Adjustment to International Competition

Short-Run Relations of Prices, Trade Flows, and Inputs in Canadian Manufacturing Industries

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Foreword

This study is part of the Council's program on Trade Policy Options and Structural Adjustment in Canada. The study was commissioned in order to improve our understanding of how Canadian manufacturing industries react to change in international competition.

This research monograph builds upon two types of research on the structure and performance of Canadian manufacturing industries. One line, stemming from the work of Harry Eastman and Stefan Stykolt, addresses industries of domestic producers who serve the small Canadian market in competition with imports. It is concerned with the productive efficiency of these industries but not with their short-run responses to international competition. The other line concerns the short-run sensitivity of responses of the manufacturing industries' prices, outputs, and employment levels to disturbances. It has focused on responses to domestic disturbances and has not attempted an integrated view of responses to international disturbances. Using annual data on many individual industries, the present study builds a statistical model of adjustments to changes in international competition – changes in prices and varieties of importable goods, and in Canadian tariffs and the exchange rate. It tracks the effects of those changes on the selling prices of Canadian producers, quantities of imports and exports, and the key input decisions – employment and capital expenditures. It draws conclusions about these adjustment processes for the typical manufacturing industry but also shows how these adjustments vary among sectors and types of industries.

The study's conclusions are fairly optimistic about the ability of manufacturing industries to adjust to global competition. Selling prices respond sensitively to international competition – more so than to domestic cost disturbances. Producers afflicted by toughened import competition do not "throw in the towel"; they increase capital expenditures and raise labour productivity in response to the challenge. Adjustments take place as if each world industry in which Canadian manufacturers compete produces a complex line of goods. Changes in international competition thus bring about not so much an overall contraction or expansion of the Canadian industry but a reconfiguration of the varieties of goods produced and the markets to which they are sold. In particular, the typical industry losing share to imports in the domestic market is at the same time increasing the proportion of its output sold abroad. The expansion of intraindustry trade is thus an important context, and in part a consequence, of the toughened import competition that many industries have faced. This pattern happily implies smaller losses of jobs and fewer costs of reallocating resources among industries than if the adjustment process depended solely on moving resources between industries.

This study was used as background research to the Economic Council's statement *Venturing Forth – An Assessment of the Canada-U.S. Trade Agreement.*

Richard Caves is currently professor of Economics and Business Administration at Harvard University (U.S.A.). Professor Caves is well-known and has written widely on international trade and industrial organization, including the effect of international trade on

the structure and performance of national markets, the structure and behaviour of multi-national enterprises and transnational comparisons of industrial organization.

Judith Maxwell
Chairman

Adjustment to International Competition

1 Introduction

During the 1970s, many Canadian manufacturing industries found themselves facing increased competition from abroad. For some important sectors, this pressure stemmed from reduced tariff protection. For others, it resulted from the development of strong industrial competitors abroad and the movement of the real exchange rate in Canada's favour early in the decade (to be reversed in the decade's latter half). Historically, manufacturing has been consigned to an import-competing role by the general structure of Canada's factor endowment and thereby forced to adjust to import-based changes in world market conditions. Shifts in that structure and the global trend of increased international integration of national industries have brought substantial export business to some industries, but export-oriented producers face international disturbances just as much as their import-competing brethren.

The analysis of the economy's equilibrating response to international disturbances and the associated issues of public policy usually lies in the domain of macro and general-equilibrium economics. Yet the first-line response of a business firm to trade disturbances takes place within the structural context of its own commodity market. The consequences for the macroeconomy and the effect of any policy intervention cannot be known without understanding the microeconomic adjustment process in the typical Canadian market.

Economists have done considerable research (summarized below) on the long-run structural consequences of import competition and small market size for the structure and performance of Canada's manufacturing industries. Cross-section studies have revealed much about the inefficiencies that can arise from non-competitive industries' responses to international competition. However, little attention has been paid to the process of adjustment that occurs in the short run when a substantial change in world prices or supply affects an industry's competitive position.[1] This study explores the microeconomic process of short-run adjustment to international disturbances in Canada's manufacturing industries, using theoretical models and research methods of the field of industrial organization to shed light on questions originating in macroeconomic policy.

These microeconomic processes hold importance for the aggregate economy for several reasons. Some adjustments bear directly on public policy. An industry that contracts in the face of strengthened foreign competition tends to idle workers and contribute to overall unemployment. The unemployed, in league with the disappointed claimants to income from the sector's capital, may press the government to curb the foreign competition. An industry that instead rationalizes its facilities and cuts its costs, may escape from its difficulties and even increase its total output. Producers afflicted by toughened external competition are regularly advised to follow the second model and forswear the first. Yet, which course of action yields them higher expected profits (or smaller losses) depends intricately on both technical factors and competitive conditions. Another policy variable that may be entwined with industrial adjustment processes is the trade balance. A nation's trade balance sometimes becomes an objective of policy, even if it lacks any clear connection to economic welfare. When the world price facing an imperfectly competitive industrial sector falls, the deterioration of the trade balance is arrested if the sector cuts its price and/or responds with rationalizing investments. But the deterioration is speeded if a non-competitive domestic price fails to meet lower import prices promptly.

The controversy over the gains from scale economies that Canada might reap from the free-trade agreement with the United States underlines the need to understand these microeconomic processes of adjustment. Wonnacott [1975] and Harris [1984] both assigned high values to these gains, drawing on empirical evidence on the scale economies available in manufacturing and making the assumption that they would be realized through free trade. Daly and Rao [1986] questioned the prediction, pointing out that the enlargement of Canada's national markets through the general process of economic growth has apparently yielded much smaller scale-economy gains than Wonnacott and Harris estimated. Magun et al. [1988] placed more emphasis on gains from free trade due to the elimination of suboptimal-scale plants than on economies from enlarging the scales of what are already Canada's larger production units. Clearly, there is need for a microeconomic investigation to determine whether the typical manufacturing industry's adjustment to changes in international competition diverges from its response to the gradual growth of national markets.

Knowledge of the short-run adjustment process can enlarge our understanding of economic behaviour beyond these specific policy issues. Microeconomic analysis

justifies its traditional neglect of short-run adjustments by the proposition that the new long-run equilibrium reached after some (permanent) disturbances is independent of the path of adjustment. Yet recent theoretical work on oligopolistic markets based on the theory of games has stressed that "history matters": when firms can behave strategically in making irreversible commitments of resources, the theoretical long run in which all resources can be shifted never comes around, and the current allocation bears the marks of generations of previous decisions about committing resources. To study sequential strategic decisions empirically is a difficult process, because the investigator needs information on the conjectures and beliefs of the decision makers, and because the outcome is not always theoretically determinate. Nonetheless, studying adjustments in differently structured industries may indicate the market structures in which strategic interaction can affect adjustment processes.

This study comprises an econometric investigation of the short-run responses of Canadian manufacturing industries during the 1970s to changes in world prices and competitive conditions. The analysis employs panel data that vary both among industries and over time. They allow us to test simple models of adjustment processes in individual Canadian manufacturing industries while observing how the sizes or speeds of adjustments vary with the industries' structures. The analysis focuses on adjustments in a series of dependent variables that are taken up successively in this study. When changing world-market conditions alter the prices of foreign goods, the import-competing Canadian industry responds with some adjustment to its selling price. That change, relative to the initiating external price disturbance, determines the change in total Canadian consumption ("domestic disappearance") and its components – actual imports and domestic production. In Chapter 4, models of the behaviour of Canadian industry selling prices and imports are formulated and estimated. (Domestic industries' outputs are not modelled explicitly, but the quantities of competing imports are.) The changes in Canadian industries' outputs are associated with changes in their inputs and structures of production. Chapter 5 takes up capital expenditures, and Chapter 6 analyses levels of employment. These input decisions are observed separately for domestic- and foreign-controlled establishments, so that their roles in the adjustment process can be compared. Finally, Chapter 7 addresses the behaviour of exports, exploring the positive correlation evident between import competition and sales of exports.

Summary of Findings

The balance of this chapter provides a summary of the project's empirical findings. Emphasis is placed on the empirical findings; certain analytical issues associated with them are discussed in Chapter 8. The statistical tests that underlie the empirical findings ideally yield a clean acceptance or rejection of any given hypothesis. In practice, however, an intermediate "uncertain" category always emerges, when acceptance of the hypothesis proves not robust to changes in the measurement of variables, specification of the model, application of statistical refinements, and the like.

The prices charged by Canadian manufacturing industries are sensitive to their variable costs (labour and materials) but exhibit only small responses to changes in these input costs. These prices are much more in the grip of international prices (we used U.S. prices to proxy them), although the effects of world-price changes take more than two years to be ingested completely. Concentrated industries' prices may be less responsive to changes in domestic costs, but they are no less (and no more) sensitive than unconcentrated industries' prices to changes in world prices. The more differentiated is an industry's product, the less sensitive is its domestic selling price to world-price disturbances. The Canadian tariff that protects it may also reduce price sensitivity. We did not discern much effect on price changes of tariff changes during the 1970s, perhaps because they were small relative to other disturbances. No influence of exchange-rate changes was detected, although they were large.

The short-run movements of imports classified to (potentially competing with) each Canadian manufacturing industry were examined, because business lost to foreign suppliers should strongly influence the adjustments undertaken by Canadian managers. Disturbances to domestic demand have an influence on imports that is strong but takes on average at least a year to work its way through. During the 1970s, imports picked off less of increases in domestic demand for the outputs of the more capital-intensive industries, apparently because domestic producers were carrying excess capacity that allowed them quickly to expand output. The degree of competition among Canadian producers probably had no effect on the response of imports to disturbances in domestic demand.[2] Imports are sensitive to changes in their relative prices, as one expects, but that sensitivity is mitigated by product differentiation (especially in its guise of physical diversity and complexity of the product). Price sensitivity is also reduced to the extent that foreign subsidiaries are present in the industry.[3] Canadian tariffs may reduce the sensitivity of imports to disturbances of domestic demand, just as they seem to make Canadian prices respond less sensitively to changes in world prices. If the findings are correct, these sensitivities should be increasing as tariffs are reduced; that corollary is important for understanding

the changes in capital spending due to international disturbances.

Annual capital expenditures by Canadian manufacturing industries are strongly influenced by recent (two-year) changes in real shipments. Spending in domestically controlled establishments also depends on the cost of capital relative to the wage level, although spending by foreign subsidiaries is not significantly affected by Canadian capital costs. The effects of real-output changes on capital spending are weaker in concentrated industries sheltered by high tariffs, perhaps because their investment decisions depend more on international disturbances and prospects. Effects of real-output changes on investment also are weaker in innovative industries, whose capital spending depends more on the innovations coming on-stream and less on changes in demand for existing products.

An important conclusion about capital spending and international disturbances is that the reductions of Canadian tariffs that occurred over the 1970s induced significant increases of capital expenditure, presumably to reconfigure product lines and operating scales. This pattern is consistent with previous research on Canada's industrial structure, which found that tariff protection accounted for the proliferation of products in inefficiently small and/or diversified production facilities. The rationalization process is particularly evident in industries that are heavily populated by multinational companies. That pattern is consistent with the proposition that multinationals are well placed to choose sensitively between supplying a product to the Canadian market from foreign and domestic plants; however, the foreign subsidiaries' Canadian competitors also undertook rationalizing investments in those industries, which tend to offer rich opportunities for juggling product lines and characteristics.

Investment spending in Canada could respond to changes in the world market *other than* through the effects of those changes on levels of domestic shipments. Only a little evidence was found that the domestic-controlled segments of Canadian industries respond positively when foreign prices rise relative to domestic variable costs. Increases in those variable costs do enlarge their capital spending (presumably to substitute capital for the more costly variable inputs, labour, and materials).

Short-run input decisions include employment as well as capital expenditures. Industries' levels of employment are closely related to their outputs, but do not adjust at all sensitively to changes in industry shipments over a period as short as a year. Furthermore, the short-run adjustments to declines in shipments are less regular (in fact, not statistically significant) than adjustments to increased shipments. Employment decreases when the average wage rises relative to the cost of capital. Usage of labour per dollar's worth of output differs among industries for both technological and economic reasons. For example, concentrated industries use less labour, because they are more capital-intensive, and because firms with market power restrict output in order to maximize their profits therefrom.[4] Tariff reductions cause producers to use less labour per unit of output in the long run, one consequence of the increases of investment induced when levels of protection are lowered. Foreign subsidiaries use less labour per dollar of shipments than domestic companies, because (for one reason) some of their sales are accounted for by finished or semifinished goods imported from their corporate siblings. Increases in the efficiency of labour utilization are associated with expanding exports. The labour-output relation does not depend on how much import competition an industry faces, although of course a short-run increase of imports (ceteris paribus) will reduce output and thereby employment.

Adjustment processes were analysed separately for the production-worker and staff components of each industry's total employment. Both their long-run and short-run determinants are quite similar, although staff employment seems less sensitive to output changes in the short run.[5] It is also less sensitive to changes in relative labour costs. Long-run tariff reductions squeeze out staff as well as production-worker labour. Although foreign subsidiaries use less labour per dollar of shipments than domestic establishments, they accomplish this by employing much less production labour yet more staff; short-run changes in their market shares are associated significantly with changes in industries' use of non-production workers. Subsidiaries' use of labour is somewhat statistically significant but less sensitive to wages relative to the cost of capital in Canada than is employment in domestic firms.[6]

Manufacturing industries' imports and exports tend to change in the same direction (intraindustry trade), a fact that called for inclusion of industries' export levels in the analysis. The basic determinants of Canadian manufacturers' exports are demand conditions in foreign markets, external prices relative to Canadian prices, and domestic producer's plant capacity. With these factors controlled, exports are highly sensitive to (that is, increase with) changes in imports in the preceding year. This relation can be divided into two components. One is the common factors causing the expansion of both imports and exports, associated with industries' structures and with changes occurring in the world market generally (for example, reduced transportation costs and diffusion of knowledge among buyers). The other is specific adjustments by Canadian

producers to import competition that bring expanded exports as one of their consequences. The magnitudes of regression coefficients assign about nine tenths of the total effect of imports on exports to the former component, one tenth to the latter. It should be noted, however, that the crucial coefficient underlying the one tenth is not statistically significant. The positive exports/imports relation is stronger in industries for which research is important and where multinational enterprises are active, weaker when technology is capital-intensive. This exports-inducement mechanism is weaker in industries that have previously enjoyed high levels of protection.

The determinants of exports also include some variables that indicate an industry's basic comparative-advantage positions. A sector's export intensity increases with its research intensity and capital intensity, and decreases with its advertising intensity.[7] The share of industry shipments accounted for by foreign subsidiaries is positively related to export intensity. This result parallels the finding that rationalizing investment is concentrated in industries where foreign subsidiaries are prevalent; in general, the conclusions of this study do not agree with the hypothesis (based on the tradition of "tariff factories") that foreign subsidiaries have been tardy in responding to the increased internationalization of Canadian manufacturing industries.

This study is large in scope and has yielded many conclusions. Some are familiar from other research or unsurprising because they affirm widely accepted economic theory. Others are novel or bear on questions that are unsettled conceptually. At some risk of overstatement, this summary concludes with a list of the study's more distinctive findings:

1 The selling prices of Canadian manufacturing industries are linked quite closely to the prices of their foreign competitors; about three fourths of the average external price change is matched by Canadian prices within two years. Producers' prices seem less sensitive to their own variable costs, especially when the domestic sellers are concentrated.

2 Canadian producers by no means retreat in disarray when import competition stiffens. During the 1970s, tariff reductions induced rationalizations that involved temporarily increased capital expenditures and yielded higher labour productivity. These fighting responses are consistent with the strong tendency for increases in an industry's exports to accompany increases of the imports with which it competes, although this positive association depends largely on structural changes that increase trade flows within the industry worldwide.

3 The structures of markets affect how fast they adjust to international disturbances. The differentiation of products slows short-run responses of both prices and quantities. This conclusion applies to the response of imports to domestic disturbances as well as to Canadian prices' reactions to external shocks. Tariffs appear to insulate domestic from international commerce in a way similar to product differentiations.

4 While adjustment to international disturbances depends on the structure of the industry, the economic behaviour reflected in average response patterns points to certain structural elements of prevalent importance in the manufacturing sector. One will make few mistakes predicting Canadian industries' responses to international disturbances by assuming that products are differentiated but sellers are otherwise fairly competitive.

5 Oligopoly behaviour provided only a few exceptions to the preceding conclusion. However, during the 1970s capital-intensive industries, many of which are concentrated, behaved in a way not consistent with competition in the long run. They raised their relative prices and adjusted their quantities as if they were maintaining excess capacity.

6 Conclusions were obtained about controversial questions of foreign subsidiaries' roles in adjustment to international disturbances. Presumably because of their participation in intrafirm trade, their presence reduces the sensitivity of imports to market prices. Their decisions about capital spending and employment are insensitive to the cost of capital in Canada, sensitive to labour costs (although less sensitive than domestic enterprises). Rationalization in response to international competition and the development of intraindustry trade are concentrated in sectors where foreign subsidiaries are prevalent, but in these industries domestic and foreign units alike take part in the adjustments.

7 Canadian manufacturers, traditionally regarded as import-competing, behave in the short run as if exports were a regular and substantial part of their business activities. The advantages that foster Canadian exports stem from research and skills and not just the traditional capital-intensive processing of natural resources.

2 Market Structure and Short-Run Adjustment: Implications of Oligopoly and Product Differentiation

Setting a theoretical framework for this inquiry poses a challenge for two reasons. First, the investigation covers the full set of Canadian manufacturing industries and not just a single sector. Many different models of market equilibrium lie in the theoretical inventory, and we must decide which (or how many) of them to employ. Second, while models of long-run equilibrium are abundant, their implications for short-run adjustment processes have had in most cases little attention. We consider the portfolio of appropriate models first, and then turn to the problem of extracting their implications for adjustment in the short run.

Market Models and Their Applicability

The proliferating models of strategic behaviour in oligopoly tempt the researcher to select them for empirical application. They include models of international strategic behaviour that convey strong implications for public policy and game-theoretic models of the sustaining (and breakdown) of collusive understandings. The latter not only characterize outcomes in oligopoly markets but also offer specific predictions about breakdowns in cooperation – when an unobservable state of nature delivers an adverse shock [Green and Porter, 1984], or when an observed favourable state of nature increases the short-run payout to defection [Rotemberg and Saloner, 1986]. The trouble is, no empirical evidence seems to confirm that breakdowns of collusive understandings lie at the core of adjustments to international competition by Canadian manufactures. For Canadian markets we prefer to rely on a well-established, home-grown model of equilibrium in an import-competing oligopoly. The Eastman-Stykolt [1960, 1967] model (hereafter ES) possesses both theoretical coherence and substantial empirical support. While this, like other oligopoly models, applies a priori only to industries with small numbers of sellers, it can be joined with familiar models of pure and monopolistic competition to cover the large-numbers markets.[1]

The Eastman-Stykolt Model

The ES model addresses the performance of an oligopoly facing import competition that is characterized by a world price determined outside of the country. The domestic industry's costs are assumed low enough (when minimized) that it can earn at least normal profits producing and selling in competition with tariff-restricted imports, but not low enough to permit substantial export sales. Substantial scale economies in production are assumed to make room for only a few producers serving the domestic market; because they are few, collusion is an active possibility. If collusion can be sustained, the natural focal point for setting the domestic price is the world price plus the domestic tariff and transfer costs applicable to imports. Indeed, the model suggests that this conspicuous focal point may make collusion easier to sustain than in the absence of such a clearly delineated international "limit price." On these assumptions, excess profits are potentially available to domestic oligopolists if their production facilities are organized so as to minimize the cost of whatever output they supply. Costs may not be minimized, because entry becomes profitable for small-scale producers who may be able to cover costs without disturbing the market's price consensus.[2]

The model assumes that the structural conditions and information structures of domestic producer groups not uncommonly make price collusion feasible. This is a refutable and important assumption, especially because of the way it interacts (in the extended or "folk" version of the model) with product differentiation and non-price competition. The extended model also assumes – on the basis of much empirical evidence explicated by recent theoretical research [Fershtman and Muller, 1986] – that collusion is less likely to be sustained on non-price dimensions of rivalry than on price. Domestic producers then may undertake many types of rent-seeking activities designed to increase sales made at collusively set prices than exceed marginal costs. Some of these activities take on particular importance in import-competing industries serving small markets. Producers may offer additional varieties of differentiated products, incurring extra fixed costs that manifest themselves in short-run lengths and plants more diversified for their scales than those found in larger and/or more competitive markets. The resulting elevation of the industry's average cost entails a normative problem parallel to that of excess entry, mentioned above. At the limit, a concentrated ES industry may fail to realize any excess profits if these forms of rivalry push average costs up to the level of the delivered (tariff-ridden) world price.

Since Eastman and Stykolt first set forth the model, a good deal of research has confirmed its fit to the Canadian secondary manufacturing sector. Bloch [1974] concluded that elevated prices in concentrated industries were accompanied by inflated costs rather than inflated profits [see also Masson and Shaanan, 1987]. Caves [1975] found evidence consistent with the model's predictions about plant scales and levels of output diversity. Hazledine [1980] confirmed that concentration of Canadian sellers is necessary for their prices to be elevated to the level of the tariff-ridden world price. Caves et al. [1980] estimated an extensive system of cross-section relationships that supported most elements of the model, including its predictions for plant scales and productivity levels, and its implication that an industry can command excess profits only if domestic producers are concentrated and import competition weak.[3] Harris [1984] employed a computable general-equilibrium model to quantify the resulting excess costs, which mount to fractions of national income far larger than those conventionally expected to result from the deadweight loss due to monopoly. Baldwin and Gorecki [1986] reported similar results from an empirical investigation of factors explaining differences between productivity levels in matched Canadian and U.S. industries [see also Saunders, 1980].

Most relevant to the study of short-run adjustments is a series of investigations undertaken by Baldwin and Gorecki [1983*a*, 1983*b*], who used the ES framework to explore changes in the organization of Canadian industries over the decade of the 1970s. Where increased international competition (due to tariff reductions, for example) had thinned the margin between the world price (of goods delivered in Canada) and the minimized cost of production, they expected to find the scales of production facilities to grow more efficient and run lengths to be increased (diversification reduced) in the typical plant. Their analysis of plant scales[4] [1983*a*] confirmed the basic cross-section result that plant sizes increase strongly and regularly with the size of the domestic market (and with export opportunities, for industries with substantial exports). But in highly concentrated industries with substantial tariff protection, plants tend to be more numerous relative to the market's size. When they tested changes in the variables over the decade 1970-79 for evidence of this relation, the strong link between plant and market size persisted, but it was no stronger in concentrated and heavily protected industries. They did find that lower rates of protection lead to significant increases in plant scales in industries with the combined traits of high tariffs, high concentration, and substantial foreign ownership. Thus, their evidence does not suggest that the adjustments to changed protection evident in the ES model are strongly evident over a decade-long period, although multinational enterprises do respond significantly.

Their analysis of diversification [1983*b*] utilized both a standard (Herfindahl) measure of in-plant diversification and a measure of "run length": the effective volume of production of each census product emerging from a plant, converted into a (plant-size) weighted average for each industry.[5] In cross-section they again confirmed corollaries of the ES model. The increase of output diversity with plant size is amplified in concentrated industries that are heavily protected. The finding implies that firms in such industries choose to proliferate outputs in large plants rather than use them in a specialized mode. Foreign ownership does not seem to exacerbate this diversification.[6] Baldwin and Gorecki [1983*b*] found that the tendency for run lengths to increase with plant sizes during 1974-79 was significantly attenuated in the concentrated industries that enjoyed high protection. Also, reductions in tariff protection were associated with increased run lengths in their sample overall.[7]

In both investigations they sought to identify the influence of changes in imports' share of domestic disappearance, independent of changes in tariffs (which, of course, are one cause of changes in imports). Increased import shares were associated with decreased plant sizes but also with increased run lengths, suggesting to Baldwin and Gorecki, that "Canadian plants, when facing import competition, become smaller and carve special niches in the market place, rather than add even more products to offset the loss in plant scale economies resulting from declining sales in their primary product lines."

Product Differentiation in Unconcentrated Industries

The strong empirical support for the ES model does not make it the model of choice for *every* Canadian manufacturing industry.[8] Rather, the empirical research summarized above marks the more concentrated industries without substantial exports as the ES model's natural domain. There remain many relatively unconcentrated industries that call for models of large-numbers competition. The model of monopolistic competition will prove quite useful for this study, because a good deal of evidence on short-run adjustments (it turns out) is consistent with the presence of product differentiation but not with any strong imprint of small-numbers rivalry. Even without application of hindsight, the model of monopolistic competition takes on some distinctive properties in the open economy that align its implications for short-run adjustments with those of the ES model.

Models incorporating international trade with the market structure of monopolistic competition [e.g., Helpman, 1984] start with closed national economies in equilibrium and

then derive the effect of opening them to trade. When pure competition is assumed, the integration of national markets affects the total output of each national industry (depending on whether it assumes exporting or import-competing status) but not the optimal scale of the individual firm. With product differentiation, however, the size of the individual firm can increase (each firm is assumed to produce one "brand" or variety) as well as the total number of varieties available for consumption in each trading country. Conversely, tariff protection can reverse the process and shrink the scale of the typical producer while it increases their number. The effect on firm size qualitatively resembles that of product rivalry and brand proliferation in the ES model, although the mechanism and the quantitative predictions are not the same.[9] The monopolistic-competition model's predictions thus resemble, for our purposes, those of the ES model more closely than those of theoretical pure competition, in which each industry adjusts along a long-run supply curve, and the individual firm either survives or fails but does not adjust.

The theoretical aptness of the monopolistic-competition model is supported by empirical evidence on the prevalence of product differentiation in international trade. Copious evidence – most of it not specific to Canada – indicates that patterns of market structure and behaviour are consistent with differentiation and inconsistent with pure competition. These include a ubiquitous positive relationship between the sizes of production units and of the markets that they serve, recorded in the literature of industrial organization, and adjustment patterns found in international trade that can be explained only if goods emanating from one country normally lack perfect substitutes in another country's outputs.

Predictions about Adjustment Processes

These long-run market models offer many implications for industries' short-run responses to changes in their world competitive positions. We first consider what responses to international price disturbances are predicted by the preceding models, then incorporate some complicating factors that prove important in the empirical analysis.

