < a_2$ is required for these threshold parameters to make Y_i observable.

Note that vector $\boldsymbol{x}_i$ in equation (9) does not need to contain a constant. If it had a constant as one of its elements, we would have an intercept term; say, β_1. In this case, the revised decision rules can be written as

$$\begin{aligned} Y_i &= 0 \quad \text{if} \quad Y_i^* < a_1 + \beta_1, \\ Y_i &= 1 \quad \text{if} \quad a_1 + \beta_1 \le Y_i^* < a_2 + \beta_1, \\ Y_i &= 2 \quad \text{if} \quad Y_i^* \ge a_2 + \beta_1. \end{aligned} \tag{11}$$

[12] Given our findings in the previous section, we have decided to include these variables in our model. Admittedly, there are both advantages and disadvantages to doing so. See Appendix D for further discussion and an alternative set of results.

That is, we really cannot identify the threshold parameters. It seems reasonable that we should use the simplest way to deal with this problem by forcing $\boldsymbol{x}_i$ to be a vector of variables with no constant term. If this solution is adopted, then the number of thresholds (e.g., a_1 and a_2) is the number of ordered choices (e.g., $Y_i = 0,1,2$) minus one. For example, if $Y_i = 0,1$, we will return to the case of the binary probit model. The parameters such as β, a_1, and a_2 can be estimated by the maximum-likelihood method.

Our baseline case for both the probit and ordered probit models is the same as in our count data model (see section 4.1.2), except for a more specific industry classification: the baseline case here is a firm in the finance, insurance, and real estate sector, instead of the service sector. This selection enables us to differentiate among various services.

5.3 Empirical findings

In this section, we analyze the estimation results for all eleven sticky-price theories. These estimation results are for the selected models identified via the model selection process (as explained in section 4.2). Table 7 reports the estimation results for five ordered probit models, and Table 8 the estimation results for six probit models. The likelihood-ratio tests (called the "chi-squared test" in the tables) and log-likelihood functions are provided in the last row of the tables. By examining the estimated coefficients of these models, we attempt to answer the following two questions: (1) for all eleven theories, what firm and market characteristics constitute the micro foundations in the broader Canadian context?, and (2) for each theory, what are the statistically significant firm and market characteristics that serve as micro foundations for firms' subscription to a given theory? We discuss the answers to these questions in turn.

5.3.1 Most important factors common to all sticky-price theories

The results reported in Tables 7 and 8 show that the factors that affect the importance rankings of all existing sticky-price theories are: industry type, customer type (households, government, or businesses), product destination (domestic or export), information availability, and contract utilization. Region, buyer concentration, state- vs. time-dependent pricing, recognition of competitor price change, and exchange rate changes are also important factors. In general, these factors influence firms' choice of a sticky-price theory as a suitable explanation for their price-setting behaviour.

As noted previously, the above factors not only affect firms' recognition of various sticky-price theories, but also affect their price-adjustment behaviour and hence their price-adjustment frequencies. Together, these factors constitute the micro foundations of firms' price-setting behaviour and beliefs.

5.3.2 Firm Characteristics and sticky-price theories

Tables 7 and 8 report the results for the discrete-choice models. Instead of presenting all significant variables for each of the eleven models, we highlight the most interesting results from our analysis.

Coordination failure (on a price decline or increase)

Consistent with the Goodman-Kruskal correlation results, the following factors trigger the recognition of both coordination failure theories: firm size, industry type (construction; retail trade; commercial, personal, and business services; information, culture, and transportation), responsiveness to price changes by competitors, and the presence of industry price leaders.

As noted previously, firms' recognition of coordination failure on price increases, and not on price declines, explains the low frequency of price adjustment. We would therefore expect to find asymmetry in the factors that explain the relative importance of these theories. As shown in Table 7, the firms operating in the manufacturing sector or having a high proportion of their sales to households are less likely to recognize coordination failure on a price decline, but these firms do not differ from the baseline case with reference to coordination failure on a price increase.

These results confirm the findings of Blinder et al. (1998) and Amirault, Kwan, and Wilkinson (2006) that coordination failure is not universally recognized and its impact depends on whether prices decline or increase. Further, we find that firms that recognize coordination failure theories are more responsive to competitors' price changes and regard cost-based pricing and customer relations as very important. These results are evidently consistent with a very competitive market, where coordination failure may still occur.

Cost-based pricing

The results suggest that firms with a higher proportion of variable costs recognize cost-based pricing as being more important to their business (all else held constant). The results also suggest that firms selling more than 50 per cent of their output to the top five buyers prefer to use the cost-based pricing approach to set prices. These two firm-specific characteristics are predominant among cost-based pricing firms. What is likely to trigger a price change for these firms? If a firm changes prices in response to changes in their wage bills, domestic inputs, or foreign exchange, they are more likely to recognize this theory as a good explanation for their pricing behaviour.

Two prominent factors serve as the micro foundations of this theory: (1) the firms that are sensitive to cost changes (wages bills, domestic inputs, and foreign exchange movements) in

triggering price adjustments, and (2) the firms are likely to be time-dependent price-setters who do regular price reviews.

Explicit and implicit contracts

For the explicit and implicit contract theories, the common significant factors are cost-based pricing, customer relations, and, to a lesser extent, menu costs, all of which lead to price rigidity. We find that retail trade does not consider the explicit contract theory as important relative to our baseline case. This is not surprising, given that price adjustment can be fairly frequent in this industry. At the other extreme, firms with sales to governments regard the explicit contract theory as important to their pricing practice. Typically, the firms that set prices according to (one-day) information delays are more likely to identify with this theory.

Implicit contracts, on the other hand, are more prominent in the industries other than commercial, personal, and business services; information, culture, and transportation; and manufacturing. Implicit contracts are also used less often between households and businesses than between businesses, and are more important when firms have a more diverse consumer base. In addition, firms with information delays of more than one month are more likely to identify implicit contracts as important.

It should be noted that many firms recognize the importance of nominal contracts, customer relations, and cost-based pricing simultaneously. Consistent with Amirault, Kwan, and Wilkinson (2006), we find that consumer relations and cost-related considerations can be more important factors in price rigidity.

Sticky information and menu costs

Although sticky information and menu costs are among the least recognized theories, they provide significant explanation for sticky prices in our count data model. Our probit model results reveal which firms are most likely to consider these theories as important to their businesses.

We find that firms reporting price-setting information delayed by one day or by more than a month are more likely to recognize the sticky-information theory. The firms in construction; manufacturing; and commercial, personal, and business services are more likely to recognize this theory. They primarily sell to households outside their own region. They are state-dependent price-setters, and utilize contracts more than the average firms. These firms also view explicit contracts and cost-based pricing as very important.

As shown in Table 8, if firms have a high buyer concentration (>50 per cent) and significant information delays (more than a month) they would recognize the menu costs theory. These firms are less likely to be contract sellers or time-dependent price-setters. Contrary to common belief, the number of employees, measured by firm size, is in fact not a defining factor for recognizing the menu costs theory. It appears that the combination of information delays, explicit contracts, and buyer concentration constitutes the micro foundations for firms to recognize the menu costs theory.

Factor stability

According to Amirault, Kwan, and Wilkinson (2006), the factor stability theory suggests that some firms operate in relatively benign environments, where prices do not need to adjust often because factors that affect prices are relatively stable. Table 8 shows that the firms in information, culture, and transportation, and primarily selling directly to consumers, are more likely to consider factor stability as important. They face a price leader in their industry. These firms are more likely to

recognize the factor stability theory if they face fewer information delays. We find that they are more likely to be state-dependent price-setters – that is, an unexpected shock or event, rather than a periodical price review, would trigger a price change. We find that firms are more likely to recognize the factor stability theory because they find it difficult to change prices in a relatively stable environment. These firms also recognize menu costs, non-price competition, and low-inflation theories; however, changes in domestic input prices or in competitors' prices are not likely to be important to these firms.

Customer relations

Customer relations theory is one of the most recognized sticky-price theories for Canadian firms – 67 per cent of firms recognize this theory as important. We find that smaller firms in construction; commercial, personal, and business services; and information, culture, and transportation are more likely to recognize this theory. In addition, the firms that worry about customer relations are less likely to consider explicit contracts. The presence of industry price leaders increases the probability of a firm recognizing this theory. As suggested by the Goodman-Kruskal correlations, we find that firms that recognize this theory as important to their business also recognize low inflation, sticky information, and coordination failure on a price decline. As the above analysis illustrates, the micro foundations of this theory are that the types of industries the firms are in and the types of clients they serve.

Non-price competition and low inflation

The non-price competition and low-inflation theories are recognized by about one-third of Canadian firms. We find that only construction firms (which are in our baseline case) are likely to recognize non-price competition. This result differs from the findings of Amirault, Kwan, and

Wilkinson (2006), who suggest that there is no interindustry variation in non-price competition. We find that the firms responding to a price change initiated by their competitors and use sales campaigns are more likely to recognize the non-price competition theory. The firms recognizing this theory also consider low inflation and cost-based pricing to be important.

According to Table 8, the firms primarily selling to governments would recognize the low-inflation theory. They are less likely to sell across borders and less sensitive to the price changes of competitors. These firms are more likely to report that a low-inflation environment restricts their ability to change prices when they report that factor stability, customer relations, and non-price competition are important.

6 Implications for Feature Research

From the above evidence price rigidity, some lessons on sampling, interviewing, and macroeconomic modelling can be drawn for future survey research.

First, different from Blinder et al.'s (1998) assumption, our empirical results suggest that regional characteristics do play a significant roll in determining how frequently firms adjust prices.[13] Moreover, the significance of the 'customer type' and 'industry type' suggests that surveys with proper industry stratifications may provide more information on price-setting behaviour. Therefore, sampling design may in part affect international survey results in the median price-adjustment frequency. Amirault, Kwan and Wilkinson (2006) report four price changes per year, which is very close to the Bils and Klenow (2004) estimate from BLS data but is twice as much as Blinder et al.'s (1998) estimate.[14]

[13] Here we refer to the significances of the 'Ontario' and 'Quebec' regional dummy variables in our count data model.
[14] Moreover, Fabiani et al. (2005) has a much higher concentration of firms that sell business-to-business rather than business-to-consumer than the Canadian survey.

