Industrial Price Formation and Industry Concentration in Canadian Manufacturing Industries

by

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Abstract

The purpose of this investigation is to test for the implications of alternative micro pricing policies at the aggregate industry level and to determine if, and to what extent, industries in a small open economy are able to adjust price when they are subjected to input cost increases. It is assumed that the pricing policy followed by firms is an s,S policy. Four a priori outcomes are considered, each reflecting varying degrees of cost pass-through ability based on the degree of industry concentration and price stickiness across Canadian manufacturing industries. The results support the theory that as fixed adjustment costs increase prices are changed less frequently and the unit return to capital is reduced. For some industries the evidence is not as conclusive. This may be explained by: varying fixed or heterogeneous costs of adjustment, both across and within industries; the influences of international trade on a small, open economy; the degree of industry concentration; and lags due to inventory adjustments.

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1 Introduction

Economic decisions are continuously being made by firms, consumers and governments. Consumers must decide whether or not to save for tomorrow or consume today, and decide whether they should provide labour or take leisure. Governments must also determine what they will spend on goods and services, how much they will invest and how much they will tax. Likewise, firms must make economic decisions about how much to produce and how much to invest. Another key economic decision firms must make is what price to charge for their output.

Price formation is a key decision made by firms which affects not only their own product prices, but the factor input prices of other firms downstream and perhaps even the aggregate price level. The goods and services produced in an economy are composed of the factors of production and include: material inputs, labour and capital, all of which must be paid for, taxes and profits. In most industries unit material costs are determined by the supplying industries producing the inputs and are bought at a price set by the supplying industry. The price paid for material inputs is determined at the time the contract is made, whether that be a month, six months or a year prior to when those inputs are used in the production process. Labour compensation is determined by negotiation with a union or must be competitive with what is being offered by the industry. In either case the firm must compensate its labour force based on whatever has been agreed to, usually for a fixed period of time. Just as labour is compensated there must also be some return to capital for its services and some measure of remuneration for the depreciation of the capital stock. In addition to these payments, firms must also pay taxes to the state and interest on any outstanding debt. Finally, there is profit, which is often lumped together with the return to capital.

A firm's decision on what price it will charge for its products is made in response to all of these things, including the degree of market power and expected changes in demand. Although the level of the price set is a response to these factors, the timing of the price level change is separate and distinct. It is for this reason that the price setting decision shall be the focus of this discussion. In addition, with input and output prices set, the only payment which can truly vary on a continuous basis is the residual, i.e., the return to capital combined with profit. This concept shall be modelled. From this perspective the firm's key decision is whether or not it allows its profit margin to be squeezed in response to input cost increases or whether it raises its price. By focusing on the return to capital and the firm's profit, the analysis becomes consistent with how governments set price in regulated industries. It is not price, per se, which is regulated; rather, it is the rate of return to capital.

Market power and the degree to which the organization of industry affects price formation have long been topics of discussion. Concentrated industries have been thought to limit competition and thus promote higher prices. Therefore, the influence of industrial organization on price formation will also be examined in this paper. Specifically, does industry concentration have an empirical role in price formation in Canada today?

Canada is a small, open, well-developed and diverse economy and, compared to other countries, it also has a large degree of foreign ownership. These characteristics bring interesting dimensions to price formation in Canada which may not be present, or at least not as extreme, in other countries, particularly its largest trading partner, the United States.

This study will focus on price formation in Canadian manufacturing industries since the early 1960s. This sector has been chosen since it is where international trade dominates, reflecting the "openness" of the economy, and is also where price signals are more readily observed. Although international trade also dominates the resource sector most of these industries are international price takers. Similarly, foreign pricing is not as dominant a factor in price formation in the services sector. Hence the manufacturing sector encompasses industries which are international price takers as well as ones in which domestic factors take precedence. The results of this analysis could then be used in further work on price formation in the resource and services sectors.

Section 2 reviews the empirical investigations which have been undertaken to analyse various factors which are thought to influence industrial price formation. It also examines theoretical models which have been developed to explain price. Section 3 describes the model, methodology and data used in this analysis, section 4 outlines the empirical results and section 5 concludes.

2 Applied Investigations

2.1 Microeconomic Foundations

Industry structure and profitability have long been a topic of discussion and study. The first wave in the study of the functioning of markets began with Mason and Bain and other economists associated with Harvard University in the 1930s and 1940s and was empirical in nature [Perrakis, 1988]. The structure-conduct-performance framework was used to analyse industry behaviour. Cross-section analysis was performed on a number of industries with profits - a measure of performance - made a function of concentration ratios and barriers to entry - measures of industry structure and advertising expenditures - a measure of conduct. In general, it was found that as the measure of concentration or barriers to entry increased, measured profits increased and it was believed that the relationship was causal in nature. High profit rates were thought to be a direct result of high concentration.

This aspect of the framework was heavily criticized and it was shown that the relationship was not necessarily causal in nature. Rather, while the variables were correlated, all may have been dependent on a common factor. This criticism resulted in a modification of the framework to allow for feedback effects. Thus, not only is it possible that structure affects conduct which, in turn, affects performance, but also that performance affects both conduct and structure.

Dornbusch [1987] draws on models of industrial organization to explain the determinants of relative price changes with respect to the degree of market concentration, the degree of product homogeneity and substitutability and the relative market shares of domestic and foreign firms. He examines a cost shock brought about by an exchange rate movement and a less-than-fully flexible money wage which leads to the need for an industry-wide adjustment in prices. Dornbusch hypothesizes that an exchange rate change, for example, a depreciation, raises foreign unit labour costs, resulting in price and output adjustments in each industry.

These adjustments depend on four factors: the world market structure, the degree of substitutability, the domestic market structure and the shape of the demand curve. The world market structure refers to the degree of world market integration of a traded commodity and the degree of trade barriers between countries, while the degree of substitution between products influences the output and price setting effects of cost and price changes.

Dornbusch analyses three models of price formation: the Cournot model, the Dixit-Stiglitz [1977] model and the Salop [1979] model of spatial competition. He finds that the Cournot model explains unchanging prices and steep price declines, with the market structure - import shares and concentration - a key factor in explaining this outcome, while the exchange rate has no effect on domestic price when there are few firms in the industry. In this case, firms absorb price changes due to exchange rate movements by allowing profit levels to move. This view is also supported by Dunn [1970] and Clarida [1991] who investigates the relationship between US manufacturing profits, exports and the real exchange rate and finds that real exchange rates have a significant influence on real US manufacturing profits. Conversely, steep price changes occur when a country, or industry, is a price taker in world markets and there are a large number of firms, that is, the market is competitive.

The models discussed by Dornbusch share common features in that they all predict that an appreciation in the exchange rate should lead to a decline in the price of imports. For homogeneous goods, the price for domestically produced goods will fall by the same amount, while for differentiated goods, the price of imports will decline relative to the price of domestically produced goods.

2.2 Effects of Market Structure

Neumann, Böbel and Haid [1983] examine the effect of various market structure variables on price-cost margins over the business cycle. The authors conclude that concentration does convey monopolistic market power and that imports exert a negative impact on price-cost margins during recessions. During a business cycle upswing the degree of concentration enables domestic producers to exercise market power because of the cost of entry. Imports are not sufficient to keep this in check. In recession, imports contribute to excess supply and market power is diluted, even in highly concentrated domestic industries.

Henley [1988] examines the interwar British coal mining industry during which the market structure of the industry was radically altered, through legislation, from one of many to a small number of producers. The author tests a general mark-up model of pricing incorporating demand and supply side factors which influence the size of the mark-up. A mark-up model of pricing is one in which the selling price for a product is determined by adding a specific percentage of mark-up to the average total or average variable cost of the product. This type of pricing is commonly used by companies and, if used by all firms in an industry, results in stable price patterns [Watson, 1963]. Henley analyses the proposition that price is demand-determined in competitive industries and mark-up determined in oligopolistic industries by testing the equation for a period before and after the implementation of the legislation. He concludes that there is strong evidence to suggest that a change in market structure could explain the rising profitability of the coal industry in the years preceding World War II.

2.3 Demand Effects

Maccini [1976] analyses the short-run behaviour of prices and output in a model that incorporates inventory adjustments and price expectations. He assumes that the firm believes that its own price will not effect the average price of the industry. The model implies that the firm will raise its price the smaller is its inventory stock, or given an increase in the expected level of market demand. In addition, an increase in the expected wage or the estimated average industry price level will induce the firm to raise its price, but less than proportionately, and lead it to also raise its rate of output.

Based on his model, Maccini analyses the effects of a positive shift in aggregate industry demand given that the system is in short-run equilibrium. Assuming that price is inelastic relative to aggregate industry demand, an increase in aggregate industry demand raises the average industry price and the level of output. However, the rise in output is less than proportionate to the increase in aggregate industry demand. In addition, since expected demand increases relative to output, the inventory stock declines. Lower inventory levels induce the firm to increase its price and this implies that the firm's estimate of the average industry price also increases. This leads to a further increase in both price and output. If price is not completely inelastic relative to aggregate industry demand, then as price rises aggregate industry demand will fall and as the expected average industry price level rises firms will lower their expectations of demand. These forces will reduce the upward pressure on price due to an increase in aggregate industry demand.

In further work Maccini [1981] estimates a price equation for the US manufacturing sector which builds on his previous analysis and suggests that changes in demand have a significant positive effect on price changes and that the lagged effect of demand changes is short - only one quarter.

Shinkai [1977] finds that demand factors make a significant contribution to price changes, but that cost factors, in particular material prices, are still the more important determinants. The author also finds that pricing behaviour remains the same between concentrated and unconcentrated industries.

2.4 External Influences

To prevent prices from fluctuating due to exchange rate movements firms establish a local currency price which the firm bases on the long-run equilibrium exchange rate [Dunn, 1970]. Fluctuations around this exchange rate are not reacted upon, with profits either being squeezed or enhanced, depending on the direction of the currency movement. This type of price stabilization system requires three elements: the profit margin must be high enough to absorb variations; the exchange rate must vary within a limited range; and the firm must see the foreign market as separate and distinct.

In the article, "Foreign Competition and Domestic Industry Profitability", Esposito and Esposito [1971] examine the influence of foreign competition and concentration on industry profit rates. They find that the level of imports or the import share of domestic shipments in an industry exerts a significant and negative effect on industry profit rates. Thus, as the import share for a given industry increases, the more the domestic industry acts like a competitive industry and hence a price taker. They also find that there are large estimation residuals associated with highly concentrated industries, suggesting that other unaccounted for influences have a significant effect on profit rates, and that there is a greater variability in profits in industries with higher levels of concentration. This implies that as concentration increases, its usefulness for predicting price behaviour (profits) declines. The authors conclude that there is an increase in the variability of profit rates because varying dispersions of market power generate varying abilities to jointly profit maximize.

Fisher [1989] hypothesizes that producers in concentrated industries will raise (lower) export price mark-ups more than producers in competitive industries if there is an expected exchange rate depreciation (appreciation). To test his hypothesis he uses the Spearman statistic of rank correlation between industry concentration and export price mark-ups. Fisher finds that there are asymmetric effects with respect to exchange rate movements. While he found support for his hypothesis with respect to an exchange rate depreciation, the same could not be said for an appreciation. He notes that there is a high rank correlation between industry concentration and export price mark-ups in the same industries in Japan and Germany, suggesting that world oligopolistic firms find other ways of maintaining market share when faced with exchange rate appreciations.

Knetter [1992] looks at the impact exchange rate changes have on the pricing decisions of firms which pay factors of production, mainly in the home currency, and derive a share of their revenues from exports. An exchange rate movement can potentially have two effects: it may change the cost of production, if inputs are imported, and it may affect the mark-up of price over cost. Adjusting a mark-up due to an exchange rate change is referred to as pricing to market [Knetter, 1992]. If the domestic price moves in proportion to the exchange rate change then there is "full pass-through" of the exchange rate change to the domestic price.

A monopolist, given constant marginal cost and constant elasticity of demand, will fully pass-through exchange rate changes to the export price. However, Knetter notes that even with a simple market structure such as monopoly the relationship between the exchange rate and the price is complex and depends on costs, demand and the sensitivity of input prices to exchange rates.

Pricing to market, or adjusting the mark-up in response to a change in the exchange rate, is greatest if the world industry has a high degree of monopoly power but the domestic firms have a relatively small share of the foreign market and, therefore, little influence over the equilibrium price. Conversely, pricing to market is lowest when the world industry is competitive but the domestic industry tends to dominate the world industry.

Frantzen [1986] suggests that in oligopolistic market structures changes in direct input costs, which are observed by all firms, are a more direct criteria for adjusting price than are short-run fluctuations in demand, which are likely more difficult to observe. The author suggests that one would expect prices to be sticky with respect to foreign and domestic short-term demand, although foreign price influences are likely significant. Frantzen notes that the empirical literature on price formation in small open economies is almost exclusively concerned with the relative importance of domestic costs and foreign prices. Many studies [Calmfors and Herin (1979), Huveneers (1981) and van Poeck and Pauwels (1980)] have demonstrated that there are both significant foreign price influences and also significant direct cost influences. This suggests that price formation in an open economy is somewhere between perfect independent price setting and foreign price following.

His analysis focuses on price formation in several manufacturing industries in the Belgian economy. Frantzen uses a first-difference equation with price as a function of input costs, foreign prices and a variable to capture cyclical demand effects. The results of his empirical investigation indicate that the coefficients on the cost variables are positive and significant and demonstrate that an increase in costs can be at least partially shifted to the price in the short run. One explanation for this is that an important part of direct normal costs are similar for both domestic and foreign competitors. This can be explained by the fact that most material input prices, especially for raw materials, are determined by competitive world markets. With the inclusion of foreign prices, the cyclical demand terms become insignificant. Frantzen concludes that the degree of cyclical price-cost margins in Belgium appears to be low.

Mann [1986] looks at the effects of exchange rate changes on industry profit margins of foreign suppliers to the US and US exporters to determine whether or not short-run profit margins are squeezed and whether the exchange rate pass-through relationship is changing. Investigations of industry data suggest that an appreciation of the US currency, along with growth in demand in the US, market structure, trade barriers and inflation in the source country affected profit margins in the early 1980s.

The starting point for Mann's analysis is the law of one price which, in a world of perfect competition, equates foreign and domestic prices through the exchange rate. This analysis is extended by relaxing the assumption of perfect competition and provides a possible explanation for the short-run variations in observed profit margins.

The following identities describe how the law of one price is related to profit margins and input costs:

$$P_d = P_f \times E \tag{1}$$

$$P_f = C_f + M_f \tag{2}$$

Subsitituting (2) into (1):

$$P_d = (C_f + M_f) \times E \tag{3}$$

Therefore:

$$\Delta P_d = \Delta C_f + \Delta M_f + \Delta E \tag{4}$$

where: P_d: domestic price in the domestic currency

P_f: foreign price in the foreign currency

E: exchange rate in terms of domestic dollars per unit of foreign dollars

C_f: foreign producer's cost in foreign currency

M_f: foreign producer's margin over costs in foreign currency

A change in the dollar price is approximately equal to the change in foreign costs plus the change in margin plus the change in the exchange rate. Thus, a change in costs or the exchange rate can be buffered by a change in profit margins. Therefore, the speed of adjustment and amount of pass-through of the exchange rate is allowed more flexibility.

Mann finds that industry pricing and profit margins are determined by the interaction of market structure and macroeconomic uncertainty. Profit margins also vary due to characteristics of market structure and the overall macroeconomic environment, particularly demand effects. Imperfect competition, in part, results from imperfect substitution, which gives suppliers some market power, a positively sloped supply curve, few firms, and wage and sales contracts. Macroeconomic determinants of prices include exchange rate movements and aggregate demand.

The slope of the domestic demand curve is determined by the number of firms producing the good, interfirm behaviour and the degree of product substitution. The marginal cost curve depends on the production technology: the wages paid, the cost of fixed capital, costs of imported intermediate inputs and other production costs.

Profit margins of firms are vulnerable to exchange rate changes and demand shocks. Thus, while market structure generates profit margins, uncertainties in the macro economy alter profit margins. Mann finds that there is a lag (2 years) in how fast exchange rate changes are passed through.

Mann's empirical results are consistent with evidence which suggests that during the early 1980s foreign producers selling into the US market absorbed the US dollar appreciation into wider profit margins rather than passing it through to lower prices. Examination of industry data over two separate time periods indicates a trend of narrowing profit margins of foreign producers during depreciation and widening profit margins during appreciation. She also finds that rising costs squeeze profit margins since costs are not fully-passed through to the price. Factors other than exchange rate changes which affect pricing decisions and profit margins include inflation in the producers' country, relative growth in demand, and industry-specific market structure and trade barriers.

She concludes that exchange rate changes have been absorbed into the profit margins of foreign producers to a large extent and for long periods of time and that this is consistent with the prediction of theoretical models in which imported goods are produced and sold under imperfect competition and macroeconomic uncertainty.

A study by Cowling and Sugden [1989] on "Exchange Rate Adjustment and Oligopoly Pricing Behaviour" in the European car market supports Mann's findings. Starting from the theoretical premise that oligopolistic prices tend to be inflexible, they find that changes in input costs are more likely to be realized in changes in profit margins than in price changes. They suggest that this seems to be a natural consequence of an oligopolistic market structure which, because of its nature, need not move prices in response to relative cost changes.

Feinberg [1986] states that many studies have found evidence suggesting imports have restrained domestic market powers with increases in import shares implying a reduction in profit margins. He uses movements of exchange rates to capture changes in international pressures on domestic markets.

Since domestic and foreign products are not perfect substitutes the law of one price cannot be expected to hold. This implies that exchange rate changes may not be passed through to domestic prices. Feinberg states that domestic market concentration may allow an industry to partially protect itself from the effects of exchange rate fluctuations and notes that Dornbusch [1984] finds that the more competitive an industry and the larger the import share, the larger will be the effect of an exchange rate movement on the price.

2.5 The Speed of Price Adjustment

Dixon [1983] states that there are two theories about the speed of the adjustment of prices in an industry to changes in labour and material costs. One focuses on the length of the production period, a theory based on the premise that inputs are valued at historical costs. Therefore, if the firm has an inventory of material inputs it will value those inputs at the purchase price even if the current price of the material inputs is higher. Given a lengthy production period one would expect long lags between changes in costs and changes in price. The second theory relates the speed of price adjustment to the degree of industrial concentration.

Dixon finds that the longer the production period, the longer it takes for prices to adjust and that the rate of adjustment is slower the more concentrated is the industry. He also finds a positive coefficient for the import share variable. This variable adjusts the concentration and interdependence measures to take account of competition from foreign suppliers. Given that there is import competition, the CR_4 ratio overstates the true degree of concentration. The industry is, in fact, less concentrated than it would appear. One can conclude from this, therefore, that the industry's ability to pass increases in costs through to the price is dampened and not adequately reflected in the CR_4. The author concludes that although the length of production period affects the lag on price adjustment, it is not the sole determinant.

Kardasz and Stollery [1988] follow on Domberger's [1979,1983] methodology to examine the relationship between market structure and the rate of price adjustment in Canadian manufacturing industries and investigate the factors which affect the responsiveness of domestic prices to their domestic and foreign determinants. The authors find that the elimination of tariff and nontariff protection would decrease the elasticity of domestic prices to domestic costs and increase the elasticity with respect to foreign prices.

Ginsburgh and Michel [1988] note that there have been a number of papers on the topic of whether there is a relationship between the degree of concentration in an industry and the speed at which price adjusts to production costs. They find that the results have been contradictory: the more concentrated an industry the more rapidly will costs be transmitted to prices, and as concentration increases price pass-through decreases. They present evidence for both theories.