Short-Run Adjustments in the ES and Other Models

The ES model offers ample comparative-statics implications – some of them quite distinctive. Consider the effect of lowered tariff protection, which many Canadian industries experienced during the 1970s.[10] When a tariff is (permanently) lowered and the price-cost margin of a sheltered ES industry is compressed, domestic producers may respond not by contracting their outputs but by "rationalizing" their facilities – enlarging plants' scales, simplifying product lines, shortening run lengths, concentrating on its more profitable products. Post-adjustment output may be increased rather than reduced, and capital expenditures should rise in the short run while the adjustment is under way. A purely competitive industry facing a lowered world price would, by contrast, contract along its supply curve, reducing its capital stock and, of course, its rate of capital spending.

The adjustment process of a domestic industry that offers a differentiated product is relevant either to the oligopolistic ES model or to monopolistic competition where sellers are numerous. The disturbance assumed so far has been a change in a parametric world delivered price of competing imports. When the product is homogeneous, it makes no difference whether a disturbance (of equal permanence) arises from the changes in world price, the exchange rate, or the rate of tariff protection. For differentiated products, some distinctions must be drawn. Suppose that the world price falls because reductions in the costs of foreign producers induce them to offer new varieties. The declining world price is accompanied by a richer array of importable varieties, which may (although they need not) include better substitutes for the typical domestic brand that increase the elasticity of demand facing the home producer. The domestic industry's response could well involve an increase in capital spending as the typical *surviving* domestic producer increases its capacity. With respect to the ES model, this type of adjustment accords with the rationalizing investment already depicted as a possible response to lower delivered prices of imports. With regard to less concentrated industries, it warns us that predictions about adjustment processes based on pure competition may be falsified to the extent that internationally traded manufactured products are differentiated.[11]

Other Factors Influencing Short-Run Adjustments

We have obtained a group of predictions about the adjustments of Canadian industries' outputs and capital expenditures to international disturbances. The predictions are conditional both on the nature of the disturbance (tariff change? expanding overseas supply?) and the domestic market structure (ES? competitive? with or without differentiation?). Before explaining the statistical design used to explore these adjustments, we consider three complicating factors – administered prices, multinational companies, and

exporting opportunities. Each of these calls for some control variables and structural elaborations in the empirical model.

Administered Prices

The copious literature on "administered prices" suggests that concentrated industries tend to lag in adjusting their prices to disturbances, whereas the ES model presumes that the delivered world price serves as a focal point in the short as well as the long run. Diverse theoretical explanations of administered prices can be found. Some suggest that price adjustments are more attenuated as the concentration of producers increases. Other versions predict that maximum stickiness of prices occurs in moderately concentrated industries. With either scenario, the administered-prices hypothesis implies that concentrated industries might delay in adjusting prices to meet stiffened import competition, as a consequence suffering short-run declines in output as imports displace them from the market. More important, that scenario of displaced domestic output compromises the prediction that home producers will rationalize their facilities aggressively, unless one assumes that their rational long-run expectations will override short-run excess capacity and shriveled cash flows due to sticky prices.

How much weight should we place on the administered-prices hypothesis in designing this project? Empirical research has tended to confirm the presence of inflexibility in several countries, although not consistently in periods of rapid general inflation such as the 1970s. Inflexibility has been inferred from the size and timing of the response of prices both to variable costs and to demand shifts associated with turns in the business cycle, as well as from the frequency of changes in nominal prices. However, among empirical studies that confirm some form of inflexibility, there is no agreement on whether it peaks in moderately concentrated oligopolies or increases monotonically with producer concentration. Nor have most investigations controlled for the import competition faced by the domestic producer group. For that reason we review evidence specific to Canada.

Two studies, Sellekaerts and Lesage [1973], and Jones and Laudadio [1977], demonstrated that prices of concentrated industries tended to rise during a period (1957/58 to 1961) when capacity utilization was low and the general price level rising slowly if at all. Both found that price increases were higher to a moderately significant degree in more concentrated industries, with changes in the industry's costs and volume of shipments controlled. Sellekaerts and Lesage found that concentrated industries' prices behaved no differently from other industries' during the boom period of 1963-66, but Jones and Laudadio concluded that they lagged during the period of 1966-69, when inflation was accelerating. McRae and Tapon [1979] used a different procedure that focused on the variability of monthly price indexes, concluding that price movements were attenuated in industries with four-firm concentration exceeding 50 per cent. Encaoua [1983], performing time-series analyses within two- and three-digit industries, found inflexibility to be associated not with the height of concentration but with the extent of foreign ownership (with which concentration is highly correlated). Jones and Laudadio observed that high levels of import competition tended to restrain industries' price increases during 1966-69; Encaoua also concluded that import competition (but not export involvement) constrains the movements of Canadian industries' prices. However, McRae and Tapon did not find that the variability of prices was related to sectors' exposure to import competition, once concentration was controlled. In conclusion, some evidence confirms that the prices of concentrated Canadian manufacturing industries have, at times, proved inflexible in the face of domestic disturbances.

Might concentrated industries' responses to changes in competing world-market prices prove similarly attenuated? Few investigators have pursued the question, but it seems risky to presume that domestic prices adjust promptly to movements in the international "limit price," an implicit assumption of the ES model. Hence we shall ascertain whether Canadian producers' prices adjust to international disturbances in accord with the ES model strictly interpreted or whether adjustments are subject to lags. Such lags would alter the short-run sequence by which the long-run ES equilibrium is restored following a disturbance.

Multinational Companies

A second factor that may affect short-run adjustment processes is the prevalence of foreign subsidiaries. Not wishing to consider them at length, we rely on a few propositions about their behaviour that are defensible from both theory and empirical evidence.

1 Multinational enterprises are best regarded as global profit-maximizers. The scale and configuration of a multinational's Canadian activities probably aim principally to maximize its expected global profit.

2 Tariff protection has been one of the significant influences attracting foreign subsidiaries to Canada's

manufacturing industries, and their configurations of activities presumably have adjusted fully to the small, protected character of the Canadian market.

3 Underlying factors that explain the interindustry distribution of multinationals imply their abundance in concentrated industries subject to product differentiation – the ES sector.

4 One advantage accruing to multinational firms is the efficient use of information on changing economic conditions worldwide. With better information and (via corporate siblings) more options for adapting to any given disturbance, their responses to disturbances may be larger and/or quicker that those of domestic firms.

These propositions together imply that the roles played by foreign-controlled establishments in Canadian industries' adjustments to changing international competition may differ substantially from their domestic rivals' responses. Fortunately, the database developed for this project decomposes industries' outputs, capital expenditures, and employment into those components due to domestic and foreign-controlled establishments. The model will allow for the possibility that the prevalence of foreign investment substantially affects an industry's pace or character of adjustment to international disturbances.

Recent empirical research touches on this question. Baldwin and Gorecki [1983*a*] confirmed that industries with high concentration, tariffs, and foreign ownership generally conform to the ES predictions about plant sizes. How foreign ownership affects plant sizes varied with the year of the analysis – decreasing them in concentrated industries in 1970 but apparently increasing them in 1979. Changes in foreign ownership did not have a significant effect on changes over time in plant scales. They did not find much evidence that foreign ownership influences the diversity of plants' outputs or changes in that diversity. Daly and MacCharles [1986], who analysed a matched sample of medium-size companies under domestic and foreign control, found the domestic firms somewhat more prone to embrace the strategy of specialization and large-scale production for the export market. However, their results are not inconsistent with multinationals commonly finding that their most profitable policy is to confine their Canadian subsidiaries to small-scale production for the domestic market. The subsidiaries are less active in exporting (on some measurements) than domestic companies, but they are more active as direct importers, and by that channel directly exposed to the problem of adjusting to changes in the relative cost of sourcing goods abroad and in Canada [MacCharles, 1987].

Exporting Opportunities

We have so far honoured tradition by treating Canadian manufacturing as an import-competing sector. However, even if the transportation equipment sector (the Auto Pact) and resource-processing industries are put aside, many of the remaining manufacturing sectors have significant exports. Theoretically, an industry that exports a significant proportion of its homogeneous product is a poor bet to fit the ES model: it is better regarded as an arbitrarily distinguished subsector of a worldwide industry in which Canada is a small producer.

With products heterogeneous and differentiated, however, exporting opportunities call for much less modification of the ES predictions. The rationalization processes following upon a reduction in the delivered price of competing imports are qualitatively the same whether the affected domestic producers change their method of competing with imports in the domestic marketplace or make an about-face and begin exporting. Canada's small size in the world economy of course implies that the size of the change in the unit's operations could be much greater when exporting is adopted. For that reason, in the empirical model we may need to distinguish between industries that do and do not have access to substantial exporting opportunities as they adjust to changes in import competition.

Empirical evidence supports the importance of this qualification for exporting. Intraindustry trade has attained widely recognized importance in commerce in manufactures among the industrial countries. While it has various theoretical explanations, product differentiation (with or without elements of oligopoly behaviour) is first among them. Thus, simultaneous adjustment of exports and imports is to be expected for a wide range of manufacturing industries. Hazledine et al. [1988] reported substantial exports *and* imports for 39 per cent of the narrowly defined products they analysed. One study [summarized by Daly and MacCharles, 1986, p. 4] found that large firms which both export and import account for 28 per cent of total shipments of manufactures. Daly and MacCharles [1986, p. 41] found that 90 per cent of the firms in their sample initially competed with imports, yet 63 per cent of the sample were making or contemplating major rationalizations, either abandoning their current product lines (20 per cent) or specializing and seeking wider markets (43 per cent). In particular, data developed by Matthews [1985] and summarized in Chapter 7 indicate that import penetration and export shipments have expanded in parallel for a surprisingly large proportion of Canadian manufacturing industries.[12] This evidence seems consistent with

the suggestion that export opportunities change the quantitative but not the qualitative response expected from producers of differentiated goods to tougher import competition.

3 Research Design and Data Patterns

The research design proceeds from this theoretical background, which suggests that the response of Canadian manufacturing industries to international competitive disturbances should be analysed with a flexible but focused model. In this chapter, we explain the choice of dependent variables for the analysis and sketch the general structure of the model. A review of some descriptive data provides background to the detailed specifications and results, reported in the four chapters that follow.

General Structure

We employ a pooled time-series, cross-section research design that utilizes five endogenous variables – the Canadian industry selling price, the value of competing imports, the levels of gross capital expenditures and employment, and the value of exports. Each variable is observed for a particular four-digit manufacturing industry and year. This set of panel data embraces at the maximum 161 manufacturing industries observed annually over the period 1970-79. The panel structure was selected to serve the following requirements:

- Capital stocks and labour inputs are fundamental scarce resources, and the efficiency with which they are deployed is a vital concern of public policy. Production capacity takes years to adjust fully to long-run disturbances; it may be insensitive to transient or temporary disturbances – even sharp ones. Adjustment costs also curb changes in employment levels. A decade is hardly more than a reasonable minimum period for observing the adjustment of actual to desired capital stocks, and the decade-long time period was exogenously imposed by the feasible span of the data set. Partly in consequence of the limited leverage in time, the model will be set up to emphasize short-run trajectories of adjustment rather than long-run destinations.[1] The 1970s does offer the virtue of substantial variation in international disturbances – relative prices (the energy price shock; expanding exports from newly industrializing countries), Canadian tariffs, and the Canadian exchange rate.

- Although the number of endogenous variables is judgmental, the preceding discussion certainly suggests a minimum based on interdependences in the adjustment process. International disturbances are treated mainly as price disturbances. While the delivered price of imports (including tariffs) is assumed exogenous to the individual industry,[2] the response of domestic industry selling prices is clearly endogenous. The exogenous change in the world price and the induced price response of Canadian producers jointly determine the change in the total quantity of the industry's line of products demanded by Canadian buyers and in imports' share of domestic disappearance. The quantity of imports therefore must be included, while the change in domestic producers' outputs will be taken as a residual and not modelled explicitly. Changes in domestic inputs, however, are central to the analysis. Two decision variables are emphasized, the annual capital expenditures (construction and machinery will be analysed separately) and employment (which can be disaggregated into production and non-production workers). Changes in exports also call for analysis, and indeed the model may follow tradition too closely in pursuing the effect of international competition via imports rather than treating imports and exports symmetrically.[3]

- Substantial statistical leverage on structural differences among industries is needed to measure their effects accurately. There is general agreement that behaviour predicted by the ES model is found in industries distinguished by high concentration of producers and tariff protection. Baldwin and Gorecki [1983*a*, 1983*b*], for example, denoted ES industries as those with both concentration and protection above the mean for Canadian manufacturing. Do these conditions yield the optimal boundary? What about the role of product differentiation? Previous research on foreign investment in Canada shows that multinational companies make some adjustments differently from domestic enterprises; the model needs to allow for the great differences among manufacturing industries in the market shares held by foreign investors. The theoretical analysis demonstrated the need to control for interindustry variation in the "sunkenness" of industries' capital stocks. The need for a well-filled arsenal of controls for market structure coupled with the desire to analyse statistical industries that correspond as well as possible to economic markets led us to work at the four-digit level of the Canadian standard industrial classification. Industries defined at that level may on average be broader than true economic markets, but it represents a reasonable choice.[4]

• A model of this type poses a number of econometric problems. The structure of the model will formally avoid simultaneous equation bias, because the endogenous variables enter other equations only with a lag. However, the panel data structure raises problems of autoregression in the time-series dimension and heteroskedasticity in cross-section. At this point we must acknowledge a major shortcoming in our ability to implement the appropriate statistical procedure. When we applied the procedure recommended by Kmenta [1986, pp. 618-25] for dealing with these problems, two adverse consequences followed. First, the procedure seems to be very sensitive to the interactive specifications used in the model. It yielded some coefficients that closely resemble their counterparts estimated by ordinary least squares, while others differed by magnitudes on the order of 100,000. Not only that, but also the procedure proved extremely expensive and generated a nasty confrontation with the project's budget constraint. We were forced, therefore, to rely on ordinary least squares for the primary results that are reported. The coefficients estimated by OLS are unbiased, although the validity of hypothesis tests will be a problem. We indicate in each chapter to what degree they were confirmed following corrections for autoregression and heteroskedasticity. Because of the compromised statistical procedures, the results must be regarded as tentative.

Summary of the Model

These considerations led to a system of six equations. The dependent variables are defined below, and the chief exogenous variables are listed in order to summarize the general structure of the model:

1 Percentage change in the Canadian industry's selling price ($CPCH_{it}$) depends on current changes in variable costs and current and lagged changes in world prices, all interacted with market structure variables.

2 Logarithm of value of imports classified to product groups coinciding with those assigned to the domestic industry (IMP_{it}) depends on lagged domestic-demand disturbances and relative prices (each interacted with market-structure elements) as well as shifts in world excess supply.

3 Logarithms of constant-dollar gross fixed capital expenditures of the Canadian industry, subdivided into machinery (KXM_{it}) and construction (KXC_{it}), depend on recent changes in real output, the cost of capital, and changes in domestic relative to world prices.

4 Logarithm of industry employment (L_{it}) depends on real output, wages relative to the cost of capital, and structural variables shifting the labour-productivity relationship.

5 Logarithm of the value of industry exports (EXP_{it}) depends on an index of demand in overseas markets, world relative to Canadian prices, the lagged change in industry capacity, and the lagged value of competing imports; the last two variables are interacted with market-structure elements, and comparative-advantage indicators are also included.

Because each variable is observed for a maximum of 161 industries and for 10 years (1970 through 1979),[5] the design potentially affords about 1,600 observations, and the effective number of degrees of freedom remains large even where lagging exogenous variables reduces the number of years covered.

In long-run equilibrium these variables are jointly determined, and (as noted above) simultaneous estimation is avoided only by the presence of lags when endogenous variables enter as regressors. Assume that a Canadian market is disturbed by a reduction in the world price (expressed in Canadian dollars). This price reduction applies competitive pressure to rival Canadian producers, forcing them to reduce their domestic prices. The total quantity of the product purchased in Canada increases due to the price decline. Imports increase by an amount depending on the price reduction and the size of the external supply disturbance. Exports may be reduced by the same price disturbance. The short-run change in output sold domestically is determined residually by the import supply disturbance and the associated change in domestic selling price (the model emphasizes the domestic industry's pricing response rather than its output response). Depending on how the disturbance affects their expectations, Canadian producers also alter their desired capital stocks and modify their annual planned capital-expenditure outlays in order to align actual to the newly desired stocks. The adjustment of actual to desired employment levels also proceeds at a pace reflecting both adjustment costs and any changes in productive efficiency induced by the disturbance. The use of lags is invoked to avoid the simultaneous estimation of panel models suggested by these interdependences, although the interannual stability of some industry variables calls the sufficiency of lags into question.

Preliminary Analysis of the Data

A review of some patterns in the data provides background for the details of the model. The goal is not to pro-

vide an economic history of the period but to highlight some relations that are important for formulating and interpreting the model that follows.

Patterns of Change in Two-Digit Industries

In a set of tables that follows, levels and changes are reported for key variables for the 20 two-digit manufacturing industries defined in the standard industrial classification.

Table 3-1 shows changes over the decade 1970-79 in real output, employment, and capital expenditures.[6] Output and employment are expressed as percentage changes between the years 1970 and 1979. Because data are missing on real capital stocks of Canadian manufacturing industries, the trend in capital expenditures is reported instead. Specifically, each industry's annual figures on real capital expenditure were combined for the four-year periods 1970-74 and 1975-79, and the percentage change calculated of the latter from the former figure. Output-weighted averages are reported at the two-digit level. This measure of the real change in capital expenditure need not be closely related to the change in the capital stock; the last column of Table 3-1 therefore should not be compared to the other columns as if it were a third term in a production-function relationship.

Although every two-digit industry's real output grew some during the 1970s, their rates of expansion varied from the modest levels experienced in tobacco, leather, and primary metals to the rapid growth of transportation equipment (influenced substantially by the Canada-U.S. Auto Pact). Because productivity also grew, the changes in employment were substantially smaller than the associated increases in real output, and employment declined in one third of the sectors. Capital expenditure showed a downward trend, however, in two thirds of the industries, in part a reflection of the boom at the start of the decade. Changes in capital spending are clearly correlated with changes in labour use among sectors, but with conspicuous exceptions. Capital outlays in chemicals were strong late in the decade,

Table 3-1

Percentage Changes in Real Output, Employment, and Capital Expenditure, by Two-Digit Manufacturing Industries, 1970-79

	Real output	Employment	Capital expenditure
Food and beverage	26.0	2.3	8.3
Tobacco products	14.2	–22.4	–8.6
Rubber and plastic products	85.5	42.7	–25.7
Leather	18.0	–9.5	–9.4
Textiles	50.4	–2.0	–17.9
Knitting mills	40.6	–10.6	–55.0
Clothing	45.3	–2.6	3.8
Wood	61.4	39.1	–7.7
Furniture and fixtures	32.4	18.4	–35.6
Paper and allied products	29.6	7.2	–11.2
Printing and publishing	56.8	16.0	1.9
Primary metals	13.4	7.8	–3.8
Metal fabricating	40.3	16.5	–3.4
Machinery	71.2	34.8	28.8
Transportation equipment	75.5	29.8	31.0
Electrical products	37.6	–2.8	–1.8
Non-metallic mineral products	51.8	14.4	24.5
Petroleum and coal products	65.3	24.8	–21.9
Chemical and chemical products	58.5	9.7	69.4
Miscellaneous manufacturing	39.8	15.8	7.8

NOTE The change in real capital expenditure is measured from the 1970-74 annual average to the 1975-79 annual average. For that reason, and because it pertains to the expenditure flow rather than the capital stock, it is not comparable to the decade-long changes in real output and employment.

SOURCE Based on data from Statistics Canada.

while spending in rubber and plastics, knitting mills, and furniture was low.

Table 3-2 reports changes in prices over the decade for the two-digit industries and their counterparts in the United States, whose wholesale prices serve as statistical proxies for world-price movements. Because the Canadian dollar depreciated in the latter part of the 1970s, the prices of foreign goods increased substantially more in Canadian dollars. In the third column of Table 3-2, the changes in U.S. wholesale prices are corrected for the movement in Canada's effective exchange rate, to indicate roughly the change in the Canadian-dollar prices of world goods.[7] Although U.S. prices rose less than Canadian prices in substantially all sectors, the typical Canadian industry was not badly squeezed by the delivered price of competing imports. This pattern suggests that the typical industry facing increased international competition did not encounter so much that it was driven to contract rapidly.

The interindustry differences in Table 3-2 show that movements of prices in Canadian sectors and their U.S. counterparts are highly correlated. Only leather, knitting mills, and mineral products seem particularly out of line, with Canada high on the first two and low on the third. Even with the petroleum sector put aside, the capital- and energy-intensive process industries' prices exhibited substantially more inflation than others. Comparison of Tables 3-1 and 3-2 suggests that output increases were small for sectors that experienced a lot of inflation, implying that the price disturbances came from the cost or supply side. The apparent supply-side origin of these price disturbances plays a prominent role in the statistical results.

Table 3-3 explores another source of disturbances to the manufacturing industries, changes in their levels of exposure to international trade. For total manufacturing the share of output exported and the share of total supply provided by imports both increased by about one third. The long-term

Table 3-2

Percentage Changes in Canadian and External (United States) Industry Selling Prices, by Two-Digit Manufacturing Industries, 1970-79

		U.S. prices	
	Canadian prices	U.S. dollars	Exchange-rate adjusted
Food and beverage	132	96	139
Tobacco products	78	94	137
Rubber and plastic products	90	83	123
Leather	122	74	122
Textiles	76	63	99
Knitting mills	46	20	46
Clothing	89	47	80
Wood	176	167	226
Furniture and fixtures	113	82	122
Paper and allied products	138	105	151
Printing and publishing	96	84	125
Primary metals	145	126	175
Metal fabricating	127	115	162
Machinery	99	76	114
Transportation equipment	96	83	124
Electrical products	88	67	104
Non-metallic mineral products	110	107	153
Petroleum and coal products	312	317	409
Chemical and chemical products	126	107	153
Miscellaneous manufacturing	113	81	120
All manufacturing	117	95	138

SOURCE Based on data from Statistics Canada; and U.S. Bureau of Labor Statistics, *Time Series Data for Input-Output Industries.*

Tableau 3-3

Imports' Share of Total Supply and Exports' Share of Output, by Two-Digit Manufacturing Industries, 1971 and 1979

	Imports' share		Exports' share	
	1971	1979	1971	1979
		(Per cent)		
Food and beverage	7.7	10.5	10.1	11.8
Tobacco products	1.2	1.7	9.5	13.4
Rubber and plastic products	18.0	23.2	3.9	11.1
Leather	23.4	32.6	5.8	7.4
Textiles	20.0	23.8	4.5	5.8
Knitting mills	26.3	30.3	2.4	1.6
Clothing	7.0	12.1	4.2	2.2
Wood	8.5	13.2	41.3	50.0
Furniture and fixtures	6.0	13.0	4.9	9.4
Paper and allied products	8.0	11.3	51.3	54.2
Printing and publishing	8.5	11.3	1.7	2.8
Primary metals	42.1	29.9	54.2	44.7
Metal fabricating	13.2	16.1	6.5	10.3
Machinery	67.1	76.9	39.8	55.5
Transportation equipment	61.3	68.8	66.1	70.6
Electrical products	29.5	41.3	13.1	21.4
Non-metallic mineral products	12.3	14.7	6.4	11.3
Petroleum and coal products	7.6	2.4	2.6	9.2
Chemical and chemical products	28.9	74.3	20.3	30.7
Miscellaneous manufacturing	43.0	52.6	18.2	24.7
All manufacturing	22.3	29.9	15.0	19.9

NOTE This table is based on 148 industries, with deletions made where the data raise questions about the match of trade and production categories.
SOURCE Based on data from Statistics Canada.

increase in the exposure of manufacturing industries to international competition, evident in all industrial countries, continued through the 1970s for Canada despite the worldwide encroachment of special protection. Exposure to trade increased on both the export and import side for the great bulk of two-digit industries. Changes in industries' import competition and export activity appear to be positively correlated,[8] indicating the increasing prevalence of intraindustry trade. The pattern agrees with the evidence cited above that the rationalization of production facilities in response to stiffer import competition seems to generate more exports.

Table 3-4 reports levels and trends in nominal tariff protection measured by the ratio of tariff revenue collected to the value of imports. This measure understates the extent of protection, because it omits non-tariff barriers and various forms of administrative protection, and hence does not reflect their changes over the decade. For manufacturing as a whole protection declined about one sixth during the decade. The declines (expressed in percentage points in the last column) were small for most industries, and one third of the sectors experienced no declines at all. When these data are compared to the discrepancies between Canadian and external price changes shown in Table 3-2, they raise concern whether the effects of tariff changes on relative prices were large enough to make themselves felt among the impacts of other disturbances.

Table 3-5 examines the incidence of foreign control over shipments made by two-digit manufacturing industries. The trend was slightly downward overall and negative in three fourths of the sectors. The increases and decreases for individual industries show no simple pattern, in relation to either their basic economic traits or disturbances depicted in the preceding tables. Changes in foreign control show no obvious correlation with changes in import penetration, tariffs, or exporting activity. This independence suggests

Table 3-4

Levels and Changes in Nominal Tariff Protection, by Two-Digit Manufacturing Industries, 1970 and 1979

	1970	1979	Change
		(Per cent)	
Food and beverage	14.2	3.9	–10.3
Tobacco products	50.8	31.5	–19.3
Rubber and plastic products	13.7	14.9	1.2
Leather	19.5	19.5	0.0
Textiles	17.4	17.1	–0.3
Knitting mills	23.6	24.4	0.8
Clothing	14.2	12.2	–2.0
Wood	4.2	3.3	–0.9
Furniture and fixtures	17.3	17.3	0.0
Paper and allied products	10.2	9.5	–0.7
Printing and publishing	8.8	7.5	–1.3
Primary metals	3.7	4.2	0.5
Metal fabricating	11.7	11.8	0.1
Machinery	6.1	5.3	–0.9
Transportation equipment	3.4	2.2	–1.2
Electrical products	11.5	11.1	–0.4
Non-metallic mineral products	7.5	6.7	–0.9
Petroleum and coal products	4.5	1.5	–3.0
Chemical and chemical products	7.2	6.1	–1.1
Miscellaneous manufacturing	12.1	11.1	–1.0
All manufacturing	12.6	10.4	–2.2

SOURCE Based on data from Statistics Canada.

that any distinctive role played by multinational companies in the adjustment process was due to their persistent presence and not to their comings and goings.