Second, the Bank of Canada face-to-face interviews for the PSS may have also played a role in the higher medium frequency of price adjustment. Unlike Blinder et al. (1998) and Fabiani et al. (2006), the Canadian PSS has no missing observations and it also presents a larger number of firms whose prices adjust more than 365 times per year. These firms also identified themselves as state-dependent price adjustors, an important characteristic in our count data model.

Finally, we find significant variation in the frequency of price-adjustment and in the relative importance of various sticky price theories between different industries and customer types. These findings provide some empirical basis for macroeconomics modelling to market prices.

7 Implications for Policy Making

According to Amirault, Kuan and Wilkinson (2006), "if prices are relatively more flexible, inflation may be more responsive to interest rate changes; thus, inflation targets may be achieved with shorter lags and fewer real side effects." For inflation targeting central banks, a good understanding on how often firms adjust prices offers valuable information about the speed of policy transmission. While the Canadian PSS shows that firms change prices on average about four times per year, there is significant dispersion across industries and across individual firms. As a result, how fast shocks transmit through a given sector or region will vary significantly, which complicates the economic monitoring that is essential for policy implementation. [15]

This chapter adds to our understanding of what explains the heterogeneity in the frequency of price adjustments and can be used in at least two important ways for policy making. First, the work provides a set of empirical results that can be used to construct better dynamic forecasting

[15] Again, admittedly, a lower frequency of price adjustment is not always associated with increased rigidity.

models. Specifically, assumptions about industry structure can greatly influence transmission lags in macroeconomic models. Clearly, standard model assumptions (one production sector, no ex-ante heterogeneity across firms, across industries in terms of their price-setting, expectation formation, full information, market structure, etc.) are too strong. The empirical results from our count data and discrete choice models can be used by researchers to relax some of these assumptions. For example, the evidence presented here suggests that firms operating in a highly competitive trade sector are likely to exhibit a higher frequency of price adjustments than intermediate goods producers that sell to other businesses. This evidence could help explain how the origin of a shock (such as an industry specific cost or demand shock) leads to variations in its transmission across sectors. Secondly, because data availability issues can often prevent high quality estimates of transmission lags of cost and demand shocks into prices at the sectoral level, the evidence presented in this chapter can provide some guidance by translating industry-, firm- and regional-specific knowledge to form expectations about transmission lags. This can be done by identifying whether a given sector recognizes a sticky price theory that is associated with a slower frequency of price adjustment, and also by considering information about the market structure. For example, our results suggest that manufacturers change prices less frequently due to sticky information. In addition, if one knows that an industry sells into a heavily concentrated sector (i.e. one with few buyers) and sells predominately to other businesses, then an even slower transmission of shocks into prices is likely. In this example, a firm meeting all three criteria (manufacturer, sells to few buyers, and sells to other businesses) would change prices roughly once a year less than the average, which could be roughly translated into an additional quarter lag in response. While this approach requires strong assumptions, for policy making a timely analysis of

regional and sector specific shocks often requires such an effective use of the available information.

8 Conclusion

Using the 2002-03 Bank of Canada price-setting survey data, we explore the price-setting behaviour of Canadian firms. In this research, we address two key questions. First, we try to learn which firm and market characteristics affect price-adjustment frequencies. We find that firms that are state-dependent price-setters, firms in the trade sector, firms with larger variable costs and more direct competitors, and firms located in the provinces of Ontario and Quebec tend to adjust prices more frequently than other firms, all else being equal. In addition, when firms recognize the theories of coordination failure on a price increase, sticky information, menu costs, factor stability, and customer relations, they tend to adjust prices less frequently.

Second, we try to find out what kind of micro foundations prompt firms to recognize some sticky-price theories but not others. We find that industry type, customer type (households, government, or businesses), product destination (domestic or export), information availability, and contract utilization constitute the micro foundations for recognizing most sticky-price theories. Furthermore, we find that coordination failure, cost-based pricing, and customer relations are the sticky-price theories widely recognized by Canadian firms. Firms need to take note of the market structures of micro foundations when maximizing their interests.

In this research, we have made several contributions to the sticky-price literature. First, contrary to the findings of Blinder et al. (1998) and Amirault, Kwan, and Wilkinson (2006), we find that the theories of sticky information and menu costs are both important sources of price rigidity, since they lower the price-adjustment frequency, albeit in only a small percentage of

firms. Second, our findings support Blinder et al.'s (1998) conclusion that sticky-price theories are not mutually exclusive, and we conclude that customer relations and cost-based pricing are the most complementary sticky-price theories (as well as the most recognized). Third, the theories of customer relations, cost-based pricing, and coordination failure (on a price increase) are strongly supported by the Canadian data. Fourth, this research provides useful information on the role of different sticky-price theories across a spectrum of firms. For example, we find that larger firms are more concerned with coordination failure than with using cost-based pricing or paying attention to customer relations, and manufacturers recognize sticky-information theory more than any other theory, all else held constant. Fifth, state-dependent price-setting firms change prices much more frequently than time-dependent price-setters. According to Amirault, Kwan, and Wilkinson (2006), the former account for approximately 34 per cent of firms in the private, non-commodity-producing sectors of the Canadian economy (much higher than in the United States; see Klenow and Kryvtsov 2008). Overall, this research shows that firms adjust prices in ways that maximize their interests based on their firm and market characteristics or micro foundations.

References

Amano, R., S. Ambler, and N. Rebei, 2007, The Macroeconomic Effects of Non-Zero Trend Inflation, Journal of Money Credit and Banking, 39 (7), 1821–1838.

Amirault, D., C. Kwan, and G. Wilkinson, 2006, Price-Setting Behaviour of Canadian Firms, Bank of Canada Working Paper No. 2006-35.

Apel, M., R. Friberg, and K. Hallsten, 2001, Micro Foundations of Macroeconomic Price Adjustment: Survey Evidence from Swedish Firms, Sveriges Riksbank Working Paper No. 128.

Ball, L. and D. Romer, 1991, Sticky Prices as Coordination Failure, American Economic Review 81(3), 539–552.

Barro, R.J., 1972, A Theory of Monopolistic Price Adjustment, Review of Economic Studies 39, 17–26.

Bils, M. and P.J. Klenow, 2004, Some Evidence on the Importance of Sticky Prices, Journal of Political Economy 112(5), 947–985.

Blinder, A.S, 1991, Why Are Prices Sticky? Preliminary Results from an Interview Study, American Economic Review 81, 89–96.

Blinder, A.S., E.R.D. Canetti, D.E. Lebow, and J.B. Rudd, 1998, Asking About Prices: A New Approach to Understanding Price Stickiness (New York: Russell Sage Foundation).

Buckle, R. and J. Carlson, 2000, Menu Costs, Firm Size and Price Rigidity, Economics Letters 66, 59–63.

Calvo, G.A., 1983, Staggered Prices in a Utility-Maximizing Framework, Journal of Monetary Economics 12(3), 383–398.

Carlton, D, 1989, The Theory and Facts About How Markets Clear: Is Industrial Organization Valuable for Understanding Macroeconomics?, in: R. Schmalensee & R. Willig, eds., Handbook of Industrial Organization, Vol. 1 (Amsterdam: North Holland) 910–943.

Cecchetti, S., 1986, The Frequency of Price Adjustment: A Study of the Newsstand Prices of Magazines, Journal of Econometrics 31, 255–274.

Clower, R., 1965, The Keynesian Counter-Revolution: A Theoretical Appraisal, in: F. Hahn and F. Brechling, eds., The Theory of Interest Rates (London: Macmillan) 103–25.

Cooper, R. and A. John, 1988, Coordinating Coordination Failures in Keynesian Models, Quarterly Journal of Economics 103(3), 441–463.

de Walque, G., F. Smets, and R. Wouters, 2004, Price Setting in General Equilibrium: Alternative Specifications, Eurosystem Inflation Persistence Network Conference Paper, <http://www.ecb.int/events/pdf/conferences/inflationpersistence/walquesmetswouters.pdf> (24 January 2006).

Dhyne, E., L.J. Álvarez, H. Le Bihan, G. Veronese, D. Dias, J. Hoffman, N. Jonker, P. Lünnemann, F. Rumler, and J. Vilmunen, 2004, Price-Setting in the Euro Area: Some Stylised Facts from Individual Consumer Price Data, <http://www.ecb.de/events/pdf/conferences/inflationpersistence/sumamrysession2.pdf> (1 May 2005).

Engel, C, 1993, Real Exchange Rates and Relative Prices - An Empirical Investigation, Journal of Monetary Economics 32, 35–50.

Fabiani, S., M. Druant, I. Hernando, C. Kwapil, B. Landau, C. Loupias, F. Martins, T.Y. Mathä, R. Sabbatini, H. Stahl, and Ad C.J. Stokman, 2005, What Firms' Surveys Tell us About Price-Setting Behaviour in the Euro Area, International Journal of Central Banking, 2006, 2(3): 3 - 47.

Goodman, L.A. and W.H. Kruskal, 1954, Measures of Association for Cross Classifications, Journal of the American Statistical Association 49, 732–764.

Gordon, R., 1981, Output Fluctuations and Gradual Price Adjustment, Journal of Economic Literature 19, 493–530.

Hall, S., M. Walsh, and T. Yates, 2000, Are U.K. Companies' Prices Sticky?, Oxford Economic Papers 52, 425–446.

Klenow, P.J. and O. Kryvtsov, 2008, State-Dependent or Time-Dependent Pricing: Does It Matter for Recent U.S. Inflation?, The Quarterly Journal of Economics, 123(3), 863–904, August.

Lohr, S.L, 1999, Sampling: Design and Analysis, (Pacific Grove: Duxbury Press).

Mankiw, N.G. and R. Reis, 2001, Sticky Information: A Model of Monetary Non-Neutrality and Structural Slumps, NBER Working Paper No. 8614.