The explanation for the former is straightforward. The more concentrated an industry the more pricing power the firms within that industry are likely to have. In the extreme case, an industry may be dominated by a monopoly, while the more likely structure of an industry is some degree of oligopoly. The more concentrated is an oligopoly, the more likely the firms within that oligopoly are to engage in tacit collusion. Generally, it is in the best interests of the firm to pass increases in costs through to the price. Thus, if costs rise and there exists a dominant firm which is the price leader in an industry, this firm would have the power to adjust price upwards with the assurance that the remaining firms in the industry would follow suit.

There are several explanations for the second theory. An oligopolist expects its competitors to react differently to a decrease in price than to an increase in price. That is, a decrease will be followed, whereas an increase will not. Another explanation for this phenomenon is that concentrated industries often have increasing returns to scale, and hence, large irreversible investments. This induces firms to peg price on long-run objectives rather than following short-run cost fluctuations. A third explanation offered maintains that in oligopolistic industries, prices do not react to continuously changing costs but react in discrete steps. Therefore, a rise in costs may not be reflected in a corresponding increase in price.

2.6 Menu Cost Models

New Keynesian economics [Blanchard and Fischer, 1989] suggests that price stickiness arises because the costs to changing prices are large enough to deter firms from changing prices immediately or because the gain to a single firm from changing price is small. Therefore, both nominal and real shocks to the economy lead to changes in output. The timing and nature of the effects of changes in demand are dependent on how individual firms respond to the signals they receive.

Menu costs refer to these physical costs of changing prices and include, for example, the costs incurred printing new labels and catalogues, and renegotiating contracts. The basic premise of the menu cost literature is that firms will only change prices in response to demand shocks or a change in the general price level if the benefits of doing so, that is the change in profits, are greater than the menu costs.

One of the early criticisms of the menu cost literature is that menu costs are too small to generate the large fluctuations in output that have been observed over the last few decades. However, due to the relative curvature of the profit function, the loss in profits due to demand shocks or a change in the general price level tends to be even smaller than the menu costs. Thus, even small menu costs can make it unprofitable to change prices.

There are several other criticisms with respect to static menu cost models. However, a dynamic modeling environment may overcome many of these problems and the works of Rotemberg, Sheshinski and Weiss, Naish and others examine the effects of menu costs in a dynamic setting. The dynamic menu cost literature aims to determine the optimal price setting behaviour of firms in an imperfectly competitive market structure faced with weighing the costs of changing prices against the potential increase in profits of doing so. There are two common types of pricing rules: time-dependent and state-dependent. Time-dependent pricing models assume that firms keep prices fixed for a set period of time. Rotemberg [1982] develops a pricing model of this type. State-dependent models assume that firms will change their prices when some condition is achieved. The most common form of state-dependent pricing is the s,S pricing rule, with the earliest work on these models by Arrow, Harris and Marschak [1951] who used it to solve optimal inventory problems. Further work was done by Barro [1972] and later extended by Sheshinski and Weiss [1977].

2.6.1 A Partial Adjustment Model

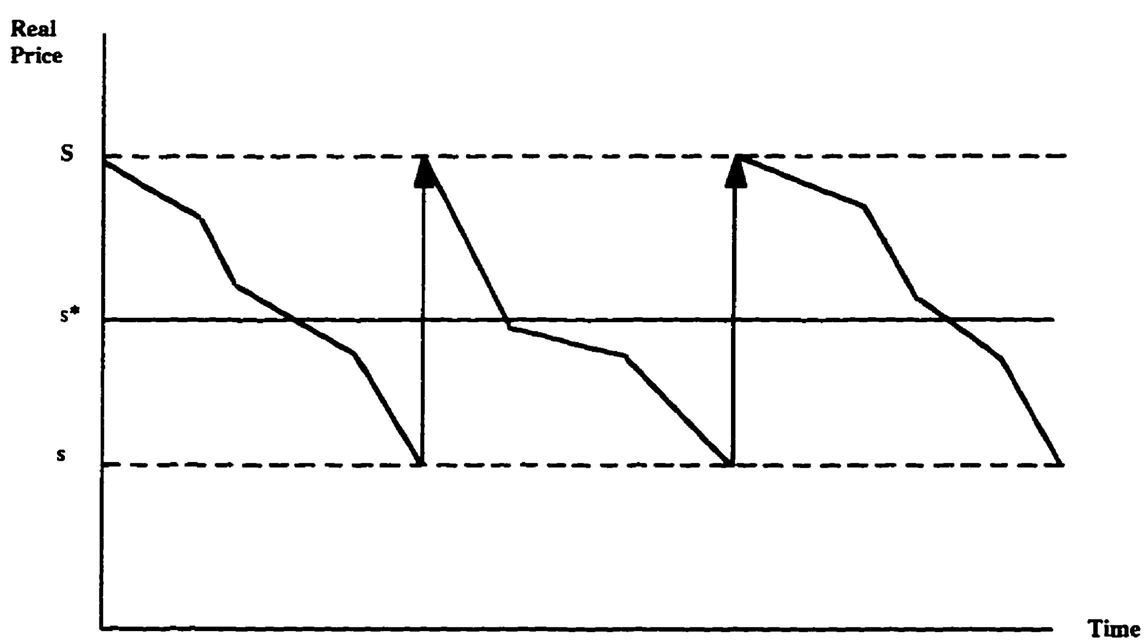
Rotemberg [1982] models price as a partial adjustment model where the costs of changing price are a convex function of the size of the price change. In this way he captures the implicit cost which results from the unfavourable reaction of customers to large price changes. Customers may prefer many small price changes rather than infrequent large movements in price. This allows for a gradual or partial adjustment of price towards an equilibrium price. Thus, an automatic full adjustment in price will not occur when there is an unexpected permanent increase in demand.

There are two types of costs of adjustment in Rotemberg's model, a convex cost for continuous adjustment and a discrete (linear) lump-sum fixed cost. Like Sheshinski and Weiss [1977] and Barro [1972], there is a cost to the firm of not being at the profit-maximizing price. Other costs, however, are not lump sum and rise more than proportionately to the size of the price change. The larger the price change is, the greater the cost of changing price. However, lump sum costs are still necessary. Without them, there is no reason to expect firms to keep prices fixed for long periods.

2.6.2 s,S Pricing Models

In s,S pricing models it is assumed that the firm has set the optimal price given the demand curve and establishes upper (S) and lower (s) threshold values for demand. If a demand shock is smaller than the threshold values in absolute terms the firm does not change its price. Firms only reset prices when this threshold value is crossed, at which point the benefit from changing price just outweighs the cost. Similarly, when prices in the economy rise relative to the firm's nominal price the firm's real price falls to a lower bound, s, at which point the firm raises its nominal price to a point equivalent to S. These threshold values are determined by the size of the adjustment costs: the larger the costs, the more firms will allow real prices to fluctuate.

Figure 1



The concept of s,S pricing policies was first used by Arrow, Harris and Marschak [1951] to solve optimal inventory problems. It was later introduced to the theory of monopoly pricing policy by Sheshinski and Weiss [1977].

Sheshinski and Weiss [1977] evaluate the effects of inflationary expectations in the formation of price policies of monopolistic firms. In the absence of discrete adjustment costs, the optimal policy would be to increase price continuously at the same rate as the increase in the general price level and costs of production. With discrete adjustment costs, the optimal policy is to change price in a number of finite intervals over which the nominal price is held constant, followed by discrete price adjustments.

The authors develop a purely deterministic model. That is, the aggregate inflation rate is perfectly anticipated. The real costs of price adjustment are independent of the expected rate of inflation and the real price fluctuates between two bounds, decreasing continuously over each interval.

They assert that an increase in the rate of inflation will increase the initial price, (firms will set a higher nominal price when they change price) and decrease the terminal price (higher rates of inflation will erode the real price more than lower rates will) and this will lead to an increase in the magnitude of each price change. However, the effect of higher rates of inflation on the frequency of price changes is ambiguous. Although it seems intuitive that an increase in the rate of inflation will lead to an increase in the frequency of price changes, Sheshinski and Weiss show that this is not necessarily the case. Its ambiguous effect on the frequency of price changes due to the fact that an increase in the inflation rate not only decreases the benefit of not changing price (real profits are eroded), but also decreases the cost of changing price. Although reduced frequency of price changes in the face of high rates of inflation are shown to be theoretically possible, Sheshinski and Weiss suggest that these instances are not likely to be found in practice. In the example used in their paper the discrete adjustment costs were set at a relatively high level (higher than the maximum profit flow), making frequent price changes undesirable. The authors assert that an increase in the level of real discrete adjustment costs will decrease the frequency of price changes and hence, each change will entail a larger adjustment in prices.

The gain to postponing a price change is measured by the profits just prior to the change plus the interest costs saved on the adjustment costs. The loss is measured by profits just after the price change. At the optimum these gains and losses should be equal. A quadratic profit function (in the absence of production costs a quadratic profit function is obtained from a linear demand function) yielded price change intervals of 1-2 years, even with very low adjustment costs. This can be explained by the fact that the loss of profits is very small in this situation.

Following on Sheshinski and Weiss [1977], Naish [1994] develops an s,S pricing model in a dynamic setting and demonstrates that small menu costs are sufficient to cause firms to set prices infrequently. Naish argues two main points. First, very small fixed adjustment costs often lead to long intervals between price changes, even when the length of the interval is optimally chosen. Second, when the interval between price changes is greater than the optimal the loss of profits by the firm is often negligible. The underlying assumptions of Naish's model are imperfect competition, steady inflation, a constant elasticity demand curve, and a Cobb-Douglas production function. It is also assumed that profits are a function of the real price.

The firm's profit function is flat at its maximum point. Therefore, failure to adjust price in the wake of small exogenous shocks implies small losses, even if price adjustment is costless. If there are costs of price adjustment, a policy of price rigidity may be optimal and provides a microfoundation for sticky prices.

Naish runs simulations with sets of parameters where the parameters chosen for the three scenarios are the most likely to cause infrequent price adjustment, even at high rates of inflation. The first set of simulations incorporate relatively elastic demand curves, an upward sloping marginal cost curve and a relatively flat profit function. The second set of simulations assume a highly elastic demand curve, steep marginal cost curves, and a high degree of curvature in the profit function. This scenario implies that prices should adjust more frequently and that there are large losses associated with deviations from optimal pricing policies. Even with this scenario, Naish finds that losses to the firm are quite small. Parameters used in the third set of simulations imply that the optimal frequency of price adjustment is small and that the losses associated with not changing price are small.

Naish uses three different rates of inflation, 10, 20 and 30 per cent and assumes that the cost of adjustment is relative to the revenues of the firm. He chooses values that seem small, however, none of the costs were verified. He concludes that large deviations from optimal pricing policies imply very small losses to the firm and this provides an explanation for the speed of adjustment or why prices are sticky.

2.6.3 Partial Adjustment vs. s,S Pricing Models

Carlson [1992] investigates the consistency of the two models discussed with empirical evidence on price formation. Overall, he finds that the data are consistent with the s,S model provided that there is heterogeneity in the relative costs to firms of making price changes. This ensures that the frequency and size of changes varies considerably across firms. In many instances the data are also consistent with the partial adjustment model. However, empirical evidence suggests that firms still fix prices for a quarter or more, consistent with an s,S pricing model, but not supportive of a partial adjustment pricing theory. Rotemberg's [1982] model may be an exception to this since it incorporates both lump sum and convex costs of adjustment, and therefore allows for prices to be sticky but also to be adjusted slowly. The evidence Carlson presents is consistent with Sheshinski and Weiss' [1977] quadratic framework and suggests that firms in the US tend to change prices once a year when inflation averages 3.5 per cent and once every six months when it averages 10 per cent.

Carlson analyses data on the average selling price and planned selling price of individual firms. Many firms (over 60 per cent since 1982) did not experience any change in their price over the previous three months and almost 70 per cent did not expect to change their price in the next three months. With an s,S pricing model, this type of behaviour is expected, even with moderate inflation. However, reconciliation with a partial adjustment model is somewhat more difficult. The data support the hypothesis that firms increase prices more frequently when inflation is high and less frequently when inflation is low. Over both periods of high and low inflation, an s,S model with a quadratic profit function is consistent with this observation.

This view is supported by Kashyap [1990] who finds that during a period of high inflation the catalogue price changes which he investigated were not larger, but did occur more frequently. Further support for the s,S pricing theory is offered by Carlton [1986] who finds that firms which keep prices fixed over long periods of time tend to make larger price changes when they do change price.

Carlson and Dunkelberg [1989] find evidence to suggest that firms which increased their price in the last quarter were more likely to plan an increase in the next quarter than were firms which did not increase their price. This evidence is consistent with a partial adjustment model when demand shifts are relatively permanent. It would also seem that this analysis refutes the s,S model, but only if all firms are assumed to make the same percentage price change with the same frequency, only staggered through time. However, if pricing rules are heterogeneous, then the s,S model is also consistent with this evidence.

Additional evidence suggests that price changes generally occur within the first quarter of the year [Seitz, 1986]. Although this is not inconsistent with the Sheshinski-Weiss model, it does suggest that once price change dates have been established they will not be changed due to moderate demand fluctuations. This may indicate the presence of an additional fixed adjustment cost not accounted for by the original s,S pricing rule put in place by the firm.

3 Model, Methodology and Data Description

This section describes the model, methodology and data used in this investigation. The purpose of the investigation is to test for the implications and consistency of micro pricing policies at the aggregate industry level. Specifically, we wish to determine if evidence of pricing behaviour at the industry level of aggregation is consistent with an s,S pricing model. The investigation will also examine the degree of price stickiness across industries and the implications for industry pricing decisions associated with small open economy effects.

Section 3.1 presents a theoretical model which is an s,S pricing model. Section 3.2 describes the empirical model used to examine the implications of price stickiness at the industry level and the remainder of section 3 describes the a priori expectations for the coefficients, the analysis with respect to industry concentration ratios and the data employed.

3.1 Theoretical Model

The theoretical model used in this analysis is Naish's s,S pricing model [1986, 1988, 1994], which is, in turn, founded on the work of Sheshinski and Weiss [1977]. The following clarifies and expands the details of the derivation and analysis of this model.

Notation:

π = real average rate of profit over the interval t=0 to T.

T = interval between price changes.

m = rate of inflation.

C = fixed costs of a nominal price adjustment.

p_t = nominal price charged by the firm at time t.

$\bar{p}_t$ = real price level at time t.

$\bar{p}_0$ = initial real price.

$\bar{p}$ = real price.

$q_t(\bar{p})$ = quantity of the firm's output demanded at time t.

$c(q_t)$ = real average unit cost of production at time t.

π_a = firm's real average profit rate excluding costs of adjustment.

w = real wage.

K = capital stock.

L = labour.

In their models the objective of the firm is to choose T, the interval between price changes, and $\bar{p}_0$, the initial optimal real price just after a price change. This means that the firm's real price over the interval is:

$$\bar{p}(t) = \bar{p}_0 e^{-mt}. \tag{5}$$

It is assumed that the firm faces constant elasticity of demand and cost curves. The firm's demand curve is:

$$q(\overline{p}) = \overline{p}^{-\beta}, \qquad \beta > 1 \tag{6}$$

and it has a Cobb-Douglas production function:

$$q = L^{\alpha}K^{1-\alpha}, \qquad 0 < \alpha < 1. \tag{7}$$

Given real cost curves, the firm's rate of real profit is:

$$f(\overline{p}) = q(\overline{p})[\overline{p} - c(q(\overline{p}))] \tag{8}$$

where c(q) is the firm's real average cost. Equations (5) and (8) imply that the firm's real average rate of profit, net of fixed costs of price adjustment, over the time period from 0 to T is:

$$\pi = \left(\frac{1}{T}\right)\left[\int_0^T f\left(\overline{p}_0 e^{-mt}\right)dt - C\right]. \tag{9}$$

The firm maximizes π subject to $\overline{p}_0$ and T. Differentiating (9) with respect to $\overline{p}_0$ and T results in the first order conditions for a maximum. Differentiating (9) with respect to $\overline{p}_0$:

$$\frac{\partial\pi}{\partial\overline{p}_0} = \int_0^T f'\left(\overline{p}_0 e^{-mt}\right)e^{-mt}dt = 0. \tag{10}$$

To solve (10) we integrate by substitution.

Let $\quad x=\overline{p}_0 e^{-mt}, \qquad f'(x)=f'(\overline{p}_0 e^{-mt}).$

Therefore,

$$dx=-m\,\overline{p}_0 e^{-mt}\,dt \qquad \text{and} \qquad e^{-mt}dt = \frac{-1}{m\overline{p}}dx.$$

The integral now becomes:

$$0 = \int_0^T f'(x)\left(\frac{-1}{m\overline{p}_0}\right)dx$$

$$0 = \left(\frac{-1}{m\overline{p}_0}\right)\int_0^T f'(x)dx$$

$$0 = \left(\frac{-1}{m\overline{p}_0}\right)f(x)\Big|_0^T$$

$$0 = \left(\frac{-1}{m\overline{p}_0}\right)f(\overline{p}_0 e^{-mt})\Big|_0^T .$$

Evaluating the integral:

$$0 = \left(\frac{-1}{m\overline{p}_0}\right)\left[f(\overline{p}_0 e^{-mT}) - f(\overline{p}_0)\right].$$

Therefore,

$$f(\overline{p}_0 e^{-mT}) = f(\overline{p}_0).$$

The firm's real price at time t=T, $\overline{p}_T$, is $\overline{p}_T = \overline{p}_0 e^{-mT}$.

Therefore,

$$f(\overline{p}_T) = f(\overline{p}_0). \tag{11}$$

Differentiating (9) with respect to T:

$$\frac{\partial \pi}{\partial T} = \left[\frac{-1}{T^2}\int_0^T f\left(\overline{p}_0 e^{-mt}\right)dt - C\right] + \frac{1}{T}\frac{\partial}{\partial T}\left[\int_0^T f\left(\overline{p}_0 e^{-mt}\right)dt - C\right]$$

$$\frac{\partial \pi}{\partial T} = \left[\left(-\frac{1}{T}\right)\left(\frac{1}{T}\right)\int_0^T f\left(\bar{p}_0 e^{-mt}\right)dt - C\right] + \frac{1}{T}\frac{\partial}{\partial T}\left[\int_0^T f\left(\bar{p}_0 e^{-mt}\right)dt - C\right]$$

Substituting π and solving the integral:

$$\frac{\partial \pi}{\partial T} = \left(-\frac{1}{T}\right)\pi + \left(\frac{1}{T}\right)\left[\int_0^T \frac{\partial f}{\partial T}\left(\bar{p}_0 e^{-mt}\right)dt + \frac{\partial T}{\partial T} f\left(\bar{p}_0 e^{-mT}\right) - \frac{\partial 0}{\partial T} f\left(\bar{p}_0 e^{-m0}\right)\right]. \quad (12)$$

The derivative with respect to a constant is zero. Therefore, the third term in the brackets of (12) is zero. Also, since $\bar{p}_0$ and e^{-mt} are not a function of T the first term within the brackets is also zero. Therefore,

$$0 = -\frac{1}{T}\pi + \frac{1}{T} f(\bar{p}_0 e^{-mT}).$$

Simplifying:

$$\frac{1}{T}\pi = +\frac{1}{T} f(\bar{p}_0 e^{-mT})$$

$$\pi = f(\bar{p}_0 e^{-mT}).$$

Since $\bar{p}_T = \bar{p}_0 e^{-mT}$,

$$\pi = f(\bar{p}_T). \quad (13)$$

Together, (11) and (13) state that the firm chooses $\bar{p}_0$ and T so that the real rate of profit at time t=0 is the same as the real rate of profit at time t=T and that this is also equal to the average real rate of profit.

The optimal initial real price, $\bar{p}_0$, is determined by substituting for c(q) and q($\bar{p}$) in equation (8) to find the instantaneous rate of profit, which is then substituted into equation (11).