Correlations in the Database

Correlations and related descriptive statistics calculated at the four-digit level of disaggregation usefully confirm and extend the conclusions drawn from Tables 3-1 to 3-5. The modest decline in average nominal tariffs was accompanied by a much larger decline in their standard deviation from 13 to 6 per cent, revealing that protection fell the most for industries formerly enjoying heavy protection. The correlation between imports' shares of domestic disappearance in 1971 and 1982 was 0.52, high but nonetheless indicating substantial variance in changes of import penetration. Imports' shares in 1971 were uncorrelated with tariff levels at the start of the decade, suggesting that tariffs modify but do not dominate the structure of trade (if they dominated, the correlation should be negative).

Correlations were examined between the changes in Canadian industries' selling prices and certain variables included in the model. Price changes for the sampled Canadian industries and for their U.S. counterparts (whose prices supply our proxy for world-price movements) are highly correlated, 0.78,[9] confirming that over a decade Canadian industries' price movements enjoy little independence. Correlations over shorter periods, however, may be much lower. The price increases over 1970-79 were not significantly correlated with tariff changes (0.06), which apparently did not contribute much to the variance of domestic price movements. However, tariff rates in 1971 and 1981 were not very highly correlated (0.41), confirming that changes in industries' levels of protection were diverse if not typically important components of changes in competing imports' prices. Price increases, uncorrelated with imports' shares of the market at the start of the decade, were positively correlated (0.21) with changes in imports' shares, which suggests that the causation ran more from domestic prices (costs) to import penetration than in the other direction.

Price changes were uncorrelated with levels of foreign ownership, producer concentration, and other suspect variables, but they were (as Table 3-2 suggested) highly correlated with industries' levels of capital intensity (capital/

Table 3-5

Levels of Foreign Control of Shipments, by Two-Digit Manufacturing Industries, 1970 and 1979

	1970	1979	Proportional change
		(Per cent)	
Food and beverage	30.7	33.3	8
Tobacco products	82.4	99.7	21
Rubber and plastic products	72.4	66.5	–8
Leather	20.6	17.2	–17
Textiles	47.0	53.1	13
Knitting mills	18.2	11.1	–39
Clothing	10.5	14.6	39
Wood	25.8	23.8	–8
Furniture and fixtures	18.2	15.2	–16
Paper and allied products	44.5	40.2	–10
Printing and publishing	10.1	8.3	–18
Primary metals	24.1	20.2	–16
Metal fabricating	42.2	37.9	–10
Machinery	75.1	58.5	–22
Transportation equipment	87.4	84.8	–3
Electrical products	72.0	63.0	–12
Non-metallic mineral products	52.9	58.7	11
Petroleum and coal products	95.2	82.9	–13
Chemical and chemical products	82.3	76.5	–7
Miscellaneous manufacturing	54.6	53.2	–3
All manufacturing	44.4	42.2	–5

SOURCE Based on data from Statistics Canada.

labour ratios, 0.39; capital/shipments ratios, 0.25).[10] Correlations between these capital intensity measures and price increases of U.S. counterpart industries' were even higher, 0.56 and 0.36, so the pattern was general and not confined to Canada. Behind it probably lay energy-price increases (energy and capital intensity seem to be correlated among industries)[11] and the expanding production of labour-intensive commodities in the newly industrializing countries (which drove down the relative prices of these goods). Nonetheless, relative prices of capital-intensive goods may have risen more rapidly in Canada, because capital intensity was also positively correlated with changes in imports' shares of the market (capital/labour, 0.41; capital/shipments, 0.51).[12] Thus, capital-intensive Canadian industries may have faced increasing cost disadvantages and import competition over the period – circumstances favourable for revealing effects important to the model.

The correlations involving price and import changes imply that supply-side disturbances prevailed, and that inference is confirmed by the negative correlation between changes in prices and real outputs, –0.16.[13] That correlation is also consistent with declining relative prices inducing rationalizations that increase output, the possibility emphasized by the ES model. Changes in Canadian and U.S. industries' real outputs were quite highly correlated, 0.35, confirming that substantially similar forces were at work. Canadian real-output changes were negatively correlated with changes in imports' shares (–0.19), as expected, and positively (but weakly) correlated with changes in shares of shipments exported (0.11). Notice that the evidence accords with shifts in the quantities or varieties of importable goods affecting Canadian industries directly rather than through mediating world-price changes. Such a connection is consistent with the prevalence of product differentiation.

Industries' output growth rates were positively but not highly correlated with the growth in their capital spending (0.14). Capital-spending growth was negatively (insignificantly) correlated with changes in import penetration (–0.07) but less than was output growth (–0.19). These values are consistent with the hypothesis that capital was spent on rationalization and not just replacement and/or capacity expansion. The growth of capital spending also was significantly correlated with changes in compensation per employee, 0.22, suggesting that input substitution contributes to explaining differences in industries' capital-expenditure profiles.

4 Industry Selling Prices and Imports

In this chapter, we specify the models that determine percentage changes in industry selling prices and levels of imports. These two variables are closely connected, making it convenient to report them together – at some cost of postponing consideration of price effects on the side of exports.

Specifying the Models

The a priori specifications of this and the models that follow do not seek to embody comprehensively the theoretical relationships outlined above. We allow the data to select among the relevant elements of market structure and modes of interaction.

Industry Selling Price

The percentage change in the industry's selling price $CPCH_{it}$ is assumed to depend on the percentage change in the prices of inputs entering into marginal cost (labour, materials) and the percentage change in its mark-up (influenced in the short run mainly by the change in prices of competing imports). Marginal-cost increases are assumed provisionally to affect price without a lag. Hence we employ:

$LCCH_{it}$ = Percentage change in wages and salaries per employee for industry i in year t, weighted by the ratio of total wages and salaries to value of shipments for i in 1970.

$MCCH_{it}$ = Percentage change in index of unit materials cost for industry i in year t, weighted by the ratio of total materials cost to value of shipments for i in 1970.

The administered-prices hypothesis suggests that concentrated industries' prices respond less sensitively to changes in their variable costs (and/or the delivered prices of competing imports). A test will be specified below.

How to incorporate international price disturbances is an important strategic question for this project. Indexes of Canadian import prices are not available at this level of disaggregation, so a proxy must be sought. Although Canadian imports arrive from diverse countries of origin, we assume that the wholesale price of the counterpart industry in the United States provides a good proxy for the unobserved world price.[1] Given the infeasibility of securing origin-specific prices of Canadian imports, the use of U.S. prices has obvious advantages. The United States is an important source of Canadian imports overall, although not for every industry. The propinquity of the U.S. market should fortify the power of the arbitrage processes to keep Canadian and U.S. wholesale prices in line. The country's large size means that most U.S. prices will be exogenous to Canadian market conditions. Furthermore, while the United States notoriously restricts some imports, it is relatively open to imports as industrialized economies go; U.S. price movements, therefore, should be correlated with world-price movements for goods not exported by the United States. Hence the domestic price change is expected to increase with:

$USPCH_{it}$ = Percentage change in the wholesale price index of the U.S. counterpart industry from year $t-1$ to year t.

If domestic and importable goods' prices are assumed to be aligned by arbitrage in competitive markets, subject to order and delivery delays, a one-year lag may improve the fit. If administered Canadian prices are marked up directly to changing world prices, that lag may prove inappropriate.

Two other components of delivered prices of imports must be controlled. One is the average nominal tariff surrounding the Canadian industry, inferred from the value of duties collected, divided by the value of imports. This variable (designated T_{it} when expressed as a fraction) is defined as a proportional change from the preceding year, in the following form:

$$TCH_{it} = (1 + T_{it})/(1 + T_{it-1}).$$

The other component is the effective exchange rate for the Canadian dollar, $EXCH_t$.[2] It is of course not specific to the individual industry. These components are combined to provide an estimate of the proportional change in the delivered Canadian-dollar price of imports competing with Canadian producers in industry i:

$MPCH_{it} = USPCH_{it}*TCH_{it}*EXCH_{t}$.

To test for a lag in the expected positive relationship, $MPCH_{it-1}$ is employed. We shall investigate the possibility that the domestic price change is not equally sensitive to all components of $MPCH_{it-1}$. Expectations about future prices probably are not equally responsive to short-run changes in each component: world price changes during this period were not likely to be quickly reversed, although inflation created much uncertainty; changes in the Canadian tariff were substantially precommitted; but exchange rates were volatile and probably not subject to much expectational consensus.

An essential feature of our design is to allow the slope coefficients for variables that measure changes over time to differ with the structural characteristics of the industry. The sensitivity of domestic prices to the prices of competing imports should be depressed by each of several factors. The first is the extent of differentiation of the product. That is conventionally proxied by the industry's ratios of advertising expenditures to sales:

ADS_{i0} = Advertising expenditures divided by value of sales, 1970.

This variable supplies a good indicator of some aspects of product differentiation, but it emphasizes differentiation related to information costs and credence problems of buyers with respect to product quality, and fails to capture very well differentiation based on the structural complexity of the good itself. Drawing on previous work [Caves and Williamson, 1985], we also employ:

DIF_{i} = Rotated factor that reflects inversely the durability of the product and the importance to the buyer of auxilliary services and information provided by the seller, directly the importance of sales promotion by the seller.[3]

It is not clear a priori whether *DIF* should be regarded as encompassing *ADS*[4] or the two variables complement one another. Although advertising/sales ratios for Canadian industries are highly correlated with those of their U.S. counterparts (which enter into *DIF*), significant behavioural differences have been noted [Caves et al., 1980, chap. 6].

Other industry-specific structural influences include the prevalence of foreign-controlled establishments:

FSH_{i0} = Shipments by foreign-controlled establishments divided by total industry shipments, 1970.

Although relations between foreign subsidiaries' activities and those of their overseas affiliates differ from firm to firm, we generally expect subsidiaries to react more sensitively to $MPCH_{it}$ than their domestic rivals. In multinational companies, direct administrative links exist between managers who make decisions about changes in Canadian and in foreign prices, reducing lags in perception and implementation. Subsidiaries market large quantities of finished goods imported from corporate affiliates,[5] and hence have a direct incentive to bring the prices of their Canadian-produced goods into conformity. The ES model invokes another structural factor via its hypothesis that tariff protection and collusion among Canadian oligopolists lead them to select the delivered world price as a "limit price." The hypothesis seems to imply that the domestic price is sensitized to international disturbances.[6] Because these conditions apply jointly, we use the product:

$C4T_{i0}$ = Fraction of industry shipments accounted for by the largest four firms, 1970, multiplied by ratio of tariff revenue collected to value of imports, 1970.

In summary, we hypothesize the following model of the determinants of industry selling prices for each industry and year ($CPCH_{it}$), where each regression coefficient is preceded by its expected sign:

$$CPCH_{it} = b_0 + b_1 LCCH_{it} + b_2 MCCH_{it} + b_3 MPCH_{it-1} - b_4 MPCH_{it-1}*ADS_{i0} + b_5 MPCH_{it-1}*DIF_{i} + b_6 MPCH_{it-1}*FSH_{i0} + b_7 MPCH_{it-1}*C4T_{i0} + u_{it}.$$

Value of Imports

The second dependent variable in the model is the logarithm of the value of imports of goods corresponding to the output of the Canadian industry (IMP_{it}). Imports depend on their lagged price relative to domestic substitutes as well as on short-run demand and (possibly) supply disturbances that do not operate through prices (at least, through price movements that we are able to measure).

Because shifts in the demand for imports cannot be observed directly, lagged domestic sales of Canadian producers must serve as a proxy for them:

$DSHP_{it-1}$ = Total shipments minus exports of domestic producers in industry i and year $t-1$, expressed in logarithms.

The lag, which helps to some degree with the problem of simultaneous relationships, is warranted by the relatively long channels of communication and transportation that separate changes in domestic demand and the arrival of induced imports. The coefficient should be positive. With demand disturbances controlled, imports should also be affected by their prices relative to competing domestic goods. The Canadian and U.S. industry selling price indexes, CSP_{it} and USP_{it}, do not control for interindustry differences in import relative to domestic prices, another, but they should indicate (if imperfectly) movements in the relative price over time. We use:

$$REL_{it} = MP_{it}/CSP_{it}$$

where *MP* is the index of the level (as *MPCH* is the change) of the delivered price of imports. REL_{it} should exert a negative influence on imports. An unavoidable misspecification intrudes here because price indexes for Canadian imports are not available at this level of disaggregation, so IMP_{it} must be expressed in nominal terms (as, therefore, was *DSHP*). If the elasticity of substitution between imports and domestic output is typically less than one over the period of a year or two that seems appropriate for lags in the adjustment, then the negative coefficient may fail to materialize.[7]

A final disturbance that might affect import flows is shifts in the capacity that exporters (actual and potential) hold ready for supplying goods to the Canadian market. Like the variable *DSHP*, such a supply or capacity disturbance is relevant on the assumption that measured price movements do not effectively summarize all quantity disturbances bearing on imports to Canada.[8] Constructing an index of output or capacity expansion by exporters to Canada worldwide is unfeasible; as a highly speculative (but cheap) substitute, we obtained:

$USQCH_{it-1}$ = Proportional change in real output of the U.S. counterpart of industry i in year $t-1$.

The expected influence of such supply disturbances is positive.

Again, the coefficients of these time-dependent variables are expected to vary with the structures of industries. The effect of changes in relative prices should be attenuated where products are differentiated and the elasticity of substitution between imports and domestic output accordingly reduced. There should be negative interactions between REL_{it} and ADS_{i0} and/or DIF_i. The influence of REL_{it} may also be affected by the prevalence of foreign ownership, which calls for an interaction with FSH_{i0}. We advance no sign prediction, because several effects may be at work. Allocative decisions made within multinational firms to adjust their activities in international trade may rely less on market-price signals, reducing *REL*'s influence. Or the multinational, with direct access to alternative production sites and substitution possibilities, may react more promptly and strongly to those prices.

The effect on imports of disturbances to domestic demand may depend on the sunkenness of capital in the Canadian industry. In the short run, the response of domestic output to demand shifts is attenuated by sunk capital; decreases are deterred by low levels of short-run marginal cost, increases (when capacity is fully utilized) by lags in expanding domestic capacity. Therefore, the change of imports relative to the *observed* change in domestic output should increase with the sunk component of costs.[9] Although the sunkenness of costs has contractual and other physical sources, we assume that the sunk component of an industry's costs is proportional to:

K/Q_i = Ratio of gross value of capital stock to value of shipments, industry i in 1970.

Interacted multiplicatively with $DSHP_{it}$, it should take a positive coefficient.

Another factor influencing the responses of imported and domestic supplies to demand disturbances is competitive conditions in the Canadian industry and its foreign competitors. Various models of oligopolistic price/output determinations can be invoked to suggest how departures from pure competition would affect the response of imports to demand disturbances. Rather than set these out in detail, we simply allow for the possibility that the coefficient of $DSHP_{it}$ may depend on:

$C4C_{i0}$ = Share of industry i shipments accounted for by the largest four producers, Canada, 1970.

We set no a priori concerning the sign of its interaction with *DSHP*.

To summarize this model of the determinants of imports, we expect:

$$\begin{aligned} IMP_{it} = {} & b_0 + b_1 DSHP_{it-1} - b_2 REL_{it} + b_3 USQCH_{it-1} \\ & + b_4 REL_{it}*ADS_{i0} - b_5 REL_{it}*DIF_i \\ & + b_6 REL_{it}*FSH_{i0} + b_7 DSHP_{it-1}*K/Q_i \\ & + b_8 DSHP_{it-1}*C4C_{i0} + u_{it}. \end{aligned}$$

Statistical Results

In order to distinguish conclusions based on the a priori specifications from modifications due to exploratory results, we report for each dependent variable the estimated model that matches the theoretical specification and then move to findings obtained as we revised and re-estimated the model.

Industry Selling Prices

Table 4-1 contains three versions of the model explaining movements of industry selling prices. Equation 4.1 approximates the theoretical specification proposed above (except for including only one of the interacted variables that represent product differentiation). Its strikingly unsatisfactory feature is the incorrect sign on the labour-cost variable, the result of the negative cross-industry correlation between the shares of labour and materials in total costs. Because prices should not respond differently to equal changes in these elements of variable costs, these two terms are combined into a single indicator of importance-weighted variable costs ($VCCH_{it}$). In equations 4.2 and 4.3 that term's coefficient is highly significant with the appropriate positive sign, but its magnitude is very small.

In equation 4.1, the coefficient of lagged change in the delivered world price of importables is positive as expected and highly significant. Its magnitude suggests that about one fifth of the preceding year's change in external prices feed into the Canadian industry's selling price. The lag was imposed on the a priori consideration that order and delivery lags in international trade should delay the arbitrage process in an auction market. We tested that assumption by replacing $MPCH_{it-1}$ with $MPCH_{it}$. The unlagged variable proved substantially more significant, greatly increasing the explanatory power of the model. Either Canadian prices are marked up directly in response to changes in the U.S. market, or the assumption about the duration of order and delivery lags is wrong. While direct evidence is lacking, the former explanation seems more plausible. Both $MPCH_{it}$ and $MPCH_{it-1}$ are included in equations 4.2 and 4.3, and both prove highly significant. Their coefficients sum to about 70 per cent, consistent with a long-run one-for-one linkage between Canadian and world prices in the manufacturing sector. The magnitude of this link also helps to explain the small estimated response of prices to variable costs.

In equation 4.1, the world-price term represents the change in U.S. prices (proxy for world prices) adjusted for changes in the Canadian tariff and exchange rate. We "unbundled" the unlagged variable $MPCH_{it}$ into these three components. Essentially all the explanatory power of the term lies in the U.S. price, and indeed the explanatory power of the model rises appreciably if the tariff and exchange-rate corrections are dropped (the U.S. price's t-value ascends from about 20 to over 40). The Canadian tariff change does take a correctly signed coefficient with a t-value around one; the exchange rate has no robust influence whatsoever, despite the statistical leverage supplied by the large depreciation of the Canadian dollar in the late 1970s.[10]

Table 4-1

Models of Determinants of Industry Selling Price

$$CPCH_{it} = \underset{(161)}{1.068} - \underset{(2.71)}{0.050}\,LCCH_{it} + \underset{(7.23)}{0.049}\,MCCH_{it} + \underset{(6.28)}{0.223}\,MPCH_{it-1} + \underset{(0.07)}{0.004}\,MPCH_{it-1}{*}DIF_i - \underset{(1.36)}{0.002}\,MPCH_{it-1}{*}C4T_{i0} - \underset{(0.26)}{0.006}\,MPCH_{it-1}{*}FSH_{i0}$$

$$\bar{R}^2 = 0.110;\ F = 26 \qquad (4.1)$$

$$CPCH_{it} = \underset{(206)}{1.011} + \underset{(3.50)}{0.030}\,VCCH_{it} - \underset{(1.56)}{0.0001}\,VCCH_{it}{*}C4C + \underset{(19.88)}{0.551}\,MPCH_{it} + \underset{(8.32)}{0.140}\,MPCH_{it-1} - \underset{(2.07)}{1.026}\,MPCH_{it}{*}ADV_i - \underset{(4.48)}{1.350}\,MPCH_{it}{*}T_{i0} - \underset{(0.24)}{0.011}\,MPCH_{it}{*}FSH_{i0}$$

$$\bar{R}^2 = 0.457;\ F = 154 \qquad (4.2)$$

$$CPCH_{it} = \underset{(204)}{1.008} + \underset{(3.95)}{0.034}\,VCCH_{it} - \underset{(2.41)}{0.0002}\,VCCH_{it}{*}C4C + \underset{(3.27)}{0.0002}\,VCCH_{it}{*}K/Q_i + \underset{(19.97)}{0.551}\,MPCH_{it} + \underset{(8.06)}{0.135}\,MPCH_{it-1} - \underset{(1.81)}{1.333}\,MPCH_{it}{*}ADV_i - \underset{(4.21)}{0.329}\,MPCH_{it}{*}T_{i0} - \underset{(0.97)}{0.044}\,MPCH_{it}{*}FSH_{i0}$$

$$\bar{R}^2 = 0.461;\ F = 137 \qquad (4.3)$$

The effects of differing market structures enter the model by means of interactions between structural elements and the variable-cost and world-price terms. In equation 4.1, the interaction of $MPCH_{it-1}$ with the product of the concentration and rate of protection takes not the positive coefficient predicted by the ES model (narrowly interpreted) but a negative coefficient. The other controls for product differentiation and the presence of foreign investment are insignificant.

Incorporating the unlagged world-price change and interacting it with these structural variables changes the picture considerably. The negative coefficient of the interaction term $MPCH_{it}*C4T_{i0}$ becomes highly significant, with its *t*-statistic rising to approximately 4. Clearly, a literal short-run interpretation of the ES model is rejected. We probed this result by dismantling the ES interaction into two terms, $MPCH_{it}*C4C_{i0}$ and $MPCH_{it}*T_{i0}$. Equations 4.2 and 4.3 both contain the latter, which takes a highly significant negative coefficient. A natural economic interpretation holds that tariff protection desensitizes domestic prices to changes in the prices of competing imports.[11] When the interaction of the world-price change with concentration is entered independently, it is totally insignificant. Concentrated industries' domestic prices are not insensitive to changes in external competition (as the administered-prices hypothesis might be taken to suggest), but neither are they especially sensitive (as the narrowly construed ES model implies).

That finding of course leaves room for the administered-prices hypotheses to apply to the adjustment of prices to variable costs. We formed the interaction $VCCH_{it}*C4C_{i0}$, finding (equation 4.2) that it takes the expected negative coefficient that is significant at 10 but not 5 per cent. This result is independent of whether concentration is interacted with $MPCH_{it}$ (that interaction does not appear in equation 4.2 or 4.3). Capital-intensive industries increased their relative prices over the period of this investigation, as Chapter 3 showed. Because concentrated industries tend to be capital-intensive, it seemed surprising that concentrated industries' prices would appear insensitive to costs in a decade of rapidly rising costs. To equation 4.3 was added the interaction $VCCH_{it}*K/Q_i$, where K/Q_i is the ratio of gross book value of capital to the industry's shipments in 1970. Its highly significant positive coefficient confirms the evidence that capital-intensive industries were raising their prices relative to variable costs. And the negative interaction of variable costs with concentration becomes significant at 1 per cent (one-tail test). The interpretation of these results is considered further after the other interactions are discussed.

Equation 4.1 failed to confirm that product differentiation desensitizes domestic selling prices to world prices in the short run. When the interaction is shifted to the unlagged world-price term and to the advertising-sales ratio (ADV_{i0}), its negative coefficient becomes significant at 5 per cent (equations 4.2 and 4.3). Thus, the desensitizing effect of product differentiation is confirmed in a different specification.[12]

The presence of multinational companies has no effect on the link between Canadian and external prices; the coefficient of this interaction is negative and insignificant in all three models. In some specifications (not shown) the sign of its coefficient of this interaction is negative and insignificant in all three models. In some specifications (not shown) the sign of its coefficient turns around to positive and its *t*-value rises into the range of 1.5 to 1.6. However, the instability of the result (and the correlation of foreign investment with other structural variables used in the model) supports the null hypothesis that foreign investment does not affect the short-run response of Canadian prices to world-price changes.

We noted above that the administered-prices hypothesis "fights against" the ES model's short-run predictions, in that insensitivity of concentrated industries' prices to *world*-price changes could short-circuit the rationalizing effect of toughened international competition. Although tariffs and product differentiation may desensitize Canadian prices to international prices, an industry's concentration per se does not affect its responsiveness. On the other hand, we confirm the insensitivity of concentrated industries' prices to variable costs that is predicted by the administered-prices model (and has been established in previous empirical studies of Canadian prices).[13] Thus, the latent contradiction between the two theoretical approaches does not emerge in practice.

In Chapter 3 the econometric problems posed by this project were noted, including the fact that the procedure employed for addressing the problems of autoregression and heteroskedasticity had been less than successful. We used the procedure described by Kmenta [1986, pp. 618-25] on equations 4.1 and 4.3 quoted in Table 4-1. In the case of 4.1, the procedure in fact repaired the sign reversal on the change in labour costs (*LCCH*) and provided the following model:

$$\begin{aligned} CPCH_{it} = {} & \underset{(85.87)}{0.977} + \underset{(3.78)}{0.200}\, LCCH_{it} + \underset{(9.05)}{0.122}\, MCCH_{it} \\ & + \underset{(3.52)}{0.210}\, MPCH_{it-1} + \underset{(1.27)}{0.016}\, MPCH_{it-1}*DIF_i \\ & + \underset{(1.04)}{0.011}\, MPCH_{it}*C4T_{i0} \\ & - \underset{(0.68)}{0.062}\, MPCH_{it}*FSH_{i0}. \end{aligned}$$

The coefficients of *LCCH* and *MCCH* both take reasonable magnitudes. The coefficient of $MPCH_{it-1}$ is little changed. Although the other coefficients exhibit large changes, they were insignificant both before and after.

When this procedure is applied to equation 4.3, the coefficients involving *MPCH* are little changed. However, those involving the change in combined variable costs (*VCCH*) now take magnitudes on the order of 10^{-5}, with their signs reversed from equation 4.3. At this point the project's budget constraint precluded a further effort to identify the source of the difficulty or to employ an alternative procedure for statistical refinement. All we can say is that no major biases are revealed in the OLS results.

The models reported in Table 4-1 do not indicate which manufacturing industries show especially distinctive processes of adjustment. There is a convenient way to relate the model's findings to the 20 two-digit industries listed in Tables 3-1 to 3-5. We re-estimated the model of Table 4-1, replacing the structural interaction variables with a series of dummy variables that allow each two-digit industry to receive its own slope and intercept coefficients. Table 4-2 reports several experiments of this type. The first column summarizes the results from applying the treatment to *VCCH*, the variable cost change. *VCCH*'s coefficient takes the value of 0.335, much higher than in Table 4-1. The coefficient of each two-digit industry's slope shift can be added to or subtracted from 0.335 in order to obtain the slope coefficient for that industry. The magnitudes of all slope shifts significant beyond the 10 per cent level are shown, along with the signs of those failing this criterion but exhibiting *t*-statistics greater than 1.0.[14] A number of industries show significant slope shifts. The negative shifts, indicating low sensitivity to variable-cost changes, appear in tobacco, paper, and several producer-good industries, while the competitive industries with high variable costs (plastics, leather, textiles, furniture) are much more cost-sensitive.