Martin, M. and C. Papile, 2004, The Bank of Canada's Business Outlook Survey: An Assessment, Bank of Canada Working Paper No. 2004-15.

Nakagawa, S., R. Hattori, and I. Takagawa, 2000, Price-Setting Behavior of Japanese Companies, Bank of Japan Working Paper.

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

Owen, A. and D. Trzepacz, 2002, Menu Costs, Firm Strategy, and Price Rigidity, Economics Letters 76, 345–349.

Rotemberg, J, 2002, Customer Anger at Price Increases, Time Variation in the Frequency of Price Changes and Monetary Policy, NBER Working Paper No. 9320.

———, 2004, Fair Pricing, NBER Working Paper No. 10915.

Small, I. and T. Yates, 1999, What Makes Prices Sticky? Some Survey Evidence for the United Kingdom, Bank of England Quarterly Bulletin, August.

Taylor, J., 1980, Aggregate Dynamics and Staggered Contracts, Journal of Political Economy 88(1), 1–23.

Wolman, A.L., 2000, The Frequency and Costs of Individual Price Adjustment, Federal Reserve Bank of Richmond Economic Quarterly 86(4), 1–22.

Table 1: Comparison between the Bank of Canada Survey and Five Other Studies

	United States	**United Kingdom**	**Sweden**	**Japan**	**European Union**	**Canada**
Timing	April 1990–March 1992	Sept. 1995	March–May 2000	April–May 2000	Feb. 2003–Nov. 2004	July 2002–April 2003
Sample size	200	654	626	630	10,583	170
Representative by industry?	Yes	No, mainly manufacturing firms (68%)	No, manufacturing and service sectors only	No, largely manufacturing firms	No, mainly manufacturing. Also construction, trade, and services	Yes
Industry distribution	Manufacturing 35% Services 27% Construction/Mining 11% Trade/Other 27%	Manufacturing 68% Retailing 13% Construction 6% Other services 13%	Manufacturing 45% Services 55%	Manufacturing: 65% Construction and Real Estate: 10% Trade: 13% All other services: 12%	Industry 63% Trade 12% Construction 4% Other services 21%	Construction 10% Manufacturing 26% Trade 14% All other services 49%
Exclusions based on firm size?	Firms with <$10 million in sales excluded	Sample dominated by large firms	Firms with fewer than 5 employees excluded	Firm size unknown	No	Firms with fewer than 20 employees excluded
Firm size distribution	$10 to $24.9 million 23% $25 to $49.9 million 14% $50 million or more 64%	< or = 100 employees 19% 101 to 500 employees 39% 500+ employees 42%	5 to 19 employees 25% 20 to 199 employees 30% 200+ employees 45%	Firm size unknown	1-49 employees 47% 50-199 employees 29% >=200 employees 24%	20 to 99 employees 32% 100 to 499 employees 28% 500+ employees 40%
All regions surveyed?	16 states in U.S. Northeast	All regions	All regions	Only companies listed on the First Section of the Tokyo Stock Exchange, excluding financial institutions, insurance, and general trading companies. Region unknown.	9 countries (Austria, Belgium, Denmark, France, Germany, Netherlands, Italy, Portugal, and Spain)	All regions

Table 2: Price-Setting Survey Literature: Key Features and Most Recognized Theories

	Blinder et al. (1998)	**Hall et al. (2000)**	**Nakagawa et al. (2000)**	**Apel et al. (2001)**	**Amirault et al. (2006)**	**Fabiani et al. (2006)**
Country	United States	United Kingdom	Japan	Sweden	Canada	European Union
Number of price adjustments per year Median [Mode]	1.4 [1]	2 [1]	1-2 [1-2]	1 [1]	4 [1]	1[1]
State- vs. time-dependent	Time: 60% (not tested)	Time: 79% (10% used mixed) (not tested)	Not tested.	Time: 58.9% (under normal conditions) (not tested)	Time: 67% Yes, time-dependent price-setters adjust less often.	
Does firm size matter for price-change frequency?	No	No, but firm size influences the number of price reviews.	Not tested.	Yes	Yes	No
Does industry or sector matter for price-change frequency?	Yes, trade sector is more flexible.	Yes, significant variation across industries.	Yes, differences between service and manufacturing.	Yes	Significant variation across industries.	Yes
Do long-term contracts matter for price-change frequency?	No, contract length and explicit contracts don't matter, but implicit contracts matter.	No.	No, but suggests that most firms use long-term contracts.	Not tested, but they suggest customer relations and contract theories matter.	No, explicit contracts or percentage of sales under contracts, but customer relations theory matters.	Not tested, but most firms have long-term agreements.
Does competitive pressure matter for price-change frequency?	No, but coordination failure explains price rigidity.	Yes, the number of competitors matters.	Not tested.	Not tested, but customer relations and factor stability are cited as reason for firms using time-dependent changes.	Yes, the number of competitors matters.	Yes, the level of competition suggested by the firm.
What sticky-price theories matter?	Implicit contracts and coordination failure theories.	Not tested.	Not tested.	Not tested.	Customer relations, menu costs, factor stability theories.	Not tested.
Results: Highest recognized theories of price stickiness (by % recognition)	Coordination failure Cost-based pricing Non-price competition Implicit contracts Explicit contracts	Constant markup* Cost-based pricing Implicit contracts Explicit contracts Procyclical elasticity*	Coordination failure Implicit contracts Explicit contracts Pricing thresholds* Non-price competition	Implicit contracts Explicit contracts Cost-based pricing Coordination failure Countercyclical cost of finance*	Cost-based pricing Customer relations Explicit contracts Non-price competition Coordination failure (cutting prices)	Implicit contracts Explicit contacts Cost-based pricing Coordination failure Quality/reference points

*These theories were not asked in the Canadian survey.

Table 3: Price-Setting Survey Literature: Product/Service Based Surveys and Other Evidence

	Small and Yates (1999)	**Buckle and Carlson (2000)**	**Owen and Trzepacz (2002)**	**Bils and Klenow (2004)**	**Dhyne et al. (2004)**
Country	England	New Zealand	United States (New York)	United States	10 E.U. countries
Timing	September 1995	1986Q3–1996Q1	August–December 1999	1995–1997	Varying by country; in total between January 1988–January 2004
Data source	Bank of England PSS; 654 firms	Micro-survey data; various firms	Micro-data, grocery chain industry: 220 goods in eight different locations	BLS CPI data 350 categories	50 similar products, and total CPI
Main results	More competitive product markets increase the propensity to change prices in response to demand shocks; but market structure does not affect the responsiveness to cost shocks. High export intensity reduces responsiveness to cost shocks. Cost increases matter more than decreases.	Menu costs and firm size matter (price duration decreases as firm size increases). Price duration is 6.7 months from survey data (average frequency less than 2).	After controlling for chain-specific effects, higher menu costs are associated with a slight decrease in the probability of a price change and the size of a price change. Firm strategy is more influential in determining the incidence and magnitude of price change.	½ prices last less than 4.3 months. More frequent than Taylor (1980) and Calvo (1983). Prices vary dramatically across categories.	Mean duration is 10.6 months (much higher than the U.S.). The hazard function is decreasing. Mass points identified 1 and 12. Pricing points common (0.99, 1.99, etc). Price changes are not highly synchronized.

Table 4: Distribution of Firm Responses to Sticky-Price Theories

First group of theories	**Unimportant (set = 0)**	**Slightly important (set =1)**	**Fairly important (set =2)**	**Very important (set =3)**
Sticky information	147	16	6	1
Coordination failure (on price decline)	117	12	22	19
Coordination failure (on price increase)	100	25	26	19
Cost-based pricing	56	23	33	58
Explicit contracts	94	16	13	47
Implicit contracts	116	17	23	14

Second group of theories	**Unimportant (set =0)**	**Important (set =1)**
Menu costs	134	26
Factor stability	117	53
Non-price competition	95	75
Customer relations	76	94
Low inflation	113	57

Table 5: Count Data Models' Estimated Results: Original Baseline Case

	Variable codes[a]	Unrestricted model Estimated coefficients	Restricted model	Marginal effect e^b
% of variable cost (standardized)	VARCOST	0.887**	0.715**	2.0435
Number of employees (standardized)	EMPLOY	-1.094**	-1.121***	0.3261
Goods sector	GOODS	-0.605		
Trade sector	TRADE	1.205**	1.713***	5.5458
Atlantic Region	ATLANTIC	-0.518		
Province of Quebec	QUEBEC	1.497***	1.502***	4.4912
Province of Ontario	ONTARIO	1.378***	1.689***	5.4153
Prairie Provinces	PRAIRIES	-0.379		
% of households sales (standardized)	HOUSESL	-0.830***	-0.743***	0.4758
% of public sector sales (standardized)	GOVSL	0.128		
% sales to other domestic regions (standardized)	OTHSL	0.786***	0.827***	2.2873
% of exported sales (standardized)	EXPORT	0.255	0.323**	1.3817
% of sales to the top five buyers: between 11%-25%	FIVEBUYER25	-1.222**	-1.111**	0.3291
% of sales to the top five buyers: between 26%-50%	FIVEBUYER50	-1.391**	-1.139**	0.3202
% of sales to the top five buyers: greater than 50%	FIVEBUYER51	-1.115**	-1.096**	0.3344
Wage costs (recognized as important)	WAGEVI	-0.926**	-0.832**	0.4350
Domestic inputs (recognized as important)	DOMINPTSVI	1.462***	1.294***	3.6470
Fees and other costs (recognized as important)	TFOCVI	-0.460		
Competitor prices (recognized as important)	COMPETITORVI	0.376	0.574**	1.7758
Exchange rates (recognized as important)	FXCHNGVI	0.245		
Changes in demand (recognized as important)	DEMNDCHNGVI	0.183		
Economic forecasts (recognized as important)	FORECASTSVI	-1.225		
Sales campaigns (recognized as important)	SLSCMPGNVI	-0.264		
Parent company directive (recognized as important)	PRNTCMPNYVI	-2.655***	-2.486***	0.0833
Information delay: day	INFOLAGDAY	-0.046		
Information delay: week	INFOLAGWEEK	-0.254		
Information delay: month	INFOLAGMONTH	-1.120**	-1.002***	0.3672
Information delay: more than a month	INFOLAGMOREMONTH	-0.567		
% of contracted sales (standardized)	CNTRCT	1.945**	1.602**	4.9609
State-dependent price-setting indicator	STATE	1.625***	1.598***	4.9422
Number of direct competitors (standardized)	COMPET	2.590**	3.507***	33.356
Industry price leader indicator	PLI	0.595	0.556*	1.7436
Price leadership indicator	PL	0.103		
Menu costs theory (recognized as important)	MENU	-1.666***	-1.723***	0.1786
Factor stability theory (recognized as important)	VARY	-0.808**	-0.634**	0.5307
Customer relations theory (recognized as important)	CSTRLTN	-0.405	-0.652**	0.5211
Non-price competition theory (recognized as important)	NPC	0.144		
Low-inflation theory (recognized as important)	LOWCPI	-0.385		
Sticky-information theory (recognized as important)	STICKYINFOYES	-1.007*	-0.911**	0.4019
Coordination failure on a price decline theory (recognized as very important)	COFAILDECVI	0.393		
Coordination failure on a price increase theory (recognized as very important)	CONFAILINCVI	-1.490***	-1.522***	0.2182
Cost-based pricing theory (recognized as very important)	CBPVI	-0.196		
Explicit contracts theory (recognized as very important)	EXPLICITVI	0.516		
Implicit contracts (recognized as very important)	IMPLICITVI	0.037		
Baseline case	Constant	4.640***	4.510***	
Test for overdispersion	ln(alpha) constant	0.557***	0.608***	
Log-likelihood function	ll	-650.896	-655.749	
Pearson chi-squared test	chi2	248.133***	238.428***	
Akaike's information criterion	aic	1409.793	1381.497	