From equation (7), the production function:

$$q^{\frac{1}{\alpha}} = LK^{\frac{(1-\alpha)}{\alpha}}$$

$$L = \frac{1}{K^{\frac{(1-\alpha)}{\alpha}}} q^{\frac{1}{\alpha}}$$

Let $k = \frac{1}{K^{\frac{(1-\alpha)}{\alpha}}}$.

Therefore,

$$L = kq^{\frac{1}{\alpha}}.$$

Let c(q)=wL/q.

Then,

$$f(\overline{p}) = q(\overline{p})[\overline{p} - c(q(\overline{p}))]$$

$$f(\overline{p}) = q\left[\overline{p} - \frac{wL}{q}\right]$$

$$f(\overline{p}) = \overline{p}^{-\beta}\left[\overline{p} - \frac{wk(\overline{p}^{-\beta})^{\frac{1}{\alpha}}}{\overline{p}^{-\beta}}\right]$$

$$f(\overline{p}) = \overline{p}^{1-\beta} - wk\overline{p}^{\frac{-\beta}{\alpha}}. \tag{14}$$

Equation (14) is the firm's instantaneous rate of profit. To solve for the optimal initial real price $\overline{p}_0$, equation (14) is substituted into equation (11):

Therefore,

$$f(\bar{p}_T)=f(\bar{p}_0)$$

$$\bar{p}_0^{1-\beta} - wk\bar{p}_0^{\frac{-\beta}{\alpha}} = \bar{p}_T^{1-\beta} - wk\bar{p}_T^{\frac{-\beta}{\alpha}}.$$

Substitute for $\bar{p}_T$:

$$\bar{p}_0^{1-\beta} - wk\bar{p}_0^{\frac{-\beta}{\alpha}} = (\bar{p}_0 e^{-mT})^{(1-\beta)} - wk(\bar{p}_0 e^{-mT})^{\frac{-\beta}{\alpha}}$$

and gather like terms and simplify:

$$\bar{p}_0^{1-\beta} - (\bar{p}_0 e^{-mT})^{(1-\beta)} = wk\bar{p}_0^{\frac{-\beta}{\alpha}} - wk(\bar{p}_0 e^{-mT})^{\frac{-\beta}{\alpha}}$$

$$\bar{p}_0^{(1-\beta)}(1-e^{-mT(1-\beta)}) = wk\bar{p}_0^{\frac{-\beta}{\alpha}}(1-e^{-mT\left(\frac{-\beta}{\alpha}\right)})$$

$$\bar{p}_0^{(1-\beta+\frac{\beta}{\alpha})} = \frac{wk(1-e^{-mT\left(\frac{-\beta}{\alpha}\right)})}{(1-e^{-mT(1-\beta)})}$$

$$\bar{p}_0^{\frac{(\alpha+\beta-\alpha\beta)}{\alpha}} = \frac{wk(1-e^{-mT\left(\frac{-\beta}{\alpha}\right)})}{(1-e^{-mT(1-\beta)})}.$$

Multiply both sides of the above expression by $\left(\dfrac{-mT(\beta-1)}{-mT\dfrac{\beta}{\alpha}}\right)\left(\dfrac{-mT\dfrac{\beta}{\alpha}}{-mT(\beta-1)}\right)$ and let

$\theta = \alpha+\beta-\alpha\beta$:

$$\bar{p}_0^{\frac{\theta}{\alpha}} = \frac{wk\beta}{\alpha(\beta-1)}\left(\frac{\dfrac{(1-e^{-mT\left(\frac{-\beta}{\alpha}\right)})}{-\dfrac{\beta}{\alpha}mT}}{\dfrac{(1-e^{-mT(1-\beta)})}{(1-\beta)mT}}\right)$$

$$\bar{p}_0 = \left(\frac{wk\beta}{\alpha(\beta-1)}\right)^{\frac{\alpha}{\theta}} \left(\frac{\dfrac{(1-e^{-mT\left(\frac{-\beta}{\alpha}\right)})}{-\dfrac{\beta}{\alpha}mT}}{\dfrac{(1-e^{-mT(1-\beta)})}{(1-\beta)mT}} \right)^{\frac{\alpha}{\theta}} . \tag{15}$$

Let $g(u) = \dfrac{(1-e^{-mT\left(\frac{-\beta}{\alpha}\right)})}{-\dfrac{\beta}{\alpha}mT}$ and $g(v) = \dfrac{(1-e^{-mT(1-\beta)})}{(1-\beta)mT}$.

Then,

$$\bar{p}_0 = \left(\frac{wk\beta}{\alpha(\beta-1)}\right)^{\frac{\alpha}{\theta}} \left(\frac{g(u)}{g(v)}\right)^{\frac{\alpha}{\theta}} . \tag{16}$$

The firm's zero inflation (m=0) profit maximizing real price p_m is derived from equation (15). Evaluating (15) when m=0 results in $0/0$. Therefore, we evaluate the limit of (15) as m goes to zero using L'Hôpital's Rule:

$$\lim_{m\to 0} \frac{(1-e^{-mT\left(\frac{-\beta}{\alpha}\right)})}{-\dfrac{\beta}{\alpha}mT} \quad \text{and} \quad \lim_{m\to 0} \frac{(1-e^{-mT(1-\beta)})}{(1-\beta)mT}.$$

By L'Hôpital's Rule, this is the same as evaluating the derivatives of the numerator and denominator:

$$\lim_{m\to 0} \frac{-e^{-mT\left(\frac{-\beta}{\alpha}\right)}\left(-T\left(\dfrac{-\beta}{\alpha}\right)\right)}{-\dfrac{\beta}{\alpha}T} = 1 \quad \text{and} \quad \lim_{m\to 0} \frac{-e^{-mT(1-\beta)}(-T(1-\beta))}{(1-\beta)T} = 1. \tag{17}$$

Therefore,

$$p_m = \left(\frac{wk\beta}{\alpha(\beta-1)}\right)^{\frac{\alpha}{\theta}}\left(\frac{1}{1}\right)^{\frac{\alpha}{\theta}}$$

$$p_m = \left(\frac{wk\beta}{\alpha(\beta-1)}\right)^{\frac{\alpha}{\theta}}.$$

The firm's average real rate of profit, excluding fixed adjustment costs is:

$$\pi_a = \left(\frac{1}{T}\right)\left[\int_0^T f\left(\bar{p}_0 e^{-mt}\right)dt\right] \tag{18}$$

To find the firm's optimal average real rate of profit excluding fixed adjustment costs we substitute equation (14), the firm's instantaneous rate of profit, into π_a:

$$\pi_a = \left(\frac{1}{T}\right)\int_0^T f\left(\left(\bar{p}_0 e^{-mt}\right)^{(1-\beta)} - wk\left(\bar{p}_0 e^{-mt}\right)^{\frac{-\beta}{\alpha}}\right)dt. \tag{19}$$

Solving the integral:

$$\pi_a = \left(\frac{1}{T}\right)\int_0^T f\left(\bar{p}_0^{(1-\beta)} e^{-mt(1-\beta)} - wk\bar{p}_0^{\frac{-\beta}{\alpha}} e^{-mt\left(\frac{-\beta}{\alpha}\right)}\right)dt$$

$$\pi_a = \frac{1}{T}\left(\frac{\bar{p}_0^{(1-\beta)} e^{-mt(1-\beta)}}{-m(1-\beta)} - \frac{wk\bar{p}_0^{\frac{-\beta}{\alpha}} e^{-mt\left(\frac{-\beta}{\alpha}\right)}}{(-m)\left(\frac{-\beta}{\alpha}\right)}\right)\Bigg|_0^T$$

$$\pi_a = \frac{1}{T}\left[\left(\frac{\bar{p}_0^{(1-\beta)} e^{-mT(1-\beta)}}{-m(1-\beta)} - \frac{wk\bar{p}_0^{\frac{-\beta}{\alpha}} e^{-mT\left(\frac{-\beta}{\alpha}\right)}}{(-m)\left(\frac{-\beta}{\alpha}\right)}\right) - \left(\frac{\bar{p}_0^{(1-\beta)} e^{-m(0)(1-\beta)}}{-m(1-\beta)} - \frac{wk\bar{p}_0^{\frac{-\beta}{\alpha}} e^{-m(0)\left(\frac{-\beta}{\alpha}\right)}}{(-m)\left(\frac{-\beta}{\alpha}\right)}\right)\right]$$

$$\pi_a = \frac{\bar{p}_0^{(1-\beta)} e^{-mT(1-\beta)}}{-mT(1-\beta)} - \frac{wk\bar{p}_0^{\frac{-\beta}{\alpha}} e^{-mT\left(\frac{-\beta}{\alpha}\right)}}{-mT\left(\frac{-\beta}{\alpha}\right)} - \frac{\bar{p}_0^{(1-\beta)}}{-mT(1-\beta)} + \frac{wk\bar{p}_0^{\frac{-\beta}{\alpha}}}{-mT\left(\frac{-\beta}{\alpha}\right)}.$$

Simplify:

$$\pi_a = \frac{\bar{p}_0^{(1-\beta)}\left(e^{-mT(1-\beta)} - 1\right)}{-mT(1-\beta)} + \frac{wk\bar{p}_0^{\frac{-\beta}{\alpha}}\left(1 - e^{-mT\left(\frac{-\beta}{\alpha}\right)}\right)}{mT\left(\frac{-\beta}{\alpha}\right)}$$

and multiply by (-1):

$$\pi_a = \frac{\bar{p}_0^{(1-\beta)}\left(1 - e^{-mT(1-\beta)}\right)}{(mT(1-\beta))} - \frac{wk\bar{p}_0^{\frac{-\beta}{\alpha}}\left(1 - e^{-mT\left(\frac{-\beta}{\alpha}\right)}\right)}{mT\left(\frac{-\beta}{\alpha}\right)}. \tag{20}$$

Substitute g(u) and g(v):

$$\pi_a = \bar{p}_0^{(1-\beta)} g(v) - wk\bar{p}_0^{\frac{-\beta}{\alpha}} g(u).$$

Substitute for $\bar{p}_0$ from (16) and simplify:

$$\pi_a = \left[\left(\frac{wk\beta}{\alpha(\beta-1)}\right)^{\frac{\alpha}{\theta}}\left(\frac{g(u)}{g(v)}\right)^{\frac{\alpha}{\theta}}\right]^{(1-\beta)} g(v) - wk\left[\left(\frac{wk\beta}{\alpha(\beta-1)}\right)^{\frac{\alpha}{\theta}}\left(\frac{g(u)}{g(v)}\right)^{\frac{\alpha}{\theta}}\right]^{\frac{-\beta}{\alpha}} g(u)$$

$$\pi_a = \left(\frac{wk\beta}{\alpha(\beta-1)}\right)^{\frac{\alpha(1-\beta)}{\theta}}\left(\frac{g(u)}{g(v)}\right)^{\frac{\alpha(1-\beta)}{\theta}} g(v) - wk\left(\frac{wk\beta}{\alpha(\beta-1)}\right)^{\frac{-\beta}{\theta}}\left(\frac{g(u)}{g(v)}\right)^{\frac{-\beta}{\theta}} g(u) \tag{21}$$

$$\pi_a = \left(\frac{wk\beta}{\alpha(\beta-1)}\right)^{\frac{\alpha(1-\beta)}{\theta}} g(u)^{\frac{\alpha(1-\beta)}{\theta}}\left(g(v)^{1-\frac{\alpha(1-\beta)}{\theta}}\right) - wkg(u)\frac{1}{\left(\frac{wk\beta}{\alpha(\beta-1)}\right)^{\frac{\beta}{\theta}}\left(\frac{g(u)}{g(v)}\right)^{\frac{\beta}{\theta}}}$$

$$\pi_a = \left(\frac{wk\beta}{\alpha(\beta-1)}\right)^{\frac{\alpha(1-\beta)}{\theta}} g(u)^{\frac{\alpha(1-\beta)}{\theta}} g(v)^{\frac{\beta}{\theta}} - wkg(u)\left(\frac{\alpha(\beta-1)}{wk\beta}\right)^{\frac{\beta}{\theta}}\left(\frac{g(v)}{g(u)}\right)^{\frac{\beta}{\theta}}$$

$$\pi_a = \left(\frac{wk\beta}{\alpha(\beta-1)}\right)^{\frac{\alpha(1-\beta)}{\theta}} g(u)^{\frac{\alpha(1-\beta)}{\theta}} g(v)^{\frac{\beta}{\theta}} - wkg(u)(\alpha(\beta-1))^{\frac{\beta}{\theta}}\left(\frac{1}{wk\beta}\right)^{\frac{\beta}{\theta}}(g(v))^{\frac{\beta}{\theta}}\left(\frac{1}{g(u)}\right)^{\frac{\beta}{\theta}}\left(\frac{\beta}{\beta}\right)$$

$$\pi_a = \left(\frac{wk\beta}{\alpha(\beta-1)}\right)^{\frac{\alpha(1-\beta)}{\theta}} g(u)^{\frac{\alpha(1-\beta)}{\theta}} g(v)^{\frac{\beta}{\theta}} - g(v)^{\frac{\beta}{\theta}}\frac{(\alpha(\beta-1))^{\frac{\beta}{\theta}}}{\beta} wk\beta^{1-\frac{\beta}{\theta}}(g(u))^{1-\frac{\beta}{\theta}}$$

$$\pi_a = \left(\frac{wk\beta}{\alpha(\beta-1)}\right)^{\frac{\alpha(1-\beta)}{\theta}} g(u)^{\frac{\alpha(1-\beta)}{\theta}} g(v)^{\frac{\beta}{\theta}} - g(u)^{\frac{\alpha(1-\beta)}{\theta}} g(v)^{\frac{\beta}{\theta}}\frac{(\alpha(\beta-1))^{\frac{\beta}{\theta}}}{\beta} wk\beta^{\frac{\alpha(\beta-1)}{\theta}}$$

$$\pi_a = g(u)^{\frac{\alpha(1-\beta)}{\theta}} g(v)^{\frac{\beta}{\theta}}\left[\left(\frac{wk\beta}{\alpha(\beta-1)}\right)^{\frac{\alpha(1-\beta)}{\theta}} - \frac{(\alpha(\beta-1))^{\frac{\beta}{\theta}}}{\beta} wk\beta^{\frac{\alpha(\beta-1)}{\theta}}\right]$$

$$\pi_a = g(u)^{\frac{\alpha(1-\beta)}{\theta}} g(v)^{\frac{\beta}{\theta}}\left[wk\beta^{\frac{\alpha(1-\beta)}{\theta}}\left(\frac{1}{(\alpha(\beta-1))^{\frac{\alpha(1-\beta)}{\theta}}} - \frac{(\alpha(\beta-1))^{\frac{\beta}{\theta}}}{\beta}\right)\right]$$

$$\pi_a = g(u)^{\frac{\alpha(1-\beta)}{\theta}} g(v)^{\frac{\beta}{\theta}}\left[wk\beta^{\frac{\alpha(1-\beta)}{\theta}}\left(\frac{\beta}{(\alpha(\beta-1))^{\frac{\alpha(1-\beta)}{\theta}}\beta} - \frac{(\alpha(\beta-1))^{\frac{\alpha(1-\beta)}{\theta}}(\alpha(\beta-1))^{\frac{\beta}{\theta}}}{(\alpha(\beta-1))^{\frac{\alpha(1-\beta)}{\theta}}\beta}\right)\right]$$

$$\pi_a = g(u)^{\frac{\alpha(1-\beta)}{\theta}} g(v)^{\frac{\beta}{\theta}}\left[wk\beta^{\frac{\alpha(1-\beta)}{\theta}}\left(\frac{\beta-\alpha(\beta-1)}{(\alpha(\beta-1))^{\frac{\alpha(1-\beta)}{\theta}}\beta}\right)\right]$$

$$\pi_a = g(u)^{\frac{\alpha(1-\beta)}{\theta}} g(v)^{\frac{\beta}{\theta}}\left[\left(\frac{wk\beta}{(\alpha(\beta-1))}\right)^{\frac{\alpha(1-\beta)}{\theta}}\left(\frac{\beta-\alpha(\beta-1)}{\beta}\right)\right]$$

$$\pi_a = g(u)^{\frac{\alpha(1-\beta)}{\theta}} g(v)^{\frac{\beta}{\theta}} \left[\left(\frac{wk\beta}{(\alpha(\beta-1))} \right)^{\frac{\alpha(1-\beta)}{\theta}} \left(\frac{\theta}{\beta} \right) \right]. \tag{22}$$

To find zero-inflation (m=0) maximized profits, L'Hôpital's Rule is applied. Using the results from equation (17):

$$\pi_m = (1)^{\frac{\alpha(1-\beta)}{\theta}} (1)^{\frac{\beta}{\theta}} \left[\left(\frac{wk\beta}{(\alpha(\beta-1))} \right)^{\frac{\alpha(1-\beta)}{\theta}} \left(\frac{\theta}{\beta} \right) \right]$$

$$\pi_m = \left(\frac{wk\beta}{(\alpha(\beta-1))} \right)^{\frac{\alpha(1-\beta)}{\theta}} \left(\frac{\theta}{\beta} \right). \tag{23}$$

Equations (9) and (18) imply

$$\pi = \pi_a - \frac{C}{T}. \tag{24}$$

This implies that a shorter interval between price changes increases both the average rate of profit and the costs of adjustment. An optimal frequency of price adjustment, T, balances these two effects in order to maximize the average rate of profit over time.

The nominal price is held constant over an interval T. Due to inflationary effects the real price drifts continuously from the initial price $\overline{p}_0$ to a lower price at the end of the period, $\overline{p}_T$, at which point the nominal price changes and the real price jumps up to the "new" initial real price $\overline{p}_0$.

The gain from postponing a price change is the profit just prior to a price change, $f(\overline{p}_T)$, while the loss incurred from not changing the price in the present period is the profit just after a price change, $f(\overline{p}_0)$ less the fixed cost of adjustment.

Naish [1994] states that it is not possible to explicitly solve for T^*, the optimal interval. However, from equations (13), (14), (22) and (24) T^* is implicitly defined as a function of fixed adjustment costs, C, the rate of inflation, m, and the parameters α and β. Naish estimates the optimal T^* using the standard formula derived by Mussa [1981], Rotemberg [1983], and Benabou and Konieczny [1993].

The assumptions underlying the derivation of this formula are consistent with Naish's [1994] model. It is assumed that there is a cost associated with changing prices and that given this cost, it is optimal to adjust price only at discrete intervals and by finite amounts. Deviations from the optimum occur between price changes. The optimal interval between price changes balances the marginal cost of changing prices more frequently with the marginal gains.

The optimal interval between price changes is approximated to be:

$$T^* \approx \left[\frac{12C}{-G''(z)}\right]^{\frac{1}{3}} (m)^{\frac{-2}{3}} \tag{25'}$$

where G(z) is the firm's rate of profit and z is the log of its price.