The other columns in Table 4-2 apply the same treatment to the delivered world price *MPCH* both with and without a one-year lag. The highly protected textile and clothing industries show the reduced sensitivity to world-price move-

Table 4-2

Regression Coefficients of Industry Selling Price, Slope Shifts for Two-Digit Manufacturing Industries

	Exogenous variable		
	$VCCH_t$	$MPCH_t$	$MPCH_{t-1}$
Basic regression coefficient	0.335[a]	0.349[a]	0.170[b]
Food and beverage	0	0.265[a]	0
Tobacco products	–0.343[ad]	0	0
Rubber and plastic products	0.567[ae]	+	0
Leather	0.382[ae]	0	0
Textiles	0.275[ae]	–	0
Knitting mills	+	0	0
Clothing	+	–0.372[c]	0
Wood	0.172[c]	0	–0.305[ad]
Furniture and fixtures	0.465[be]	0	0
Paper and allied products	–0.339[ad]	0	0
Printing and publishing	0	0	0
Primary metals	–0.310[ad]	0.305[ae]	0
Metal fabricating	0	0	0
Machinery	–0.410[ad]	0	0
Transportation equipment	–	0	0
Electrical products	–0.353[ad]	0	0
Non-metallic mineral products	–0.333[ad]	0	0
Petroleum and coal products	+	+	+
Chemical and chemical products	0	0.275[ae]	–

NOTE a = 1 per cent significance; b = 5 per cent significance; c = 10 per cent significance; d = intercept shift positive and significant at 5 per cent; e = intercept shift negative and significant at 5 per cent.

ments noted above,[15] while homogeneous products such as primary metals and chemicals are especially sensitive.

Imports

Table 4-3 reports two models of the determinants of imports. In equation 4.4, lagged shipments to the domestic market proxying demand disturbances exert the expected positive influence on imports. We also estimated the model with this term unlagged in order to evaluate the assumed lag; the coefficients of the lagged and unlagged terms are about equally significant, and the former specification mitigates the problem of simultaneity. Demand disturbances were expected to have a larger effect on imported goods competing with domestic capital-intensive industries, because the short-run marginal cost curves of domestic suppliers would be more steeply sloped in the neighbourhood of capacity output and their outputs accordingly less responsive. In both equations 4.4 and 4.5, however, the interaction of *DSHP* with capital intensity takes a *negative* coefficient that is highly significant in a two-tail test. An explanation offers itself that is obvious although untestable, given the absence of data on capacity utilization. Capital-intensive industries were raising their relative prices (and their margins over variable costs) during this period, and their outputs were growing slowly. Therefore, they probably experienced substantial excess capacity (as did the Canadian manufacturing sector generally during those years).[16] Their short-run marginal costs should be steeply sloped when capacity is fully utilized but low and flat when it is underutilized, and hence especially sensitive to demand disturbances. That explanation for the observed result is sufficient but may not be necessary.

In equation 4.4, the hypothesis is rejected that the concentration of the domestic industry has any effect on the reaction of its domestic shipments to disturbances (and thus on the induced change in imports). As with industry selling prices, concentration appears to wield no effect on adjustments to international disturbances. In equation 4.5, that term is dropped and replaced by an interaction of the domestic-demand disturbance with the initial tariff rate. The reasoning is that tariffs (theoretically, and empirically in the analysis of industry selling prices) may insulate the domestic and external markets from one another, reducing the sensitivity of one to disturbances in the other. In equation 4.5, the coefficient of that interaction is correctly signed and highly significant.[17]

Imports diminish when their relative price (*REL*) increases, as expected, despite the misspecification that results because their values cannot be deflated. The coefficient is highly significant, as is the interaction of *REL* with the factor indicating structural product differentiation. The construction of that factor implies that relative-price effects are mitigated where differentiation is based on intrinsic complexity and diverse attributes of the goods in question, although reinforced where it rests chiefly on sales-promotion outlays. (Substituting the industry's advertising-sales ratio for *DIF* confirms that interpretation.) Relative-price effects on imports are significantly mitigated by the extent to which foreign subsidiaries account for the industry's total shipments. That attenuation implies that controlled imports and trade between corporate affiliates are influenced by proprietary information independent of (and imperfectly correlated with) movements of market prices. However, this result could be given other interpretations.

Finally, shifts in the real output of the U.S. counterpart industry (*USQCH*) were included to capture the influence of external supply shifts on imports. The variable's coefficient takes the expected sign but is not significant.[18]

Table 4-3

Determinants of Value of Imports Classified to Each Industry

$$IMP_{it} = \underset{(6.36)}{6.976} + \underset{(10.46)}{0.979}\, DSHP_{it-1} - \underset{(6.46)}{0.431}\, DSHP_{it-1}{*}K/Q_i + \underset{(0.39)}{0.037}\, DSHP_{it-1}{*}C4C_{i0} - \underset{(4.48)}{2.138}\, REL_{it} - \underset{(8.14)}{0.467}\, REL_{it}{*}DIF_i$$
$$+ \underset{(11.10)}{1.913}\, REL_{it}{*}FSH_{i0} + \underset{(0.92)}{0.435}\, USQCH_{it-1}$$
$$\bar{R}^2 = 0.350;\ F = 94.7 \qquad (4.4)$$

$$IMP_{it} = \underset{(7.14)}{6.479} + \underset{(15.18)}{1.272}\, DSHP_{it-1} - \underset{(8.14)}{0.508}\, DSHP_{it-1}{*}K/Q_i - \underset{(4.75)}{0.170}\, DSHP_{it-1}{*}T_{i0} - \underset{(4.64)}{2.137}\, REL_{it} - \underset{(5.66)}{0.329}\, REL_{it}{*}DIF_i$$
$$+ \underset{(13.63)}{2.059}\, REL_{it}{*}FSH_{i0} + \underset{(0.96)}{0.439}\, USQCH_{it-1}$$
$$\bar{R}^2 = 0.382;\ F = 108 \qquad (4.5)$$

The results of applying corrections for autoregression and heteroskedasticity to the models quoted in Table 4-3 were similar to our experience with Table 4-1. The revised estimation of model 4.4 yields:

$$IMP_{it} = \underset{(43.98)}{18.611} + \underset{(10.69)}{0.980}\, DSHP_{it-1} + \underset{(1.94)}{0.405}\, DSHP_{it-1}{*}K/Q_i - \underset{(7.66)}{1.125}\, DSHP_{it}{*}C4C_{i0} - \underset{(8.34)}{2.145}\, REL_{it} - \underset{(3.23)}{0.527}\, REL_{it}{*}DIF_i + \underset{(7.46)}{2.128}\, REL_{it}{*}FSH_{i0} - \underset{(1.46)}{0.450}\, USQCH_{it-1}.$$

Little change occurs in the coefficients of *DSHP* and the terms involving *REL* that were significant in the OLS model. However, the coefficient of *DSHP*K/Q* shifts from significant negative to almost significant positive, while that of *DSHP*C4C* goes to a significant negative. These reversed signs are consistent with plausible priors that capital-intensive industries operate on steeply-sloped marginal-cost curves, while concentrated industries maintain excess capacity. However, most empirical evidence seems to contradict at least the former assumption for Canadian manufacturing in the 1970s. In any case, the previous conclusions about *DSHP*s interactions are called into question. When equation 4.5 is re-estimated, the terms in *REL* are again largely unchanged, while those in *DSHP* are greatly reduced in magnitude, and their signs are reversed.

The imports equation supplies several significant lessons for our investigation of industries' adjustments to international disturbances. It confirms the expectation that imports and domestic output are good substitutes for each other in the typical industry. It supports the implication drawn from the domestic-price equation that high tariffs tend to insulate as well as protect the domestic market. (Recall the prediction that with products differentiated, reduced protection or increased international competition may increase the demand elasticity faced by the typical domestic producer.) It is consistent with the evidence already noted on the peculiar behaviour of capital-intensive industries during the 1970s. And it supports our expectation that foreign-controlled companies make use of direct information (i.e., do not depend just on market-price signals) in responding to international disturbances.

Table 4-4 translates the main conclusions of Table 4-3 into their implications for individual two-digit industries,

Table 4-4

Regression Coefficients of Value of Imports, Slope Shifts for Two-Digit Manufacturing Industries

	Exogenous variables	
	$DSHP_{t-1}$	REL_t
Basic regression coefficient	0.833[a]	0.207
Food and beverage	–0.627[ad]	0
Tobacco products	0	0
Rubber and plastic products	0	0
Leather	0.547[be]	–4.909[c]
Textiles	–	0
Knitting mills	1.573[be]	–
Clothing	0	0
Wood	–	–6.604[b]
Furniture and fixtures	1.264[ae]	–8.727[c]
Paper and allied products	0.870[ae]	–4.099[a]
Printing and publishing	0	0
Primary metals	–0.359[bd]	–
Metal fabricating	+	–7.076[b]
Machinery	0	0
Transportation equipment	–0.359[c]	19.739[ae]
Electrical products	0	0
Non-metallic mineral products	–0.545[ad]	0
Petroleum and coal products	–0.649[ad]	0
Chemical and chemical products	0	+

NOTE a = 1 per cent significance; b = 5 per cent significance; c = 10 per cent significance; d = intercept shift positive and significant at 5 per cent; e = intercept shift negative and significant at 5 per cent.

reporting the estimated slope shifts for the coefficients of domestic disturbances (*DSHP*) and the relative price of imports (*REL*). The slope shifts for *DSHP* echo the unexpected negative interaction with *K/Q* in negative shifts for primary metals, mineral products, and petroleum and coal products. These are industries in which capacity constraints might be expected to yield coefficients greater than unity. The positive shifts turn up instead in industries with low-capital intensity such as leather and furniture; only paper fits the theoretical hypothesis.

Table 4-4 shows that the negative effect of relative price turns up only in selected industries (that is, the uninteracted regression coefficient becomes positive and insignificant). The tendency of foreign control to dampen the effect of relative prices is strongly evident in transportation equipment, but only in that sector.

5 Gross Fixed Capital Expenditures

The third dependent variable in the model is the industry's annual level of real gross fixed capital expenditure (KX_{it}). This flow is subdivided into expenditures on plant construction (KXC_{it}) and machinery (KXM_{it}), each expressed in logarithms for estimation.[1] We make no distinction between the qualitative determinants of these two components.

Specifying the Model

The model employs the standard approach for relating investment to desired capital stocks, determined in turn by desired output (capacity) and the cost of capital. We control for the differences in industries' scales of activity by including as a regressor the initial capital stock:

K_i = Industry i's gross capital stock, 1970, expressed in logarithms.[2]

Because product differentiation (certainly) and oligopoly (possible) have been found to affect adjustments by Canadian industries, we do not confine ourselves to the standard (Jorgenson) approach, which wraps up the determinants relevant to a purely competitive industry into a term that emphasizes the price of output relative to full cost of additional output. Instead, two separate terms are employed, one measuring the change in the industry's selling price relative to its international competitors', the other indicating lagged changes in real output. The former variable is:

$$RPCH_{it} = USP_{it}/USP_{it-1} - CSP_{it}/CSP_{it-1}$$

where CSP_{it} is the index of the Canadian industry's selling price in year t. This variable can be formulated in several other ways by making use of the change in domestic variable costs instead of, or in addition to, the change in the domestic selling price. We also employ:

QCH_{it} = Ratio of industry i's real output in year t to its output in year t–2.

$RPCH_{it}$, the change in the estimated world price relative to the domestic selling price, and QCH_{it} should both exert positive influences on the industry's desired level of capital stock.[3]

Another standard term in models of investment determinants is the cost of capital. We borrow a series from the CANDIDE model that is calculated at the two-digit industry level, making the assumption that each four-digit industry's cost of capital is adequately represented by that of the two-digit industry that includes it:

$COCC_{it}$ = Index of the cost-of-capital expenditures in construction, industry i in year t, embracing changes in both the rate of discount and the price index of capital goods.

COCM is its counterpart for capital expenditures on machinery and equipment. Each should exert a negative influence on annual capital expenditures.

We assume that industries' fixed effects can be represented by differences in their initial capital stocks and in their market-structure elements, interacted with the regressors that vary over time. One structural element is the product of the initial concentration ratio and rate of tariff protection, $C4T_i$, used to indicate the degree to which an industry is expected to match the ES pattern of adjustment and allocation. A fall in the relative world price of a good produced competitively in Canada would induce a decline in expected domestic output, and hence in capital expenditures; however, an ES industry could maintain or expand its capital outlays in order to rationalize its production scales and run lengths. Therefore, with $RPCH_{it}$ controlled, capital expenditure should decrease with the interaction $RPCH_{it}*C4T_i$.

Other interactions should also modify the response of capital expenditures to price disturbances. To the extent that an industry serves export markets, an increase in $RPCH_{it}$ encourages the expansion of capacity, so we expect as positive coefficient for $RPCH_{it}*XSH_i$, where:

XSH_i = Exports divided by value of industry shipments, 1970.

For reasons mentioned above, foreign-controlled establishments may react differently from those whose expected profits depend proximately only on conditions in Canada. The interaction $RPCH_{it}*FSH_i$ is included, but without a prior concerning its sign.

A final interaction involves the industry's level of research and development expenditures. Research-intensive industries' prospects for future sales depend less on the quantity (currently) demanded of existing products or the prices that they command and more on the demand expected for improved products, or for existing products made available at lower costs due to process improvements. The variable:

RND_i = Employees engaged in research activities divided by total employees, 1975,

should indicate both research activities in Canada and those undertaken elsewhere, but supplying product or process improvements that may be implemented in Canada [Caves et al., 1980, chap. 7]. We expect a negative influence for the interaction QCH_{it}*RND_i. Another possibility to be explored below is that ES industries' capital expenditures are less sensitive to QCH in ES industries, or less predictably responsive.

To summarize, the model that we estimate is:

$$KXC_{it} = b_0 + b_1K_i + b_2QCH_{it} + b_3RPCH_{it} - b_4COCC_{it} - b_5RPCH_{it}*C4T_i + b_6RPCH_{it}*EXP_i + b_7RPCH_{it}*FSH_i - b_8QCH_{it}*RND_i - b_9RPCH_{it}*RND_i + u_{it}.$$

The model for KXM_{it} is identical except for replacement of $COCC_{it}$ by $COCM_{it}$.

Statistical Results

The results concerning the behaviour of capital expenditures appear in Table 5-1, which contains four pairs of equations; the first member of each pair pertains to spending on construction, the second to machinery and equipment. In Tables 4-1 and 4-3, the first model quoted was in essence our first result from estimating the a priori specification. Equation 5.1, however, reflects some refinements of the theoretical specification, in particular a discovery about how tariff changes affect firms' capital spending plans. Initially, each year's capital spending was related to the current year's tariff change. When no relationship whatsoever was observed, we reflected that the tariff cuts had been precommitted by the government, and hence known in advance to managers making investment decisions. What then should have influenced each year's investment spending was the change anticipated over the whole period 1971-82, which can be inferred from realized tariff rates. Specifically, we defined the variable

DT_i = Difference between the i^{th} industry's average rate of protection in 1982 and 1971, divided by one half the sum of those two rates.

Equation 5.1 drops the variable $RPCH$, relative trend of world and domestic product prices, on which the theoretical specification centred. Reasons for that shift are discussed below.

Now the findings of Table 5-1 may be summarized. The industry's initial gross capital stock (K_i) takes a highly significant positive coefficient. Because of the rising prices observed in the capital-intensive industries, we expected that they might undertake less gross expenditure in relation to their initial capital stocks. That hypothesis was confirmed for machinery investment (t = –3.92) but not for construction (this test is not shown in Table 5-1).

The standard cost-of-capital term (available at the two-digit level from the CANDIDE model) was expected to wield a negative influence on capital spending. Instead, it persistently takes a positive coefficient that is significant for spending on construction. We tested whether it behaves better in the more capital-intensive industries but found no confirmation. We then reflected that wages had undergone major changes in the 1970s. Capital expenditures, in part, serve to substitute plant and equipment for labour, and hence may depend on the cost of capital *relative to* the average wage. Expressed in this form ($CCWC$, $CCWM$), the coefficients of the variable do indeed become negative, but the right-signed coefficients are not blessed with statistical significance in most specifications (see equations 5.3); effects of this change on other coefficients are trivial.

The variable QCH_{it} is an accelerator-type measure of the two-year change in the industry's constant-dollar shipments. Its positive coefficient proved robust and highly significant, indicating that extrapolations of expected output from the recent past continued to influence capital spending in the 1970s. We tested two interactions of QCH with elements of market structure. First, it might have a weaker and less predictable influence in the ES industries – those above average in both concentration and tariff protection and (in theory) closely tied to international competition. In each equation, the sign of QCH_{it}*$C4T_i$ supports that hypothesis; it is highly significant for machinery but not for construction.[4] The accelerator effect was expected to be smaller in innovative industries, because planned capacity rests more on innovations coming on-stream. The coefficient of the interaction term QCH_{it}*RND_i also takes a negative

Table 5-1

Determinants of Capital Expenditures on Construction and Machinery

$$KCX_{it} = \underset{(17.30)}{-6.245} + \underset{(47.21)}{1.069}\,K_i + \underset{(4.82)}{1.080}\,QCH_{it} - \underset{(1.33)}{0.004}\,QCH_{it}{*}C4T_i - \underset{(1.13)}{0.102}\,QCH_{it}{*}RND_i + \underset{(2.20)}{1.302}\,COCC_{it} - \underset{(4.39)}{0.384}\,DT_i$$

$$\bar{R}^2 = 0.660;\ F = 399 \qquad (5.1c)$$

$$KXM_{it} = \underset{(15.51)}{-3.382} + \underset{(74.89)}{1.002}\,K_i + \underset{(4.10)}{0.552}\,QCH_{it} - \underset{(3.94)}{0.006}\,QCH_{it}{*}C4T_{i0} - \underset{(2.60)}{0.144}\,QCH_{it}{*}RND_i + \underset{(1.39)}{0.471}\,COCM_{it} - \underset{(3.66)}{0.196}\,DT_i$$

$$\bar{R}^2 = 0.822;\ F = 973 \qquad (5.1m)$$

$$KXC_{it} = \underset{(17.08)}{-6.149} + \underset{(46.92)}{1.060}\,K_i + \underset{(4.75)}{1.060}\,QCH_{it} - \underset{(1.46)}{0.004}\,QCH_{it}{*}C4T_{i0} - \underset{(1.82)}{0.167}\,QCH_{it}{*}RND_i + \underset{(2.40)}{1.416}\,COCC_{it} + \underset{(0.55)}{0.084}\,DT_i$$

$$- \underset{(3.73)}{1.122}\,DT_i{*}FSH_{i0}$$

$$\bar{R}^2 = 0.663;\ F = 348 \qquad (5.2c)$$

$$KXM_{it} = \underset{(15.14)}{-3.306} + \underset{(74.55)}{0.997}\,K_i + \underset{(4.05)}{0.543}\,QCH_{it} - \underset{(4.06)}{0.007}\,QCH_{it}{*}C4T_{i0} - \underset{(3.16)}{0.177}\,QCH_{it}{*}RND_i + \underset{(1.25)}{0.423}\,COCM_{it} + \underset{(0.64)}{0.060}\,DT_i$$

$$- \underset{(3.34)}{0.614}\,DT_i{*}FSH_{i0}$$

$$\bar{R}^2 = 0.824;\ F = 843 \qquad (5.2m)$$

$$KXC_{it} = \underset{(16.40)}{-6.509} + \underset{(43.06)}{1.078}\,K_i + \underset{(6.57)}{1.535}\,QCH_{it} - \underset{(1.04)}{0.003}\,QCH_{it}{*}C4T_{i0} - \underset{(0.97)}{0.083}\,QCH_{it}{*}RND_i - \underset{(0.74)}{1.841}\,CCWC_{it} - \underset{(4.47)}{0.380}\,DT_i$$

$$- \underset{(1.68)}{0.819}\,DWPM_{it}HIK - \underset{(4.28)}{1.739}\,DWPM_{it}LOK$$

$$\bar{R}^2 = 0.655;\ F = 275 \qquad (5.3c)$$

$$KXM_{it} = \underset{(13.60)}{-3.402} + \underset{(64.41)}{0.999}\,K_i + \underset{(5.06)}{0.729}\,QCH_{it} - \underset{(3.54)}{0.006}\,QCH_{it}{*}C4T_{i0} - \underset{(2.46)}{0.134}\,QCH_{it}{*}RND_i - \underset{(0.60)}{0.893}\,COCM_{it} - \underset{(3.61)}{0.194}\,DT_i$$

$$+ \underset{(0.46)}{0.141}\,DWPM_iHIK - \underset{(2.32)}{0.592}\,DWPM_{it}LOK$$

$$\bar{R}^2 = 0.805;\ F = 606 \qquad (5.3m)$$

$$KXC_{it} = \underset{(16.82)}{-8.070} + \underset{(44.98)}{1.066}\,K_i + \underset{(7.02)}{1.632}\,QCH_{it} - \underset{(1.03)}{0.003}\,QCH_{it}{*}C4T_{i0} - \underset{(1.76)}{0.153}\,QCH_{it}{*}RND_i + \underset{(2.77)}{1.600}\,COCC_{it} + \underset{(0.92)}{0.136}\,DT_i$$

$$- \underset{(3.99)}{1.152}\,DT_i{*}FSH_{i0} - \underset{(1.26)}{0.478}\,DUSP_{it} + \underset{(4.63)}{1.477}\,DVC_{it}$$

$$\bar{R}^2 = 0.666;\ F = 257 \qquad (5.4c)$$

$$KXM_{it} = \underset{(13.23)}{-4.052} + \underset{(67.60)}{0.993}\,K_i + \underset{(5.34)}{0.773}\,QCH_{it} - \underset{(3.66)}{0.006}\,QCH_{it}{*}C4T_{i0} - \underset{(2.95)}{0.163}\,QCH_{it}{*}RND_i + \underset{(1.33)}{0.458}\,COCM_{it} + \underset{(0.11)}{0.069}\,DT_i$$

$$- \underset{(3.29)}{0.604}\,DT_i{*}FSH_{i0} + \underset{(0.38)}{0.090}\,DUSP_{it} + \underset{(1.80)}{0.366}\,DVC_{it}$$

$$\bar{R}^2 = 0.808;\ F = 549 \qquad (5.4m)$$

coefficient throughout – highly significant for machinery, marginal for construction.

Now we return to the tariff-change variable, DT_i. In equations 5.1 and 5.3 it takes a highly significant negative coefficient, supporting the hypothesis that the prospect of permanently lower protection bestirred substantial amounts of rationalizing investment.[5] In those two equations the term appears without any conditions on the industry's structure, although we predicted the effect in those industries with high levels of product differentiation and/or concentration. But interactions with these qualifying variables did not prove significant, indicating that rationalization processes seem more ubiquitous than theory predicts.[6] The effect of another conditioning factor, the extent of foreign investment, suggested an explanation. In equations 5.2 and 5.4, the term DT_i*FSH_i takes a highly significant negative coefficient, in essence capturing all the influence of DT_i. The result implies that the extent of rationalizing investment increases with the prevalence of foreign subsidiaries.[7] This proposition is not equivalent to an assertion that only the foreign subsidiaries do (and need to do) the rationalizing. Their role is investigated in the next section.

Although the accelerator variable *QCH* picks up the influence of shifts in both domestic demand and exports, the model (equations 5.1 and 5.2) provides no channel for investment spending to be influenced by general changes in competitive conditions in the world market. To represent their influence, the model included the one-year change in the external (U.S.) price relative to the industry's selling price. However, that relative-price term proved quite insignificant. One possible reason is that the domestic price is both endogenous in the model and relatively low on information relevant to guiding capital expenditures.

As an alternative, changes in world prices were related to changes in the industry's variable costs, on the conjecture that the prospects for the industry's international competitive position should rest more on its cost position than its prices. We defined:

$DWPM_{it}$ = Ratio of the U.S. counterpart industry's price index in year t to its value in t–1, minus the ratio of our index of domestic variable costs in year t to its value in t–1 (see the discussion of Table 4-1).

In most specifications this variable took a coefficient that was significant but *negative* – contrary to the expectation. That result is illustrated in equation 5.3, where the term is allowed to take a different coefficient for industries with ratios of capital stock to shipments above (*HIK*) and below (*LOK*) the sample mean. That was done because we suspected the perverse sign might reflect the special situations of the capital-intensive industries during the 1970s. However, equation 5.3 locates the more systematic (perverse) behaviour in the less capital-intensive sector.

The other evident theoretical explanation for this result is that changes in *DWPM* emanated chiefly from the cost side. To pursue this conjecture, we broke *DWPM* into its world-price (*DUSP*) and variable-cost (*DVC*) components (equation 5.4). The unexpected behaviour turns out to rest on a positive relationship between capital spending and changes in variable costs. The traditional neoclassical hypothesis of factor substitution is the natural explanation for this pattern, which may have been more evident in the 1970s than at other times due to the strong wage and energy-cost inflation that affected many industries during that decade.[8]

With still no link established between external (U.S.) price changes and capital spending, one more formulation of the world market's influence was tried. Plans for investment spending may depend not on trends in world prices and costs but on the currently realized outcome of competition between imports and domestic supplies – imports' share of domestic disappearance. However, the data revealed no link between the current level of capital spending and recent trends in imports' share.[9]

In conclusion, once we control for the obvious domestic determinants of capital spending by manufacturing industries, no evidence is found that investment depends directly on conditions in the world market. The threats and opportunities associated with international competition appear to affect investment only through their effect on short-run industry output. Several such channels were identified, however, among the determinants of imports and industry selling prices. When foreign costs and prices decline relative to those in Canada, imports increase and (to an extent dependent on demand and substitution elasticities) domestic output tends to fall. Product differentiation and high (initial) levels of protection dampen and retard these influences, and thus weaken and postpone the effect of changes in foreign supply conditions on capital spending.

The one direct influence of international competition on capital spending, revealed in Table 5-1, is, of course, the rationalization induced by tariff reductions. Because of its apparent affinity for industries with substantial foreign investment, we consider it further in the next section. A comforting feature of Table 5-1 is the high level of agreement evident between the results of the models for spending on construction and those for spending on machinery and equipment. The fits are better for the latter, which agrees

with the apparent difference in the relative lumpiness of the two types of investment, but no important conflicts are evident between them in the significant levels of magnitudes of (comparable) coefficients.

Applying corrections for autoregression and heteroskedasticity to Table 5-1 did not produce the puzzling shifts in coefficients' magnitudes found in Tables 4-1 and 4-3, but it did rearrange significant levels considerably. In the re-estimated equations 5.4 these changes were observed: the coefficients of *QCH* decline in magnitude by about two thirds; *QCH*'s interactions with other variables are not statistically significant; the perverse coefficients of *COC* become more significant; the coefficients of *DUSP* increase greatly in size and become statistically significant; and the change in domestic variable cost (*DVC*) becomes insignificant in equation 5.4c.