Likelihood-ratio test between the full model and final selected model: LR Chi2(19) = 9.7

e^b = exp(b) = factor change in expected count for unit increase in X.

* significant at 10% ** significant at 5% *** significant at 1%

Notes: (a) Scale variables are standardized for the estimation [(variable_value – mean)/(standard deviation)].

(b) High-order parameters are included in the estimation for fit; their values are not included here because they have no immediate interpretation.

Table 6: Scale Variable Summary Statistics (N=170)

	Variable	Medium	Mean	Std. dev.	Min	Max
Number of employees	EMPLOY	270	2769	8073	6	55000
% of variable cost	VARCOST	70%	63.0%	25.7%	0	98
% sales to home region	HOMESL	60%	59.6%	35.4%	0	100
% sales to other domestic regions	OTHSL	11.5%	21.2%	24.3%	0	100
% of exported sales	EXPORT	0%	19.2%	30.1%	0	100
% of households sales	HOUSESL	0%	31.4%	41.7%	0	100
% of business sales	BUSSL	82.5%	60.7%	41.3%	0	100
% of public sector sales	GOVSL	0%	8.0%	19.1%	0	100
% of contracted sales	CNTRCT	62.5%	52.1%	44.9%	0	100
Number of competitors	COMPET	6	33	119	0	1000

Table 7: Ordered Probit Models: Estimation Results

Variable description	Variable codes	Coordination failure (on price decline) (COFAILDEC)	Coordination failure (on price increase) (COFAILINC)	Cost-based pricing (CBP)	Explicit contracts (EXPLICIT)	Implicit contracts (IMPLICIT)
				Estimated coefficients		
Cost structure (standardized)	VARCOST			0.317***		-0.285**
Number of employees (standardized)	EMPLOY	0.252*	0.319***	-0.579***		
Industry type: construction	CONST	-1.500***	-1.217**			
Industry type: manufacturing	MANUF	-1.142***				-0.575
Industry type: retail and wholesale trade	RWTRADE	-0.701*	-0.915**		-0.765*	
Industry type: commercial, personal, business services	CPBS	-1.143***	-0.535*			-0.909***
Industry type: information, culture, and transportation	INFOCULTTRANS	-1.179***	-0.605*	0.712**		-1.327***
Atlantic Region	ATLANTIC					
Province of Quebec	QUEBEC			1.197***		
Province of Ontario	ONTARIO					
Prairie Provinces	PRAIRIES	0.617**	0.472*			
% of households sales (standardized)	HOUSESL	-0.494***				-0.428**
% of public sector sales (standardized)	GOVSL		-0.212*	0.278***	0.215**	
% sales to other domestic regions (standardized)	OTHSL	-0.236*				
% of exported sales (standardized)	EXPORT	-0.262*	-0.321**			0.215
% of sales to the top five buyers: between 11%-25%	FIVEBUYER25		0.655**		0.497*	-1.063***
% of sales to the top five buyers: between 26%-50%	FIVEBUYER50					-0.805*
% of sales to the top five buyers: greater than 50%	FIVEBUYER51		0.43	0.647***		-0.623
Wage changes	WAGEVI			0.937***		
Domestic input cost changes	DOMINPTSVI	0.365		0.702***		
Changes in taxes, fees, or other costs	TFOCVI					-0.697*
Competitor's price change	COMPETITORVI	0.464**	0.748***			
Foreign exchange rate changes	FXCHNGVI		0.797***	0.516**	0.780**	
Demand changes	DEMNDCHNGVI		-0.398			
Economic forecast changes	FORECASTSVI					0.728*
Sales campaigns	SLSCMPGNVI					
Parent company incentives/directives	PRNTCMPNYVI	1.320**				1.202**
Information delay: day	INFOLAGDAY		1.042***	-0.55	1.363***	
Information delay: week	INFOLAGWEEK					
Information delay: month	INFOLAGMONTH	0.922***				

(continued)

Table 7 (concluded)

Variable description	Variable codes	Coordination failure (on price decline) (COFAILDEC)	Coordination failure (on price increase) (COFAILINC)	Cost-based pricing (CBP)	Explicit contracts (EXPLICIT)	Implicit contracts (IMPLICIT)
				Estimated coefficients		
Information delay: more than a month	INFOLAGMOREMONTH		0.759**			1.021***
% of contracted sales	CNTRCT				1.175***	-0.321**
State-dependent price-setting	STATE			-0.464**		
Number of direct competitors (standardized)	COMPET			-0.169*		
Industry price leader indicator	PLI	0.463*				0.590**
Price leadership indicator	PL	-1.147***	-0.676***	0.587***		
Menu costs	MENU	0.415			0.509*	0.423
Factor stability	VARY			0.369*		
Customer relations	CSTRLTN	0.815***	0.580**		0.580**	0.791***
Non-price competition	NPC		-0.534**			-0.406*
Low inflation	LOWCPI		0.491**	-0.345		
Sticky information	STICKYINFOYES			0.668**		
Coordination failure (price increase)	COFAILINCVI			0.672**		0.575*
Coordination failure (price decline)	COFAILDECVI					
Cost-based pricing	CBPVI	0.615**	0.617***		0.552**	0.743***
Explicit contracts	EXPLICITVI		-0.805***			0.483*
Implicit contracts	IMPLICITVI		1.186***			
Cut point between unimportant and slightly important	_cut 1	1.095***	0.867***	0.623***	1.158***	0.983***
Cut point between slightly important and fairly important	_cut 2	1.376***	1.427***	1.184***	1.620***	1.402***
Cut point between fairly important and very important	_cut 3	2.074***	2.284***	1.920***	1.974***	2.237***
Log-likelihood function	ll	-131.165	-151.434	-171.361	-128.854	-129.038
Chi-squared test	chi2	61.961***	80.015***	106.597***	116.999***	70.807***

* significant at 10% ** significant at 5% *** significant at 1%

Note: (a) Scale variables are standardized. (b) No asterisk indicates significant at 15% and the model is sensitive to its removal.

Table 8: Probit Models: Estimation Results (N=170)

Variable description	**Variable codes**[a]	**Sticky information** (SITICKINFOYES)	**Menu costs** (MENU)	**Factor stability** (VARY)	**Customer relations** (CSTRLTN)	**Non-price competition** (NPC)	**Low inflation** (LOWCPI)
		Estimated coefficients					
Number of employees (standardized)	EMPLOY				-0.365**		
Industry type: construction	CONST	1.640**			0.978**		
Industry type: manufacturing	MANUF	1.474**				-0.941***	
Industry type: retail and wholesale trade	RWTRADE					-0.860**	
Industry type: commercial, personal, business services	CPBS	1.374**			0.881***	-0.624**	
Industry type: information, culture, and transportation	INFOCULTTRANS			0.736*	0.857**	-0.846**	
Atlantic Region	ATLANTIC	1.448**					
Province of Quebec	QUEBEC	-0.861		-0.975***	-0.727**		
Province of Ontario	ONTARIO				0.519*		
Prairie Provinces	PRAIRIES	-1.002*					
% of sales to households (standardized)	HOUSESL	0.657**		0.381***			
% of sales to public sector (standardized)	GOVSL				-0.212		0.243**
% sales to other domestic regions (standardized)	OTHSL	0.440**			0.216	0.190*	
% of exported sales (standardized)	EXPORT	0.43			0.281**		-0.310**
% of sales to the top five buyers: greater than 50%	FIVEBUYER51		0.857***				
Wage changes	WAGEVI	-0.931*					
Domestic input cost changes	DOMINPTSVI			-0.941***			
Competitor's price change	COMPETITORVI			-0.728**		0.521**	
Foreign exchange rate changes	FXCHNGVI	-1.840**					
Demand changes	DEMNDCHNGVI	-1.023*					
Sales campaigns	SLSCMPGNVI `					0.720**	
Information delay: day	INFOLAGDAY	1.432**	-1.216*		-0.757*		
Information delay: week	INFOLAGWEEK			-0.977**			
Information delay: month	INFOLAGMONTH			-1.144***			
Information delay: more than a month	INFOLAGMOREMONTH	2.312***	1.095***	-0.887**			

(continued)

Table 8 (concluded)