Let $\overline{p} = e^z$ and substitute in equation (14):

$$G(z) = e^{z(1-\beta)} - wke^{z\left(\frac{-\beta}{\alpha}\right)}$$

$$G'(z) = (1-\beta)e^{z(1-\beta)} - \left(\frac{-\beta}{\alpha}\right)wke^{z\left(\frac{-\beta}{\alpha}\right)}$$

$$G''(z) = (1-\beta)^2 e^{z(1-\beta)} - \left(\frac{\beta^2}{\alpha^2}\right)wke^{z\left(\frac{-\beta}{\alpha}\right)}. \tag{25}$$

Equation (25) is evaluated at the profit maximizing real price p_m. Let z_m=log p_m. Substituting in (25) for p_m:

$$G''(z_m) = (1-\beta)^2\left(\frac{wk\beta}{\alpha(\beta-1)}\right)^{\frac{\alpha}{\theta}(1-\beta)} - wk\left(\frac{\beta^2}{\alpha^2}\right)\left(\frac{wk\beta}{\alpha(\beta-1)}\right)^{\left(\frac{\alpha}{\theta}\right)\left(\frac{-\beta}{\alpha}\right)}$$

$$G''(z_m) = (1-\beta)^2\left(\frac{wk\beta}{\alpha(\beta-1)}\right)^{\frac{\alpha(1-\beta)}{\theta}} - wk\left(\frac{\beta^2}{\alpha^2}\right)\left(\frac{wk\beta}{\alpha(\beta-1)}\right)^{\frac{-\beta}{\theta}}$$

$$G''(z_m) = (1-\beta)^2\left(\frac{wk\beta}{\alpha(\beta-1)}\right)^{\frac{\alpha(1-\beta)}{\theta}} - wk\left(\frac{\beta^2}{\alpha^2}\right)\left(\frac{\alpha(\beta-1)}{wk\beta}\right)^{\frac{\beta}{\theta}}\left(\frac{\beta}{\beta}\right)$$

$$G''(z_m) = (1-\beta)^2\left(\frac{wk\beta}{\alpha(\beta-1)}\right)^{\frac{\alpha(1-\beta)}{\theta}} - \left(\frac{\beta^2}{\alpha^2}\right)wk\beta\left(\frac{1}{wk\beta}\right)^{\frac{\beta}{\theta}}\frac{(\alpha(\beta-1))^{\frac{\beta}{\theta}}}{\beta}$$

$$G''(z_m) = (1-\beta)^2\left(\frac{wk\beta}{\alpha(\beta-1)}\right)^{\frac{\alpha(1-\beta)}{\theta}} - \left(\frac{\beta^2}{\alpha^2}\right)wk\beta^{1-\frac{\beta}{\theta}}\frac{(\alpha(\beta-1))^{\frac{\beta}{\theta}}}{\beta}$$

$$G''(z_m) = wk\beta^{\frac{\alpha(1-\beta)}{\theta}}\left[(1-\beta)^2\left(\frac{1}{(\alpha(\beta-1))}\right)^{\frac{\alpha(1-\beta)}{\theta}} - \left(\frac{\beta^2}{\alpha^2}\right)\frac{(\alpha(\beta-1))^{\frac{\beta}{\theta}}}{\beta}\right]$$

$$G''(z_m) = wk\beta^{\frac{\alpha(1-\beta)}{\theta}}\left[\frac{(1-\beta)^2\alpha^2\beta}{(\alpha(\beta-1))^{\frac{\alpha(1-\beta)}{\theta}}\alpha^2\beta} - \frac{\beta^2(\alpha(\beta-1))^{\frac{\beta}{\theta}}(\alpha(\beta-1))^{\frac{\alpha(1-\beta)}{\theta}}}{(\alpha(\beta-1))^{\frac{\alpha(1-\beta)}{\theta}}\alpha^2\beta}\right]$$

$$G''(z_m) = wk\beta^{\frac{\alpha(1-\beta)}{\theta}}\left[\frac{(1-\beta)^2\alpha^2\beta}{(\alpha(\beta-1))^{\frac{\alpha(1-\beta)}{\theta}}\alpha^2\beta} - \frac{\beta^2(\alpha(\beta-1))}{(\alpha(\beta-1))^{\frac{\alpha(1-\beta)}{\theta}}\alpha^2\beta}\right]$$

$$G''(z_m) = wk\beta^{\frac{\alpha(1-\beta)}{\theta}}\left[\frac{(1-\beta)^2\alpha^2\beta}{(\alpha(\beta-1))^{\frac{\alpha(1-\beta)}{\theta}}\alpha^2\beta} + \frac{\beta^2(\alpha(1-\beta))}{(\alpha(\beta-1))^{\frac{\alpha(1-\beta)}{\theta}}\alpha^2\beta}\right]$$

$$G''(z_m) = wk\beta^{\frac{\alpha(1-\beta)}{\theta}}\left[\frac{[(1-\beta)\alpha\beta][\alpha(1-\beta)+\beta]}{(\alpha(\beta-1))^{\frac{\alpha(1-\beta)}{\theta}}\alpha^2\beta}\right]$$

$$G''(z_m) = \left(\frac{wk\beta}{(\alpha(\beta-1))}\right)^{\frac{\alpha(1-\beta)}{\theta}}\left[\frac{[(1-\beta)\alpha\beta]\theta}{\alpha^2\beta}\right]$$

$$G''(z_m) = \left(\frac{wk\beta}{(\alpha(\beta-1))}\right)^{\frac{\alpha(1-\beta)}{\theta}}\left(\frac{(1-\beta)\theta}{\alpha}\right)$$

$$G''(z_m) = -\left(\frac{(\beta-1)\theta}{\alpha}\right)p_m^{(1-\beta)}. \tag{26}$$

From (21) optimal total revenue, TR, is:

$$TR = \left(\frac{wk\beta}{\alpha(\beta-1)}\right)^{\frac{\alpha(1-\beta)}{\theta}}\left(\frac{g(u)}{g(v)}\right)^{\frac{\alpha(1-\beta)}{\theta}} g(v). \tag{27}$$

To find the zero inflation optimal total revenues, TR_m, (27) is evaluated at m=0. As demonstrated in the derivation of the firm's zero inflation profit maximizing price, by L'Hôpital's Rule, as m goes to zero, g(u) and g(v) go to one. Therefore,

$$TR_m = \left(\frac{wk\beta}{\alpha(\beta-1)}\right)^{\frac{\alpha(1-\beta)}{\theta}} = p_m^{(1-\beta)}. \tag{28}$$

From (24):

$$\pi_m = \left(\frac{\theta}{\beta}\right) TR_m$$

$$TR_m = \left(\frac{\beta}{\theta}\right)\pi_m = G(z_m)\left(\frac{\beta}{\theta}\right). \qquad (28')$$

Substituting sequentially, equation (28) and (28′) into equation (26):

$$G''(z_m) = -\left(\frac{(\beta-1)\theta}{\alpha}\right)TR_m = -\left(\frac{(\beta-1)\theta}{\alpha}\right)G(z_m)\left(\frac{\beta}{\theta}\right)$$

Rearranging terms:

$$\frac{G''(z_m)}{G(z_m)} = -\frac{\frac{(\beta-1)\theta}{\alpha}}{\frac{\theta}{\beta}} = -\frac{\beta(\beta-1)}{\alpha}. \qquad (29)$$

Equation (29) measures the curvature of the profit rate function around the profit maximizing real price. As β goes to one, $\frac{G''(z_m)}{G(z_m)} \approx 0$, or the curve is flat.

Let $C = \frac{1}{A}TR_m$. Substituting (26) into T^*:

$$T^* = \left[\frac{\frac{12TR_m}{A}}{\left[\frac{\theta(\beta-1)}{\alpha}\right]TR_m}\right]^{\frac{1}{3}}(m)^{\frac{-2}{3}} = \left[\frac{12TR_m}{A}\left(\frac{\alpha}{\theta(\beta-1)TR_m}\right)\right]^{\frac{1}{3}}(m)^{\frac{-2}{3}}$$

$$T^* = \left[\frac{12}{A}\left(\frac{\alpha}{\theta(\beta-1)}\right)\right]^{\frac{1}{3}}(m)^{\frac{-2}{3}}. \qquad (30)$$

The parameters which affect the optimal T^* are the inflation rate, m, fixed costs of price adjustment, C, the elasticity of demand, β, and the slope of the marginal cost curve, α. As the inflation rate increases, T^* falls or the optimal interval between price changes becomes shorter (prices are changed more frequently). As fixed adjustment costs, C, increase, T^* increases and prices are changed less frequently.

The effect of α and β on T^* varies, depending on the combination of the slopes of the demand and marginal cost curves. As Naish [1994] outlines in the description of three simulations, a highly elastic demand curve combined with a fairly steep marginal cost curve results in a very curved profit function, which implies more frequent price adjustment. Conversely, the same marginal cost curve, in combination with an inelastic demand curve, results in a fairly flat profit function and implies that the optimal frequency of price adjustment is low (T^* is large) and deviations from the optimal pricing policy are associated with small losses.

An industry price equation consists of several firms setting price as described. However, when many firms set price the relative prices of the individual firms are interdependent and this must be accounted for in the industry price model.

As argued in Naish [1988] the aggregate industry price level can be defined as a weighted geometric average of the individual firm prices. This means that either the sum of the logs of the relative prices equals zero (geometric average) or the sum of the weighted relative prices equals one (arithmetic average). This relationship is based on the following assumptions:

(1) no two firms change price at exactly the same time;

(2) the interval T between price changes is, in general, different across firms and as n becomes large T uniformly goes to zero;

(3) the weight a_i on firm i is independent of the time at which firm i changes its price.

Together these assumptions: ensure that the industry price level changes continuously when n is large; allow for the average real price of a single firm to be represented as an integral; ensure that if there is a shock to which several firms respond to by changing prices then the behaviour of several firms changing price at the same time will not continue indefinitely into the future; and, that the aggregate rate of inflation in the industry is approximately constant over time (unless exogenous shocks to the industry occur).

3.2 Empirical Methodology

3.2.1 Others and Their Methods

In empirical investigations on industry price formation it is common practice to use lagged prices as an explanatory variable. Rotemberg [1982] notes that numerous empirical studies include lagged prices as an important explanatory variable of current prices. Kardasz and Stollery [1988] investigate the response of domestic prices to their domestic and foreign determinants for a broad range of Canadian manufacturing industries. Their model is based on a partial adjustment model within a small open economy. In addition to a lagged price variable, the explanatory variables they use are foreign price, input prices, which include capital stock and the state of technology, and material inputs, and a demand pressure variable, defined as a weighted average of the output levels of major using industries. Henley [1988] models price in the United Kingdom coal industry using a first-difference equation with price as a function of demand, measured by capacity utilization, and the price, lagged. A more detailed model of price is presented by Maccini [1981]. Maccini formulates his price model as a single, first-difference equation, with price as function of finished goods inventories, unfilled orders, the number of employees, the stock of raw materials, and the capital stock, all lagged one period, demand, wages, the raw materials price, all with various lag structures, and the stock of money and the output price itself, both with various lag structures. All variables are represented as natural logarithms.

Many studies have included a measure of foreign influences as explanatory variables, particularly in cases where the economy under investigation is a relatively open economy. In addition to Kardasz and Stollery [1988], Frantzen [1986] includes foreign price as an explanatory variable and assumes that its lag is, at most, two quarters. Other investigations which include the effect of foreign influences on domestic prices include Esposito and Esposito [1971], Dixon [1983], Newmann, Böbel and Haid [1983] and Odagiri and Yamashita [1987]. Since Canada is a small open economy it is reasonable to assume that prices may be influenced by foreign prices.

Frantzen [1986] uses a first difference equation to model price formation in Belgian industries. Among his explanatory variables are costs of material inputs and labour. Other authors have included industry concentration as an explanatory variable of prices or profit rates, including Esposito and Esposito [1971], Dixon [1983], Neumann, Böbel, and Haid [1983], Odagiri and Yamashita [1987] and Kardasz and Stollery [1988].

Studies more oriented towards the micro-foundations of the industry include advertising sales ratios to capture the market power of the firm. Advertising sales ratios are generally used as a proxy for product differentiation. This approach is employed by Odagiri and Yamashita [1987], while Neumann, Böbel and Haid [1983] use the number of trade marks registered by a firm. Neumann, Böbel and Haid also use import ratios and the degree of vertical integration.

3.2.2 An Empirical Model

Ideally, our empirical model should be directly based on our theoretical model. In other words, fixed adjustment costs should be explicitly included in the empirical analysis. However, this is a nontrivial exercise and beyond the scope of this thesis. For purposes of this analysis, the impact of adjustment costs will be implicitly modelled. The formal incorporation of fixed adjustment costs is left for future work.

This thesis is interested in the unit return to capital and the impact of per unit input cost changes and other influences, on that return. The theoretical model outlined above analyses the implications of firms maximizing the average real rate of profit over the interval between price changes subject to the cost of price adjustment. The average real rate of profit at the beginning and at the end of the period between price changes is the same and both are equal to the real average rate of profit over the interval. Therefore, the firm's objective is to maximize the average real rate of profit over the interval between price changes by choosing the optimal initial real price and the length of the interval.

In section 3.1 it was demonstrated that the optimal interval, T^*, is a function of the inflation rate, m, fixed costs of price adjustment, C, and the parameters α and β, while the optimal initial real price for any interval is a function of the real wage, w, the inflation rate, m, the length of the interval between price changes, T, and the parameters α and β.

The optimal average real rate of profit over the interval T, net of fixed costs of price adjustment is given by equation (22). An increase in the real wage, w, or other input costs, shifts the cost curve upwards and the average real profit rate, or profit per unit of output, falls. Without fixed costs of price adjustment this causes firms to increase price, which leads to a decline in output and profit per unit of output increases. If firms are able to adjust price quickly, then it would appear that for a given increase in costs per unit of output (wages), there is little impact on the per unit rate of profit. However, if there are lags in the adjustment process then price will not adjust quickly and the profit rate will fall. Once price adjusts, the average profit rate will adjust to a new optimal rate.

Differentiating equation (24) with respect to C, total fixed adjustment costs:

$$\pi = \pi_a - \frac{C}{T}$$

$$d\pi = -\left(\frac{TdC}{T^2} - \frac{CT'dC}{T^2}\right)$$

$$d\pi = -\frac{1}{T}\left(dC - \frac{CT'dC}{T}\right)$$

$$\frac{d\pi}{dC} = -\frac{1}{T}\left(1 - \frac{CT'}{T}\right).$$

where $T' = \frac{dT}{dC}$. Therefore,

$$\frac{d\pi}{dC} = -\frac{1}{T}\left(1 - \frac{\frac{dT}{dC}}{\frac{T}{C}}\right)$$

Let $\varepsilon = \frac{\frac{dT}{dC}}{\frac{T}{C}}$. Therefore, if $\varepsilon<1$, $\frac{d\pi}{dC} < 0$, or as fixed costs of price adjustment increase, the average real rate of profit falls. Therefore, with large fixed costs of price adjustment the firm may choose not to adjust price immediately. This can be seen formally from (25'). Differentiating T^* with respect to C:

$$\frac{dT^*}{dC} \approx \frac{1}{3}\left[\frac{12C}{-G''(z)}\right]^{\frac{-2}{3}} (m)^{\frac{-2}{3}} \left(\frac{12}{-G''(z)}\right) > 0$$

since $G''(z)<0$. As fixed adjustment costs increase, the interval between price changes increases, or price changes become less frequent. Multiplying by $\frac{T^*}{C}$:

$$\frac{\frac{dT^*}{dC}}{\frac{T^*}{C}} \approx \frac{\frac{1}{3}\left[\frac{12C}{-G''(z)}\right]^{\frac{-2}{3}} (m)^{\frac{-2}{3}} \left(\frac{12}{-G''(z)}\right)}{\frac{\left[\frac{12C}{-G''(z)}\right]^{\frac{1}{3}} (m)^{\frac{-2}{3}}}{C}}$$

which simplifies to

$$\frac{\frac{dT^*}{dC}}{\frac{T^*}{C}} \approx \frac{\frac{1}{3}\left(\frac{1}{-G''(z)}\right)}{\frac{\left[\frac{C}{-G''(z)}\right]}{C}} \approx \frac{1}{3} < 1$$

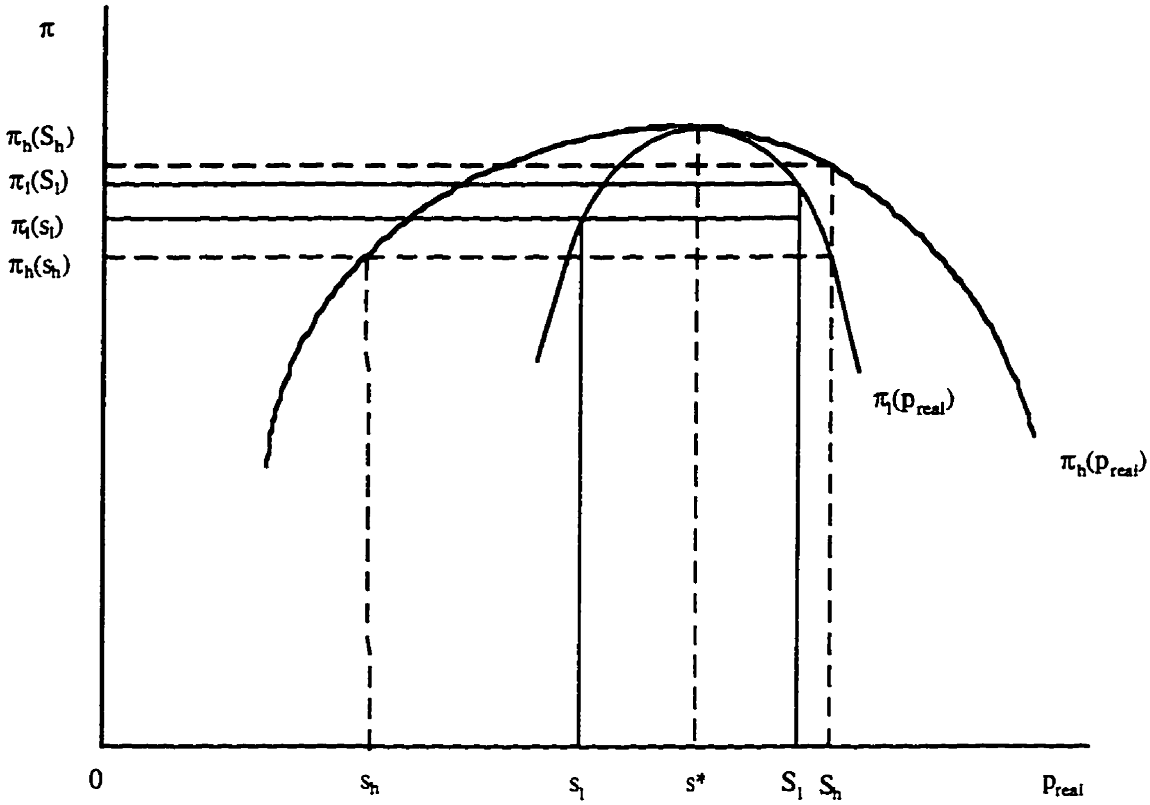
Therefore,

$$\frac{d\pi}{dC} = -\frac{1}{T}\left(1 - \frac{1}{3}\right) = -\frac{1}{T}\left(\frac{2}{3}\right) = \frac{-2}{3T} < 0. \qquad (31)$$

As fixed costs of price adjustment increase the real average rate of profit declines.

The effect of α and β on T^* varies, depending on the combination of the slopes of the demand and marginal cost curves. As Naish [1994] outlines, a highly elastic demand curve combined with a fairly steep marginal cost curve results in a very curved profit function, which implies more frequent price adjustment. Conversely, the same marginal cost curve, in combination with an inelastic demand curve, results in a fairly flat profit function and implies that the optimal frequency of price adjustment is low (T^* is large).