Table 5-2 shows how the effects of output growth and tariff reductions on capital expenditures are differentiated among the two-digit sectors. The first two columns report slope shifts for the accelerator term *QCH* in construction (*CQCH*) and machinery (*MQCH*) investment. Those effects do not differ much among two-digit industries. The smaller acceleration effect in ES-type and innovative industries may be seen in negative shifts for transportation equipment, electrical, petroleum and coal, and chemical products (all large but not statistically significant). The large positive shift for printing and publishing may reflect nothing more than a high-income elasticity of demand.

The last two columns of Table 5-2 address the effect of decade-long tariff reductions in construction (*CDT*) and machinery (*MDT*). The results are rather puzzling, in that no sectors show significant negative slope shifts (negative shifts for rubber and plastics are large but not statistically significant). A number of sectors that might seem plausible sites for rationalizing investment in fact exhibit significant positive slope shifts for expenditure on machinery. The pattern is quite consistent with offset effects for industries without extensive foreign investment, transportation equipment excepted. Just as rationalization following tariff reductions proved more pervasive than we expected (in Table 5-1), there is also little differentiation of response

Table 5-2

Regression Coefficients for Capital Expenditures, Slope Shifts for Two-Digit Manufacturing Industries

	Exogenous variables			
	$CQCH_t$	$MQCH_t$	CDT_t	MDT_t
Basic regression coefficient	2.044[b]	0.256	–0.571	–0.950[b]
Food and beverage	0	1.739[be]	0	0.789[c]
Tobacco products	0	5.301[ae]	0	0
Rubber and plastic products	0	0	0	–
Leather	0	0	–	1.480[c]
Textiles	0	0	0	+
Knitting mills	+	3.367[be]	26.325[be]	21.197[a]
Clothing	0	0	0	+
Wood	0	0	+	0.972[a]
Furniture and fixtures	0	0	1.776[b]	0
Paper and allied products	–	0	0	0
Printing and publishing	6.983[c]	0	0	1.367[b]
Primary metals	–2.728[bd]	0	0	1.071[cd]
Metal fabricating	0	0	0	0.850[c]
Machinery	0	0	0	0.829[cd]
Transportation equipment	–	0	0	1.093[b]
Electrical products	–	0	0	+
Non-metallic mineral products	0	+	0	0
Petroleum and coal products	0	–	0	+
Chemical and chemical products	–	0	–	0

NOTE a = 1 per cent significance; b = 5 per cent significance; c = 10 per cent significance; d = intercept shift positive and significant at 5 per cent; e = intercept shift negative and significant at 5 per cent.

among two-digit industries that one might have anticipated.[10]

Capital Spending in Domestic and Foreign Sectors

The database contains observations for each year on shipments and capital expenditures (construction and machinery) broken down by establishments under domestic and foreign control. The continual public controversy surrounding foreign investment warrants exploring differences in the adjustment of these two sectors to international disturbances. Furthermore, theory and behavioural evidence on multinational companies suggest that their adjustment patterns may differ substantially from those of domestic firms, even if each group pursues the same goal of maximizing its expected profits.

In Chapter 2, the reasons were listed for expecting that: 1) establishments under foreign and domestic control in a given industry, may differ in their adjustments to international competitive conditions, and 2) the distribution of foreign-controlled units among industries is likely to be related to the extent and character of industries' adjustments to international disturbances. Findings reported in Table 5-1 strongly confirm the latter proposition – that rationalizing investment due to tariff reduction occurs in proportion to an industry's tenancy by foreign-controlled establishments.

In this section we estimate and compare capital-expenditure models for the industries' domestic- and foreign-controlled sectors. The models estimated were identical to those reported in Table 5-1 with the following modifications:

1 We lack direct estimates of the capital stocks initially possessed by the domestic and foreign sectors. Therefore, we multiplied each industry's initial stock of gross fixed capital (K_i) by the initial share of shipments held by domestic-controlled (KD_i) and foreign-controlled (KF_i) sectors, respectively.[11]

2 The accelerator term QCH (two-year change in real output) was expressed as the output change for the domestic ($QCHD_{it}$) and foreign ($QCHF_{it}$) sectors, respectively. Whether one sector's investment plans respond more to changes in its own output (and share) than to changes in the whole industry's output is an empirical question.

3 Although the domestic sector of every industry in the sample is large enough to pose no serious data problems in the estimation, difficulties do arise for industries with small foreign-controlled sectors, mostly associated with zero values for their shipments in some years. We had to delete 11 industries with small foreign shares and problematic shipments data – unfortunately most of them high-tariff industries.[12]

With each industry's establishments divided into domestic and foreign sectors and capital spending into construction and machinery, four models are estimated for each specification. In Table 5-3, only one specification is presented, identical to that of equation 5.4. The models estimated for domestic- and foreign-controlled sectors are similar in many ways. Their exploratory power is the same, despite the weaker performance that one might expect for the foreign-controlled sector (because of these firms' diverse national origins and relationships to their corporate affiliates). The controls for initial capital stocks behave similarly, as do the accelerator terms measuring output growth over two years. Each sector's capital spending is better explained by its own past output growth than by output growth for the industry as a whole. The cost-of-capital terms are here expressed relative to wages; in that form, the coefficient is significant for domestic establishments but not for foreign-controlled ones.

The offset to the accelerator term in concentrated, protected industries proves to be significant only for domestic-controlled establishments, an outcome consistent with evidence that foreign subsidiaries are less well-placed than domestic companies to recognize their interdependence within a national market. The offset to the accelerator term for research-intensive sectors conversely is negative and significant only for the foreign-controlled sector, a finding consistent with the affinity of multinational enterprises for research-intensive activities and the roles of subsidiaries in Canada as arbitrators of innovations.

We found (Table 5-1) that the extent of rationalizing investment associated with tariff reductions increases with the prevalence of foreign investment. That the foreign subsidiaries should do most of the rationalizing is consistent with the "tariff factory" origin of many subsidiaries in Canada, which implies that they have more to rationalize. On the other hand, the affinity of foreign investment for complex and differentiated products that are subject to brand proliferation and diversification suggests that rationalization might be concentrated in industries with large populations of subsidiaries, but not confined to them.

The statistical results are not completely clear on whether the domestic, as well as the foreign sector, is involved in rationalizing investments. For both the construction and machinery expenditures of the foreign-controlled sector, the

Table 5-3

Determinants of Capital Expenditures on Construction and Machinery, Domestic- and Foreign-Controlled Sectors

$$KXCD_{it} = \underset{(11.80)}{-5.601} + \underset{(37.78)}{1.009}\,KD_i + \underset{(5.80)}{0.689}\,QCHD_{it} - \underset{(2.77)}{0.009}\,QCHD_{it}{*}C4T_{i0} + \underset{(0.17)}{0.015}\,QCHD_{it}{*}RND_i - \underset{(2.71)}{7.629}\,CCWC_{it}$$
$$+ \underset{(0.84)}{0.145}\,DT_i - \underset{(2.73)}{0.935}\,DT_i{*}FSH_{i0} + \underset{(1.16)}{0.520}\,DUSP_{it} + \underset{(0.96)}{0.347}\,DVC_{it}$$
$$\bar{R}^2 = 0.592;\ F = 176 \qquad (5.5cd)$$

$$KXMD_{it} = \underset{(10.53)}{-3.410} + \underset{(53.74)}{0.975}\,KD_i + \underset{(7.24)}{0.434}\,QCHD_{it} - \underset{(6.11)}{0.014}\,QCHD_{it}{*}C4T_{i0} + \underset{(0.55)}{0.035}\,QCHD_{it}{*}RND_i - \underset{(2.17)}{4.1163}\,CCWM_{it}$$
$$- \underset{(0.52)}{0.066}\,DT_i - \underset{(0.49)}{0.121}\,DT_i{*}FSH_{i0} + \underset{(1.58)}{0.512}\,DUSP_{it} + \underset{(0.35)}{0.091}\,DVC_{it}$$
$$\bar{R}^2 = 0.735;\ F = 356 \qquad (5.5md)$$

$$KXCF_{it} = \underset{(10.18)}{-5.406} + \underset{(34.19)}{0.994}\,KF_i + \underset{(2.64)}{0.359}\,QCHF_{it} + \underset{(0.82)}{0.002}\,QCHF_{it}{*}C4T_{i0} - \underset{(0.71)}{0.089}\,QCHF_{it}{*}RND_i + \underset{(0.01)}{0.016}\,CCWC_{it} - \underset{(0.41)}{0.080}\,DT_i$$
$$- \underset{(2.62)}{0.992}\,DT_i{*}FSH_{i0} - \underset{(1.61)}{0.783}\,DUSP_{it} + \underset{(3.73)}{1.486}\,DVC_i$$
$$\bar{R}^2 = 0.579;\ F = 168 \qquad (5.5cf)$$

$$KXMF_{it} = \underset{(9.28)}{-3.270} + \underset{(54.37)}{0.998}\,KF_{it} + \underset{(3.68)}{0.329}\,QCHF_{it} - \underset{(1.27)}{0.003}\,QCHF_{it}{*}C4T_{i0} - \underset{(4.18)}{0.352}\,QCHF_{it}{*}RND_i - \underset{(0.84)}{1.775}\,CCWM_{it} + \underset{(0.15)}{0.020}\,DVC_{it}$$
$$- \underset{(2.77)}{0.719}\,DT_i{*}FSH_{i0} + \underset{(0.41)}{0.138}\,DUSP_{it} + \underset{(0.30)}{0.082}\,DVC_{it}$$
$$\bar{R}^2 = 0.757;\ F = 405 \qquad (5.5mf)$$

same result is obtained as for the full industries. In the domestic-controlled sector, the result holds for construction (equation 5.5cd); for machinery, the sign is right but the coefficient insignificant (equation 5.5md). We cannot reject the hypothesis that rationalizing investments occur in both subsectors (although more surely in the foreign-controlled).[13]

The similarity of the domestic and foreign sectors' reactions to short-run price signals in the world market holds interest for indicating whether a business unit's nationality affects its market responses. The results on industry-wide price effects (Table 5-1) might conceal significant differences between the domestic and foreign sectors. In Table 5-3, no such differences appear in responses to changes in margins between domestic prices and variable costs. Although the two subsectors' reactions to trends in the margin between world prices and variable costs do exhibit differences, they are not robust enough to merit emphasis. However, more revealing results appear in equation 5.5, which allows the changes in U.S. price and domestic variable costs to take separate coefficients. We had expected capital expenditure to respond positively to a fattening of this margin; the contradictory result obtained in Table 5-1 was traced to the substitution of capital for variable inputs when the latters' prices rise. Equations 5.5cd and 5.5md suggest that capital spending by domestic producers *does* increase with external prices, while capital spending by foreign-controlled sectors does not. The positive response of capital spending to increased variable costs, however, turns up only in the foreign-controlled sector (and there only for construction). The significance levels of these coefficients are marginal, but the result does accord with other findings that assign multinationals' investment and production decisions less reliance on short-run price signals than those of their domestic competitors.

6 Employment

The emphasis of this study has been on the short-run trajectory of industries' responses to changing international competition. The importance of labour utilization for economic efficiency and of unemployment for macroeconomic performance call for an analysis of short-run changes in industries' employment levels, in the process of adjustment to changed international competition. In this chapter, findings are reported on the behaviour of industries' total annual employment levels (L_{it}), and also on differences observed in the adjustment of production- and non-production-worker employment, and between foreign- and domestic-controlled establishments.[1]

Analytical Background

The issues surrounding short-run changes in employment are complex because they involve at least two sophisticated aspects of adjustment by the value-maximizing enterprise. First, a production-function relationship links an industry's desired level of output to decisions made jointly about its levels of employment, capital stock (via decisions on capital expenditures and scrappage), and other inputs. Because rationalization processes involve at the least changes in scales and mixes of activities, the structures of production relationships are likely to change in the course of adjustments and rationalizations. Nonetheless, they supply a framework for specifying the model. Second, because of adjustment costs, labour adjustment involves investment-type considerations. Firms avoid laying off workers with firm-specific human capital if rehiring them might soon become desirable. Symmetrically, fixed costs of recruting and integrating new employees may slow changes of employment following increases in the derived demand for labour services.

The former issue leads directly to the standard approach to specifying the firm's (and thus the industry's) derived demand for labour. Assume a Cobb-Douglas production function in the form:

$$Q = A^{\gamma}K^{\alpha}L^{\beta}$$

where Q indicates the industry's real output; K its capital stock; L the units of labour input utilized; and A the efficiency parameter. The coefficients α and β represent the familiar factor-share coefficients, and γ allows for factors changing the efficiency of the production process. If labour and capital are employed at the levels that serve to equate their marginal products to the wage (w) and user cost (c) respectively, then we can eliminate K from the expression and rewrite it as

$$Q = A^{\gamma}\left(\frac{\alpha L}{\beta} * \frac{w}{c}\right)^{\alpha} L^{\beta}.$$

When we take natural logarithms and rearrange this expression to indicate the demand for labour, it can be written as an estimating equation utilizing the panel database:

$$\ln L_{it} = a_0 + \Sigma a_j X_{jit} + b_1(w_{it}/c_{it}) + b_2(\ln Q_{it}) + u_{it}.$$

Here L_{it} represents the desired level of employment, the X_j are variables affecting the efficiency term of the production function (they may vary among industries, over time, or both), and u_{it} represents a random disturbance. This model provides the framework for the empirical analysis.

The influence of labour-adjustment costs in the short run can be addressed with varying degrees of sophistication. Siedule investigated the feasibility of using the approach of Ball and St. Cyr [1966], which is based on cost minimization in the short run (with the capital stock given) in light of the cost and marginal productivity of overtime hours. A sufficient reason for passing up this approach is the absence of data needed to implement it empirically. Moreover, its emphasis appears misplaced if our concern is the trajectory of reorganization induced by changes in the industry's competitive position, and not short-run optimization within a static organization of production. The same could be said of dynamic labour-demand models with quadratic adjustment costs [Nickell, 1986]. Their sophisticated accounts of optimization based on expectations and adjustment costs ask a great deal of the data. Even so, they do not embrace structural changes, the chief concern of this study. The dynamic labour-demand approach cannot be implemented directly, but it does suggest fruitful modifications of the estimation model proposed above. For example, the panel structure of the data allow us to distinguish between the long-run effects of differences between industries to be distinguished from short-run effects of changes over time for the typical industry.

Specifying the Model

The core variables in the estimating equation have already been introduced: L_{it}, total employed workers; Q_{it}, real output in 1971 dollars; and $WCOC_{it}$, the ratio of total wages and salaries per employee to the estimated user cost of capital.[2] To be specified are the X variables that indicate efficiency shifts between sectors and/or over time. Consider first those associated with an industry's international competitiveness and exposure. In Chapter 5, an important effect was observed on capital spending of the decade-long change in tariff protection:

DT_i = Difference between the i^{th} industry's average rate of nominal protection in 1982 and 1971, divided by one half the sum of those two rates.

Tariff reduction accelerated capital spending, which supplies strong evidence of a rationalization process; the rationalization was presumably labour-saving, so DT is expected to affect employment positively.[3]

Because of the importance assigned to product differentiation by the preceding results, changes to an industry's competitive position originating outside of Canada may be better indicated by revealed changes in trade penetration than by changes in the relation between external prices and domestic costs. Emphasis was in fact placed on the former:

MSH_{it} = Imports classified to industry i in year t, divided by domestic disappearance (shipments plus imports minus exports) for that industry.

XSH_{it} = Exports classified to industry i in year t, divided by shipments by the domestic industry.

These variables may exert two distinct types of influences on labour utilization. Canada's comparative advantage in international trade has rested on the export of goods intensive in natural resources and capital, and the import of goods intensive in labour. Coefficients of MSH and XSH should (especially in the cross-section dimension) take, respectively, positive and negative signs to reflect differences in labour intensity correlated with industries' comparative-advantage positions. Contrary to this prediction, however, changes in industries' competitive positions may signal a strengthened incentive to rationalize the use of resources, so that short-run changes in MSH and XSH could have quite different effects. In particular, analogous to the effect expected of DT, increases in import shares could induce the reduction of labour use. The same effect could accompany the seizure of enlarged export opportunities, although the relationship is less clear (for reasons discussed in Chapter 7).

Somewhat similar considerations bear on the prevalence of foreign direct investment in an industry:

FSH_{it} = Shipments by foreign-controlled enterprises in industry i in year t, divided by total industry shipments.

Foreign subsidiaries might use less labour to produce a given volume of shipments than domestic competitors for two reasons. Their shipments run to resales of finished goods imported from affiliates and final goods incorporating imported components [MacCharles, 1987], which utilize less domestic labour services (and other value-added components) than the shipments of domestic establishments. And efficiency advantages may allow subsidiaries to obtain more output from a given quantity of labour (and other inputs?).

Another structural factor affecting labour demand is the degree of concentration and competition in an industry. Once more, different considerations apply in their short and long runs. The extensive literature on the determinants of producer concentration make it clear that concentration is associated with capital intensity and other features of technology that give rise to extensive economies of scale. Because of that causal structure, concentration is expected to serve as an instrumental variable (negatively) proxying interindustry differences in labour input per unit of output. Firms in concentrated industries should also differ from competitive firms in their elasticities of input demand to output at the margin; recognition of the gap between price and marginal revenue induces the firm to select an activity level relative to its short-run cost function such that another unit of output requires a smaller increase of labour inputs.[4] However, the ES model also associates concentration with collusion on the delivered world price and rent-seeking forms of non-price competition that impair productivity. The variable

$C4C_i$ = Share of shipments by industry i accounted for by the largest four producers in 1970,

will be employed in various ways below without strong priors on the sign or form of its influence. A further complication is that the vagaries of oligopolistic rivalry and the lesser pressure to minimize cost that may affect concentrated industries could also make their production functions less predictable than those in more competitive industries.

Statistical Results

Because the preceding discussion indicated a rather diverse set of possible influences of regressors other than the basic Q and $WCOC$, we do not attempt to reduce the specification to one a priori best model. That is both because the interindustry and intertemporal dimensions inject diverse influences and because the efficiency-related regressors DT, MSH, XSH, and FSH are collinear. A series of models appears in Table 6-1.[5]

Certain manoeuvres used in models must be explained first. Two ways were employed to model the differential effects of industries' concentration levels on slope coefficients. The effect of $C4C$ can be assumed continuous throughout its range, which suggests a multiplicative specification (for example, Q and Q^*C4C). Or its effect can be assume discontinuous, suggested by the evidence of a threshold concentration ratio at which mutual dependence among oligopolistic rivals starts to be recognized effectively. To capture this discontinuity, we defined dummy variables to distinguish highly concentrated (HC) and unconcentrated (LC) industries,[6] then formed interactions with (for example) Q by including the terms Q^*HC, Q^*LC, and HC in the model. Although the discrete procedure discards some information on interindustry differences in concentration, it has the advantage of allowing direct tests for differences in the precision with which slope coefficients are estimated for the two industry groups.

Consider this interaction between output level and concentration first. In equation 6.1, the multiplicative interaction is shown. The sensitivity of employment to output indeed decreases significantly with the level of concentration. The coefficients of both Q and Q^*C4C are highly significant. The appropriately negative coefficient of $WCOC$ is also highly significant, and the magnitudes of the coefficients of these variables are quite insensitive to the changes in specification shown in Table 6-1. Equation 6.2 shows the alternative mode of interacting Q and $C4C$. The coefficient of Q in the highly concentrated industries is 10 per cent smaller than in the less concentrated sector; both coefficients are highly significant. We determined that very little useful information is discarded by dichotomizing industries by a threshold value of $C4C$ rather than using it as a continuous variable.

Table 6-1

Determinants of Industry Employment: Factors Affecting the Employment-Output Relationship

$$L_{it} = \underset{(9.42)}{1.257} + \underset{(66.17)}{1.262}\, Q_{it} - \underset{(24.10)}{0.478}\, Q_{it}{}^*C4C_{i0} - \underset{(13.79)}{0.010}\, WCOC_{it} + \underset{(3.32)}{0.081}\, DT_i$$

$$\bar{R}^2 = 0.881;\ F = 3{,}265 \qquad (6.1)$$

$$L_{it} = \underset{(9.38)}{-1.181} + \underset{(82.26)}{0.842}\, QLC_{it} + \underset{(55.11)}{0.757}\, QHC_{it} - \underset{(12.69)}{0.010}\, WCOC_{it} + \underset{(2.80)}{0.577}\, HC_i$$

$$\bar{R}^2 = 0.869;\ F = 2{,}704 \qquad (6.2)$$

$$L_{it} = \underset{(8.90)}{-1.044} + \underset{(61.60)}{0.844}\, Q_{i0} + \underset{(1.78)}{0.018}\, DQUP_{it} + \underset{(0.91)}{0.009}\, DQDN_{it} - \underset{(22.14)}{0.018}\, WCOC_{it}$$

$$\bar{R}^2 = 0.830;\ F = 1{,}980 \qquad (6.3)$$

$$L_{it} = \underset{(7.29)}{0.983} + \underset{(61.39)}{1.206}\, Q_{it} - \underset{(19.72)}{0.412}\, Q_{it}{}^*C4C_{i0} - \underset{(12.29)}{0.008}\, WCOC_{it} - \underset{(8.72)}{0.332}\, FSH_{i0} + \underset{(0.25)}{0.029}\, DFSH_{it}$$

$$\bar{R}^2 = 0.885;\ F = 2{,}729 \qquad (6.4)$$

$$L_{it} = \underset{(9.49)}{1.384} + \underset{(62.70)}{1.264}\, Q_{it} - \underset{(22.80)}{0.490}\, Q_{it}{}^*C4C_{i0} - \underset{(12.94)}{0.010}\, WCOC_{it} + \underset{(2.17)}{0.104}\, XSH_{i0} - \underset{(1.89)}{0.202}\, DXSH_{it}$$

$$\bar{R}^2 = 0.881;\ F = 2{,}398 \qquad (6.5)$$

$$L_{it} = \underset{(9.26)}{1.291} + \underset{(63.56)}{1.261}\, Q_{it} - \underset{(23.26)}{0.481}\, Q_{it}{}^*C4C_{i0} - \underset{(12.91)}{0.010}\, WCOC_{it} - \underset{(1.55)}{0.032}\, DK/K_{it-1}$$

$$\bar{R}^2 = 0.880;\ F = 2{,}989 \qquad (6.6)$$

The elasticity of labour demand with respect to shipments (equation 6.2) is less than unity – 0.84 in the unconcentrated, 0.76 in the concentrated industries. This elasticity commingles long-run differences between industries with short-run effects of output changes.[7] In equation 6.3, they were separated by dividing the shipments variable into three components. Q_{i0} is the logarithm of real shipments in 1970, the beginning of the decade; it picks up the interindustry component. The term for the intertemporal change in shipments itself was broken into two components in order to allow output increases and decreases to have unequal effects. Specifically, $DQUP_{it}$ is the logarithm of the one-year change when an increase occurred; $DQDN_{it}$ is the logarithm of the absolute value of the change when real shipments fell. One would expect, respectively, positive and negative coefficients for *DQUP* and *DQDN*. However, both coefficients are positive. The coefficient of *DQUP* is significant at 5 per cent (one-tail test) but very small. The results indicate that the adjustment of labour input to changes in real shipments must be rather slow, and labour hoarding apparently operates when shipments decline.

The coefficient of the ratio of the wage to the cost of capital is appropriately negative, highly significant, and robust to specification changes. When the coefficients of *WCOC* are allowed to differ between unconcentrated and concentrated industries, they prove nearly identical.

Now we consider the *X* variables that shift the employment-output relationship. In equation 6.1, the decade-long tariff change, *DT*, takes a significant positive coefficient, indicating that tariff reductions during the 1970s caused industries to reduce the labour input associated with a given level of real output. This relation is consistent with the positive effect of tariff reductions on capital expenditures reported in Chapter 5: the rationalizing investment induced by trade liberalization yielded increased labour productivity as one of its consequences. In equations 6.4 and 6.5, the influences of foreign investment and exporting activity are tested. In each case we separate the variable (e.g., FSH_{it}) into its base-year (1970) level (FSH_{i0}) and the difference between current and previous year ($DFSH_{it}$), to distinguish long-run from short-run effects. In equation 6.4, foreign investment exerts the expected long-run effect of lowering the employment-output relation; raising an industry's foreign share from 0 to 50 per cent lowers predicted employment per unit of sales by one sixth. (As we noted above, this differential can be given at least two interpretations.[8]) However, the insignificant coefficient of *DFSH* shows that short-run changes in the prevalence of foreign subsidiaries were not correspondingly associated with changes in labour utilization.[9] This result is consistent with the finding of Chapter 5 that adjustment processes differ between industries where foreign investment is prevalent and other industries, but in the former no sharp contrast appears between the behaviour of foreign- and domestic-controlled market tenants.

The similar treatment of export intensity (*XSH*) in equation 6.3 indicates that among manufacturing industries exporting was historically not slanted toward capital-intensive activities (positive coefficient of XSH_{i0}). However, changes in export intensity are associated with improvements in labour productivity and/or substitution of other inputs for labour (negative coefficient of $DXSH_{it}$). When the same treatment is applied to import intensity (MSH_{it}), no significant influence is found for either the long-run level or the short-run change (not shown in Table 6-1). Displacement of domestic production by imports obviously affects employment via the domestic producers' output levels, but direct effects on labour productivity are associated only with *DT*.[10]

The evidence reported so far indicates that the rationalization process bestirred by international competition involves capital-labour substitution.[11] As a further check on this pattern, we estimated equation 6.6, which includes the variable:

DK/K_{it-1} = Ratio of capital expenditure made by industry *i* in year *t*–1 to *i*'s capital stock in 1970.

The coefficient's sign indicates that the employment-output relation is reduced by the preceding year's capital expenditures, but it is not statistically significant.

As with the other endogenous variables, we estimated a version of the determinants of L_{it} in which interaction terms, based on market structure, are replaced by intercept and slope dummies for all but one of the two-digit industries in the manufacturing sector. The exogenous variables subjected to this treatment were Q_{it} and $WCOC_{it}$, and the results are shown in Table 6-2. The slope shifts for Q_{it} depict the obvious differences among industries' labour intensities. The significant slope shifts for relative factor prices are mostly positive and indicate the insensitivity of labour usage in certain industries that rely mainly on process technologies – tobacco, knitting mills, petroleum and coal products. (Printing and publishing activities are diverse in their input requirements, but would seem to offer limited opportunities for factor substitution.)