Variable description	Variable codes[a]	Sticky information (SITICKINFOYES)	Menu costs (MENU)	Factor stability (VARY)	Customer relations (CSTRLTN)	Non-price competition (NPC)	Low inflation (LOWCPI)
		Estimated coefficients					
Percentage of contracted sales (standardized)	CNTRCT		-0.600***		-0.516***		
State-dependent price-setting	STATE	0.876*	-0.547*	0.502*			
Number of direct competitors (standardized)	COMPET	0.424***					-2.691***
Industry price leader indicator	PLI		0.540**	-0.722**	0.731***		
Price leadership indicator	PL			0.870**			
Menu costs	MENU			0.599*			
Factor stability	VARY		0.648**				0.512**
Customer relations	CSTRLTN					0.364	1.040***
Non-price competition	NPC			0.500*			0.494**
Low inflation	LOWCPI			0.619**	1.040***	0.603***	
Sticky information	STICKYINFOYES				0.6		-0.696*
Coordination failure (price decrease)	COFAILDECVI	0.951		0.758*	1.390***		
Coordination failure (price increase)	COFAILINC					-0.731**	
Cost-based pricing	CBPVI	1.196***	-0.432	0.455*		0.470**	
Explicit contracts	EXPLICITVI	1.103**	0.822**		0.503	-0.421*	
Implicit contracts	IMPLICITVI						
Constant	Constant	-3.534***	-1.644***	-0.247	-1.235***	-0.28	-1.810***
Log-likelihood function	ll	-35.987	-70.03	-71.868	-78.273	-99.799	-81.943
Chi-squared test	chi2	62.777	35.477	67.236	77.214	33.713	52.988

* significant at 10% ** significant at 5% *** significant at 1%

Note: (a) The following were insignificant in all six models: VARCOST, FIVEBUYER25, FIVEBUYER50, TFOCVI, FORECASTVI, PARENTCOMPANYVI.

(b) Scale variables are standardized for the estimation.

Figure 1: Price-Adjustment Frequency: A Comparison between Canada and the United States

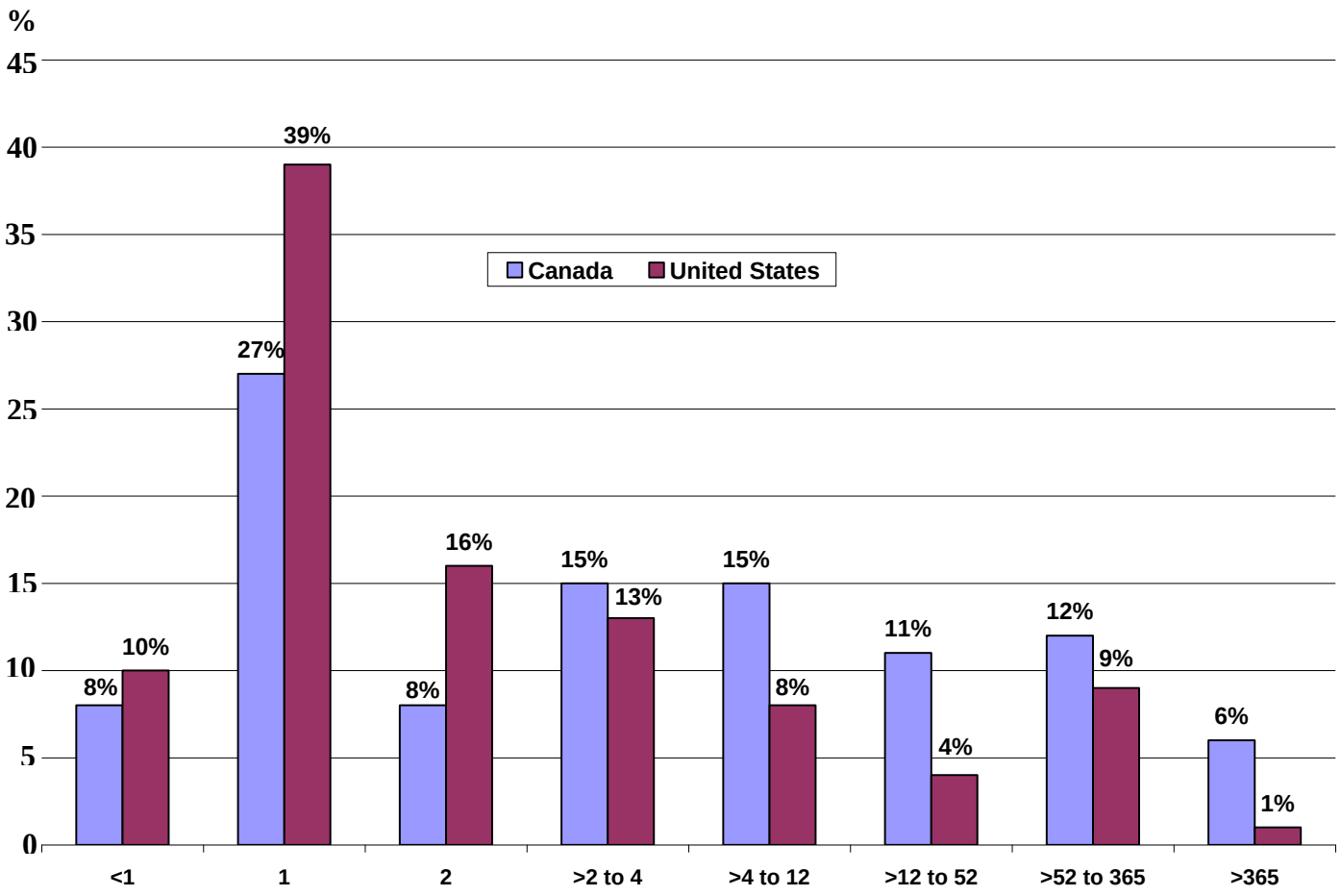
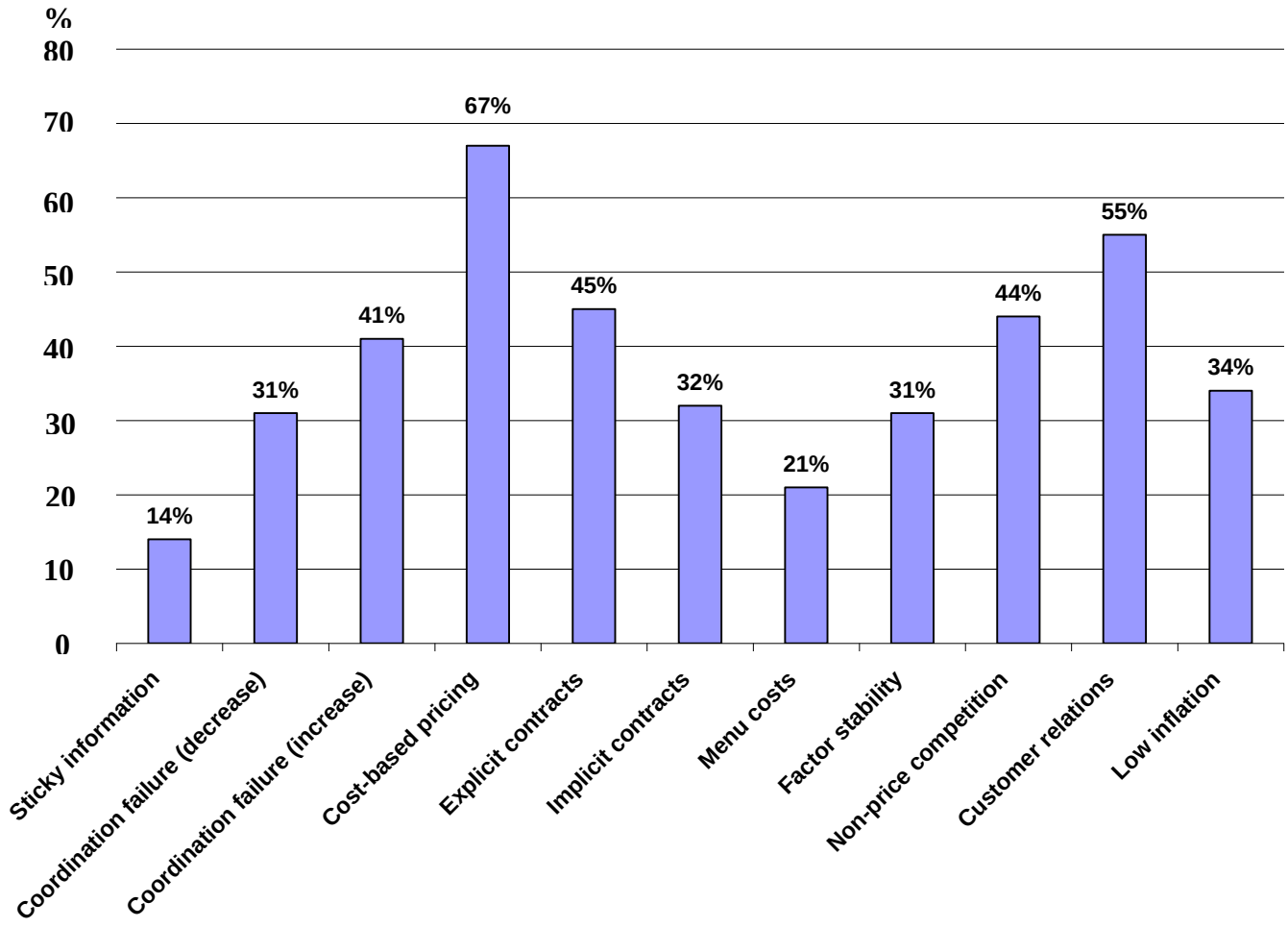


Figure 2: Patterns of Theory Recognition by Firms (%)



Appendix A: The Survey Methodology

The Bank of Canada's price-setting survey was conduced from 2002–03 via structured interviews with the senior management of 170 firms across Canada. The firms selected for the survey had to be able to set their prices autonomously in response to market conditions. Thus, the sample was selected to be representative of the private, for-profit, unregulated, and non-commodity-producing segment of the Canadian economy in terms of industry sector, firm size, and, to some extent, regional distribution (see Amirault, Kwan, and Wilkinson 2006). Drawing upon the experience of the Bank's regional offices in conducting firm-based surveys, a non-random form of sampling, widely employed in business surveys and known as "quota sampling,"[16] was used to generate a representative sample of firms (Amirault, Kwan, and Wilkinson 2006).