Figure 2



The empirical model estimated in this paper will be used to examine the implications of the theoretical models of Sheshinski and Weiss [1977] and Naish [1986, 1988, 1994] on industry pricing and the effects on the unit return to capital and draws on the empirical models outlined above. The empirical model to be estimated is of the form:

$$\begin{aligned}\Delta UCY_{jt} = \beta_0 + \beta_1 \Delta ULY_{jt} + \beta_2 \Delta ULY_{jt-1} + \beta_3 \Delta UMY_{jt} + \beta_4 \Delta UMY_{t-1} + \\ \beta_5 \Delta CAP_{jt} + \beta_6 \Delta CAP_{jt-1} + \beta_7 \Delta GMP_{jt} + \beta_8 \Delta GMP_{jt-1} + \mu_{jt}\end{aligned} \tag{32}$$

$\beta_1<0,\ \beta_2\geq 0;$ $\beta_3<0,\ \beta_4\geq 0;$

$\beta_1>0,\ \beta_2=0;$ $\beta_3>0,\ \beta_4=0;$

$\beta_1=0,\ \beta_2=0;$ $\beta_3=0,\ \beta_4=0;$

$\beta_5>0;\ \beta_6>0;\ \beta_7\geq 0;\ \beta_8\geq 0.$

where:

$$UCY_{jt}=\frac{RC_{jt}/P_t}{GOK_{jt}} \qquad ULY_{jt}=\frac{W_{jt}/P_t}{GOK_{jt}}$$

$$UMY_{jt}=\frac{MAT_{jt}/P_t}{GOK_{jt}} \qquad CAP_{jt}=\frac{GDP_{jt}}{CAPSTOCK_{jt}}$$

For industry j at time t:

UCYjt: unit return to capital

RCjt: return to capital

Pt: GDP price deflator for total economy

GOKjt: real gross output

ULYjt: unit labour costs

Wjt: wage bill (including supplementary labour income)

UMYjt: unit material input costs

MAT_{jt}: material input costs

CAPjt: capacity utilization

GDPjt: real gross domestic product

CAPSTOCKjt: capital stock, including structures and machinery and equipment

GMPjt: gross import price

The unit return to capital is used as a proxy of the average rate of profit since a separate measure for industry profits is not available. Input costs are split into unit wage costs and unit material costs. In addition, to disaggregating input costs, capacity utilization is used to capture the effect of changes in demand and the gross import price measures the degree to which the domestic industry acts as a price taker (a factor relevant in a small open economy environment).

The OLS estimation technique is applied. In some instances dummy variables are incorporated to account for shifts in the function. These shifts imply that the constant term changes in response to special events while the coefficients remain constant. Special events would include abnormal conditions, such as recessions, strikes and changes in taxation structures.

3.3 Coefficients: A Priori Expectations

3.3.1 High Pass-Through

Under the hypothesis of high pass-through $\beta_1>0$, $\beta_2=0$. This may indicate that the industry uses a mark-up over cost pricing rule. It also suggests that adjustment costs may not be large in this industry and therefore it is optimal for the industry or firms to adjust price quickly. If price is adjusted fully in the current period, then it is expected that $\beta_2=0$, or no further adjustment is necessary in the next period. A similar argument holds for β_3 and β_4. In addition, it may be that the mark-up over costs pricing rule used refers only to increases in either labour or materials but not both. In this case only the coefficients pertaining to the mark-up rule will be nonzero.

If $\beta_1=0$ and $\beta_3=0$ then any increase in wages or material costs is fully passed through to price leaving the return to capital unaffected. Since costs are fully passed through in the current period there should be no effect in period t+1 of an increase in wages or material costs in period t. Therefore, it is expected a priori that $\beta_2=0$ and $\beta_4=0$. These industries would also be facing relatively low costs of adjustment.

If $\beta_1<0$ or $\beta_3<0$, then the industry is not able to immediately pass through wage or material cost increases. However, this may be optimal behaviour for the industry if adjustment costs are large. It may also be an indication that firms in this industry are world price takers and therefore, are unable to increase price when domestic costs of production increase.

Although it may not be optimal for firms in the industry to adjust price in the current period due to large costs of adjustment, it may be optimal to adjust price in the following period. Therefore, $\beta_2>0$ and $\beta_4>0$. One would expect that, in real terms, firms in the industry would try to set price such that the return to capital over the entire period is maximized. Therefore, it would not be unreasonable to suggest that $\beta_2>|\beta_1|$ or $\beta_3>|\beta_4|$ as possible outcomes. In addition, if this industry also uses a mark-up over costs pricing rule but also has large costs of adjustment, then this is feasible. However, if cost increases are only offset by price increases and the return to capital lost in previous periods is not recouped, then it is expected that $\beta_2=|\beta_1|$ and $\beta_3=|\beta_4|$.

3.3.2 Low Pass-Through

If $\beta_1<0$ or $\beta_3<0$, then the industry is not able to immediately pass through wage or material cost increases. However, this may be optimal behaviour for the industry if adjustment costs are large.

If $\beta_2=0$ and $\beta_4=0$, it suggests that the industry is not able to recoup losses due to an increase in wage or material costs. This would be an indication of an industry which is a world price taker and is therefore unable to adjust its price due to domestic cost increases. Thus, the return to capital is squeezed.

3.3.3 Moderate Pass-Through

Between the extremes of industries with high pass-through and those with low pass-through are industries which may be characterized as having moderate pass-through ability. The coefficients on ULY_t, ULY_{t-1}, UMY_t and UMY_{t-1} in this group would include various combinations of the characteristics of coefficients within the high and low pass-through groups. As well, these industries may face high costs of adjustment with respect to one of these major inputs but not the other. Likewise, they may be able to fully pass through cost increases with respect to one input and not the other. For instance, if the industry is an international price taker it is likely that unit material costs are also determined in world markets. Therefore, not only would firms in the domestic industry experience a cost increase but so would firms in the same industry in other countries. It is therefore likely that the world price would increase when unit material costs increase.

3.3.4 Other Coefficients

It is expected a priori that the coefficients on capacity utilization, β_5 and β_6, are positive. That is, as demand increases, capacity utilization increases and the return to capital increases.

On the foreign price, two outcomes are intuitive. If the industry is not influenced by a foreign price, that is, if it is not a price taker in the international economy, then $\beta_7=0$ and $\beta_8=0$. However, if the industry is a foreign price taker, that is, if the industry has very little ability to influence price, then $\beta_7>0$, $\beta_8>0$. It may also be the case that $\beta_7=0$, $\beta_8>0$ or $\beta_7>0$, $\beta_8=0$, depending on how quickly foreign price increases are passed through to the domestic price.

3.4 Industry Concentration Ratio Analysis

Not only is industry concentration an indication of market structure, it is also an indicator of market power. There is no one ideal measure of concentration since opinions differ on the relative importance of the different concepts used to measure the size-distribution of firms.

The most widely used measure of concentration is the concentration ratio or CRn which is defined as the share of output, sales, employment, or some other base, of the largest n firms in an industry. In general, the concentration ratio of the largest three, four or five firms is used, although there is no economic justification for this number except that an oligopoly is defined as industry dominance by a few firms.

In general, concentration is measured with respect to domestic industries. However, if there is competition from imports then a high degree of concentration within an industry may be of less concern in price determination. Domestic concentration may still be of concern in this situation, however, particularly if the industry is considered to be of some national importance and its success or failure is dependent on a few firms.

In this analysis, once coefficients are estimated for each industry, their relation to concentration in a given industry is investigated. The regression coefficients on the equations which estimate return to capital will either suggest that an industry has some or full ability to pass through cost increases to price in the current period or that it does not. After two periods it is expected that costs will be passed through, in varying degrees, in all industries. Grouping moderate and low pass-through together, this suggests the following possible outcomes:

1) high pass through, high concentration: $\beta_1 \geq 0$, $\beta_2 = 0$; $\beta_1 < 0$, $\beta_2 > 0$
$\beta_3 \geq 0$, $\beta_4 = 0$; $\beta_3 < 0$, $\beta_4 > 0$.
2) high pass through, low concentration: $\beta_1 \geq 0$, $\beta_2 = 0$; $\beta_1 < 0$, $\beta_2 > 0$
$\beta_3 \geq 0$, $\beta_4 = 0$; $\beta_3 < 0$, $\beta_4 > 0$.
3) low pass through, low concentration: $\beta_1 < 0$, $\beta_2 \geq 0$; $\beta_3 < 0$, $\beta_4 \geq 0$.
4) low pass through, high concentration: $\beta_1 < 0$, $\beta_2 \geq 0$; $\beta_3 < 0$, $\beta_4 \geq 0$.

Case (1), where the concentration ratio suggests that an industry is highly concentrated and the coefficients suggest the ability to exercise full pass-through of cost increases may be an indication of industries with market power. If $\beta_1 = 0$, $\beta_2 = 0$, $\beta_3 = 0$, $\beta_4 = 0$, then this indicates an industry which faces relatively low costs of adjustment and, therefore, it is optimal for firms in this industry to adjust price quickly. If β_1 or β_3>0,then β_2 and β_4=0. This would be an indication that the industry follows a mark-up over costs rule. Again, the industry likely faces relatively low costs of adjustment. If β_1<0 or β_3<0 then this is an indication of an industry which may face relatively high costs of adjustment. Therefore, it adjusts price over two periods, but is still able to fully pass through cost increases.

The explanation for pass-through ability in case (1) is also relevant for case (2). These industries are not concentrated though, so it does not seem reasonable that they could have market power. However, this may be the case if the industry is protected, that is if the industry has excessively high import tariffs protecting the domestic market.

Industries under case (3) would be competitive industries (price takers). If these industries compete on international markets then it is likely that the import price plays a significant role in the determination of the return to capital. It is possible that these industries could have either high or low costs of adjustment.

Similar arguments hold for case (4). Even though these industries are concentrated and should therefore have the market power to increase price sufficiently to offset any negative effects on profits they are not able to prevent profits from being squeezed. Therefore, it is likely that β_7 and or β_8>0. Although the industry may be concentrated domestically it is a world price taker. Therefore, it cannot fully adjust price when domestic costs increase. The foreign price determines domestic industry profit rates.

3.5 The Data

The data employed in this paper are compiled by Statistics Canada and are reported in Catalogues 31-402: **Industrial Organization and Concentration in Manufacturing, Mining and Logging Industries**, and 15-201: **The Input-Output Structure of the Canadian Economy**. Capital stock measures were obtained from the Wealth and Capital Stocks Division. Concentration statistics are based on Statistics Canada's 4-digit Standard Industrial Classification (SIC), while data from the System of National Accounts are at the L level of aggregation corresponding to a mixture of 3- and 4-digit SIC codes.

All data series used in the estimation procedure are annual time series and generally cover the period from 1961 to 1992. Concentration ratio data are for 1986. In general, there were 29 observations for any given regression estimation.

Gross import prices are a weighted sum of the commodity import prices for a given industry and include tariffs and transportation costs to the border. These prices are in Canadian dollars and include any effects of exchange rate changes.

There are several aggregate price deflators which one can use to deflate nominal data series. The Consumer Price Index (CPI) measures the prices of a basket of consumer goods. Therefore, it reflects prices as experienced by the consumer. However, a GDP deflator measures producers' prices and for this reason is employed in this analysis. The aggregate deflator for GDP at factor cost is used rather than the aggregate deflator for GDP at market prices since the latter includes indirect taxes (such as the Goods and Services Tax (GST)) and subsidies. The prices in the equations to be estimated should be unaffected by changes in indirect taxes and hence, these movements are excluded by using the aggregate deflator for GDP at factor cost. Generally, the three deflators grow at approximately the same rate. However, growth rates of these price indexes vary in any given year by as much as 3.9 percentage points, reflecting the differences in what each index captures.

4 Empirical Results and Analysis

Each estimated equation has unit labour and unit material costs as explanatory variables and it is these two costs combined which determine the industry's variable costs. Therefore, the coefficients from these two terms are considered together.

Industry concentration is used to determine into which of the four categories described earlier a given industry falls and is also examined in evaluating and explaining an industry's pass-through ability. Industries with concentration ratios greater than or equal to 50 per cent were considered to be highly concentrated. In some instances the concentration ratio data used in this analysis were more disaggregated than required. For these industries, a weighted average of the concentration ratios of the pertinent sub-industries was used to proxy a concentration ratio for the aggregate industry. These weights were calculated using each sub-industry's share of total shipments of the industry in question, scaled by its concentration ratio. The coefficients on the import price are also used as an explanation for pass-through ability.

If a coefficient was not significantly different from zero as indicated by the t-statistic, the coefficient was assumed to be zero. The estimated coefficient was used if the relevant t-statistic was significant, at a minimum, at the 10 per cent level. In most cases the t-statistics were significant at the 5 per cent level.

Overall, the results from 77 of the 95 regressions run were consistent with the a priori assumptions on the coefficients of β_1, β_2, β_3, and β_4, although in some cases the Durbin

Watson statistic presented inconclusive results as to whether or not first order autocorrelation was present and some of the R^2 values were not particularly high (meat and meat products (R^2=.516), other office furniture and fixtures (R^2=.564), plastic products (R^2=.567), clothing (R^2=.598), other metal rolling, casting and extruding (R^2=.596)).[1]

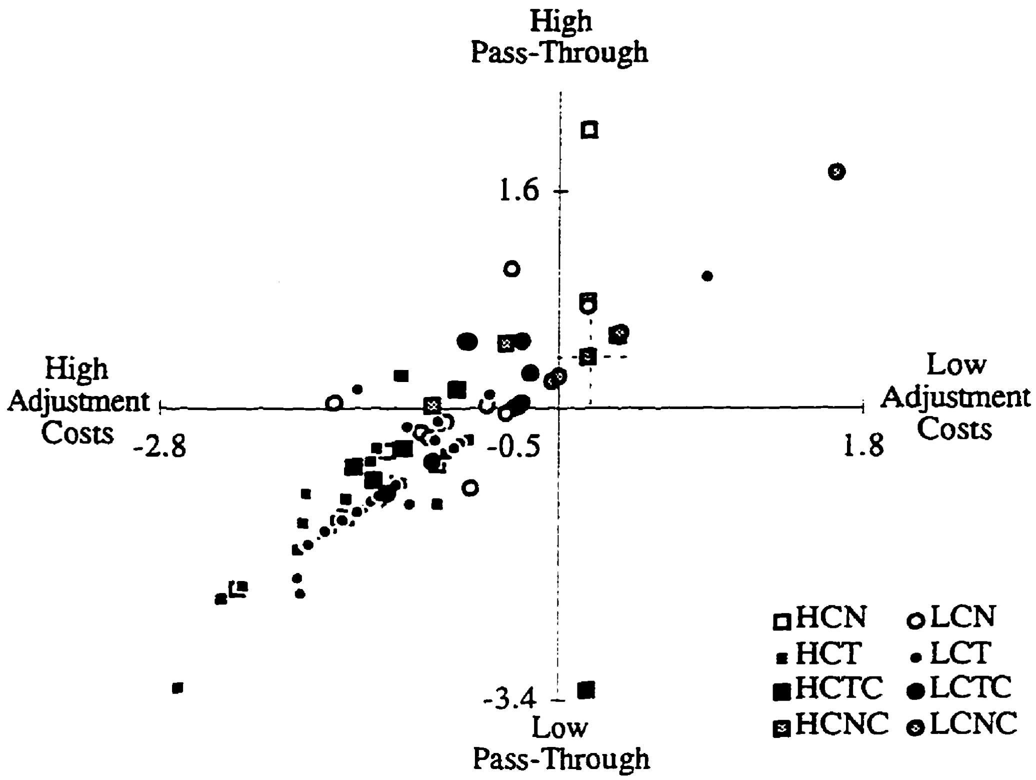
In general, there tended to be a distinguishing relationship between the coefficients on unit labour costs and unit material costs (β_1, β_2, β_3, β_4) consistent with each of the four a priori outcomes outlined. The regression results are highlighted in Figure 3.

Each of the 95 industries have been plotted based on the degree of adjustment costs and their pass-through ability. Adjustment costs are considered high or low depending on how quickly cost increases are passed through to the price. For example, if the coefficients on unit labour costs (β_1) and unit material costs (β_3) are zero for the current period the industry would be considered to have low adjustment costs, since cost increases have been passed through to the price leaving the unit return to capital unaffected. If the industry has high adjustment costs ($\beta_1 + \beta_3 < 0$) but is able to pass these costs through in the next period ($\beta_1 + \beta_2 + \beta_3 + \beta_4 \geq 0$), it is considered to have high pass-through.

There are eight symbols on this chart. The first two letters indicate the concentration of the industry, where HC indicates high concentration based on the industry concentration ratio, and LC indicates low concentration. T indicates that the unit return to capital is influenced by the import price; N indicates industries where there is no import price influence; and C indicates industries where capacity utilization is significant.

[1] Detailed regression results are available upon request.

Figure 3



Note: Adjustment costs are the sum of $\beta_1+\beta_3$.
Pass-through is the sum of $\beta_1+\beta_2+\beta_3+\beta_4$.

1) high pass through, high concentration: $\beta_1 \geq 0,\ \beta_2 = 0;\ \beta_1 < 0,\ \beta_2 > 0.$

$\beta_3 \geq 0,\ \beta_4 = 0;\ \beta_3 < 0,\ \beta_4 > 0.$

There were three recurring outcomes within this case: group 1(i) $\beta_1=0$, $\beta_2=0$, $\beta_3=0$, $\beta_4=0$; group 1(ii) $\beta_1<0$, $\beta_2>0$, $\beta_3<0$, $\beta_4>0$; and, group 1(iii) $\beta_1=0$, $\beta_2=0$, $\beta_3>0$, $\beta_4=0$.

The results of group 1(i), $\beta_1=0$, $\beta_2=0$, $\beta_3=0$, $\beta_4=0$ may be an indication of an industry with market power. These industries may face relatively low costs of adjustment and therefore, it is optimal for firms in these industries to adjust price quickly. Labour costs relative to capital costs may be a very small component of overall costs of production. Therefore, these industries are able to pass labour cost increases through to the price with relative ease.

Five industries fall into this category: distillery products, brewery products, tobacco products, man-made fibre yarn and woven cloth and stamped, pressed and coated metal. The import price is not a determining factor of unit return to capital in any of these industries, although for distillery products the coefficient on the gross import price in period t is significant but negative, which is a counter-intuitive result. However, the gross import price includes tariffs and taxes, and may therefore be acting as a proxy for commodity taxes in the distillery industry. The coefficient on capacity utilization is significant in the regressions for man-made fibre yarn and woven cloth and stamped, pressed and coated metal. However, in period t-1 the result is counter-intuitive for man-made fibre yarn and woven cloth, as the coefficient is negative.

The results of these regressions, combined with the high concentration ratios in these industries suggests that these may be industries with market power. However, the distillery, brewery, and tobacco products industries are all protected from international competition by high import duties and excise taxes. In 1994, import duties as a share of total merchandise imports were at least 20 per cent in all of these industries (distilled beverages 56.4 per cent, tobacco 112 per cent, and ale, lager, etc. 20 per cent).

Industries falling into group 1(ii) where $\beta_1<0$, $\beta_2>0$, $\beta_3<0$, $\beta_4>0$, may be indicative of industries which face high costs of adjustment but are able to pass costs through with some lag. This would be true if $\beta_1=|\beta_2|$ and $\beta_3=|\beta_4|$. This occurred in two industries: copper rolling, casting and extruding and office, store and business machines. In both cases the gross import price in period t is significant. The coefficient on GMP_{t-1} is negative for copper rolling, casting and extruding, a counter-intuitive result. As well, the Durbin Watson statistic for this regression is 1.112, which suggests an inconclusive result for the null hypothesis of zero first order autocorrelation. Consequently, the variance of β_8 may be underestimated resulting in a significant t-statistic and rejection of the null hypothesis that $\beta_8=0$. The coefficient on CAP_t, β_5, is also significant but negative for office, store and business machines. Again, the Durbin Watson statistic is inconclusive, suggesting this result may be dubious.

To determine whether or not full-pass-through was achieved but with a lag the joint significance tests of $\beta_1+\beta_2=0$ and $\beta_3+\beta_4=0$ were tested. Both null hypotheses could not be rejected for copper rolling, suggesting that full pass-through is achieved. However, for office, store and business machines the hypothesis $\beta_3+\beta_4=0$ was rejected, suggesting that full pass-through is not achieved, at least over a two-year period. An additional test was conducted to determine whether or not the joint costs on labour and materials are passed through to the price. However, the hypothesis that $\beta_1+\beta_2+\beta_3+\beta_4=0$ was also rejected at the 1 per cent significance level.