Equation 6.1 was re-estimated with corrections for heteroskedasticity and autoregression, with the following result:

Table 6-2

Regression Coefficients for Industry Employment, Slope Shifts for Two-Digit Manufacturing Industries

	Exogenous variables	
	Q_{it}	$WCOC_{it}$
Basic regression coefficient	0.916[a]	–0.014[a]
Food and beverage	–	–0.013[a]
Tobacco products	0.507[be]	0.049[ae]
Rubber and plastic products	–	0
Leather	+	0
Textiles	0	0.009[c]
Knitting mills	–	–
Clothing	–	0.033[b]
Wood	–	+
Furniture and fixtures	0.270[be]	0.019[ce]
Paper and allied products	0.086[ce]	+[e]
Printing and publishing	–	0.026[c]
Primary metals	–[d]	0.015[bd]
Metal fabricating	–0.140[b]	+
Machinery	+[db]	0[d]
Transportation equipment	–0.112[b]	0
Electrical products	0	–
Non-metallic mineral products	–0.106[b]	0
Petroleum and coal products	–0.156[b]	0.012[b]
Chemical and chemical products	0	0.010[c]

NOTE a = 1 per cent significance; b = 5 per cent significance; c = 10 per cent significance; d = intercept shift positive and significant at 5 per cent; e = intercept shift negative and significant at 5 per cent.

$$L_{it} = \underset{(6.98)}{2.495} + \underset{(19.88)}{1.458}\, Q_{it} - \underset{(9.37)}{0.715}\, Q_{it}{*}C4C_i + \underset{(1.63)}{0.001}\, WCOC_{it} + \underset{(4.43)}{0.202}\, DT_i.$$

The major change is the disappearance of the significant negative coefficient of *WCOC*. The apparent evidence from Table 6-1 of factor substitution as a significant influence on employment variations must therefore be regarded as doubtful. The coefficients of terms involving Q increase somewhat in absolute value, and the employment-displacing effect estimated for tariff reductions is doubled in magnitude.

Production-Worker and Staff Employment

The influences investigated in Table 6-1 may affect production workers and non-production workers (staff) in different ways. If staff employment represents a fixed cost, as is commonly thought, it should be less sensitive than production-worker employment to short-run changes in shipments. Also, the prevalence of labour hoarding may differ between the two groups. The processes of adjustment to intensified import competition (and the increasing orientation toward exports documented in Chapter 7) might be expected to affect production workers and staff differently. Therefore, we partitioned the dependent variable used in Table 6-1 and formed two new dependent variables:

LP_{it} = Logarithm of total production-worker employment, industry i in year t.

LS_{it} = Logarithm of total non-production-worker employment, industry i in year t.

In the database, the mean industry's staff employment is 22.3 per cent of its total employment. Models of the type reported in Table 6-1 were re-estimated with *LP* and *LS* as dependent variables.

Overall, the similarities of the models estimated for production workers and staff are more striking than their differences. The elasticities of employment with respect to real shipments and relative factor prices differ very little between them. In Table 6-3, equation 6.7 is specified identically to equation 6.3 and equation 6.8 to equation 6.4. Equation 6.7p shows that the long- and short-run relation of production-worker employment to real shipments closely resembles that estimated for total employment with low but statistically significant short-run sensitivity and an asymmetry between upward and downward changes of real shipments suggestive of labour hoarding. For staff employment (equation 6.7s), however, no significant sensitivity to short-run increases of shipments during the 1970s is evident; for reductions in real shipments (*DQDN*, measured positively), staff employment tended to behave perversely, but the coefficient is not statistically significant. Comparison of these two equations show that staff employment was about one-fourth less elastic with respect to relative factor prices than was production-worker employment, although both coefficients are highly significant.[12]

Most of the factors shifting the labour-shipments relationship exert quite similar effects for production workers and staff. Tariff reductions significantly diminish both classes of employment (the elasticity is one-tenth lower for staff than for production workers).[13] Neither is directly affected when imports capture an increased market share (except via the change in real domestic shipments), although both coefficients are positive and somewhat significant. The one sharp contrast appears in equations 6.8p and 6.8s. A higher initial

Table 6-3

Determinants of Industry Employment: Production Workers and Staff

$$LP_{it} = \underset{(7.64)}{-0.995} + \underset{(53.40)}{0.812}\, Q_{i0} + \underset{(2.40)}{0.026}\, DQUP_{it} + \underset{(1.75)}{0.020}\, DQDN_{it} - \underset{(20.88)}{0.019}\, WCOC_{it}$$

$$\bar{R}^2 = 0.789;\ F = 1{,}526 \qquad (6.7p)$$

$$LS_{it} = \underset{(28.39)}{-3.513} + \underset{(64.34)}{0.929}\, Q_{i0} - \underset{(0.11)}{0.001}\, DQUP_{it} - \underset{(1.26)}{0.014}\, DQDN_{it} - \underset{(16.80)}{0.015}\, WCOC_{it}$$

$$\bar{R}^2 = 0.835;\ F = 2{,}060 \qquad (6.7s)$$

$$LP_{it} = \underset{(7.28)}{1.119} + \underset{(53.88)}{1.204}\, Q_{it} - \underset{(18.17)}{0.432}\, Q_{it}{*}C4C_{i0} - \underset{(10.23)}{0.008}\, WCOC_{it} - \underset{(11.89)}{0.526}\, FSH_{i0} - \underset{(0.80)}{0.098}\, DFSH_{it}$$

$$\bar{R}^2 = 0.863;\ F = 2{,}053 \qquad (6.8p)$$

$$LS_{it} = \underset{(11.24)}{-1.905} + \underset{(48.34)}{1.185}\, Q_{it} - \underset{(12.48)}{0.326}\, Q_{it}{*}C4C_{i0} - \underset{(9.95)}{0.009}\, WCOC_{it} + \underset{(4.01)}{0.190}\, FSH_{i0} + \underset{(2.19)}{0.293}\, DFSH_{it}$$

$$\bar{R}^2 = 0.858;\ F = 1{,}958 \qquad (6.8s)$$

level of foreign investment in an industry sharply reduced the production-worker labour and increased the staff content of an industry's employment. In cross-section, this pattern is simply consistent with the well-known structural determinants of the interindustry distribution of foreign investment (e.g., importance of innovation, product differentiation, and various other sources of non-production scale economies to the firm). But the relationship also appears in time-series, with the large and significant coefficient of $DFSH_{it}$ in equation 6.8s.

In conclusion, production-worker and staff employment behave quite similarly. There appears only a bit of the contrast between their short-run behaviour patterns that would be predicted on the assumption that the former represents a variable and the latter a fixed cost. Expansions of real shipments in the 1970s failed to induce increases in staff employment, and the (small) average reductions that occurred in the shares held by foreign subsidiaries apparently account for some of the downward trend. Tariff reductions caused businesses to diminish their use of both production workers and staff, although concentrated industries seemed to have augmented their non-production workers as part of the rationalization process.

Employment in Domestic- and Foreign-Controlled Establishments

Another distinction can be made between employment in establishments under domestic and foreign control. In parallel to the final section of Chapter 5, we re-estimated the models reported above for these dependent variables:

LD_{it} = Logarithm of total employment in domestic-controlled establishments, industry i in year t.

LF_{it} = Logarithm of total employment in foreign-controlled establishments, industry i in year t.

In the average year and industry in our database, foreign-controlled employment represented 40.6 per cent of total employment.[14]

In specifying models of LD and LF, we retained industry-wide real shipments as an exogenous variable but always included FSH_{it} as a regressor to control for differences in the prevalence of subsidiaries. As with the distinction between production workers and staff, little substantial difference was found. Employment in foreign subsidiaries is about one-third less sensitive to relative factor prices in Canada, as one would expect, but the coefficient remains highly significant for the subsidiaries ($t = -7.31$). The level of employment in the subsidiaries is positively related to the height of the tariff, as the "tariff factory" tradition would imply; the slope coefficient is 0.38, with a t-ratio of 2.74. In domestic establishments, the coefficient of the tariff level is actually negative (–0.38) and significant ($t = -2.68$), for which we have no explanation. Overall, our analysis of employment in domestic and foreign establishments sheds

little further light on the findings of Chapter 5 concerning the roles of domestic- and foreign-controlled companies in adjustments to changing international competition. The issue receives further attention in Chapter 7.

7 Exports

Introduction

Exports play a somewhat ambivalent role in this analysis. The international price and supply disturbances under study affect domestic industries by changing both the state of import competition and the extent of export opportunities. A strictly neoclassical approach would presume that any given manufacturing industry either suffers a comparative disadvantage and faces import-based disturbances, or enjoys a comparative advantage and faces disturbances via export markets – but not both.[1] Indeed, the traditional import-competing status of Canadian manufacturing (with some resource-processing industries excepted) is assumed by the Eastman-Stykolt approach and thus underlies its empirical applications (including the present study). Yet, the widely observed phenomenon of intraindustry trade denies this dichotomy between import-competing and export status, and suggests that external disturbances which change the supply conditions for competing imports will alter the industry's exports as well.

The shift of Canada's exports away from the nation's traditional natural-resources base has been widely noted [e.g., Morici, 1988]. Clearly, a lot of this change can be explained by general-equilibrium forces limiting expansion of the resource sectors, plus an important choice of public policy – the Auto Pact. However, a strikingly large number of manufacturing industries have shown a pattern of increase of *both* imports' share of the market and exports' share of industry shipments. This pattern is illustrated by Matthews' [1985] calculations of trends in trade shares. For a mixture of three- and four-digit industries he observed imports, exports, total shipments, and apparent domestic disappearance (shipments minus exports plus imports) for various years between 1966 and 1980. He determined judgmentally whether an increase, decrease, or no change had occurred in each of three ratios – exports/shipments, imports/domestic disappearance, and shipments/domestic disappearance. His classifications are summarized in Table 7-1. The shipments/domestic disappearance ratio serves to indicate the change in industry's net comparative-advantage position. As the bottom line shows, the typical industry experienced no change in its net position, and deteriorations outnumbered improvements. However, fully 42 per cent of the industries experienced increases in both the imports and exports ratios. Another 20 per cent experienced an increase in one ratio with no deterioration of the other. For only six of 132 industries did one ratio increase while the other decreased – the pattern predicted by traditional international-trade theory. And only 12 experienced a decline in *either* the exports or the imports ratio. Imports/shipments increased for 59 per cent of the industries, but exports/shipments increased for 49 per cent.

As Matthews noted, despite the predominant expansion of intraindustry trade, a calculation of Canada's revealed comparative advantage (his Table 8-3) shows the traditional pattern still in place: a strong advantage in wood products and paper, a weaker one in primary metals and transportation equipment, but a generally strong comparative disadvantage in everything else. Thus, the changing participation of Canada's manufacturing industries in international trade seems part of a broad drift of industrial reorganization that is affecting levels of trade in manufactures pervasively while leaving long-established patterns of net comparative advantage largely unchanged.

These patterns certainly warrant the examination of changes in exports as part of industries' adjustments to international disturbances. Before setting up the model, however, we must consider the relation between intraindustry trade and the Eastman-Stykolt framework underlying this study.

Theoretical Background and Related Evidence

When exports and competing imports expand simultaneously, the direction of causation between them is obviously an open question. We shall retain the assumption that disturbances on the import side drive the adjustment process and make an effort to check its empirical validity. From that point of reference, we inquire whether the adjustments set in train by imports-increasing disturbances can cause domestic producers to expand their export sales: Do imports beget exports, by means of adjustment processes addressed in the generalized ES model?

Observers have conjectured that producers, deprived of a profitable niche in the domestic market, would expand their operating scales and sell much enlarged quantities on both

Table 7-1

Changes in Exports/Shipments, Imports/Domestic Disappearance, and Shipments/Domestic Disappearance, Selected Manufacturing Industries, 1966-80

Change in exports/shipments	Change in imports/domestic disappearance	Change in shipments/domestic disappearance			Total number of industries
		+	0	–	
+	+	15	24	16	55
+	0	6	2	x	8
+	–	2	x	x	2
0	+	x	0	19	19
0	0	0	38	0	38
0	–	4	0	x	4
–	+	x	x	4	4
–	0	x	0	2	2
–	–	0	0	0	0
Total number of industries		27	64	41	132

NOTE Cells indicated by x should be empty if underlying trend estimates were consistent, and were in fact empty.
SOURCE Calculated from Matthews [1985], Table A-6. Some figures differ slightly from those reported in Matthews' text, apparently because he counted both industry totals and selected product components for a few industries.

the domestic *and export* markets. Such an outcome is, however, tricky to model, because exporting must be shown profitable as a result of pressure from competing imports but unprofitable in its absence. If the domestic firm producing at a small scale in a protected market could march profitably onto the world market by enlarging its scale or simplifying the varieties that it produces, one must explain why that strategy was elected only when competitive pressure from imports increased. This axiom rules out any simple story of reversion to exporting because of the shrinkage of profits in the domestic market. To assert that the domestic market went from "more profitable" to "less profitable" is not sufficient if the export market was "profitable" all along (and unaffected by the imports-increasing disturbance).

The axiom seems to leave open only one direct route for predicting increased exports as a consequence of an increase in import competition. Assume that the firm has some monopoly power in the domestic market but receives a parametric net price for any sales on export markets. Assume also that, if it exports, it must charge the same price to domestic and foreign customers. This constraint could arise either if its exports can be costlessly arbitraged back to the domestic market, or if foreign governments strictly enforce antidumping legislation in its export markets. As White [1974] showed, depending on the firm's cost function and the domestic demand function, it could pass up the export market even if its marginal costs are less than the net unit revenue it obtains from exports, because the profits gained from exporting do not offset the profits lost on domestic sales when the home and export prices are aligned. Furthermore, a disturbance (such as increased import competition) which reduces the profitability of domestic sales could induce a policy switch that brings about substantial export sales. At some critical point, a little more import competition begets a lot of exports.

This model's assumptions are quite restrictive. An implicit assumption of the standard ES model, not challenged by any of its empirical tests, is the existence of a substantial margin between the delivered price of imports and the net (f.o.b.) revenue obtainable on export sales. If this assumption holds, then the arbitrage of reimports does not deter price discrimination by the potential exporter. Reductions in tariffs or international transport costs of course do tighten the arbitrage constraint on price differences. Foreign antidumping laws are a real threat, but their importance is limited by the small size of the typical Canadian manufacturer on world export markets. Also, abundant if casual evidence suggests that manufacturers commonly "price to market" independently in their various national markets. Hence, antidumping constraints seem too weak to support reliance on empirical predictions from White's model.

The inability to predict that imports beget exports on the basis of standard neoclassical assumptions suggests a search for other mechanisms to explain the expansion of intra-industry trade. Two factors suggest themselves, each rele-

vant to Canada's situation. The first harks back to the discovery of intraindustry trade by Balassa [1966] and Grubel [1967] in the context of European integration through the Common Market. The members of the European Community undertook a *simultaneous* reduction in their trade barriers, so that producers in each national industry found their potential unit revenues from exports increasing at the same time that more stringent competition arose from imports. In a differentiated-product industry, exports and imports should expand at the same time if the net price realized from exports rises at the same time the delivered price of competing imports falls; the process resembles the theoretical opening of monopolistically competitive markets to external trade, causing an expansion in the production scales of individual brands and/or in the number of brands produced worldwide and consumed in each country.

In partial equilibrium, with the disturbance assumed to come solely from the import side, this scenario does not apply: the lowering of its tariff leaves an industry's net revenue from exporting unchanged. Nor does the scenario apply when the industry's comparative advantage deteriorates or the country's real exchange rate appreciates; those disturbances should cause the industry's potential net revenue from export sales to fall. Therefore, the mechanism apparently responsible for the expansion of intraindustry trade during the European Community's formation should have operated in the situation of Canadian manufacturing in the 1970s, only to the extent that any given industry's tariffs (or international transport and transaction costs) were being reduced in other countries as in Canada. If increases in the typical industry's exports are positively correlated with increases of the competing imports that it faces, the changes in imports could simply be proxying the effect of lowered barriers to imports by Canada's trading partners.

Another factor that can link exports to import disturbances lies outside the neoclassical pale. Competing imports may embody some element of innovation, and the domestic producer's cost of imitation or innovative response may fall and/or the benefit from innovative response may rise when the competitive threat is imminent.[2] With information about external markets costly to acquire, the Canadian firm may rationally invest in learning about them and discover a previously unsuspected exporting opportunity only when beset by import competition.[3] While these responses may be important in practice, they are hard to research empirically except by means of case studies; if import competition causes some firms (industries) to learn about export opportunities, how can we predict who will choose to pay the tuition, and who will not? If only some of these pupils obtain useful knowledge and actually export, how can we predict which will succeed?

Some evidence on the changing pattern of Canadian manufactured exports is relevant, mainly for assessing the pattern's consistency with the elements of the ES model – product differentiation, scale economies, and specialization and run lengths. Balcome [1986] surveyed 254 Canadian manufacturing firms that undertake some exports, finding evidence consistent with the widespread prevalence of product differentiation. In designating factors "most important to export sales performance," 50 per cent of the respondents picked "product characteristics," 42 per cent named price, while marketing skills and production capabilities trailed behind. Furthermore, custom production is common: 44 per cent reported production to order, 17 per cent custom design, and only 39 per cent production to stock. These data strongly support an approach assuming that differentiation is important at the margin for Canadian exports.

Balcome's findings downplay the importance of fixed costs, scale economies, and run lengths. Only 14 per cent of the respondents cited reduced unit costs due to increased output as the main benefit from exporting, while 67 per cent cited simply the increased net revenue and 19 per cent the diversification value of export sales. Furthermore, cost reduction was mentioned least frequently by small firms, the ones expected to benefit most from increasing production for export. Cost reduction was cited least commonly by finished-products manufacturers, suggesting that scale economies are more important for the exporters of more homogeneous goods (fabricated materials, food products). The ES model implies that increased export orientation would lead to the narrowing of the firm's product line, but Balcome found the opposite (positive) association between export orientation and the five-year change in product-line breadth. Finally, the survey fails to confirm that heavy fixed costs are incurred to enter export markets. Overall, Balcome's results suggest that a lot of Canadian manufactured exports might match the "bespoke tailoring" model, subject to differentiation but not to important scale economies.

Baldwin and Gorecki [1987] also addressed rationalization processes and the expansion of exports. For the 1970-79 period, the expansion of industries' exports was found positively associated with the acquisition of established plants by outside firms but not with the creation of new plants (although plant creation is strongly related to the expansion of domestic shipments). As Baldwin and Gorecki noted, the pattern is consistent with a process of corporate diversification, by which firms move resources from declining markets to those that are expanding due to changes in trade patterns. It is also consistent with expanding exports stemming from the reconfigured activities of established facilities, with the changes supported by cash and other resources transferred from other activities.[4]

A final empirical finding bears on dumping and (in general) the exporter's ability to price independently among markets. Balcome found no strong evidence of dumping: 44 per cent of respondents reported about the same unit profits on export as domestic sales, and the proportion reporting lower profits on export as domestic sales, and the proportion reporting lower profits (35 per cent) did not greatly exceed the proportion reporting higher profits (21 per cent). Dumping is not ubiquitous, but patterns of pricing vary too much among markets to warrant heavy reliance on the theoretical assumption that dumping is unfeasible. That assumption is necessary, we saw, for the one neoclassical-type model of exports begotten by imports.

Modelling Export Shipments

In specifying a model for exports, we shall assume that Canadian exporters are small sellers on the world market but may offer differentiated goods. Variations in the quantities exported, therefore, may not depend only on world price and domestic marginal costs (and the resulting supply schedule). The dependent variable will be the logarithm of the value of exports for each industry and year (EXP_{it}). Export-price indexes do not exist for finely disaggregated industries; this shortcoming affects the interpretations of some regressors.

Demand Variations

An index of demand of Canadian exports, taken from the CANDIDE model, is based on national incomes of the customer countries weighted by the proportion of Canadian exports that they receive. This index is calculated at the two-digit level of industry classification, and we assume that a given two-digit index can serve for each included four-digit industry. This variable, expressed in logarithmic form, is denoted as $DEMAND_{it}$. Exports should increase with *DEMAND*, even with price controlled, if they are differentiated products that enter as normal goods into buyers' consumption.

Prices and Variable Costs

Exports should increase with world prices (exchange-rate adjusted) relative to Canadian prices or (marginal) costs. The selling-price index of the U.S. counterpart industry serves as a proxy for external prices in Canada's export markets, as it did for the world prices of competing imports. With the majority of Canada's manufactured exports going to the United States during the period of our analysis, the assumption is more appropriate here than it was for the imports equation (Chapter 4), where the U.S. selling price behaved well. If Canadian exportables are homogenous and sell at the same price at home and abroad, the quantity of exports should depend on the external price of exportables relative to domestic marginal costs. If they are differentiated or customized, the more appropriate datum may be the margin between the external price and the price obtained from domestic sales, reflecting influences of both costs and domestic market conditions. Although this study's evidence favours the latter hypothesis, we employ both:

$PRICE1_{it-1}$ = U.S. industry selling-price index multiplied by effective exchange rate (price of foreign exchange), divided by Canadian industry selling-price index, industry i in year $t-1$.

$PRICE2_{it-1}$ = U.S. industry selling-price index multiplied by effective exchange rate, divided by average of indexes of unit labour and unit materials costs (weighted by their importance in the industry's total costs), industry i in year $t-1$.

Exports should increase with the relative prices of competing goods abroad. Recall that the dependent variable cannot be deflated, which affects the interpretation of the coefficient.

Capacity

The expansion of an industry's exports may be constrained in the short run by the capacity that it has available. The unit variable costs controlled by *PRICE2* are short-run average rather than marginal costs, and hence will not capture this constraint accurately (we can think of additions to an industry's capacity shifting down the unobserved short-run marginal cost relative to this average). The following variable approximates the extra output producible as a result of the preceding year's capital expenditures:

$SUPPLY_{it-1}$ = Logarithm of previous year's current-dollar value of industry shipments, multiplied by ratio of previous year's capital expenditures to the value of the industry's capital stock in 1970; this is inflated to the current year's prices by the ratio of industry i's selling price in year t to its value in year $t-1$.

SUPPLY is inflated to current prices because the dependent variable is undeflated; capital-stock data are available only for 1970, not for each year of our analysis.[5] *EXP* should increase with *SUPPLY*.

The presence of lagged output in the variable *SUPPLY* tends to make the model into an explanation of the industry's ratio of exports to shipments. That implication makes clear the need to include additional exogenous variables indicating comparative-advantage factors to explain differences in industries' exports/shipments ratios. Previous research focused on testing this type of relationship has not been very successful, and Leamer [1984] made us actually aware of the hazard of misspecification in explaining international-trade structures in this manner. Thus, although comparative-advantage variables are not optimally tested by means of national exports/shipments ratios, their omission could cause omitted-variable bias.

We propose to include the following comparative-advantage indicators without specific justification:

RND_i = Research and development outlays of industry i divided by value of shipments, 1975.

ADS_{i0} = Adversiting outlays of industry i divided by value of shipments, 1970.

K/L_i = Value of gross capital stock per employee, industry i, 1970.

Finally, industries affected by the Canada-U.S. Auto Pact make exceptionally large export sales because of the structure of that agreement; these are controlled by the dummy variable:

$AUTO_i$ = Dummy variable set equal to 1 for sectors affected by the Auto Pact.

Links to Import Disturbances

The simplest approach to the question whether import competition promotes exports is to include as a regressor:

IMP_{it-1} = Logarithm of the value of imports classified to industry i in year $t-1$.

This is a reduced-form approach that by-passes the question of the mechanism by which imports-induced responses could affect exports. Expanding imports could reflect common factors such as reduced transport costs or widely diffused innovations that expand world trade overall, including Canadian exports. The sign of the coefficient of IMP_{it-1} cannot be predicted; after all, traditional international trade theory suggests that an increase in competing imports would be associated with a deterioration of an industry's comparative advantage and a *reduction* of any exports that it might supply.

Interactions

Other hypotheses are tested by allowing the coefficients of the variables already defined to vary with industry structure. A number of hypotheses suggest themselves.

One of them provides a strategic test of the ES model. That model assumes that the industry's comparative disadvantage puts export markets well out of its reach. If ES industries with high concentration and tariff protection increase their exports smoothly when protection is reduced, the ES framework would be undermined, and a monopolistic-competition model (assuming Nash behaviour) favoured. Conversely, if import disturbances beget less exports in concentrated and protected industries, the ES model is supported. The crucial interaction term then is $IMP_{it-1}*C4C_i*T_{i0}$.

Foreign subsidiaries play a complex role in the adjustment of Canada's trade pattern. On some survey evidence, foreign subsidiaries have developed export sales less actively than domestic companies [Daly and MacCharles, 1986]. That conclusion is plausible: a Canadian subsidiary and an identical domestic firm might both find exporting profitable, yet the subsidiary could eschew exporting because its corporate siblings have still lower costs. Nonetheless, we found the rationalization (capital expenditures) prompted by tariff reductions concentrated in industries populated by foreign subsidiaries, although the rationalizing activities in those industries are not confined to the foreigners.

Differences in the behaviour of subsidiaries (or in the industries that they populate) can be tested in various ways. With FSH_{it} defined as the share of shipments by foreign-controlled establishments in industry shipments, the term $SUPPLY_{it-1}*FSH_{it}$ serves to test whether the orientation of capacity additions toward foreign markets varies with foreign control. (No sign is predicted a priori.) In the same spirit, we can condition the coefficient of *IMP* on multinationals' participation by means of $IMP_{it-1}*FSH_{it}$. A negative sign is indicated by the Daly-MacCharles results. Besides its interactive influence, *FSH* may exert an additive effect on *EXP*. Foreign investment in Canada (extractive sectors and the automotive industries excepted) originally had a bias toward substituting local production for imports, implying a negative (but non-behavioural) relation between *FSH* and *EXP*.

The effects of import changes (*IMP*) and increments to industry capacity (*SUPPLY*) may also depend on the comparative-advantage variables. Attention falls upon *K/L* in particular, because in the 1970s capital-intensive Canadian industries behaved as if they were raising their prices in response to increases in their variable costs and (as a result) carried substantial excess capacity. If this behaviour was unique to Canada – probably not the case – their exports should have been depressed relative to their supply capability. Their access to export markets through rationalization should have been attenuated, implying a negative coefficient for *SUPPLY*K/L*. We have no strong prior whether capital intensity affected the partial relation between import changes and induced exports.

The ability of imports to beget an industry's exports should depend on the character of product differentiation. The interaction *IMP*RND* should take a positive coefficient if research-intensive markets offer more possibilities for learning and (sometimes) successful experimentation following imports-based disturbances. The sign for the interaction with advertising *IMP*ADS* is less clear. Although advertising indicates the differentiation of products, Canada appears (both on average and at the margin) to have a comparative disadvantage in the most heavily advertised goods (consumer non-durables).