The quota sample has many advantages and disadvantages compared with a random probability sample. The benefits of using a quota sampling technique are as follows: (i) a higher response rate, (ii) the sample is 'representative' a priori and weighting for under-represented groups is not necessary, (iii) small firms can be represented easily (and therefore are not a source of bias), (iv) the turnaround time for quota samples is generally shorter, and (v) perhaps most importantly, the quota sampling method is most cost effective in face-to-face interviews.[17] Because firms were interviewed by the Bank in all ten provinces, the ability to select a firm based on their location within a region, as well as industry and firm size, was very important in minimizing the resources used to conduct the survey. If firms were selected randomly, the selection could have been done in relatively isolated areas, which would have greatly increased the difficulty in conducting face-to-face interviews.

[16] See Martin and Papile (2004) for a description of the Bank of Canada's regional offices' survey experience. The non-random sampling used in the regional offices and in the price survey is called "quota sampling" because, for a given subgroup in a target universe, a "quota" of respondents is selected that, when aggregated, is intended to produce a representative sample of the target universe. Thus, in instances where an initial company contact chooses not to participate in the survey, another firm with comparable industry or firm-size characteristics is selected from commercial business directories, to achieve sample targets.

[17] Blinder et al. (1998) note that personal interviews conducted by knowledgeable economics professionals can improve the quality of the survey results. Our experience with missing responses and errors in completed surveys returned by fax suggests that Blinder et al.'s preference for personal interviews is well founded.

Although the quota sampling method has advantages, it inherently has potential biases limiting the degree to which statistical inference can be made in our analysis (Lohr 1999). The sources of potential bias are: (i) familiar firms are more likely to be selected (selection bias), (ii) firms in more convenient locations are more likely to be selected (location bias), and (iii) the non-response rate may be non-random (non-random non-response rate bias).

The potential selection bias is minimized in the Bank's survey, and hence it is less likely to be a large source of bias. In this survey, firms were selected from a list that was generated from large in-house databases, which include all firms that are familiar or unfamiliar with the Bank. In several cases, firms selected had no previous contact with the surveyors.

The potential location bias is restricted by the fact that firms selected must meet the industry and size stratum requirements. These do have some impact on the prior preference for locations of firms. The Bank is fully aware of this kind of bias and makes every effort to minimize it.

The potential bias caused by the non-randomness of the non-response rate is more prominent among the three sources of potential bias. As with the first two sources of bias, the magnitude of the third source is unknown. Therefore, the analysis must be interpreted with caution.

Appendix B: Variable Definitions and Descriptions

Table B1: Master List of All Variables

Variable group	Variable name	Variable description	Categorical
Cost structure	VARCOST	% of the firm's total cost that is variable	
Firm size	EMPLOY	number of employees	
Industry	INDUSTRY	industry: set =1 if construction, =2 if manufacturing, =3 if retail or wholesale trade, =4 if information, culture, or transportation, =5 if finance, insurance, or real estate, and =6 if commercial, personal, or business services	Yes
Consumer type: % of sales	HOUSESL	consumers type: % of sales to households	
	BU.S.SL	consumers type: % of sales to businesses	
	GOVSL	consumers type: % of sales to governments	
Product destination: % of sales	HOMESL	product destination: % of sales to home region	
	OTHSL	product destination: % of sales to domestic consumers outside of the home region	
	DOMESTIC	product destination: = 100% of sales sold domestically	
	EXPORTS	product destination: % of sales to other countries	
Top five buyers: % of sales	FIVEBUYER	consumers power: set =1 if the top five buyers represent 0-10% of sales, =2 if 11-25, =3 if 26-50, and =4 if 51-100	Yes
Price leadership	PLI	price leadership dummy variable: there is a price leader in the industry	Yes
	PL	price leadership dummy variable: the firms believe themselves to be the price leader	Yes
Pricing triggers/motivations to adjust transaction price	REGUALR	price-adjustment trigger: "we routinely change prices at regular intervals," taking a value 0-3 given level of importance [unimportant (0) to very important (3)]	Yes
	WAGE	price-adjustment trigger: "when wages change, so does our price," taking a value 0-3 given level of importance [unimportant (0) to very important (3)]	Yes
	DOMESTINPUTS	price-adjustment trigger: "when domestic inputs change, so does our price," taking a value 0-3 given level of importance [unimportant (0) to very important (3)]	Yes
	TFOC	price-adjustment trigger: "when taxes, fees, or other charges change, so do prices," taking a value 0-3 given level of importance [unimportant (0) to very important (3)]	Yes
	COMPETITORS	price-adjustment trigger: "when price changes by competitors, so does our price," taking a value 0-3 given level of importance [unimportant (0) to very important (3)]	Yes
	FXCHANGES	price-adjustment trigger: "when exchange rates change, so does our price," taking a value 0-3 given level of importance [unimportant (0) to very important (3)]	Yes
	DEMANDCHANGES	price-adjustment trigger: "when demand changes, so does our price," taking a value 0-3 given level of importance [unimportant (0) to very important (3)]	Yes
	FORECASTS	price-adjustment trigger: "when economic/inflation forecasts change, so does our price," taking a value 0-3 given level of importance [unimportant (0) to very important (3)]	Yes
	SALESCAMPAIGNS	price-adjustment trigger: "when sales campaigns change, so does our price," taking a value 0-3 given level of importance [unimportant (0) to very important (3)]	Yes
	PARENTCOMANY	price-adjustment trigger: "when directives from parent company change, so does our price," taking a value 0-3 given level of importance [unimportant (0) to very important (3)]	Yes
Contract sales	CNTRCT	contract sales: % of sales under contracts	
Competitive forces	COMPET	competitive forces: number of direct competitors	
State-dependent pricing	STATE	price reviews: reviews prices spontaneously or in response to specific events	Yes
First group of sticky-price-setting theories	STICKINFO	sticky-price theory: sticky-information theory: "the information used to review (and ultimately change) prices is available infrequently. Therefore, prices may be slow to adjust to new conditions," taking a value 0-3 given level of importance [unimportant (0) to very important (3)]	Yes
	COFAILDEC	sticky-price theory: coordination failure on a price cut, "firms delay price cuts because they don't want to be the first in the industry to cut prices," taking a value 0-3 given level of importance [unimportant (0) to very important (3)]	Yes

(continued)

Table B1 (concluded)

Variable group	Variable name	Variable description	Categorical
First group of sticky-price-setting theories	COFAILINC	sticky-price theory: coordination failure on a price increase: "firms delay raising prices because they don't want to be the first in the industry to raise prices," taking a value 0-3 given level of importance [unimportant (0) to very important (3)]	Yes
	CBP	sticky-price theory: cost-based pricing: "prices depend mainly on the costs of labour and raw materials used in producing goods and services. Therefore, prices don't change until costs change," taking a value 0-3 given level of importance [unimportant (0) to very important (3)]	Yes
	EXPLICIT	sticky-price theory: explicit contracts: "firms would like to adjust prices more often to reflect market conditions, but fixed-price contracts make it difficult to pass on a price increase when a contract is active," taking a value 0-3 given level of importance [unimportant (0) to very important (3)]	Yes
	IMPLICIT	sticky-price theory: implicit contracts: "firms delay price increases because they have an implied understanding with customers that they will not raise prices in tight markets," taking a value 0-3 given level of importance [unimportant (0) to very important (3)]	Yes
Second group of sticky-price-setting theories	MENU	sticky-price theory: menu costs: "it would be too costly to change prices more often (time, effort, out-of-pocket costs)," taking a value 0 or 1 given level of importance [unimportant (0) or important (1)]	Yes
	VARY	sticky-price theory: factor stability: "factors influencing prices do not change often enough to warrant changes," taking a value 0 or 1 given level of importance [unimportant (0) or important (1)]	Yes
	CSTRLTN	sticky-price theory: customer relations: "prices could not change more often without disturbing customer relations," taking a value 0 or 1 given level of importance [unimportant (0) or important (1)]	Yes
	NPC	sticky-price theory: non-price competition: "we are more likely to amend product characteristics (e.g., warranty, delivery lag) than prices," taking a value 0 or 1 given level of importance [unimportant (0) or important (1)]	Yes
	LOWCPI	sticky-price theory: low inflation: "low inflation makes large price changes more noticeable," taking a value 0 or 1 given level of importance [unimportant (0) or important (1)]	Yes
Frequency of price adjustment	PRICECHANGE	price-adjustment frequency: the number of times a firm actually adjusted their transaction price on their main product in the past twelve months	