Group 1(iii), when $\beta_1=0$, $\beta_2=0$, $\beta_3>0$, $\beta_4=0$, describes an industry which perhaps follows a mark-up over cost pricing rule and faces relatively low costs of adjustment. Although the industry is concentrated and appears to demonstrate market power, this is not necessarily the case. This occurred in one case, nonferrous smelting and refining. The coefficient on capacity utilization in period t (β_5) and the gross import price in period t are also significant. This has some intuitive appeal, since both the export share of total output and the import share of total domestic sales for this industry are both greater than 50 per cent, suggesting that this industry is highly integrated with and competing in an international market.

TABLE 1
Case 1: High Pass-Through, High Concentration
Coefficients and Summary Statistics

Industry (j)	Constant	ΔULY_t	ΔULY_{t-1}	ΔUMY_t	ΔUMY_{t-1}	ΔCAP_t	ΔCAP_{t-1}	ΔGMP_t	ΔGMP_{t-1}	R^2	DW
Distillery Products	-0.020	0.059	0.436	0.073	-0.093	-0.303	-0.025	-0.158	-0.004	0.965	1.959
	(2.368)	(0.093)	(0.671)	(0.262)	(0.327)	(0.968)	(0.078)	(2.218)	(0.073)		
Brewery Products	-0.001	-0.258	-0.907	-0.406	0.506	-0.242	-0.102	-0.026	-0.102	0.894	1.848
	(0.218)	(0.317)	(1.179)	(0.823)	(1.087)	(1.216)	(0.525)	(0.307)	(1.142)		
Tobacco Products	0.007	0.874	-0.397	-0.278	-0.090	0.044	-0.061	0.055	0.025	0.942	2.012
	(1.124)	(1.382)	(0.611)	(1.211)	(0.379)	(0.653)	(0.873)	(0.957)	(0.436)		
Man-made Fibre Yarn	-0.003	-0.546	-0.555	0.018	0.099	0.383	-0.270	0.235	0.133	0.877	1.804
& Woven Cloth	(0.296)	(1.342)	(1.339)	(0.086)	(0.477)	(2.446)	(1.729)	(1.695)	(1.023)		
Stamped, Pressed	0.000	0.201	0.129	-0.032	0.065	0.149	-0.044	0.064	0.025	0.873	2.069
& Coated Metals	(0.031)	(1.036)	(0.654)	(0.848)	(1.579)	(4.314)	(1.511)	(1.019)	(0.431)		
Copper Rolling,	0.001	-0.909	0.726	-0.339	0.324	-0.308	0.042	0.341	-0.333	0.759	1.112
Casting & Extruding	(0.276)	(3.070)	(2.128)	(3.057)	(3.376)	(0.965)	(0.120)	(2.665)	(2.983)		
Office, Store	-0.088	-0.613	0.322	-0.815	0.090	-0.400	0.332	0.091	0.019	0.997	1.643
& Business Machines	(5.191)	(5.727)	(3.187)	(21.436)	(2.839)	(2.056)	(1.810)	(3.938)	(0.763)		
Non-ferrous Smelting	0.001	0.617	-0.283	0.201	-0.132	1.580	-0.044	0.166	-0.062	0.775	1.958
& Refining	(0.185)	(1.313)	(0.624)	(2.379)	(1.500)	(5.041)	(0.144)	(2.677)	(1.195)		

The numbers in parentheses are t-statistics

2) high pass through, low concentration: $\beta_1 \geq 0,\ \beta_2 = 0;\ \beta_1 < 0,\ \beta_2 > 0.$
$\beta_3 \geq 0,\ \beta_4 = 0;\ \beta_3 < 0,\ \beta_4 > 0.$

The results of the regressions suggest that four combinations of the coefficients on β_1, β_2, β_3, β_4 fall into this case: group 2(i) $\beta_1=0$, $\beta_2=0$, $\beta_3=0$, $\beta_4=0$; 2(ii) $\beta_1<0$, $\beta_2>0$, $\beta_3=0$, $\beta_4=0$; group 2(iii) $\beta_1=0$, $\beta_2=0$, $\beta_3<0$, $\beta_4>0$; and, group 2(iv) $\beta_1=0$, $\beta_2=0$, $\beta_3>0$, $\beta_4=0$.

Since these industries are not concentrated, if $\beta_1=0$, $\beta_2=0$, $\beta_3=0$, $\beta_4=0$, it does not seem reasonable that the industry could have market power. However, this may be the case if the industry is protected, that is if the industry has high import tariffs protecting the domestic market. These are also industries which face low costs of adjustment. Four industries fall into this category: meat and meat products, feed, plastic and synthetic resin and sign and display. In general, the coefficients on the gross import price and capacity utilization were not significant in these regressions.

However, one exception is the gross import price in period t in the sign and display industry. Although imports do not play a dominant role in this industry (the import share of domestic sales in 1992 was 16.8 per cent), since the industry is not very concentrated (the concentration ratio was 14 per cent in 1986), it may be that firms price up to their competition, regardless of who it is. Therefore, one would expect that if part of their competition came from abroad, then they would take advantage of any price increases which occurred in the products of their foreign competition.

TABLE 2

Case 2: High Pass-Through, Low Concentration

Coefficients and Summary Statistics

Industry (j)	Constant	ΔULY_t	ΔULY_{t-1}	ΔUMY_t	ΔUMY_{t-1}	ΔCAP_t	ΔCAP_{t-1}	ΔGMP_t	ΔGMP_{t-1}	R^2	DW
Meat & Meat Products	0.001	0.374	-0.687	0.014	0.086	0.042	-0.029	0.006	-0.046	0.516	2.295
(excl. poultry)	(0.294)	(0.486)	(0.777)	(0.245)	(1.648)	(1.058)	(0.706)	(0.173)	(1.458)		
Feed	-0.002	0.797	-0.833	-0.049	0.123	-0.048	-0.010	-0.078	-0.062	0.861	2.355
	(0.635)	(1.097)	(1.104)	(0.504)	(1.280)	(0.243)	(0.073)	(0.716)	(0.554)		
Plastic & Synthetic	-0.010	-1.152	-0.574	-0.024	-0.079	0.310	0.013	0.201	0.069	0.780	1.539
Resin	(0.814)	(1.299)	(0.691)	(0.084)	(0.311)	(1.166)	(0.048)	(0.783)	(0.277)		
Sign & Display	-0.002	-0.065	-0.233	-0.291	0.238	0.058	0.072	0.141	-0.042	0.869	1.211
	(0.532)	(0.261)	(0.937)	(1.155)	(0.986)	(1.365)	(1.843)	(2.382)	(0.645)		
Pulp & Paper	0.004	-1.549	-0.480	1.350	-0.105	1.244	0.524	-0.030	0.152	0.860	1.548
	(0.579)	(1.764)	(0.568)	(2.664)	(0.197)	(3.234)	(1.318)	(0.154)	(0.804)		
Other Metal Rolling,	0.000	-0.205	-0.216	0.216	0.019	0.674	-0.569	-0.089	0.010	0.596	1.747
Casting & Extruding	(0.074)	(0.668)	(0.654)	(2.121)	(0.188)	(2.903)	(2.265)	(1.291)	(0.143)		
Hosiery	0.010	-0.813	0.951	-0.132	-0.176	0.087	-0.045	0.241	0.161	0.942	2.083
	(1.683)	(3.522)	(3.685)	(1.042)	(1.373)	(3.054)	(1.666)	(3.202)	(2.271)		
Sawmills, Planing	-0.001	-1.515	1.197	-0.141	0.356	0.133	0.293	0.570	-0.256	0.909	2.387
& Shingle Mills	(0.155)	(2.749)	(1.893)	(0.561)	(1.226)	(0.814)	(1.612)	(5.294)	(2.025)		

The numbers in parentheses are t-statistics

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TABLE 2-*Continued*

Industry (j)	Constant	ΔULY_t	ΔULY_{t-1}	ΔUMY_t	ΔUMY_{t-1}	ΔCAP_t	ΔCAP_{t-1}	ΔGMP_t	ΔGMP_{t-1}	R^2	DW
Jewellery & Precious Metals	0.003 (1.272)	0.160 (0.722)	-0.499 (1.446)	-0.388 (9.560)	0.224 (5.653)	-0.004 (0.161)	0.080 (3.081)	0.140 (6.557)	-0.004 (0.234)	0.921	2.369
Other Manufacturing Nec	0.002 (0.669)	-0.220 (1.151)	0.254 (1.191)	-0.658 (3.947)	0.278 (2.047)	0.048 (1.457)	-0.012 (0.345)	0.212 (2.688)	-0.004 (0.052)	0.879	2.030
Poultry Products	-0.004 (1.554)	1.0315 (2.291)	-0.222 (0.580)	-0.245 (2.721)	0.1321 (1.520)	-0.199 (4.215)	0.054 (1.655)	0.178 (1.815)	-0.104 (1.209)	0.704	1.024

The numbers in parentheses are t-statistics

One explanation for the ability of the meat products industry to fully pass-through cost increases is that it is able to take advantage of the fact that the production of one of its major competitors, the poultry processors, is regulated by a marketing board. Import quotas for chicken are also in place. Thus, since one of the industry's major competitor's price is set (it is not a price taker), the meat and meat products industry may be able to take advantage of this by pricing its output up to the price of its competitor without fear of significant loss of market share.

Industries indicative of group 2(iv) also have low relative costs of adjustment. Similar to those industries which are highly concentrated, the coefficients on β_1, β_2, β_3, β_4 in this group indicate that these industries may follow a mark-up over material input costs pricing rule. Two industries fall into this category: pulp and paper, and other metal rolling, casting and extruding. However, the Durbin Watson statistics for both of these regressions provide inconclusive evidence of first-order autocorrelation.

Groups 2(ii) and 2(iii) both suggest that industry regressions exhibiting these coefficients are able to pass through cost increases (provided that the coefficients in the current and lagged periods are equal but opposite in sign) but face moderate costs of adjustment which affect labour costs in the case of group 2(ii) and material input costs in the case of group 2(iii).

Group 2(ii) was the result for the regressions on hosiery and sawmills, planing and shingle mills, while group 2(iii) was the result for the regressions on jewellery and precious metals and other manufacturing. For each of the regressions the joint hypotheses of $\beta_1 + \beta_2 = 0$ in terms of group 2(ii) and $\beta_3 + \beta_4 = 0$ for group 2(iii) were tested. The hypothesis $\beta_1 + \beta_2 = 0$

was not rejected for hosiery or sawmills, while $\beta_3 + \beta_4 = 0$ was not rejected for other manufacturing, suggesting that full pass-through occurs in these industries within a two-year period. The hypothesis $\beta_3 + \beta_4 = 0$ was rejected for precious metals. However, the difference in the coefficients appears to be marginal, suggesting that close to full pass-through is achieved.

The regression for poultry products suggests that pricing may not be as straightforward. For this industry, $\beta_1 > 0$, $\beta_2 = 0$, $\beta_3 < 0$, $\beta_4 = 0$, suggesting that price may be a mark up over a blend of labour and material costs, particularly since the coefficient on β_1 is not significantly different from one. The joint hypothesis $\beta_1 + \beta_2 + \beta_3 + \beta_4 = 0$ is not rejected, suggesting that this industry has full pass-through ability. This is not surprising, since poultry production and processing is regulated. Prices for these commodities are set using a cost of production formula which includes a fixed rate of return. In addition, it may be easier for regulators to anticipate labour cost increases, particularly if there are collective agreements in place, than it is for them to anticipate material input cost changes.

3) low pass through, low concentration: $\beta_1 < 0$, $\beta_2 \geq 0$; $\beta_3 < 0$, $\beta_4 \geq 0$.

This category may be split into two. In one, the coefficients suggest that there is moderate pass through of cost increases. These industries are identified as: group 3(i) $\beta_1 = 0$, $\beta_2 = 0$, $\beta_3 < 0$, $\beta_4 = 0$; group 3(ii) $\beta_1 < 0$, $\beta_2 = 0$, $\beta_3 = 0$, $\beta_4 = 0$; group 3(iii) $\beta_1 < 0$, $\beta_2 = 0$, $\beta_3 < 0$, $\beta_4 > 0$; and, group 3(iv) $\beta_1 < 0$, $\beta_2 > 0$, $\beta_3 < 0$, $\beta_4 = 0$. The other consists of industries with low pass-through ability, and is indicated by $\beta_1 < 0$, $\beta_2 = 0$, $\beta_3 < 0$, $\beta_4 = 0$.

If $\beta_1<0$, $\beta_2=0$, $\beta_3<0$, $\beta_4=0$, this implies that this industry is faced with large relative adjustment costs. However, it is still in a competitive industry as suggested by the concentration ratio so that even though it passes through these cost increases in the next period total profits over the two periods are less then they would have been without the increase in costs.

Out of the 95 industries tested, 14 fell into this group, including: bread and other bakery products, miscellaneous textile products, other wood, iron foundries, power boiler and structural metal, heating equipment, machine shops, truck, bus body and trailers, miscellaneous transportation equipment, small electrical appliances, chemicals (nec), agriculture implements, hardware, tool and cutlery, and paint and varnish. In all cases, the gross import price in period t is significant.

Industries with moderate pass-through ability may further be divided into those with relatively low costs of adjustment (groups 3(i) and 3(ii)) and those with relatively high adjustment costs (groups 3(iii) and 3(iv)).

Results of 7 of the regressions run suggest that either $\beta_1<0$, $\beta_2=0$, $\beta_3<0$, $\beta_4>0$ or $\beta_1<0$, $\beta_2>0$, $\beta_3<0$, $\beta_4=0$, indicating industries where adjustment costs are relatively large. These industries included: wooden box and coffin, other furniture and fixtures, other metal fabricating, other machinery and equipment, other electrical products, platemaking, typesetting and bindery, concrete products, and toilet preparations. Other furniture and fixtures is the only industry in this group where the gross import price in either period was not significant. The coefficients on the gross import price in both periods were significant in other machinery and equipment and other electrical and electronic equipment, however, in period t-1 the coefficients had the wrong sign. This was also the case for other metal fabricating. However, in the regression for this industry, the coefficient on the gross import price in period t is not significant. For toilet preparations the joint hypothesis $\beta_1 + \beta_2 = 0$ was not rejected at the 1 per cent significance level, while the hypothesis $\beta_3 + \beta_4 = 0$ was not rejected for the other six regressions. These results suggest that these seven industries have moderate pass-through ability.

When $\beta_1=0$, $\beta_2=0$, $\beta_3<0$, $\beta_4=0$ (group 3(i)) or $\beta_1<0, \beta_2=0$, $\beta_3=0$, $\beta_4=0$ (group 3(ii)), this suggests almost full pass-through ability. These may be industries where there are moderate costs of adjustment which slow the price adjustment process down, but not significantly so. Nine industries exhibit these characteristics: fruit and vegetables, footwear, contract textile dyeing and finishing, pharmaceutical and medicine, sporting goods and toys, plastic products, clothing, sash, door and other millwork, and office furniture. The gross import price is significant in four of the regressions (footwear, pharmaceutical and medicine, plastic products, and office furniture).

TABLE 3
Case 3: Low Pass-Through, Low Concentration
Coefficients and Summary Statistics

Industry (j)	Constant	ΔULY_t	ΔULY_{t-1}	ΔUMY_t	ΔUMY_{t-1}	ΔCAP_t	ΔCAP_{t-1}	ΔGMP_t	ΔGMP_{t-1}	R^2	DW
Bread & Other Bakery Products	0.005	-0.655	-0.107	-0.673	0.061	0.071	0.051	0.643	0.018	0.969	2.317
	(2.281)	(2.673)	(0.468)	(4.850)	(0.523)	(1.900)	(1.141)	(5.966)	(0.240)		
Miscellaneous Textile Products	-0.005	-0.746	-0.126	-0.569	0.140	0.057	-0.016	0.137	-0.021	0.704	1.976
	(2.338)	(2.909)	(0.479)	(3.850)	(1.426)	(1.293)	(0.344)	(2.832)	(0.521)		
Other Wood	-0.001	-0.870	0.200	-0.616	0.185	-0.039	0.069	1.010	-0.054	0.865	2.570
	(0.346)	(2.823)	(0.719)	(3.438)	(1.108)	(0.479)	(0.756)	(7.963)	(0.566)		
Office Furniture	0.001	-0.096	-0.204	-0.472	0.103	0.068	-0.019	0.374	-0.021	0.817	2.158
	(0.499)	(0.446)	(0.919)	(3.816)	(0.808)	(2.307)	(0.630)	(2.475)	(0.147)		
Iron Foundries	-0.002	-1.073	-0.012	-0.765	-0.060	0.112	0.155	0.360	-0.084	0.877	1.248
	(0.499)	(7.570)	(0.085)	(5.113)	(0.328)	(0.670)	(1.008)	(2.517)	(0.701)		
Power Boiler & Structural Metal	0.001	-0.875	-0.251	-0.449	-0.057	0.024	-0.044	0.321	0.175	0.811	1.547
	(0.364)	(3.896)	(1.054)	(2.502)	(0.327)	(0.330)	(0.693)	(2.598)	(1.531)		
Heating Equipment	0.000	-0.848	0.210	-0.571	0.030	-0.014	-0.021	0.315	0.208	0.748	2.216
	(0.023)	(3.693)	(0.832)	(3.369)	(0.126)	(0.230)	(0.365)	(2.493)	(1.720)		
Machine Shops	0.000	-0.324	-0.015	-0.708	0.047	0.106	-0.057	0.235	-0.021	0.818	1.607
	(0.104)	(2.085)	(0.094)	(5.559)	(0.393)	(2.542)	(1.440)	(3.215)	(0.269)		

The numbers in parentheses are t-statistics

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TABLE 3-*Continued*

Industry (j)	Constant	ΔULY_t	ΔULY_{t-1}	ΔUMY_t	ΔUMY_{t-1}	ΔCAP_t	ΔCAP_{t-1}	ΔGMP_t	ΔGMP_{t-1}	R^2	DW
Truck, Bus Body	-0.004	-0.840	0.081	-0.772	0.074	0.014	0.003	0.257	-0.041	0.900	1.333
& Trailer	(1.067)	(4.557)	(0.371)	(5.236)	(0.452)	(0.378)	(0.083)	(3.284)	(0.451)		
Misc. Transportation	0.001	-0.892	-0.171	-0.824	0.086	-0.048	-0.058	0.326	0.231	0.928	1.489
Equipment	(0.328)	(4.851)	(0.882)	(5.285)	(0.586)	(0.727)	(0.963)	(3.849)	(2.633)		
Small Electrical	-0.016	-0.851	0.298	-0.973	-0.047	-0.108	-0.010	0.215	-0.055	0.946	1.393
Appliances	(2.877)	(2.329)	(1.143)	(7.327)	(0.314)	(1.882)	(0.164)	(1.776)	(0.431)		
Chemical & Chemical	-0.002	-1.013	-0.074	-0.509	0.226	-0.066	0.053	0.270	0.011	0.807	1.917
Products Nec	(0.451)	(3.847)	(0.273)	(2.341)	(1.212)	(0.789)	(0.682)	(2.308)	(0.089)		
Agriculture Implement	-0.010	-1.426	0.217	-0.960	-0.187	-0.059	0.078	0.093	0.146	0.747	2.220
	(1.513)	(3.966)	(0.614)	(3.066)	(0.543)	(0.896)	(1.291)	(0.315)	(0.542)		
Hardware, Tool	0.001	-0.588	-0.400	-0.786	-0.105	0.006	-0.041	0.088	0.010	0.735	2.176
& Cutlery	(0.397)	(3.311)	(1.708)	(5.292)	(0.709)	(0.092)	(0.804)	(2.015)	(0.214)		
Paint & Varnish	0.005	-0.679	0.506	-0.593	0.111	-0.069	0.043	0.307	0.023	0.937	1.658
	(1.595)	(1.840)	(1.314)	(3.658)	(0.610)	(0.561)	(0.374)	(2.769)	(0.209)		
Wooden Box & Coffin	-0.002	-0.616	0.036	-0.398	0.203	0.067	-0.007	0.466	0.114	0.869	2.248
	(0.739)	(3.251)	(0.191)	(3.064)	(1.746)	(1.106)	(0.111)	(3.115)	(0.719)		
Other Furniture & Fixtures	0.000	-0.774	-0.512	-0.329	0.370	-0.012	0.011	0.002	0.010	0.564	1.949
	(0.064)	(2.725)	(1.627)	(2.222)	(2.680)	(0.711)	(0.608)	(0.063)	(0.224)		