Statistical Results

The results are reported in two steps. Considered first are the fundamental determinants of *EXP*, shifts in foreign demands and domestic capacity, relative prices, and the Auto Pact. Then come the results for other variables and for modified specifications. Exploration prompted one change from the model proposed above: *PRICE*1 and *PRICE*2 are best disaggregated into their components, the selling price of the U.S. counterpart industry (USP_{it-1}) and the Canadian industry selling price (CSP_{it-1}) or variable-cost index. The foreign and domestic components of *PRICE* take coefficients with rather different (absolute) values. Furthermore, *PRICE*1 (incorporating the Canadian industry selling price) is considerably more significant than *PRICE*2 (incorporating an index of variable cost).

Basic Results

In equation 7.1 (Table 7-2), all signs are correct and all coefficients significant. Because of marginal-supplier effects commonly found in short-run trade patterns, we expect a high elasticity of exports with respect to external demand. The estimated elasticity is biased upward, because the value of export shipments cannot be deflated.[6] Table 7-2 shows that the estimated value of this elasticity is sensitive to specification reaching 2.13 in equation 7.4 (which includes the structural comparative-advantage variables), but insignificant and below unity in other models. The elasticity of exports' value with respect to external prices is similarly overestimated, while the negative effect of Canadian price increases on exports (very sensitive to specification) correspondingly understates the elasticity of quantity with respect to supply price and/or costs.

Because the variable *SUPPLY* combines the effects of industry capacity changes and interindustry scale differences, we added (equations 7.3 and 7.5) the term Q_{i0}, real shipments of industry *i* in 1970, the beginning of the period analysed. Its coefficient is highly significant, but the coefficient of *SUPPLY*, which should now be picking up strictly a capacity-expansion effect, also remains highly significant.

Equation 7.2 introduces the variable that is the fulcrum of this analysis, IMP_{it-1}. Its coefficient is positive and highly significant, indicating a responsive elasticity of the value of exports to the preceding change in imports of 0.44.[7] How much of this is short-run dynamics, and how much is due to industry structure (cross-section)? We partitioned *IMP* into its interindustry and intertemporal components, the level of imports at the beginning of the period (1971, IMP_{i0}) and the (logarithm of the) change in imports between 1971 and the year of observation ($DIMP_{it}$).[8] In equation 7.3, the coefficient of *DIMP* is only 10 per cent as large as that of IMP_{i0} and not statistically significant. The shortness of the time series and the time needed for the adjustment make the small coefficient no surprise. One must conclude that the parallel expansion of imports and exports rests mostly on the structural traits of industries and on disturbances not specific to Canada. Nonetheless, the magnitude of *DIMP*s coefficient seems not without interest.

Equation 7.4 includes several additive variables that may affect industries' export orientation, and three of these prove highly significant (in two-tail tests). Exports increase with the industry's research intensity, confirming that Canada's stock of intellectual and research capital has come to contribute to its export base. Foreign investment also has a positive effect, indicating a shift of subsidiaries away from predominantly import-replacing production. This shift is consistent with the evidence of multinational firms' increasing role in international trade among the industrial countries, generally.[9] Advertising intensity exerts a significant negative influence (and probably filters out what would otherwise appear as a negative component of the influence of multinational enterprises). Finally, the coefficient of capital intensity is positive and significant,

Table 7-2

Determinants of Industries' Export Shipments

$$EXP_{it} = \underset{(2.30)}{12.115} + \underset{(1.91)}{1.305}\, DEMAND_{it} + \underset{(29.69)}{0.775}\, SUPPLY_{it} + \underset{(8.61)}{3.090}\, AUTO_i + \underset{(1.84)}{0.859}\, USP_{it-1} - \underset{(3.01)}{1.354}\, CSP_{it-1}$$

$$\bar{R}^2 = 0.491; \quad F = 251 \qquad (7.1)$$

$$EXP_{it} = \underset{(2.16)}{-10.534} + \underset{(1.03)}{0.735}\, DEMAND_{it} + \underset{(18.52)}{0.543}\, SUPPLY_{it} + \underset{(5.00)}{1.750}\, AUTO_i + \underset{(1.40)}{0.609}\, USP_{it-1}$$

$$- \underset{(2.08)}{0.865}\, CSP_{it-1} + \underset{(16.51)}{0.445}\, IMP_{it-1}$$

$$\bar{R}^2 = 0.595; \quad F = 280 \qquad (7.2)$$

$$EXP_{it} = \underset{(2.60)}{-12.476} + \underset{(1.37)}{0.987}\, DEMAND_{it} + \underset{(5.27)}{0.256}\, SUPPLY_{it} + \underset{(4.56)}{1.547}\, AUTO_i + \underset{(1.51)}{0.642}\, USP_{it-1}$$

$$- \underset{(0.46)}{0.196}\, CSP_{it-1} + \underset{(7.66)}{0.483}\, Q_{i0} + \underset{(6.94)}{0.368}\, IMP_{i0} + \underset{(0.71)}{0.037}\, DIMP_{it}$$

$$\bar{R}^2 = 0.622; \quad F = 233 \qquad (7.3)$$

$$EXP_{it} = \underset{(0.76)}{-3.740} + \underset{(3.38)}{2.128}\, DEMAND_{it} + \underset{(30.27)}{0.729}\, SUPPLY_{it} + \underset{(9.03)}{3.048}\, AUTO_i - \underset{(0.39)}{0.171}\, USP_{it-1}$$

$$- \underset{(1.32)}{0.555}\, CSP_{it-1} + \underset{(2.72)}{0.417}\, FSH_{i0} + \underset{(11.53)}{1.257}\, RND_i - \underset{(8.80)}{1.739}\, ADS_{i0} + \underset{(6.51)}{0.007}\, K/L_i$$

$$\bar{R}^2 = 0.581; \quad F = 200 \qquad (7.4)$$

$$EXP_i = \underset{(3.03)}{-14.31} + \underset{(1.52)}{1.051}\, DEMAND_{it} + \underset{(4.81)}{0.227}\, SUPPLY_{it} + \underset{(4.10)}{1.392}\, AUTO_i + \underset{(8.48)}{0.519}\, Q_{i0}$$

$$+ \underset{(1.88)}{0.792}\, USP_{it-1} - \underset{(1.14)}{0.469}\, CSP_{it-1} + \underset{(15.09)}{0.400}\, IMP_{it-1} - \underset{(3.98)}{0.066}\, IMP_{it-1} {}^{*} T_{i0}$$

$$\bar{R}^2 = 0.624; \quad F = 238 \qquad (7.5)$$

consistent with previous evidence on the capital-intensive processing of natural resources for export.

Comparison of the models in Table 7-2 show that the coefficients and significant levels of the core variables unfortunately tend to be rather sensitive to changes in specifications. This sensitivity is especially evident for *DEMAND* and the price terms *USP* and *CSP*, which become insignificant in some specifications, but the other core variables' coefficients also suffer. It appears imprudent to give much emphasis to predictions based on the quantified coefficients.

The same correction for autoregression and heteroskedasticity used on other parts of the model was applied to equation 7.1, where it proved feasible only if we dropped the dummy variable for industries affected by the Auto Pact. The following result was obtained:

$$EXP_{it} = \underset{(6.06)}{-14.04} + \underset{(5.68)}{2.387}\, DEMAND_{it} + \underset{(13.66)}{0.382}\, SUPPLY_{it}$$

$$+ \underset{(6.84)}{1.104}\, USP_{it-1} - \underset{(9.73)}{1.078}\, CSP_{it-1}$$

The significant levels of all variables but *SUPPLY* increase substantially, as do the magnitudes of the coefficients of *DEMAND* and *CSP*. None of the qualitative conclusions drawn from Table 7-2 are changed.

Interaction Terms

Following the specifications discussed above, interactions were investigated between industry-structure variables and

IMP or *SUPPLY* by adding to equation 7.2 both the interaction and (as an additive term) the variable that was interacted. A positive and highly significant interaction ($t = 4.11$) appears between *IMP* and FSH_{i0}, the initial share of shipments accounted for by foreign subsidiaries. *IMP* also interacts positively with *RND* ($t = 3.03$), and these influences are highly collinear.[10] Taking the coefficient of *IMP*FSH* at its face value, it implies that imports' export-increasing effect is enlarged 38 per cent in an industry where foreign subsidiaries hold a 50-per-cent share over an industry occupied solely by domestic enterprises. In evaluating the degree of inconsistency between this result and Daly-MacCharles, we should recognize that two distinct interpretations can be given to this statistical relation: 1) in the short run, rationalization by foreign subsidiaries facing import competition generates more exports than responses by similarly situated domestic enterprises; 2) Canada's exports are expanding more rapidly in those industries which, in the long run, have been both import-competing and conducive to multinationals' operations. In light of equation 7.3, the latter interpretation certainly carries the greater force.

We checked whether other structural variables affect the exports-generating effect of import disturbances. One is the variable used to discriminate industries that most closely fit the ES model, highly concentrated and protected initially by high tariffs. When *IMP* is interacted with the product of the four-firm concentration ratio and the initial nominal tariff, the interaction's positive coefficient is not statistically significant.[11] Thus, we obtain no clear conclusion about the reality of "pure" ES industries in oligopolistic equilibria and with no access to export markets. We get neither the significant negative coefficient that would confirm their presence nor the significant positive coefficient that (arguably) would support a generalized monopolistic-competition model.

Other variables interacted with *IMP* represent the bases for comparative advantage in Canada's manufacturing industries. Already reported was a significant positive interaction between *IMP* and *RND*. No remotely significant interaction exists with advertising (*ADS*). However, the interaction $IMP_{it-1}*K/L_i$ takes a significant negative coefficient ($t = -3.80$) and the coefficient of the additive term K/L_i becomes positive and significant ($t = 4.72$). Examination of the coefficients' magnitudes shows that, although capital intensity is a drag on the re-orientation of domestic production facilities toward exports, it does not actually eliminate the positive net influence of import disturbances within the observed range of values. A significant negative interaction also exists between *K/L* and *SUPPLY*. This result is consistent with the pricing behaviour that we noted among capital-intensive industries in the 1970s (Chapter 3). It suggests that capital- (and resource-) intensive activities, traditionally dominating Canadian manufactured exports, do not contribute much to the growth of exports at the margin.[12]

In equation 7.5, interaction is tested between the lagged level of imports and the initial level of nominal tariff protection. Chapter 4 reported previously that tariff protection not only distorts the allocation of resources in the long run but also desensitizes it to international disturbances in the short run. That same finding applies to the influence of imports on exports: the higher the initial level of protection, the smaller is the exports-inducing effect of any disturbance that increases imports. A significant negative interaction was also observed between the effect on exports of the decade-long tariff change and the incidence of foreign investment ($t = -3.13$). This implies that tariff reductions tended to expand exports from industries heavily populated by "tariff factories." Once again, our results do not support the Daly-MacCharles [1986] findings concerning the laggard status of foreign subsidiaries in adjusting to international disturbances.

We conclude that the exports-inducing effect of imports is modified by certain structural features (initial protection, prevalence of foreign subsidiaries, research intensity). This result can be related to the problem of whether the positive influence of imports on exports operates in cross-section, time-series, or both. Evidence so far has favoured cross-section, with time-series supported only by a non-significant though substantial coefficient. The likelihood of a substantial short-run influence would be increased if these comparative-advantage variables display the same interactions with $SUPPLY_{it}$, the measure of lagged capacity expansion, as with IMP_{it-1}. In fact, none of the interactions with $SUPPLY_{it-1}$ proved statistically significant except for a negative interaction with ADS_i, which can be interpreted simply as the marginal counterpart of the finding that Canadian manufacturers suffer a comparative disadvantage in promotion-intensive consumer goods (equation 7.4). The lack of abundant interactive effects on *SUPPLY* tends to confirm that the positive association of exports with imports picks up mainly the effect of market-structure elements and changes that are (world) market-wide and not specific to Canada. Although the responses of domestic industries to import competition have certainly not reduced exports, no positive response has been shown that is focused within Canada. One can attribute this largely negative finding either to the relatively small intertemporal variance of imports or the weak theoretical foundations of a country-specific effect, noted previously.

Table 7-3 reports slope-shift coefficients for individual industries on the core variables $DEMAND_{it}$, $SUPPLY_{it}$,

Table 7-3

Regression Coefficients for Exports, Slope Shifts for Two-Digit Manufacturing Industries

	Exogenous variables		
	$DEMAND_{it}$	$SUPPLY_{it}$	$PRICE1_{it}$
Basic regression coefficient	1.256	0.494[a]	0.166[c]
Food and beverage	–	0.363[a]	+
Tobacco products	0	–1.466[a]	0
Rubber and plastic products	0	–	0
Leather	0	0	–0.397[b]
Textiles	0	–0.246[b]	0.399[b]
Knitting mills	0	0	0
Clothing	–3.945[c]	+	0
Wood	0	0.441[a]	–
Furniture and fixtures	0	–	0
Paper and allied products	–7.310[a]	1.054[a]	0
Printing and publishing	–6.485[c]	1.047[a]	0
Primary metals	0	0	–
Metal fabricating	0	0	–0.389[c]
Machinery	0	0.356[c]	0
Transportation equipment	–	0.673[a]	+
Electrical products	0	0.400[b]	0
Non-metallic mineral products	0	+	0
Petroleum and coal products	0	0.518[a]	0
Chemical and chemical products	–4.112[b]	0.218[c]	0.518[b]

NOTE a = 1 per cent significance; b = 5 per cent significance; c = 10 per cent significance. No intercept shifts were statistically significant.

and $PRICE1_{it}$. The results add only a little to the preceding analysis. The influence of foreign demand is attenuated significantly only for the paper and chemical sectors. The influence of domestic supply expansion is naturally evident in industries with strong traditional involvement in exporting – wood, paper, transportation equipment, and petroleum and coal – but also in some of the newer exporters. Only a few sectoral shifts in price sensitivity are significant, and these have no compelling interpretation.

8 Analytical Conclusions

This study yields two types of conclusions. Those relevant directly to public policy in Canada (and perhaps other countries) were summarized in Chapter 1. Others, set forth in this chapter, contribute to the general body of economic analysis not specific to Canada. This project represents an experiment in applying models and concepts from the field of industrial organization to the analysis of short-run adjustment processes. Whether the speeds and/or trajectories of adjustment to international disturbances depend on the market's structure is not a question that can be pursued from a strong base of either existing theory or past empirical observation. That fact (plus the deficiencies and limitations inevitable in empirical analysis) makes the conclusions tentative and exploratory. Nonetheless, the potential importance of this conjunction between microeconomic analysis and macroeconomic policy questions seems sufficient to warrant underlining the analytical conclusions that have been obtained, however, many qualifications must be attached to them.

Oligopoly Behaviour and Adjustment

The study was based on a "folk" model of differentiated oligopoly that combines the traditional Eastman-Stykolt (ES) model of collusive protected oligopoly with the phenomenon of product differentiation. It is important to distinguish the elements of differentiation and oligopolistic interdependent, because the empirical results assign only limited importance to collusive behaviour and a good delay more to differentiation.

The only contribution of standard oligopoly theory found useful in this short-run analysis is the administered-prices hypothesis, holding that the prices of collusive oligopolies are sticky when subjected to disturbances. The hypothesis seems contrary to the traditional ES model, which requires that the pricing point selected by cooperating oligopolists is the delivered world price of competing imports. We confirmed empirically that oligopolies' prices are insensitive to changes in their (domestic) variable costs. However, no such insensitivity was observed in the response of Canadian selling prices to counterpart prices abroad. Furthermore, the response of domestic to foreign prices is quite rapid, suggesting an element of administration. Therefore, the evidence on price responses does not contradict the ES model.

Concentrated industries' behaviour could also affect the degree to which domestic demand disturbances affect supplies of imports. For example, it would be dampened if oligopolists' interaction entailed sticky prices and excess production capacity, making domestic output increasingly sensitive to demand shocks in the short run. We do not find any such effect across all industries. However, the response of imports to domestic demand disturbances does appear to be attenuated in markets whose domestic producers are concentrated, at least when corrections for autoregression and heteroskedasticity are employed. (These corrections worked badly enough that they are not automatically assumed to override the results of ordinary-least-squares estimation.)

The ES model (original or folk version) implies that (permanently) intensified import competition should induce a rationalization process. That process, set in motion by tariff reductions or long-run changes in Canada's comparative advantage, was a central concern of this investigation. It can be observed in the determinants of industries' short-run decisions about capital expenditures and employment. Here the ES model was, by and large, not supported. The increases in capital expenditures bestirred by tariff reductions proved pervasive and not confined to concentrated industries. The presence of (product and spatial) differentiation is a sufficient explanation for this relation, leaving no necessary role for oligopoly behaviour. The ES model is thus not supported in its assertion that concentrated, protected oligopolies will have especially large amounts of rationalization to undertake.

However, concentrated industries' short-run decisions about factor use do exhibit some distinctive features. Capital expenditures of highly concentrated and heavily protected industries are less sensitive to changes in their outputs (i.e., weaker accelerator effects) than other industries. This attenuation could reflect the focus of their capacity decisions instead on the shifting state of competing imports, a possibility that seems more likely because the attenuation is found only in domestic firms' capital expenditures and not foreign subsidiaries' (a priori less likely to partake in cooperative behaviour in the national market).

Other aspects of the rationalization process also seem largely independent of oligopoly behaviour. The generation of intraindustry trade (with increases of imports apparently

inducing subsequent increases of exports) does not differ between protected oligopolies and other industries. The ES model requires for consistency that domestic producers have no substantial access to export markets, so it would be supported by a negative relationship. Other apparent effects of concentration (for example, on the marginal employment-output relation) can be sufficiently explained by the capital intensity of concentrated industries or the lumpiness of their capital spending.

Product Differentiation and Adjustment

If oligopoly behaviour explains only a little of the adjustment process, the existence of differentiation explains a lot. The evidence says not only that differentiation matters, but also that markets for manufactures behave quite pervasively as if differentiation were present. The open-economy model of monopolistic competition implies that intensified import competition promotes short-run increases in capital expenditure, in order to reconfigure the structure of varieties offered. The model also implies reduced employment, because the overall scale of domestic production should probably contract. That pattern, confirmed by the data, is inconsistent with pure competition. It is, however, consistent with the generalized ES model. We cannot discriminate empirically between the amount of rationalizing investment that would occur in a monopolistically competitive market and a differentiated ES market, in which oligopolistic rent-seeking would proliferate product varieties and increase the scope for rationalization. Thus, ES fades because of the weak empirical showing of oligopolistic behaviour, noted above, and not because the observed rationalization of differentiated-good markets contradicts it.

Product differentiation should on certain assumptions slow the process of short-run adjustment. When the price of competing imports falls, the price of the domestic substitutes in equilibrium should fall, whether the substitutability is perfect or imperfect. The equilibrium decline of the differentiated substitute's price could but need not be less than the undifferentiated substitute's price decline (depending on demand and cost conditions). But to make it *slower* (but not necessarily smaller overall), new theoretical elements must be recognized. Substitution of one variety for another compels the buyer to make investment-type decisions – to collect information on or sample alternative brands, or perhaps to incur switching costs. Responses to market disturbances for monopolistic competitors also require investments to reconfigure product attributes, operating scales, information flows transmitted to buyers, and the like. In short, differentiation implies the existence of diverse adjustment and switching costs for both supplier and customer, and the optimal time taken to incur these costs may be substantial. That is the theoretical basis for expecting differentiation to slow rates of adjustment to market disturbances.

The empirical evidence in this study takes several forms. Domestic prices respond more slowly to import-price changes where differentiation is present. Symmetrically, the quantity of imports varies less sensitively when the relative prices of imported and domestic goods are disturbed. However, the capital expenditures promoted by tariff reduction do not seem to increase with indicators of the product's differentiation. This result supports our suggestion that some patterns of behaviour prevail as if differentiation were pervasive.[1]

Evidence of differentiation may lie in the finding that tariffs insulate domestic producers as well as protect them. Domestic prices are less sensitive to disturbances in international prices where (initial) tariffs are high. Similarly, the quantity of imports is less sensitive to demand disturbances in highly protected Canadian markets.[2] A sufficient explanation for this pattern is that, for a highly protected industry, rates of tariff protection on some of the products classified to it are, in fact, prohibitive.

Behaviour of Multinational Enterprises

With nearly half of shipments in the average Canadian manufacturing industry accounted for by subsidiaries of multinational enterprises, whether their prevalence affects the speed and trajectory of adjustment is an important question. They interface with international markets in part through administrative links to corporate siblings abroad, and thus only partly through the market signals that guide domestically controlled units. Any difference in the efficacy or properties of these modes of coordination potentially distinguishes the short-run responses of the two types of producers.

The model allowed a number of tests whether the prevalence of foreign subsidiaries affects short-run adjustments. The answer turned out sometimes to be yes, sometimes no. Their market share has no effect on the sensitivity of Canadian selling prices to changes in delivered world prices. Nor does it affect how much imports change in response to a disturbance to domestic demand.[3] However, capital expenditures by subsidiaries are insensitive to the prices that their outputs command on world markets, while the expenditures of domestically controlled establishments do increase with those prices. The sensitivity of the volume of imports to differences between external and domestic prices is miti-

gated by the prevalence of subsidiaries, consistent with administrative links causing quantity changes to depend less on price signals and more on non-price information.

Differences were analysed in the input decisions of establishments under foreign and domestic control. Subsidiaries' capital expenditures are predicted better by recent changes in their own shipments than by industry shipments as a whole – a reflection of the considerable stability of subsidiaries' market share. The increases in capital spending that followed upon tariff reductions proved strongly related to the prevalence of subsidiaries in the market, and tariff reductions also prompt subsidiaries to shed labour more actively. Although not only subsidiaries do the adjusting in those industries that host extensive foreign investment,[4] those attributes of a market that promote foreign investment also cause extensive rationalization to follow upon trade liberalization. These chiefly comprise extensive differentiation of the product and (in producer goods) close quasi-contractual linkages between supplier and customer. In our view, the effects of the prevalence of foreign investment devolve not from some distinctive behaviour of multinational firms but from the rich menu of configurations of product and transaction that both foster multinationals and make resource allocations sensitive to trade restrictions.[5]

Foreign multinationals operating in Canada source their labour locally but their capital in international markets. We expected and confirmed that subsidiaries' capital expenditures are insensitive to the cost of capital in Canada while their employment level responds to the Canadian wage level. (Domestic establishments are sensitive to both factor prices.) Due to the nature of their operations, subsidiaries employ less labour relative to their output than do competing domestic establishments: their shipments include both resales of goods imported from corporate affiliates and components assembled from those same sources. Subsidiaries employ relatively more staff and less production labour than domestic competitors, and the marginal declines in staff employment in Canadian manufacturing during the 1970s may have been partly due to declines in subsidiaries' market shares.

Consistent with the subsidiaries' active role in adjustment processes, the tendency of increases in imports to beget increased exports rises with the foreigners' share of industry shipments. This study's research design does not distinguish very well between two interpretations of the behaviour: 1) in the short run, rationalization by foreign subsidiaries facing import competition generates more exports than responses by similarly situated domestic enterprises;[6] 2) subsidiaries' presence is associated with underlying shifts in Canada's comparative advantage, so that Canada's exports are expanding more rapidly in those industries which have been both import-competing and conducive to multinationals' operations.[7] The two interpretations are not mutually exclusive and both are consistent with the underlying (empirically confirmed) theory of the basic function of the multinational enterprise.

In summary, this study's findings confirm numerous corollaries of the theory of multinational operations. They explain the concentration of rationalizing activities in those industries dominated by foreign subsidiaries. They yield no general conclusion that subsidiaries are either "fast" or "slow" in the process of adjustment, but they give some support to the proposition that administrative links to affiliates abroad make subsidiaries' allocative decisions less sensitive to information conveyed through market-price signals.

Intraindustry Trade

Previous research on intraindustry trade has emphasized theory and evidence on its equilibrium level. This study has sought to shed light on the mechanism that generates it. Theory indicates that in an international market for a differentiated product, growth of the market or reduced international transaction costs will enlarge intraindustry trade. On restrictive assumptions, a disturbance that increases imports competing with a national industry will bestir rationalizing changes that enlarge its exports. With access to both cross-section and time-series observations, we sought to untangle these hypotheses.

Previous analyses of Canadian trade data have documented the prevalence of increasing intraindustry trade. The analysis of this study confirms its association with certain traits of the market's structure, such as the importance of innovation, absence of capital intensity, and affinity for foreign investment. These traits mark industries that are susceptible to the general expansion of intraindustry trade. We do not find a statistically significant link running directly through the adjustment process within Canada. Changes in competing imports do not exert a significant positive effect on subsequent changes in exports. Nonetheless, this study's findings are certainly not inconsistent with the expansion of intraindustry trade being part of the rationalization process, for these reasons: 1) tariff reduction promotes capital expenditure in the short run, and capacity changes have a positive supply effect on exports; 2) the analysis certainly rejects the negative relation between changes in imports and exports that is predicted by neoclassical theory of international trade; and 3) the non-significant coefficient of exports' lagged response to lagged changes in

imports takes a magnitude of 3.7 per cent; compared to the inferred long-run relationship (40 per cent), that magnitude is small but not trivial.

The analysis of intraindustry trade compels a second thought on this study's research design. The focus on disturbances associated with import competition was chosen axiomatically at the start of the project, and the consequence of induced exports was uncovered as it proceeded. With the wisdom of hindsight, the model could have been set up to deal symmetrically with disturbances associated with import threats and export opportunities. Although it is difficult to spot a priori any specific conclusion likely to be vulnerable to a failure to control for adjustment to export disturbances, the study is open to the charge of omitting a parallel channel of adjustment and possibly misestimating the magnitudes or correlates of the adjustments that were tracked. Indeed, statistical evidence of this omitted line of causation is not hard to find: include lagged exports in the model determining the volume of imports (Table 4-3), and they take a coefficient that is positive and statistically significant, although smaller and less significant than the coefficient of lagged imports in the export equation (Table 7-2). Although no conclusion is more trite than the availability of opportunities for further research, the agenda in this case is unusually clear.

Appendix

Definitions of Variables

There follows an alphabetical list of definitions of all variables used in the study. The subscript i indicates that the variable varies among industries, while the subscript t indicates that it varies over time.

ADS_{i0} Advertising expenditures divided by value of sales, 1970.

$C4C_{i0}$ Share of industry shipments accounted for by the largest four producers, 1970.

$C4T_{i0}$ Fraction of industry shipments accounted for by the largest four producers, 1970, multiplied by ratio of tariff revenue collected to value of imports, 1970.