Table B2: Derived Categorical Explanatory Variables

Variable group	Variable name	Variable description
Industry type	MANUF	industry dummy: manufacturing
	CONST	industry dummy: construction
	RWTRADE	industry dummy: retail and wholesale trade
	CBPS	industry dummy: commercial, business, and personal services
	FIRE	industry dummy: finance, insurance, and real estate
	INFOCULTTRANS	industry dummy: information, culture, and transportation
	GOODS	industry sector dummy: manufacturing and construction
	SERVICE	industry sector dummy: information, culture, and transportation; commercial, personal, and business services; finance, insurance, and real estate
	TRADE	industry sector dummy: wholesale and retail trade
Top five buyers: % of sales	FIVEBUYER10	customer power: the top five buyers represent 0-10% of sales
	FIVEBUYER25	customer power: the top five buyers represent 11-25% of sales
	FIVEBUYER50	customer power: the top five buyers represent 26-50% of sales
	FIVEBUYER51	customer power: the top five buyers represent more than 50% of sales
Price-setting information delay	INFOLAGDAY	price-setting information lag: one day
	INFOLAGWEEK	price-setting information lag: less than one week
	INFOLAGMONTH	price-setting information lag: less than one month
	INFOLAGMOREMONTH	price-setting information lag: more than one month
Canadian regions	ATLANTIC	regional dummies: =1, the firm is located in Atlantic Canada, if not =0.
	ONTARIO	regional dummies: =1, the firm is located in Ontario, if not =0.
	QUEBEC	regional dummies: =1, the firm is located in Quebec, if not =0.
	PRAIRIES	regional dummies: =1, the firm is located in Prairies, if not =0.
	BC	regional dummies: =1, the firm is located in British Columbia, if not =0.
First group of sticky-price-setting theories	STICKINFOYES	sticky-price theory: sticky-information theory: "the information used to review (and ultimately change) prices is available infrequently; therefore, prices may be slow to adjust to new conditions," taking a value 1 if the firm said "important," otherwise set equal to 0.
	COFAILDECVI	sticky-price theory: coordination failure on a price cut, "firms delay price cuts because they don't want to be the first in the industry to cut prices," taking a value 1 if the firm said "very important," otherwise set equal to 0.
	COFAILINCVI	sticky-price theory: coordination failure on a price increase: "firms delay raising prices because they don't want to be the first in the industry to raise prices," taking a value 1 if the firm said this theory is "very important," otherwise set equal to 0.
	CBPVI	sticky-price theory: cost-based pricing: "prices depend mainly on the costs of labour and raw materials used in producing goods and services; therefore, prices don't change until costs change," taking a value 1 if the firm said this theory is "very important," otherwise set equal to 0.
	EXPLICITVI	sticky-price theory: explicit contracts: "firms would like to adjust prices more often to reflect market conditions, but fixed-price contracts make it difficult to pass on price increases when a contract is active," taking a value 1 if the firm said this theory is "very important," otherwise set equal to 0.
	IMPLICITVI	sticky-price theory: implicit contracts: "firms delay price increases because they have an implied understanding with customers that they will not raise prices in tight markets," taking a value 1 if the firm said this theory is "very important," otherwise set equal to 0.
Pricing triggers/ motivations to adjust transaction price	REGULARVI	price-adjustment trigger: "we routinely change prices at regular intervals," taking a value 1 if the firm said this theory is "very important," otherwise set equal to 0.
	WAGEVI	price-adjustment trigger: "when wages change, so does our price," taking a value 1 if the firm said this theory is "very important," otherwise set equal to 0.
	DOMESTINPUTSVI	price-adjustment trigger: "when domestic inputs change, so does our price," taking a value 1 if the firm said this pricing trigger is "very important," otherwise set equal to 0.

(continued)

Table B2 (concluded)

Variable group	Variable name	Variable description
Pricing triggers/ motivations to adjust transaction price	TFOCVI	price-adjustment trigger: "when taxes, fees, or other charges change, so do prices," taking a value 1 if the firm said this pricing trigger is "very important," otherwise set equal to 0.
	COMPETITORSVI	price-adjustment trigger: "when price changes by competitors, so does our price," taking a value 1 if the firm said this pricing trigger is "very important," otherwise set equal to 0.
	FXCHANGESVI	price-adjustment trigger: "when exchange rates change, so does our price," taking a value 1 if the firm said this pricing trigger is "very important," otherwise set equal to 0.
	DEMANDCHANGESVI	price-adjustment trigger: "when demand changes, so does our price," taking a value 1 if the firm said this pricing trigger is "very important," otherwise set equal to 0.
	FORECASTSVI	price-adjustment trigger: "when economic/inflation forecasts change, so does our price," taking a value 1 if the firm said this pricing trigger is "very important," otherwise set equal to 0.
	SALESCAMPAIGNSVI	price-adjustment trigger: "when sales campaigns change, so does our price," taking a value 1 if the firm said this pricing trigger is "very important," otherwise set equal to 0.
	PARENTCOMANYVI	price-adjustment trigger: "when directives from parent company change, so does our price," taking a value 1 if the firm said this pricing trigger is "very important," otherwise set equal to 0.

Appendix C: Count Model Sensitivity Analysis: Alternative Baseline Case

In Table C1, we report the results of the same negative binominal regression model that appears in section 4.2.1 with an alternative baseline case. We undertake this analysis to examine the robustness of the model. Our categorical variables remain the same in this alternative baseline case, but we use the raw scale variables, rather than their standardized counterparts. By doing so, this alternative baseline case becomes a small firm (six employees) in the finance, insurance, and real estate industry located in British Columbia. This firm sells to business in its home region, does not use any contracts, and has no direct competitors. As in the original baseline case, this firm also has no information delays and is a time-dependent price adjustor. It sells less than 10 per cent of its sales to its top five buyers, and believes that neither sticky-price theory nor a pricing trigger (except the variable REGULAR) is very important.

When we adopt this alternative baseline case, we find that the magnitude of the marginal effects for each of the scale variables (Table 6) is significantly higher, and the constant term (our estimate for our baseline case) is insignificantly different from zero. In essence, moving from the original baseline case to the alternative one reveals marginal effects from the perspective of a low-frequency price adjustor, rather than from that of a high-frequency price adjustor. Note that the sign and level of significance of the parameter estimates in the restricted model of the alternative baseline case are identical to those of the original baseline case. The maximized values of the two log-likelihood functions are also identical. The major difference between these two models, as shown in column 5 of Table 5 and Table C1, is that in the restricted model of the alternative baseline case, a unit change in a firm's variable cost, sales outside of its home region, sales to household, and contracted sales leads to a smaller/greater amount of price-adjustment frequency, depending on the negative/positive sign of the beta coefficient estimate. The coefficient estimates associated with other categorical variables have remained unchanged. This indicates that the two baseline cases are both acceptable, depending on which will make the interpretation straightforward.

Table C1 : Count Data Model Results: Alternative Baseline Case

Variable description	Variable codes	Unrestricted model Estimated coefficients	Restricted model Estimated coefficients	Marginal effect e^b
% of variable cost	VARCOST	0.035**	0.028**	1.028
Number of employees	EMPLOY	-0.00014***	-0.00014***	1.000
Goods sector	GOODS	-0.605		
Trade sector	TRADE	1.205**	1.713***	5.546
Atlantic Canada	ATLANTIC	-0.518		
Province of Quebec	QUEBEC	1.497***	1.502***	4.491
Province of Ontario	ONTARIO	1.378***	1.689***	5.414
Prairie Provinces	PRAIRIES	-0.379		
% of households sales	HOUSESL	-0.020***	-0.018***	0.982
% of public sector sales	GOVSL	0.007		
% sales to other domestic regions	OTHSL	0.032***	0.034***	1.035
% of exported sales	EXPORT	0.008	0.011**	1.011
% of sales to the top five buyers: between 11%-25%	FIVEBUYER25	-1.222**	-1.111**	0.329
% of sales to the top five buyers: between 26%-50%	FIVEBUYER50	-1.391**	-1.139**	0.320
% of sales to the top five buyers: greater than 50%	FIVEBUYER51	-1.115**	-1.096**	0.334
Wage costs (recognized as important)	WAGEVI	-0.926**	-0.832**	0.435
Domestic inputs (recognized as important)	DOMINPTSVI	1.462***	1.294***	3.647
Fees and other costs (recognized as important)	TFOCVI	-0.46		
Competitor prices (recognized as important)	COMPETITORVI	0.376	0.574*	1.775
Exchange rates (recognized as important)	FXCHNGVI	0.245		
Changes in demand (recognized as important)	DEMNDCHNGVI	0.183		
Economic forecasts (recognized as important)	FORECASTSVI	-1.225		
Sales campaigns (recognized as important)	SLSCMPGNVI	-0.264		
Parent company directive (recognized as important)	PRNTCMPNYVI	-2.655***	-2.486	0.083
Information delay: day	INFOLAGDAY	-0.046		
Information delay: week	INFOLAGWEEK	-0.254		
Information delay: month	INFOLAGMONTH	-1.120**	-1.002**	0.367
Information delay: more than a month	INFOLAGMOREMONTH	-0.567		
% of contracted sales	CNTRCT	0.043**	0.036**	1.037
State-dependent price-setting indicator	STATE	1.625***	1.598***	4.943
Number of direct competitors	COMPET	0.022**	0.029***	1.029
Industry price leader indicator	PLI	0.595	0.556*	1.744
Price leadership indicator	PL	0.103		
Menu costs theory (recognized as important)	MENU	-1.666***	-1.723***	0.179
Factor stability theory (recognized as important)	VARY	-0.808**	-0.634**	0.530
Customer relations theory (recognized as important)	CSTRLTN	-0.405	-0.652**	0.521
Non-price competition theory (recognized as important)	NPC	0.144		
Low-inflation theory (recognized as important)	LOWCPI	-0.385		
Sticky-information theory (recognized as important)	STICKYINFOYES	-1.007*	-0.911**	0.402
Coordination failure on a price decline theory (recognized as very important)	COFAILDECVI	0.393		
Coordination failure on price increase theory (recognized as very important)	CONFAILINCVI	-1.490***	-1.522***	0.218
Cost-based pricing theory (recognized as very important)	CBPVI	-0.196		
Explicit contracts theory (recognized as very important)	EXPLICITVI	0.516		
Implicit contracts (recognized as very important)	IMPLICITVI	0.037		
Baseline case	Constant	-0.409	-0.055	
Test for overdispersion	lnalpha	0.557***	0.608***	
Log-likelihood function	ll	-650.896	-655.749	
Pearson chi-squared test	chi2	248.133	238.428	
Akaike's information criterion	aic	1409.793	1381.497	

Likelihood-ratio test between the full model and final selected model: LR chi2(19) = 9.7

e^b = exp(b) = factor change in expected count for unit increase in x. See equation (6b).

* significant at 10% ** significant at 5% *** significant at 1%

Notes: (a) Scale variables are standardized for the estimation [(variable_value – mean)/(standard deviation)].

(b) High-order parameters are included in the estimation for fit; their values are not included here because they have no immediate interpretation.