The numbers in parentheses are t-statistics

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TABLE 3-*Continued*

Industry (j)	Constant	ΔULY_t	ΔULY_{t-1}	ΔUMY_t	ΔUMY_{t-1}	ΔCAP_t	ΔCAP_{t-1}	ΔGMP_t	ΔGMP_{t-1}	R^2	DW
Other Metal Fabricating	-0.007	-0.582	-0.223	-0.479	0.264	0.028	-0.013	0.131	-0.184	0.777	2.153
	(2.241)	(2.166)	(0.876)	(4.177)	(2.423)	(0.587)	(0.279)	(1.472)	(1.983)		
Other Machinery & Equipment	0.000	-0.389	-0.152	-0.596	0.301	0.039	-0.030	0.391	-0.178	0.836	1.560
	(0.193)	(1.805)	(0.626)	(3.504)	(2.014)	(1.667)	(1.339)	(5.659)	(2.267)		
Other Electrical & Electronic Products	-0.004	-0.476	0.182	-0.515	0.351	0.063	0.074	0.224	-0.166	0.783	2.003
	(1.580)	(1.934)	(0.744)	(2.852)	(2.545)	(1.203)	(1.538)	(2.666)	(1.987)		
Concrete Products	0.002	-0.672	-0.038	-0.523	0.499	0.037	0.138	0.316	0.054	0.764	1.869
	(0.542)	(2.140)	(0.115)	(2.242)	(2.141)	(0.281)	(1.054)	(2.760)	(0.422)		
Platemaking, Typesetting & Bindery	0.001	-0.419	0.322	-0.529	-0.045	0.091	0.018	0.041	0.002	0.799	1.767
	(0.490)	(2.377)	(1.927)	(3.130)	(0.237)	(1.010)	(0.220)	(1.365)	(0.066)		
Toilet Preparations	-0.002	-0.937	1.207	-0.730	-0.218	-0.060	0.021	0.165	0.084	0.803	1.602
	(0.651)	(2.732)	(3.427)	(3.713)	(1.248)	(0.800)	(0.253)	(1.700)	(0.923)		
Fruit & Vegetable	0.001	-0.753	-0.303	-0.504	0.189	-0.013	-0.067	0.044	-0.014	0.931	1.324
	(0.383)	(1.328)	(0.465)	(2.802)	(1.085)	(0.125)	(0.584)	(0.795)	(0.265)		
Footwear	0.001	-0.096	-0.204	-0.472	0.103	0.068	-0.019	0.374	-0.021	0.782	2.158
	(0.499)	(0.446)	(0.919)	(3.816)	(0.808)	(2.307)	(0.630)	(2.475)	(0.147)		
Contract Textile Dyeing & Finishing	-0.008	-0.064	-0.011	-0.251	0.161	0.435	-0.001	0.028	0.133	0.775	2.047
	(0.714)	(0.302)	(0.056)	(1.737)	(0.907)	(2.098)	(0.052)	(0.205)	(0.933)		

The numbers in parentheses are t-statistics

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TABLE 3-*Continued*

Industry (j)	Constant	ΔULY_t	ΔULY_{t-1}	ΔUMY_t	ΔUMY_{t-1}	ΔCAP_t	ΔCAP_{t-1}	ΔGMP_t	ΔGMP_{t-1}	R^2	DW
Pharmaceutical & Medicine	0.003 (0.754)	-0.233 (0.721)	-0.216 (0.631)	-0.850 (3.703)	0.081 (0.352)	-0.024 (0.307)	-0.043 (0.557)	0.220 (2.312)	0.348 (3.173)	0.961	2.084
Sporting Goods & Toys	-0.003 (0.771)	-0.489 (1.608)	0.207 (0.615)	-0.452 (3.013)	0.108 (0.707)	0.038 (0.859)	-0.039 (0.834)	0.026 (0.258)	-0.035 (0.382)	0.744	1.368
Plastic Products	0.000 (0.085)	-0.892 (2.469)	-0.345 (1.041)	-0.098 (0.979)	0.000 (0.005)	0.043 (0.520)	-0.013 (0.177)	0.259 (3.017)	0.037 (0.384)	0.567	1.742
Clothing (excl. hosiery)	-0.001 (0.480)	-0.549 (2.469)	0.045 (0.197)	-0.084 (0.725)	0.030 (0.257)	0.013 (0.356)	-0.029 (0.840)	0.008 (0.172)	0.044 (0.836)	0.598	1.720
Sash, Door & Other Millwork	0.003 (0.934)	-1.381 (3.666)	-0.054 (0.148)	-0.139 (0.925)	0.220 (1.578)	-0.005 (0.064)	0.108 (1.323)	-0.045 (0.673)	-0.018 (0.272)	0.749	1.685

The numbers in parentheses are t-statistics

4) low pass through, high concentration: $\beta_1<0$, $\beta_2\geq0$; $\beta_3<0$, $\beta_4\geq0$.

As with case (3), case (4) may be divided into industries with moderate or low pass through ability. Moderate pass through is consistent with: 4(i) $\beta_1<0$, $\beta_2=0$, $\beta_3<0$, $\beta_4>0$; 4(ii) $\beta_1<0$, $\beta_2>0$, $\beta_3<0$, $\beta_4=0$; 4(iii) $\beta_1=0$, $\beta_2=0$, $\beta_3<0$, $\beta_4=0$; 4(iv) $\beta_1<0$, $\beta_2=0$, $\beta_3=0$, $\beta_4=0$, and 4(v) $\beta_1<0$, $\beta_2=0$, $\beta_3>0$, $\beta_4=0$. Low pass-through is indicated by $\beta_1<0$, $\beta_2=0$, $\beta_3<0$, $\beta_4=0$.

As in case (3), in case (4) if $\beta_1<0$, $\beta_2=0$, $\beta_3<0$, $\beta_4>0$ or $\beta_1<0$, $\beta_2>0$, $\beta_3<0$, $\beta_4=0$, then this indicates industries where adjustment costs are relatively large. Results of 11 of the regressions run suggested that either $\beta_1<0$, $\beta_2=0$, $\beta_3<0$, $\beta_4>0$ or $\beta_1<0$, $\beta_2>0$, $\beta_3<0$, $\beta_4=0$, indicating industries where adjustment costs are relatively large. These industries included: miscellaneous food products, asphalt roofing, other converted paper products, steel pipe and tube, aluminum rolling, casting and extruding, wire products, record players, radio and TV receivers, non-metallic mineral products, primary steel, major appliances, and battery manufacturing. Asphalt roofing and other converted paper products are the only two industries in this group where the gross import price in either period was not significant.

The hypothesis $\beta_1+\beta_2=0$ was not rejected for the regressions on the nonmetallic minerals industry and primary steel, while the hypothesis $\beta_3+\beta_4=0$ was not rejected for miscellaneous food, asphalt, other converted paper products, and steel pipe and tube. This suggests that full pass-through of either unit labour or unit material costs occurs in these industries. In one case, $\beta_1=0$, $\beta_2=0$, $\beta_3<0$, $\beta_4=0$ suggesting almost full pass-through ability with some costs of adjustment. This occurred in the regression for the cane and beet sugar

TABLE 4
Case 4: Low Pass-Through, High Concentration
Coefficients and Summary Statistics

Industry (j)	Constant	ΔULY_t	ΔULY_{t-1}	ΔUMY_t	ΔUMY_{t-1}	ΔCAP_t	ΔCAP_{t-1}	ΔGMP_t	ΔGMP_{t-1}	R^2	DW
Biscuit	0.012	-2.291	-0.833	-0.276	0.256	-0.165	-0.178	-0.004	-0.107	0.942	1.783
	(1.992)	(5.182)	(1.017)	(1.120)	(0.920)	(1.413)	(1.451)	(0.030)	(1.126)		
Wine	-0.014	-0.544	-0.150	-0.698	0.175	-0.304	-0.309	0.093	-0.194	0.937	1.960
	(3.522)	(1.893)	(0.507)	(4.780)	(1.293)	(2.492)	(2.644)	(2.342)	(5.087)		
Rubber Products	-0.010	-1.069	0.310	-0.602	0.187	-0.267	0.180	0.219	-0.119	0.945	1.869
	(2.358)	(2.727)	(0.617)	(2.917)	(1.028)	(1.662)	(0.922)	(2.123)	(1.064)		
Carpet, Mat & Rug	-0.002	-1.088	-0.016	-0.721	0.116	-0.071	0.087	0.537	0.252	0.952	2.069
	(0.304)	(2.568)	(0.046)	(4.506)	(0.693)	(0.373)	(0.595)	(3.960)	(1.684)		
Aircraft & Aircraft Parts	0.004	-1.286	0.089	-1.109	0.256	-0.037	0.031	0.831	-0.220	0.910	1.936
	(1.000)	(7.091)	(0.473)	(6.555)	(1.393)	(1.286)	(0.952)	(5.621)	(1.434)		
Motor Vehicle	0.002	-0.802	0.382	-0.612	0.091	0.038	0.026	0.575	-0.095	0.949	1.861
	(0.615)	(2.774)	(1.419)	(6.170)	(0.978)	(1.448)	(0.971)	(5.740)	(0.982)		
Railroad Rolling Stock	0.004	-1.209	0.127	-1.035	-0.017	-0.066	-0.029	0.382	0.075	0.932	1.505
	(1.214)	(4.167)	(0.561)	(7.863)	(0.131)	(2.236)	(0.993)	(3.245)	(0.540)		
Shipbuilding & Repair	0.005	-0.745	0.006	-0.769	0.057	0.046	-0.043	0.603	-0.284	0.944	1.986
	(1.807)	(8.419)	(0.007)	(6.161)	(0.514)	(1.556)	(1.578)	(5.634)	(2.708)		

The numbers in parentheses are t-statistics

Continued on next page

TABLE 4-*Continued*

Industry (j)	Constant	ΔULY_t	ΔULY_{t-1}	ΔUMY_t	ΔUMY_{t-1}	ΔCAP_t	ΔCAP_{t-1}	ΔGMP_t	ΔGMP_{t-1}	R^2	DW
Electronic Equipment	0.000	-0.795	0.143	-0.889	0.052	-0.007	0.003	0.246	0.155	0.915	1.856
	(0.057)	(5.814)	(1.095)	(7.388)	(0.456)	(0.133)	(0.046)	(3.445)	(2.290)		
Clay Products	0.000	-0.880	-0.230	-0.704	0.322	0.238	0.104	-0.044	-0.006	0.916	0.985
	(0.067)	(2.688)	(0.585)	(1.888)	(0.989)	(1.077)	(0.564)	(0.547)	(0.078)		
Cement	0.003	-0.851	-0.216	-1.048	0.239	-0.122	-0.186	0.239	0.143	0.883	1.708
	(0.650)	(2.572)	(0.545)	(4.413)	(1.174)	(0.873)	(1.229)	(2.684)	(1.597)		
Glass & Glass Products	-0.001	-0.573	-0.309	-0.377	0.086	0.211	-0.267	0.172	0.225	0.932	2.164
	(0.698)	(3.007)	(1.639)	(2.984)	(0.674)	(3.141)	(3.767)	(2.583)	(3.025)		
Floor Tile, Linoleum, Coated Fabric	-0.012	-0.985	-0.121	-0.737	-0.108	-0.079	-0.100	0.414	0.095	0.886	1.545
	(1.758)	(4.589)	(0.575)	(6.237)	(0.934)	(1.304)	(1.580)	(3.504)	(0.758)		
Wool Yarn & Woven Cloth	-0.007	-0.540	0.386	-0.692	-0.016	0.063	0.129	0.430	0.084	0.839	1.824
	(1.335)	(2.119)	(1.693)	(5.029)	(0.112)	(0.693)	(1.276)	(4.886)	(0.960)		
Miscellaneous Food Products	0.005	-1.550	0.095	-0.310	0.198	0.068	-0.007	0.126	-0.046	0.931	1.712
	(2.236)	(3.457)	(0.217)	(3.928)	(2.196)	(1.438)	(0.169)	(2.437)	(0.845)		
Asphalt Roofing	-0.004	-0.899	-0.122	-0.430	0.406	-0.145	0.087	0.010	0.035	0.711	1.755
	(0.571)	(2.024)	(0.267)	(3.043)	(2.796)	(1.246)	(0.865)	(0.199)	(0.694)		
Other Converted Paper Products	-0.001	-0.582	0.249	-0.458	0.554	0.058	0.087	0.133	-0.138	0.707	1.855
	(0.227)	(2.359)	(0.902)	(3.385)	(4.181)	(1.107)	(1.886)	(1.155)	(1.158)		

The numbers in parentheses are t-statistics

Continued on next page

TABLE 4-*Continued*

Industry (j)	Constant	ΔULY_t	ΔULY_{t-1}	ΔUMY_t	ΔUMY_{t-1}	ΔCAP_t	ΔCAP_{t-1}	ΔGMP_t	ΔGMP_{t-1}	R^2	DW
Steel Pipe & Tube	0.001	-0.805	0.181	-0.405	0.317	0.220	0.103	0.291	-0.096	0.796	1.295
	(0.365)	(4.647)	(1.366)	(3.786)	(2.650)	(1.748)	(0.888)	(4.510)	(1.511)		
Aluminum Rolling, Casting & Extruding	-0.001	-0.886	0.305	-0.701	0.193	0.233	0.241	0.496	-0.107	0.836	2.073
	(0.114)	(3.102)	(1.101)	(6.073)	(1.775)	(0.944)	(0.901)	(4.664)	(1.138)		
Wire & Wire Products	-0.002	-0.793	-0.082	-0.613	0.209	0.093	-0.060	0.513	-0.197	0.973	1.251
	(1.686)	(7.964)	(0.746)	(11.615)	(4.134)	(3.735)	(2.529)	(11.181)	(4.596)		
Record Players, Radio & TV Receivers	-0.032	-1.118	0.086	-0.735	0.238	-0.062	-0.125	0.207	0.022	0.926	2.216
	(2.444)	(7.461)	(0.546)	(6.728)	(2.510)	(0.456)	(1.086)	(2.305)	(0.205)		
Non-metallic Mineral Products	0.000	-0.915	-0.071	-0.613	0.456	0.184	0.080	0.360	0.029	0.930	1.280
	(0.012)	(3.934)	(0.319)	(4.051)	(2.240)	(1.910)	(1.092)	(3.748)	(0.333)		
Primary Steel	0.000	-0.677	0.497	-0.709	0.100	0.239	0.030	0.498	0.055	0.973	1.586
	(0.149)	(2.958)	(2.290)	(4.346)	(0.566)	(1.365)	(0.227)	(4.485)	(0.607)		
Major Appliances (elec. & non-elec.)	-0.001	-1.304	0.496	-0.539	0.136	-0.163	0.047	0.190	0.144	0.882	2.083
	(0.260)	(5.936)	(2.200)	(4.634)	(1.250)	(3.102)	(0.971)	(4.149)	(3.147)		
Battery	0.001	-1.107	0.048	-0.540	-0.074	-0.026	0.002	0.339	-0.068	0.911	2.177
	(0.237)	(4.846)	(3.318)	(5.613)	(1.228)	(0.371)	(0.009)	(2.861)	(0.551)		
Cane & Beet Sugar	-0.006	-1.638	-2.403	-0.182	0.003	-0.240	0.457	0.109	0.171	0.757	2.117
	(0.471)	(1.091)	(1.652)	(3.237)	(0.047)	(0.922)	(1.508)	(1.885)	(2.657)		

The numbers in parentheses are t-statistics

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TABLE 4-*Continued*

Industry (j)	Constant	ΔULY_t	ΔULY_{t-1}	ΔUMY_t	ΔUMY_{t-1}	ΔCAP_t	ΔCAP_{t-1}	ΔGMP_t	ΔGMP_{t-1}	R^2	DW
Paper Box & Bag	0.000	-1.033	0.410	0.215	-0.082	0.047	-0.076	0.031	0.087	0.813	1.300
	(0.144)	(3.166)	(1.244)	(2.200)	(0.672)	(0.963)	(1.848)	(0.745)	(2.081)		
Printing & Publishing	0.002	-0.613	-0.258	-0.805	-0.214	-0.069	-0.075	0.210	0.085	0.901	1.840
	(0.857)	(1.706)	(0.693)	(4.132)	(1.061)	(1.258)	(1.328)	(3.240)	(1.210)		

The numbers in parentheses are t-statistics

industry. The coefficient on the gross import price in both period t and period t-1 is significant. Similarly, almost full pass-through ability is demonstrated by the regression for the biscuit industry ($\beta_1<0$, $\beta_2=0$, $\beta_3=0$, $\beta_4=0$).

Low pass-through ability, as indicated by $\beta_1<0$, $\beta_2=0$, $\beta_3<0$, $\beta_4=0$, occurred in 13 industries, including: wine, rubber products, carpet, mat and rug, aircraft and parts, motor vehicles, railroad rolling stock, shipbuilding, electronic equipment, clay products, cement, glass and glass products, floor tile and linoleum, and wool yarn and woven cloth. The gross import price in period t was a significant explanatory variable in all cases except clay products. In addition, the gross import price in period t-1 is significant in the regressions for glass and glass products and electronic equipment. However, it was also significant, but negative in the regressions for wine and shipbuilding. As in the distillery industry, it may be that the gross import price is acting as a proxy for commodity taxes in the wine industry.

5) other results

The results for the remaining regressions could not be readily classified into the four a priori cases. There may be several underlying influences which are producing these results. For instance, there may be heterogeneous costs of adjustment across firms within the industry. Hence the estimated coefficients at the industry level of aggregation do not give a clear indication of pass-through ability. This may be the result in cases where there are labour contracts which expire in different periods or where there are lengthy production processes. For example, if an industry were made up of two firms, each contributing a significant share of industry output and each with different labour contracts in place but both subject to similar labour costs, then if labour negotiations occur for one firm in period t and in period t-1 for the other firm, the firm where labour costs increased first would be limited in its ability to raise price because the costs of its domestic competitor have not risen. Similarly, a rise in unit material costs may be transmitted to price at different rates across firms within the same industry if firms have varying levels of accumulated inventories, either of finished goods or raw materials. Cost increases would impact the unit return to capital with a lagged effect and price increases could therefore be delayed without adversely affecting the unit return to capital. The results of the regressions for leather tanneries, commercial refrigeration equipment, communications, energy wire and cable, industrial chemicals (nec), household furniture, and miscellaneous leather and allied products are consistent with this explanation.

Three industries (refined petroleum and coal products, soft drink and ready-mix concrete) demonstrate pass-through ability with a lagged effect. In each of these industries there appears to be a mark-up over costs which reacts to input price changes in the previous period. For the soft drink industry there appears to be a mark-up over material costs. Inventories have played an increasing role in the industry through time. In addition, the material input share of gross output increased has increased from 48 per cent in 1961 to 61 per cent in 1992, demonstrating the increased importance of material inputs to the overall cost of production in this industry. As with the soft drink industry the ready-mix concrete industry also appears to follow a mark-up over material costs rule. This has some intuitive appeal since material inputs account for roughly 70 per cent of gross output in this industry and, although finished goods inventories play a minimal role, there may be significant inventories of raw materials given their importance to the production process.

Material inputs also account for a significant portion of gross output in the refined petroleum and coal products industry and finished goods inventories also account for a significant share of gross output. These attributes suggest that this may be an industry which uses a mark-up over costs pricing rule, but due to inventory effects, there is a lag on price movements due to cost increases. This is a highly concentrated industry (see Table 6) and therefore, one which probably has market power.

The results for four industries (soap and cleaning compounds, broad knitted fabric, motor vehicle parts and accessories, and ornamental and architectural metal products) suggest that these are industries with large adjustment costs but also industries which adjust price with respect to the combined costs of unit labour and material costs. To determine whether cost increases are fully passed through to the price in these industries the joint null hypothesis $\beta_1+\beta_2+\beta_3+\beta_4=0$ was tested and with the exception of broad knitted fabric, the hypothesis could not be rejected at the 1 per cent significance level. This suggests that these industries have full pass-through ability and a degree of market power. In the case of the broad knitted fabric industry, the coefficient on CAP_t is significant and negative, a counter-intuitive result, and may be affecting the values of the coefficients of the other variables.

These results are consistent with the concentration ratios for the soap and cleaning compounds and motor vehicle parts and accessories industries which suggest that these industries are highly concentrated. The ornamental and architectural metal products industry is not highly concentrated, a seemingly counter-intuitive result. Although the import price is significant in this industry, suggesting imports play a significant role, transportation costs may be an important cost also and may provide a degree of protection to local manufacturers. Therefore, the industry may not be highly concentrated in general, but the competition in any arbitrary local economy may be limited.

The results of the remaining three industries (veneer & plywood, vegetable oil mills, and fish products) are somewhat more difficult to explain. In some cases the coefficients on unit labour costs and unit material costs are larger than one in magnitude and the sign on the coefficients appears to be counter-intuitive. That is, the coefficient in period t is positive, while the coefficient in period t-1 is negative.

It may be that the output of the fish processing and the veneer and plywood industries is heterogeneous in nature and this is resulting in seemingly dubious results. Fish processing in Canada is essentially two industries: the east coast fishery and the west coast fishery. Although some of the fish processed is similar in nature, each fishery has a unique mainstay. The east coast fishery was dominated by cod and shellfish over the estimation period, while the west coast fishery is dominated by salmon. In addition, salmon fishing is cyclical, resulting in large swings in output of the fish processing industry. The veneer and plywood industry is not highly concentrated and produces a variety of products. Thus, aggregation of these data may be hiding more than it reveals.

The vegetable oil mills industry is also varied in what it produces and what it uses as input materials. The industry processes various types of oilseeds, including canola, flax, linseed, sunflower seeds and soybeans. High capacity utilization is important in keeping this industry profitable. In addition, although the import price does not appear to affect domestic producers, the international competition for feedstocks is fierce and, combined with tariff protection in other vegetable oil producing countries, this may be introducing other significant factors which have not been accounted for in the empirical model.

TABLE 5
Other Results
Coefficients and Summary Statistics

Industry (j)	Constant	ΔULY_t	ΔULY_{t-1}	ΔUMY_t	ΔUMY_{t-1}	ΔCAP_t	ΔCAP_{t-1}	ΔGMP_t	ΔGMP_{t-1}	R^2	DW
Ornamental & Arch. Metal Products	0.0014	-0.441	0.4171	-0.101	0.1618	0.1106	0.0229	0.0938	0.2094	0.906	1.871
	(0.514)	(2.249)	(2.134)	(1.190)	(1.890)	(2.622)	(0.588)	(2.029)	(4.100)		
Leather Tanneries	0.002	-0.601	-0.602	-0.403	0.161	0.063	-0.046	0.263	-0.022	0.780	2.071
	(0.449)	(1.792)	(1.915)	(4.242)	(1.867)	(1.017)	(0.782)	(2.728)	(0.242)		
Veneer & Plywood	0.001	-1.352	2.330	0.830	-0.962	0.179	0.241	-0.025	0.095	0.774	2.128
	(0.160)	(2.978)	(4.773)	(2.812)	(3.030)	(0.983)	(1.578)	(0.258)	(1.065)		
Commercial Refrigeration Equipment	-0.004	-0.983	-0.422	-0.913	0.149	-0.003	-0.037	0.230	0.131	0.894	1.398
	(1.381)	(5.667)	(2.174)	(9.343)	(1.970)	(0.127)	(1.530)	(3.640)	(1.983)		
Communications, Energy Wire & Cable	-0.008	-0.796	-0.573	-0.201	0.506	0.087	0.024	-0.022	-0.193	0.898	1.267
	(2.214)	(3.122)	(2.369)	(2.392)	(6.007)	(1.086)	(0.370)	(0.340)	(3.067)		
Refined Petroleum & Coal Products	-0.002	-1.037	2.095	-0.074	0.113	0.209	0.004	0.036	0.001	0.664	2.373
	(0.723)	(0.998)	(2.054)	(1.292)	(1.889)	(0.819)	(0.016)	(0.654)	(0.023)		
Industrial Chemicals Nec	-0.013	-2.174	0.168	-0.497	-0.776	-0.458	-1.039	0.559	0.088	0.926	1.879
	(1.864)	(4.346)	(7.121)	(3.385)	(1.908)	(1.060)	(2.090)	(4.664)	(0.699)		
Soap & Cleaning Compounds	-0.004	-0.040	0.441	-0.550	0.240	-0.016	0.105	0.133	-0.060	0.944	1.888
	(1.297)	(0.143)	(1.843)	(5.071)	(2.421)	(0.276)	(1.910)	(1.672)	(0.665)		

The numbers in parentheses are t-statistics

Continued on next page

TABLE 5-*Continued*

Industry (j)	Constant	ΔULY_t	ΔULY_{t-1}	ΔUMY_t	ΔUMY_{t-1}	ΔCAP_t	ΔCAP_{t-1}	ΔGMP_t	ΔGMP_{t-1}	R^2	DW
Vegetable Oil Mills (excl. corn oil)	-0.004	-2.169	-3.304	-0.111	-0.071	0.238	0.136	0.053	0.142	0.712	2.227
	(0.704)	(1.427)	(2.481)	(1.361)	(0.902)	(2.471)	(1.207)	(0.613)	(1.804)		
Household Furniture	-0.002	-0.791	-0.484	-0.169	0.009	0.009	-0.030	0.012	0.020	0.812	1.982
	(0.941)	(5.476)	(2.955)	(1.626)	(0.098)	(0.797)	(2.499)	(0.630)	(1.087)		
Fish Products	0.004	-1.171	0.261	0.062	-0.264	0.031	0.005	0.236	0.127	0.881	1.969
	(1.414)	(4.559)	(1.037)	(0.555)	(2.518)	(1.342)	(0.207)	(3.425)	(1.792)		
Dairy Products	0.004	1.620	-0.636	-0.160	0.172	0.079	0.021	0.044	-0.014	0.946	1.607
	(2.113)	(2.440)	(0.895)	(1.498)	(1.764)	(2.112)	(0.520)	(0.910)	(0.269)		
Soft Drink	-0.001	-0.034	0.584	0.006	0.542	0.200	-0.091	-0.050	-0.131	0.586	1.887
	(0.275)	(0.113)	(1.324)	(0.036)	(2.946)	(1.466)	(0.638)	(0.531)	(1.307)		
Miscellaneous Leather & Allied Products	-0.006	-1.092	0.324	-0.779	-0.472	-0.047	0.021	0.498	0.135	0.847	1.802
	(1.750)	(5.614)	(1.568)	(5.443)	(2.673)	(1.049)	(0.557)	(4.342)	(1.277)		
Broad Knitted Fabric	-0.002	-0.676	-0.180	0.012	0.202	0.193	-0.219	-0.014	-0.009	0.956	1.705
	(0.367)	(3.824)	(1.021)	(0.159)	(2.681)	(1.944)	(2.205)	(0.280)	(0.174)		
Motor Vehicle Parts & Accessories	-0.003	-0.872	-0.130	-0.201	0.558	0.076	-0.004	0.239	0.048	0.875	2.020
	(0.863)	(3.629)	(0.514)	(0.809)	(2.445)	(1.864)	(0.125)	(3.276)	(0.674)		
Ready-mix Concrete	-0.001	0.047	0.094	-0.284	0.477	0.140	0.335	-0.019	-0.011	0.587	1.974
	(0.182)	(0.054)	(0.127)	(1.145)	(1.726)	(0.774)	(1.588)	(1.077)	(0.587)		

The numbers in parentheses are t-statistics

TABLE 6
Industry Concentration Ratios, 1986

Case 1: High Pass-Through, High Concentration			
Distillery Products	83.1	Stamped, Pressed & Coated Metals	53.0
Brewery Products	97.5	Copper Rolling, Casting & Extruding	82.4
Tobacco Products	93.9	Office, Store & Business Machines	58.9
Man-made Fibre Yarn & Woven Cloth	71.9	Non-ferrous Smelting & Refining	74.5
Case 2: High Pass-Through, Low Concentration			
Meat & Meat Products (excl. poultry)	32.7	Other Metal Rolling, Casting & Extruding	32.0
Feed	23.4	Hosiery	33.0
Plastic & Synthetic Resin	44.2	Sawmills, Planing & Shingle Mills	16.0
Sign & Display	14.0	Jewellery & Precious Metals	48.3
Pulp & Paper	47.3	Other Manufacturing Nec	25.1
Poultry Products	37.3		
Case 3: Low Pass-Through, Low Concentration			
Bread & Other Bakery Products	46.5	Other Furniture & Fixtures	22.9
Miscellaneous Textile Products	27.0	Other Metal Fabricating	25.7

Continued on next page

TABLE 6 - *Continued*

Other Wood	48.8	Other Machinery & Equipment	21.2
Office Furniture	42.8	Other Electrical & Electronic Products	49.2
Iron Foundries	49.7	Concrete Products	38.5
Power Boiler & Structural Metal	43.3	Platemaking, Typesetting & Bindery	10.1
Heating Equipment	25.6	Toilet Preparations	32.9
Machine Shops	7.8	Fruit & Vegetable	46.3
Truck, Bus Body & Trailer	48.1	Footwear	24.9
Misc. Transportation Equipment	46.9	Contract Textile Dyeing & Finishing	36.1
Small Electrical Appliances	42.9	Pharmaceutical & Medicine	26.2
Chemical & Chemical Products Nec	46.3	Sporting Goods & Toys	31.9
Agriculture Implement	41.6	Plastic Products	23.9
Hardware, Tool & Cutlery	24.9	Clothing (excl. hosiery)	26.6
Paint & Varnish	34.9	Sash, Door & Other Millwork	20.0
Wooden Box & Coffin	18.1		

Continued on next page

TABLE 6 - *Continued*

Case 4: Low Pass-Through, High Concentration

Biscuit	76.7	Other Converted Paper Products	52.1
Wine	68.2	Miscellaneous Food Products	66.8
Rubber Products	58.0	Asphalt Roofing	85.9
Carpet, Mat & Rug	51.1	Steel Pipe & Tube	57.5
Aircraft & Aircraft Parts	63.1	Aluminum Rolling, Casting & Extruding	89.5
Motor Vehicle	94.0	Wire & Wire Products	55.1
Railroad Rolling Stock	78.0	Record Players, Radio & TV Receivers	87.9
Shipbuilding & Repair	77.6	Non-metallic Mineral Products	73.0
Electronic Equipment	66.2	Primary Steel	91.1
Clay Products - domestic - imported	83.2 60.2	Major Appliances (elec. & non-elec.)	86.2
Cement	80.5	Battery	71.0
Glass & Glass Products	78.4	Cane & Beet Sugar	100.0
Floor Tile, Linoleum, Coated Fabric	74.0	Paper Box & Bag	55.9
Wool Yarn & Woven Cloth	55.0	Printing & Publishing	53.8

Continued on next page

TABLE 6 - *Continued*

Other Results

Leather Tanneries	71.9	Fish Products	42.4
Veneer & Plywood	46.5	Dairy Products	46.6
Commercial Refrigeration Equipment	40.3	Soft Drink	54.6
Communications, Energy Wire & Cable	80.7	Miscellaneous Leather & Allied Products	23.4
Refined Petroleum & Coal Products	68.4	Broad Knitted Fabric	24.2
Industrial Chemicals Nec	58.4	Motor Vehicle Parts & Accessories	91.3
Soap & Cleaning Compounds	64.1	Ready-mix Concrete	42.8
Vegetable Oil Mills (excl. corn oil)	68.2	Ornamental & Arch. Metal Products	22.6
Household Furniture	27.0		

Source: Statistics Canada

5 Conclusion

The purpose of this investigation is to test for the implications of alternative micro pricing policies at the aggregate industry level and to determine if, and to what extent, industries in a small open economy are able to adjust price when they are subjected to input cost increases. It is assumed that the pricing policy followed by firms is an s,S policy. In the s,S pricing model developed by Sheshinski and Weiss [1977] and Naish [1986, 1988, 1994] the firm maximizes the average real rate of profit over the interval between price changes by determining the optimal frequency of price changes subject to fixed adjustment costs. As fixed adjustment costs increase price is changed less frequently and provides an explanation for the price stickiness which is observed in the economy.

Four a priori outcomes are considered, each reflecting varying degrees of cost pass-through ability and price stickiness across Canadian manufacturing industries. The results of 77 of the 95 regressions run are consistent with a priori expectations. The unit return to capital varies (consistent with price stickiness observed in the economy) as cost increases are passed through to the price. This may be explained, in part, by varying fixed costs of adjustment, both across and within industries, by the influences of international trade on a small, open economy, and by the degree of industry concentration. Although the results of 15 of the remaining regressions did not conform to a priori expectations the results are consistent when other factors, such as heterogeneous costs of adjustment and lags due to inventory adjustments, are considered. The results of only 3 of the regressions could not be explained by the framework.

International prices play a significant role in the prospects of 61 of the 95 Canadian manufacturing industries analysed, consistent with what is expected in a small open economy. Of these industries, 27 are highly concentrated and 24 are classified as having low or moderate pass-through ability. These industries appear to be world price takers and, as a consequence, they are unable to prevent their unit return to capital from being squeezed when domestic costs of production increase. The fortunes of these industries are dictated through exchange rate movements and world price increases.

This suggests that industry concentration may be necessary to compete globally; the firms operating in these industries may need to be of a certain size in order to be competitive. These results also suggest that the use of concentration ratios alone do not provide an adequate indication of industry market power. However, they also suggest that even as Canada's economy becomes more open with trade agreements such as the North American Free Trade Agreement (NAFTA) and the General Agreement on Tariffs and Trade (GATT), there may still be industries which have market power and this may or may not be desirable from the point of enhancing a competitive economy. Although industry concentration may play a limited empirical role in price formation in Canadian manufacturing industries, concentration issues may still have a significant role in international markets.

The industries analysed in this paper represent the manufacturing sector in Canada. It would be interesting to extend this analysis to include the resource and services sectors. It would also be interesting to determine if similar industries in a relatively closed economy, such as the United States, demonstrate similar characteristics as those found for these Canadian manufacturing industries.

The constant term was significant in 13 of the 95 regressions estimated, suggesting that there may be another variable or variables which should be included in these regressions. For some industries (office, store & business machines, small electrical appliances, record players, radio & TV receivers, and communications and energy wire & cable) it may be that rapid technological change plays a significant role. Further investigation of these 13 industries should be undertaken in order to determine whether or not there are other significant explanatory variables for the unit return to capital in these industries.

Better regression results might be obtained for some industries by accounting for the influence of taxes and tariffs or by using more disaggregated data which are more representative of a homogeneous industry. In addition, the timing and dynamic path of price adjustment and its effects on the unit return to capital could be examined using data of a shorter periodicity.

This research could be further expanded in two areas. Nonlinear estimation techniques could be used such as the generalized method of moments as outlined by Hansen and Singleton [1982]. In addition, adjustment costs should be explicitly modelled in the estimation process. However, this would require firm level data.

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Appendix A

Industry Definitions

Table A-1 lists the industries used in this analysis and their corresponding 1980 Standard Industrial Classification (SIC) numbers. Each industry is also defined by Statistics Canada's System of National Accounts L level of aggregation. These industries comprise L-numbers 14 -108 inclusive.

TABLE A-1
1980 Standard Industrial Classification (SIC)
Industry Definitions

Industry	1980 SIC
Meat & Meat Products (excl. poultry)	1011
Poultry Products	1012
Fish Products	102
Fruit & Vegetable	103
Dairy Products	104
Feed	1053
Vegetable Oil Mills (excl. corn oil)	106
Biscuit	1071
Bread & Other Bakery Products	1072
Cane & Beet Sugar	1081
Miscellaneous Food Products	109, 1051, 1052, 1082, 1083
Soft Drink	111
Distillery Products	112
Brewery Products	113
Wine	114
Tobacco Products	121, 122
Rubber Products	151-159
Plastic Products	161-169
Leather Tanneries	1711
Footwear	1712
Miscellaneous Leather & Allied Products	1713, 1719
Man-made Fibre Yarn & Woven Cloth	181, 1829
Wool Yarn & Woven Cloth	1821
Broad Knitted Fabric	183
Miscellaneous Textile Products	191, 193, 1991, 1993-1995, 1999
Contract Textile Dyeing & Finishing	1992
Carpet, Mat & Rug	192
Clothing (excl. hosiery)	243-245, 2491-2493, 2495-2499
Hosiery	2494
Sawmills, Planing & Shingle Mills	251
Veneer & Plywood	252
Sash, Door & Other Millwork	254
Wooden Box & Coffin	256, 258
Other Wood	259

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TABLE A-1-*Continued*

Industry	1980 SIC
Household Furniture	261
Office Furniture	264
Other Furniture & Fixtures	269
Pulp & Paper	271
Asphalt Roofing	272
Paper Box & Bag	273
Other Converted Paper Products	279
Printing & Publishing	281, 283, 284
Platemaking, Typesetting & Bindery	282
Primary Steel	291
Steel Pipe & Tube	292
Iron Foundries	294
Non-ferrous Smelting & Refining	295
Aluminum Rolling, Casting & Extruding	296
Copper Rolling, Casting & Extruding	297
Other Metal Rolling, Casting & Extruding	299
Power Boiler & Structural Metal	301-302
Ornamental & Architectural Metal Products	303
Stamped, Pressed & Coated Metals	304
Wire & Wire Products	305
Hardware, Tool & Cutlery	306
Heating Equipment	307
Machine Shops	308
Other Metal Fabricating	309
Agricultural Implement	311
Commercial Refrigeration Equipment	312
Other Machinery & Equipment	319
Aircraft & Aircraft Parts	321
Motor Vehicle	323
Truck, Bus Body & Trailer	324
Motor Vehicle Parts & Accessories	325
Railroad Rolling Stock	326
Shipbuilding & Repair	327
Misc. Transportation Equipment	328, 329
Small Electrical Appliances	331
Major Appliances (elec. & non-elec.)	332

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TABLE A-1-*Continued*

Industry	1980 SIC
Record Players, Radio & TV Receivers	334
Electronic Equipment	335
Office, Store & Business Machines	336
Communications, Energy Wire & Cable	338
Battery	3391
Other Electrical & Electronic Products	333, 337, 3392-3399
Clay Products	351
Cement	352
Concrete Products	354
Ready-Mix Concrete	355
Glass & Glass Products	356
Non-metallic Mineral Products Nec	357-359
Refined Petroleum & Coal Products	361, 369
Industrial Chemicals Nec	371
Plastic & Synthetic Resin	373
Pharmaceutical & Medicine	374
Paint & Varnish	375
Soap & Cleaning Compounds	376
Toilet Preparations	377
Chemical & Chemical Products Nec	372, 379
Jewellery & Precious Metals	392
Sporting Goods & Toys	393
Sign & Display	397
Floor Tile, Linoleum, Coated Fabric	3993
Other Manufacturing Nec	391, 3991, 3992-3994, 3999

Source: Statistics Canada