Appendix D: Alternative Ordered Probit and Probit Estimations

In section 5.2.1, we argue that if one wishes to closely identify the relationship between the ranking of a specific theory and its observable characteristics, it is important to control for the rankings of other theories. This view is largely driven by the fact that, because a firm's price-setting behaviour is a function of firm- and market-specific characteristics, and because price-setting theories are not mutually exclusive (as shown in section 5.1), we should control for the presence of other theories if we wish to isolate the above-mentioned relationship. In section 5.2.1, we have done this by including the "very important" response for the first group of theories and the "important" response for the second group. Admittedly, this approach has both advantages and disadvantages.

The advantage of this approach is that we should be better able to isolate recognition of one theory from another, and thus identify a closer relationship between the firms' characteristics and theory rankings. In addition, this approach should avoid the possibility of omitting relevant explanatory variables that would lead to bias. This approach is consistent with Blinder et al. (1998), who provide a more appropriate basis for comparison.

There are two potential disadvantages to this approach. First, there is the question of whether there is an endogeneity problem by including these controls, which may lead to another kind of bias. Second, if a macroeconomist wanted to use our results to determine whether a firm would find a specific theory important, it is unlikely that they would also know the firm's ranking of other theories and would therefore not be able to condition their selection as we have done.

To respond to these concerns, we present the results of an alternative set of ordered probit models in Table D1, and probit models in Table D2. These models have been estimated in the same way as those presented in section 5.2.1, except that we have excluded the ranking of other theories in the regressions. We have a number of observations regarding these results.

First, in comparison with the regression results reported in Tables 7 and 8, we find that ten of the eleven alternative models have the same or lower pseudo R-squared and, more importantly, we identify, on average, fewer statistically significant firm and market characteristics. In particular, we find that fewer industry-type variables are identifiable without controlling for other theory responses. This result is not surprising, given the theory response correlations and their statistical significance in the results presented in Tables 7 and 8.

The one model that does better without controlling for other theory rankings is the menu costs theory. We find that, once we remove the three significant theory variables, three more firm characteristic variables become statistically significant in the model. However, only 21 of the 170 firms said that menu costs were important. This conclusion is drawn from a smaller number of observations.

In general, we find that there are a number of similarities between the two sets of results. We find that many explanatory variables remain significant in both models, and the sign and magnitude of the estimated coefficients are very similar. Overall, however, we conclude that, by including the "very important" and "important" responses to other theories in our model, our results are more consistent with those of the Goodman-Kruskal tests and we are better able to explain the data.

In response to the second criticism of this approach, we have three observations. First, economists do not observe all the information provided in this data set. Therefore, the fact that we control for other responses is not inconsistent with our overall approach. Second, by controlling for other theory responses, we can link more firm and market characteristics with the theory of interest, which is perhaps more important than the perceived conditioning problem, and we avoid potential omitted variable bias. Third, given that the result is conditional on a cross-sectional sample, we have no instruments with which to evaluate the potential problem of endogeneity caused by including other theory responses.

Table D1: Ordered Probit Models: Estimation Results

Variable description	Variable codes[a]	Coordination failure (price decline) (COFAILDEC)	Coordination failure (price increase) (COFAILINC)	Cost-based pricing (CBP)	Explicit contracts (EXPLICIT)	Implicit contracts (IMPLICIT)
		Estimated coefficients				
Cost structure (standardized)	VARCOST	-0.448***		0.347***		
Number of employees (standardized)	EMPLOY		0.185*	-0.575***	-0.387**	
Industry type: construction	CONST	-0.902*				
Industry type: manufacturing	MANUF	-1.203***				
Industry type: retail and wholesale trade	RWTRADE		-0.561*		-0.791**	
Industry type: commercial, personal, and business services	CPBS	-1.278***				
Industry type: information, culture, and transportation	INFOCULTTRANS	-0.929**		0.758**		-0.686*
Atlantic Region	ATLANTIC					
Province of Quebec	QUEBEC	0.674**		1.009***		
Province of Ontario	ONTARIO					
Prairie Provinces	PRAIRIES	0.733**	0.625**			
% of households sales (standardized)	HOUSESL	-0.485***	-0.182*			-0.283**
% of public sector sales (standardized)	GOVSL		-0.193*	0.325***	0.179*	
% sales to other domestic regions (standardized)	OTHSL		0.192**			
% of exported sales (standardized)	EXPORT					
% of sales to the top five buyers: between 11%-25%	FIVEBUYER25				0.465*	-0.672**
% of sales to the top five buyers: between 26%-50%	FIVEBUYER50		-0.609**			-0.613*
% of sales to the top five buyers: greater than 50%	FIVEBUYER51			0.668***		
Wage changes	WAGEVI	0.661**		0.811***		
Domestic input cost changes	DOMINPTSVI	0.399*		0.515***		
Changes in taxes, fees, or other costs	TFOCVI					-0.585
Competitor's price change	COMPETITORVI	0.455*	0.582***			
Foreign exchange rate changes	FXCHNGVI		0.854***		0.670**	0.586**
Demand changes	DEMNDCHNGVI		-0.425*	-0.438**		
Economic forecast changes	FORECASTSVI		-0.809			
Sales campaigns	SLSCMPGNVI					
Parent company Incentives/directives	PRNTCMPNYVI	1.702***				
Information delay: day	INFOLAGDAY		0.52		1.014***	
Information delay: week	INFOLAGWEEK					
Information delay: month	INFOLAGMONTH	1.110***				
Information delay: more than a month	INFOLAGMOREMONTH		0.581*			1.059***

(continued)

Table D1 (concluded)

Variable description	Variable codes	Coordination failure (price decline) (COFAILDEC)	Coordination failure (price increase) (COFAILINC)	Cost-based pricing (CBP)	Explicit contracts (EXPLICIT)	Implicit contracts (IMPLICIT)
		Estimated coefficients				
% of contracted sales	CNTRCT	1.681**	-0.317***	0.963*	0.979***	-0.243**
State-dependent price-setting	STATE			-0.428**		
Number of direct competitors (standardized)	COMPET	2.409***				
Industry price leader indicator	PLI	-0.594*		0.534**		0.616***
Price leadership indicator	PL	0.375				
Cut point between unimportant and slightly important	_cut 1	1.119	0.582***	0.22	0.474***	0.598***
Cut point between slightly important and fairly important	_cut 2	1.432**	1.078***	0.759***	0.900***	0.948***
Cut point between fairly important and very important	_cut 3	2.163***	1.789***	1.460***	1.233***	1.660***
Log-likelihood function	ll	-126.567	-167.923	-178	-134.5	-147.766
Chi-squared test	chi2	71.156	47.039	93.318	105.707	33.351

* significant at 10% ** significant at 5% *** significant at 1%

Notes: (a) Scale variables are standardized for the estimation [(variable_value – mean)/(standard deviation)].

(b) High-order parameters are included in the estimation for fit; their values are not included here because they have no immediate interpretation.

Table D2: Probit Models: Estimation Results (N=170)

	Variable codes[a]	**Sticky information** (SITICKINFOYES)	**Menu costs** (MENU)	**Factor stability** (VARY)	**Customer relations** (CSTRLTN)	**Non-price competition** (NPC)	**Low inflation** (LOWCPI)
		Estimated coefficients					
Number of employees (standardized)	EMPLOY				-0.308**		
Industry type: construction	CONST				0.869**		
Industry type: manufacturing	MANUF	1.098***				-0.389*	
Industry type: commercial, personal, business services	CPBS						
Industry type: information, culture, and transportation	INFOCULTTRANS				0.561*		
Atlantic Region	ATLANTIC		0.598*	0.668**	0.970***		
Province of Quebec	QUEBEC	1.084**			0.553		
Province of Ontario	ONTARIO			-0.633**			
Prairie Provinces	PRAIRIES				0.772***		
% of sales to households (standardized)	HOUSESL				0.672**		0.524*
% of sales to public sector (standardized)	GOVSL	0.346*	0.417**	0.303**			
% sales to other domestic regions (standardized)	OTHSL						
% of exported sales (standardized)	EXPORT	0.238	0.174		0.260**	0.167*	
% of sales to the top five buyers: between 11%-25%	FIVEBUYER25				0.177		-0.277**
% of sales to the top five buyers: between 26%-50%	FIVEBUYER50		0.652*				
% of sales to the top five buyers: greater than 50%	FIVEBUYER51						
Domestic input cost changes	DOMINPTSVI		1.305***				
Changes in taxes, fees, or other costs	TFOCVI						
Competitor's price change	COMPETITORVI			-0.799***			
Foreign exchange rate changes	FXCHNGVI	-1.291*					
Demand changes	DEMNDCHNGVI			-0.469*		0.340*	
Economic forecast changes	FORECASTSVI	-1.280**					
Sales campaigns	SLSCMPGNVI	-0.930**			-0.353		
Information delay: day	INFOLAGDAY			-1.007			
Information delay: week	INFOLAGWEEK	-1.264*	-0.842*			0.489	
Information delay: month	INFOLAGMONTH	1.369**			-0.750**		
Information delay: more than a month	INFOLAGMOREMONTH			-1.011***			
Percentage of contracted sales (standardized)	CNTRCT			-1.010***			
State-dependent price-setting	STATE	1.867***	1.128***	-0.886**			
Number of direct competitors (standardized)	COMPET	0.318*	-0.378***		-0.399***		
Industry price leader indicator	PLI	0.661*					
Price leadership indicator	PL	0.312**					-1.992***
Constant	Constant	-43.367	-73.013	-82.059	-93.555	-111.005	-95.263
Log-likelihood function	ll	48.019	29.51	46.853	46.652	11.302	26.348
Chi-squared test	chi2						

* significant at 10% ** significant at 5% *** significant at 1%

Notes: (a) Scale variables are standardized for the estimation [(variable_value – mean)/(standard deviation)]. (b) The following were all insignificant in all six models: VARCOST, SLSCMPGNVI, PARENTCOMPANYVI, RWTRADE.

(b) High-order parameters are included in the estimation for fit; their values are not included here because they have no immediate interpretation.