$CCWC_{it}$ $COCC_{it}$ divided by average wage.

$CCWM_{it}$ $COCM_{it}$ divided by average wage.

$COCC_{it}$ Index of the cost-of-capital expenditures on construction in year t, reflecting changes in both the rate of discount and the price index of capital goods.

$COCM_{it}$ Index of the cost-of-capital expenditures on machinery and equipment in year t, reflecting changes in both the rate of discount and the price index of capital goods.

$CPCH_{it}$ Percentage change in the Canadian industry's selling price from its value in year t–1.

CSP_{it} Index of industry selling price, year t.

$DFSH_{it}$ Change in FSH_i from year t–1 to year t.

DIF_{it} Rotated factor that reflects inversely the durability of the product and the importance to the buyer of auxilliary services and information provided by the seller, directly the importance of sales promotion by the seller [for fuller explanation see Caves and Williamson, 1985].

DK/K_{it} Ratio of capital expenditure made by industry i in year t to i's capital stock in 1970.

$DMSH_{it}$ Change in MSH_i from year t–1 to year t.

$DQDN_{it}$ Logarithm of absolute value of the change in real industry shipments from year t–1 to year t, when real shipments fell (zero otherwise).

$DQUP_{it}$ Logarithm of change in real industry shipments from year t–1 to year t, when real shipments rose (zero otherwise).

$DSHP_{it}$ Logarithm of total shipments minus exports of domestic producers in year t (shifted back to year t–1, in estimated model).

DT_i Difference between industry's average rate of tariff protection in 1982 and 1971, divided by one half the sum of these two rates.

$DUSP_{it}$ USP_{it}/USP_{it-1}.

DVC_{it} Ratio of index of domestic industry's variable costs (share-weighted changes in unit costs of labour and materials) in year t to value of index in year t–1.

$DWPM_{it}$ $DUSP_{it} - DVC_{it}$ (change in external prices minus change in domestic variable costs).

$DXSH_{it}$ Change of XSH_i from year t–1 to year t.

$EXCH_t$ Proportional change in effective exchange rate (price of Canadian dollar) in year t.

EXP_{it} Logarithm of exports shipments made by the industry.

FSH_{i0} Shipments by foreign-controlled establishments divided by total industry shipments, 1970.

FSH_{it} Shipments by foreign-controlled establishments divided by total industry shipments in year t.

HC_i Dummy variable set equal to 1 for industries with values of $C4C \geq$ the sample average in 1970.

HIK_i Dummy variable set equal to 1 for industries with K/Q_i above the industry mean.

IMP_{it} Logarithm of value of imports classified to product groups coinciding with those assigned to the domestic industry.

K_i Logarithm of industry's gross capital stock, 1970.

KD_i Approximation to logarithm of gross capital stock of domestic establishments, 1970 (logarithm of product of industry capital stock and $[1 - FSH_{i0}]$).

KF_i Approximation to logarithm of gross capital stock of foreign-controlled establishments, 1970 (logarithm of product of industry capital stock and FSH_{i0}).

K/Q_i Ratio of gross value of capital stock to value of shipments in 1970.

KXC_{it} Logarithm of constant-dollar gross fixed capital expenditures on construction.

KXM_i Logarithm of constant-dollar gross fixed capital expenditures on machinery and equipment.

L_{it} Logarithm of average industry employment for the year.

LC_i Dummy variable = $1 - HC_i$.

$LCCH_{it}$ Percentage changes in wages and salaries per employee for the industry in year t.

LD_{it} Logarithm of average employment in domestic-controlled establishments.

LF_{it} Logarithm of average employment in foreign-controlled establishments.

LOK_i Dummy variable equal to 1 for industries with K/Q_i below the industry mean.

LP_{it} Logarithm of average employment of production workers.

LS_{it} Logarithm of average employment of non-production workers.

$MCCH_{it}$ Percentage change in index of unit materials cost for the industry in year t.

MP_{it} Index of delivered price of importables competing with industry i in year t (estimated from index of U.S. wholesale price adjusted for tariff and exchange rate).

$MPCH_{it}$ Change in delivered price of importables competing with industry i in year t (estimated from U.S. wholesale price adjusted for changes in tariff and exchange rate).

MSH_{it} Imports classified to industry i in year t divided by domestic disappearance (shipments plus imports minus exports) for that industry and year.

Q_{i0} Value of Q_{it} for 1970.

Q_{it} Logarithm of annual industry shipments expressed in 1971 prices.

QCH_{it} Ratio of industry's real output in year t to its output in year t–2.

$QCHD_{it}$ Real output of domestic establishments of industry i in year t divided by real output of these establishments in year t–2.

$QCHF_{it}$ Real output of foreign-controlled establishments of industry i in year t divided by real output of these establishments in year t–2.

QHC_{it} Q_{it} for industries in which $C4C_{i0}$ exceeds its sample mean (zero otherwise).

QLC_{it} Q_{it} for industries in which $C4C_{i0}$ is less than its sample mean (zero otherwise).

REL_{it} MP_{it}/CSP_{it} (index of delivered price of imports relative to domestic industry selling price).

RND_i Employees engaged in research activities divided by total industry employment, 1975.

$RPCH_{it}$ $USP_{it}/USP_{it-1} - CSP_{it}/CSP_{it-1}$ (change in external price relative to domestic industry selling price).

T_{it} Ratio of tariff revenue collected to value of imports of goods classified to product classes included in industry i for year t.

TCH_{it} $(1 + T_{it})/(1 + T_{it-1})$ (change in estimated nominal tariff).

USP_{it} Index of the wholesale price of the U.S. counterpart industry in year t.

$USPCH_{it}$ Percentage change in the wholesale price index of the U.S. counterpart industry in year t.

$USQCH_{it}$ Proportional change in real output of the U.S. counterpart of industry i in year t.

XSH_{i0} Exports divided by value of industry shipments, 1970.

XSH_{it} Exports divided by value of industry shipments, year t.

$WCOC_{it}$ Ratio of total annual wages and salaries per employee to estimated user cost of capital.

Notes

Chapter 1

1 For a review of the specific policy issues that arise, see Economic Council of Canada's statement on *Managing Adjustment: Policies for Trade-Sensitive Industries* [1988].

2 The coefficient is robustly insignificant when ordinary least squares estimation is employed. When an (intermittently successful) procedure to correct for autoregression and heteroskedasticity was employed, however, it becomes highly significant and implies that concentrated industries maintained excess capacity that permitted quick responses to demand disturbances.

3 We believe that lesser sensitivity prevails because multinational firms' information channels make their "quantity" decisions less dependent on market-price signals than domestic firms' decisions; however, other plausible interpretations can be found.

4 That is, they choose outputs that represent lower levels of short-run marginal cost relative to product price, thereby using less labour (and other variable inputs) per dollar of sales.

5 Staff are not protected more against short-run reductions of output than are production workers; that is, they do not benefit more from "labour hoarding." However, that statistical finding may be due to a longer-run tendency of industries squeezed by the difficult conditions of the 1970s to economize on the use of staff.

6 All statements about the influence of wage rates on employment should be considered uncertain or qualified. Relative factor prices did not exert a significant influence in our limited experiments with correction for autoregression and heteroskedasticity. Statements about this relation in the text refer to statistically significant OLS results.

7 Consumer non-durables that are promoted extensively are not Canadian export specialties. However, their markets worldwide are associated with internationalization through foreign direct investment rather than commodity trade.

Chapter 2

1 We do not distinguish sharply between Eastman and Stykolt's original formulation, which did not embrace product differentiation and non-price competition, and the "folk" version of the model that has incorporated them [see Muller, 1982; Hazledine, 1988]. Whether the adjustment processes examined in this study turn more on small-numbers behaviour or on non-price rivalry without oligopolistic interdependence (monopolistic competition) becomes, however, an important issue in our research.

2 More generally, price collusion coupled with entry that is free but subject to fixed costs yields a non-optimal outcome [Brander and Spencer, 1985].

3 Magun et al. [1988] sought to quantify the incidence of suboptimal-scale facilities that might be ejected by increased international competition. Hazledine [1984] demonstrated the wide dispersion of productivity levels among plants in Canadian manufacturing industries and showed through simulated calculations the sizes of the real-productivity gains that could be obtained by elimination of the less efficient and expansion of the more efficient units. This pattern of dispersed efficiency levels is consistent with the ES mechanism. However, we do not know that Canada's plant-efficiency dispersion is abnormal compared to other countries [cf. Klotz et al., 1981], nor the degree to which it results from competitive conditions (emphasized by Hazledine) rather than its many other possible determinants.

4 To obtain the measure chiefly used in their analysis, they distinguished the larger plants accounting for 50 per cent of industry shipments in both the Canadian industry and its U.S. counterpart. They calculated the mean size of these top-half Canadian plants relative to the mean size of the top-half plants in the U.S. industry. The average value of this ratio in their sample of industries was 69 per cent in 1970, rising to 74 per cent in 1979.

5 Like the growth of relative plant scales, the change in diversification (over 1974-79) indicated that some rationalization was taking place: it declined by 17 per cent (i.e., a Herfindahl index of diversification increased by that proportion).

6 Caves [1975] found that plants of multinational enterprises show more diversification than domestically controlled plants of comparable size. However, Baldwin and Gorecki suggested that result may have been due to an underlying tendency for more foreign investment to take place in industries with richer menus of product varieties.

7 Confirming evidence comes from the survey of medium-size companies by Daly and MacCharles [1986, chap. 3], who

found that rationalization involves increased specialization and much increased resort to the export market.

8 In their study of relative product prices in Canada and the United States, Hazledine et al. [1988] stressed the diverse exposures to international trade (exports and imports) of Canadian manufactured products. Consistent with the Baldwin-Gorecki studies, they found the ES model applicable only to part of the products sampled. Specifically (and excluding products for which competing imports are prohibited) 20 per cent of their products face substantial import competition but sold no significant exports, while 34 per cent seem insulated for international competition on both the export and import sides (29 per cent show substantial exports and import competition, 17 per cent substantial exports only). Canadian prices are elevated 29 per cent above their U.S. counterparts in the import-competing industries, but only 4 per cent in the sheltered industries (whose Canadian producers are no less concentrated).

9 Harris [1984] quantified the consequences of product differentiation for the sizes of welfare effects of changes in trade policy affecting Canada.

10 Canada's receipts from customs and import duties as a percentage of the value of imports fell from 7.95 per cent in 1965 to 4.62 per cent in 1980. This fall was substantial, although proportionally smaller than for most OECD countries, and it left average Canadian tariffs at the upper end of the industrialized OECD nations. See OECD [1985] and further data reported below.

11 For some empirical evidence, see Caves and Khalilzadeh-Shirazi [1977], and Caves and Williamson [1985].

12 MacCharles [1987] provided extensive evidence on intra-industry trade at the level of the plant and company.

Chapter 3

1 The model accordingly lacks features that would be expected if it addressed long-run behaviour of the macroeconomy. For example, changes in the exchange rate can evidently affect resource commitments by the individual traded-goods industry in the short run, although in general equilibrium we should expect no long-run effect.

2 The evidence of pricing to market in international trade makes the assumed endogeneity of import prices dubious for manufactured goods (see footnote 3, below). The absence of disaggregated import-price indexes for Canada made it impossible to pursue this question, and import-price movements will in fact be assumed to move with the external prices of goods importable by Canada.

3 If the domestic manufacturing industries were assumed purely competitive, this system of relations could be derived in an integrated fashion, with imports, domestic output, and a single "world price" determined jointly and factor-demand equations related explicitly to the output decision. A central objective of this study, however, has been to keep open a range of options concerning the market structures that could be generating the observed short-run adjustments. Price rather than quantity is assumed to serve as the main market decision variable, which implies the residual determination of industry output. This assumption is more plausible if short-run marginal costs appear fairly constant in the observed ranges of output; attention will be paid to any evidence contradicting this constancy. The factor-demand equations (capital expenditures and labour), set up to emphasize short-run adjustments toward desired values, are consistent with actual outputs diverging from expected ones. Finally, factor prices are assumed exogenous in the factor-demand equations, which seems reasonable in light of the substantially disaggregated level of analysis. The system of relations is believed consistent with an integrated treatment of decisions by value-maximizing enterprises in normally adjusting markets, even if a fully integrated treatment is sacrificed in order to allow the data to designate the exact market processes at work.

4 The closest parallel in the literature to the research design employed here was developed by Williamson [1984; also Caves and Williamson, 1985] for analysing the competition between imports and domestic output in Australian manufacturing industries. He employed panel data for 36 industries with annual observations over a period of a decade. His model embraced mutually adjusting movements of import prices, domestic prices (and their components – margins and input prices), and imports' market shares. He found that differences in the competitiveness of both the Australian producers and rival overseas suppliers of imports affected this adjustment process, with prices set by concentrated producers generally displaying less sensitivity to disturbances. He also found that the adjustments made by Australian industries depend on the proportions of their activities accounted for by subsidiaries of foreign multinational enterprises. In addition, adjustments in market shares were limited by sunk costs, and product differentiation substantially affected the mutual sensitivity of the prices of domestic and imported goods.

5 The industries analysed are the full set of four-digit manufacturing industries after deletion of those that could not reasonably be matched between the Canadian and U.S. standard industrial classifications. The match is needed because of the use of U.S. variables to proxy market conditions external to Canada. Data on some variables are available before 1970, permitting their use as lagged exogenous variables for the full data set. Data on most of the Canadian industry variables are available to 1982, but the lack of some U.S. data in convenient form after 1979 limits our use of Canadian data in the 1980s.

6 All Canadian data used in this study are taken directly from the Statistics Canada research database. Their definitions

correspond to the standard published variables, and so will not be repeated in this study. The database differs from the published information only in that variables suppressed on account of disclosure are here available for analysis. United States variables imported for the analysis will be explained and sources given when they are introduced.

7 The exchange rate is a weighted average taken over all of Canada's major trading partners and not just the United States; the objective is not to indicate just the specific relative-price change between the two countries.

8 This pattern is documented in more detail in Chapter 7.

9 The number of observations vary somewhat among the correlations noted in this section, but 0.16 corresponds to approximately 5 per cent and 0.20 to 1 per cent statistical significance.

10 Confirming evidence is found in the price-based analysis of productivity growth developed by Fluet and Lefebvre [1987]. Their tables show that the capital-intensive two-digit sectors typically provided negative pass-throughs of their productivity gains to consumers, especially in 1974-80.

11 For evidence of the complementarity of energy and capital in U.S. industries, see Hudson and Jorgenson [1974]. Rao and Preston [1984] did find substitutability between them for Canada.

12 Tariff changes were negatively correlated with capital intensity, but not strongly so. Tariff levels were negatively correlated with capital/labour ratios at the start of the decade (–0.12), more negatively correlated at its end (–0.32).

13 It also appears in the results for earlier periods of Jones and Laudadio [1977]. The same correlation was observed in the U.S. counterpart industries, –0.17.

Chapter 4

1 Karikari [1988] followed a different strategy, assuming that import prices are not necessarily linked to world prices, and that Canadian importers set prices as followers with respect to domestic sellers (leaders). Because he possessed data on both Canadian imports' prices and the U.S. prices of exportables to Canada, he could potentially discriminate between that approach and the hypothesis advanced here – that Canadian producers, to some degree, price as followers on the world market. However, his analysis of determinants of the prices of imports gives quite different answers for 1970-74 and 1975-80, the imports' prices significantly related to U.S. prices in 1970-74, to domestic prices in 1975-80 (when the large depreciation of the Canadian dollar occurred).

2 Expressed as the proportional change in the price of foreign exchange.

3 This is the first factor extracted from the same variables utilized by Caves and Williamson [1985], who provided an explanation for the methodology. The data based on U.S. counterpart industries were obtained from various sources, chiefly Bailey [1975] and the Line of Business data collected by the Federal Trade Commission.

4 Throughout this study, time and industry subscripts will be omitted when there is no danger of confusion.

5 Daly and MacCharles [1986, p. 22] summarized evidence that two thirds of subsidiaries' imports (in turn 15 to 20 per cent of their shipments) are finished goods for resale.

6 See Brack [1987] for an interesting if not wholly successful attempt to analyse price adjustment in terms of an explicit conjectural-variations model of oligopolistic interaction.

7 We could *assume* that *MP* provides an appropriate deflator for imports, but the assumption is highly dubious. Fortunately, we are concerned not with an accurate estimate of this substitution elasticity but with testing whether the substitution differs among industries in accord with differences in their markets structures.

8 This feature of the model is justified by the assumed importance of product differentiation. For example, imports can increase because new varieties come available on the world market, with no (first-order) change in their average price.

9 The argument assumes that imports, coming from diverse points of production, are supplied to a small importing country more elastically (in the short run) than is domestic output. The corollary that imports' share of a national market should increase at the peak of the business cycle has been confirmed in various countries and time periods. The argument also assumes that domestic industries during the 1970s were generally operating near capacity, which could prove false.

10 Recall the finding of Karikari [1988] that the prices of Canadian imports were sensitive to domestic prices in these years. Clearly, in the short run, importers absorb some effects of a depreciation.

11 A referee pointed out a competing statistical explanation. The industries protected by Canada's highest tariffs are those for which the United States is not a significant exporter, so the result may indicate simply that the U.S. price is a poorer proxy for the world price in such industries.

12 Our results on these desensitizing factors are in close agreement with those of Kardasz and Stollery [1988]. They found the sensitivity of Canadian to U.S. industry prices to decrease with tariffs, with a dummy for non-tariff barriers, and with an index of intraindustry trade used as a proxy for the extent of product differentiation. They also found the sensitivity of prices to domestic variable costs to increase with the height of tariffs and with a dummy variable indicating an industry serving a regional market.

13 Strictly speaking, the finding that concentrated industries' prices are insensitive to variable costs does not prove that those prices are inflexible, only that they are insensitive. This study does not test inflexibility as such.

14 Miscellaneous manufacturing (39) was the omitted sector. We also included an intercept-shift dummy for each industry. These are not reported, but where slope-shift coefficients are significant we show whether a significant intercept shift was also present. The magnitudes of non-significant slope-shift coefficients were almost invariably small.

15 Recall the competing interpretation offered in footnote 11.

16 This conjecture seems consistent with Zohar's [1982, pp. 41-47] estimates of utilization by two-digit industry to 1977. In the mid-1970s, only a few labour-intensive sectors achieved utilization over 90 per cent, and only non-metallic minerals among the more capital-intensive sectors exceeded 80 per cent.

17 A hypotheses found in the literature is that imports serve as marginal supplies to a market, swelling during booms, squeezed out in recessions. It implies that the coefficient of *DSHP* should exceed unity. That is not the case in equation 4.4, but equation 4.5 does imply that pattern for industries with low-capital intensity protected by low tariffs.

18 If time and resources permitted, a much better specification of this variable would have been the increase in outputs or exports by all countries supplying goods to Canada. The theory of international trade with product differentiation highlights the importance of increased total supply and number of varieties available for the elasticity of substitution facing the typical domestic producer, and thereby the number and production scale for domestic differentiated producers.

Chapter 5

1 Each flow was deflated by one of a set of indexes that pertain to two-digit manufacturing sectors, more aggregated than those used in our database.

2 No estimates are available for stocks of plant and machinery separately, so the same total has to be used to normalize both construction and machinery investments.

3 *QCH* embodies a hypothesis taking the form of the accelerator relationship. However, it is expressed in proportional rather than the standard absolute form. This choice was made reluctantly because of other compelling reasons for expressing the dependent variable in logarithms.

4 Because the presumed ES industries failed to show the predicted unity of response to international prices (Chapter 4), we should consider whether competing hypotheses could account for their apparently consistent response here. Additions to capacity in concentrated industries are more likely to be lumpy and thus less predictable on the basis of recent output changes.

5 One might object to this interpretation, because the ES model, in fact, implies that *any* change in protection would have positive short-run effects on investment. It would induce proliferation of products and small-scale entry when it increases, simplification of product lines and enlargement of scales when it decreases. Therefore, it is important to recognize that the changes in average protection for the bulk of industries over this period were negative (see Table 3-4).

6 This result parallels the finding of Baldwin and Gorecki [1983*b*] that tariff reductions over the years 1974-79 led to increased run lengths across Canadian manufacturing, not just in the highly protected and concentrated industries flagged by the ES model.

7 Notice the consistency of this finding with results of Baldwin and Gorecki, summarized in Chapter 2. They found that during the 1970s, lower levels of tariff protection promoted the enlargement of plant scales in industries characterized by high concentration, heavy foreign investment, and high initial tariffs.

8 The interpretation agrees with the somewhat improved performance of the wage-adjusted cost of capital in equation 5.3 and with results reported in Chapter 6. Notice the consistency of this finding with evidence reviewed in Chapter 3: the apparent prevalence of cost-side disturbances and the positive correlation between industries' rates of capital expenditure and their money-wage changes.

9 We tested whether the rationalizing effect of tariff changes was greater, the higher the share of the market held by imports at the start of the decade. This hypothesis obtained some support, with the signs as expected and a *t*-statistic of 1.12 for construction spending and 1.66 for machinery.

10 When sectoral dummies are included (as in the models summarized in Table 5-2), the coefficient of the cost of capital relative to the wage becomes not only correctly signed but also statistically significant or close to significant.

11 The procedure assumes (unavoidably) that both subsectors of an industry have the same capital-shipments ratios, although that of the foreign subsidiaries is probably smaller.

12 They are: 1,750, leather; 1,810, cotton; 1,831, fabric and yarn; 1,873, embroidery and fancy-work; 2,450, children's clothing; 2,460, fur goods; 2,492, hat and cap manufacturers; 2,580, coffin and casket makers; 2,680, electric lamp and shade manufacturers; 3,280, boat building; and 3,530, stone products.

13 When industries are subdivided into their domestic and foreign sectors, we also get support (especially in the foreign

sector) for the hypothesis that rationalizing investment is more prevalent in the more concentrated industries. This finding, consistent with the ES model, is not at all evident when industries are treated as wholes.

Chapter 6

1 This chapter draws heavily on an exploratory analysis prepared by Tom Siedule [1987], using the general framework and database of this study.

2 The variable *WCOC* is the inverse of the ratio of cost of capital to the average wage, which in Chapter 5 proved a significant determinant of capital spending by domestic (but not foreign) establishments. Analysing short-run employment fluctuations in total manufacturing, Hazledine [1979] found that wages did not significantly influence employment. He did confirm that the demand for labour is affected by the degree to which industrial capacity is out of line with its currently desired level.

3 Data on the nominal tariff, T_{it}, can be used to check whether industries' production structures are equilibrated to the current level of protection rather than being adjusted in the course of a rationalization process.

4 This relation would hold, for example, if firms engage in Cournot competition, products are homogeneous, and short-run marginal cost curves are upward-sloping.

5 Models of the determinants of L_{it} could be estimated with a somewhat larger data set than the equations reported previously; because no use was made of U.S. variables, 11 years (1971-81) could be covered in the time-series dimension.

6 Siedule employed the latter approach, identifying a division between highly concentrated and unconcentrated industries such that the break falls at about 1.3 times the mean level of concentration, distinguishing 26 industries as concentrated. Siedule's cut-point was used here.

7 Specifically, the change in actual output will sometimes be constrained by the firm's inability to adjust employment fully in the short run, so that the estimated coefficient overstates the short-run response of employment to changes in *desired* output. The adjustment costs themselves cause the long-run response to exceed the short-run response. For Canadian manufacturing in the aggregate, Hazledine [1979] found that the constraining effect of output of employment in the short run is statistically significant but quantitatively small.

8 The coefficient is not far out of line with the Daly-MacCharles [1986, p. 22] estimate of the fraction of subsidiaries' shipments due to resold imports.

9 The small variance of *DFSH* may be the source of this result.

10 The regression coefficient of $DMSH_{it}$ is indeed negative, suggesting that expanding imports force productivity increases, but the *t*-statistic is only –0.57, and the magnitude of the coefficient is one tenth that of $DXSH_{it}$ in equation 6.5.

11 Recall inter alia the positive effects of variable-cost changes on capital expenditures found in equations 5.4 and 5.5.

12 For production workers, no difference exists in the sensitivity of employment to relative factor prices between concentrated and unconcentrated industries. For staff, perhaps surprisingly, the elasticity in unconcentrated industries is only one fourth that in concentrated industries and weakly significant ($t = -1.59$).

13 We allowed the coefficient of the current nominal tariff (T_{it}) to differ between concentrated and unconcentrated industries. For total employment, the coefficient is insignificant in the concentrated industries, positive and significant for the unconcentrated ones (consistent with the result for the decade-long tariff change reported in equation 6.1). When employment is broken into production workers and staff, however, the coefficients for both are significantly negative, with the elasticity for staff 50 per cent larger than for production workers. This result may indicate that for such industries the response to lessened production involved the employment of relatively more non-production workers to differentiate and customize products.

14 Recall that some industries with little or no foreign investment are excluded from this phase of the analysis.

Chapter 7

1 Of course, there may be some industries producing non-traded goods, such as bricks or fresh bread, that lack either status.

2 Suggestive is the evidence of Mansfield and Romeo [1980] on the speed of imitation by local competitors of innovations produced abroad by subsidiaries of U.S. multinational firms.

3 These hypotheses are supported by organizational and evolutionary approaches to the firm, which offer several bases for predicting that firms will make some major reallocation only in the face of a substantial change in threats or opportunities in the environment. The implicit contract among the firm's participants embraces policy as well as pecuniary commitments, and is costly to renegotiate. Information is highly incomplete, and investment of search effort occurs only in the face of some unusual stimulus (opportunity or threat). Profit and other objectives are formulated as targets, and rule-of-thumb behaviour persists as long as they are reasonably attained. See Cyert and George [1969], and Nelson and Winter [1982, chap. 5] for analyses along these lines.

4 Consistent with this, Hazledine [1985] found that nearly all productivity growth within Canadian industries in the 1970s

was associated with cost reduction in ongoing plants, and not with the exit of (old) inefficient and entry of (new) efficient facilities. Furthermore, the renewal of ongoing plants manifests itself in considerable churning of the efficiency ranking of these continuing operations.

5 A more refined specification would capture the net addition to the capital stock available at the beginning of the preceding year. The unavailability of annual capital-stock and depreciation data and the importance of productivity improvements embodied in new plant and equipment are invoked to justify the variable as specified.

6 If we assume that export prices adjust fully to changes in prices (including the exchange rate) outside of Canada, we can of course convert the regression coefficient into an income elasticity of demand for export quantities. Evidence from diverse sources on export pricing in the short run suggests, however, that export prices underadjust in the short run, so the assumption would lead to an overstated correction.

7 The absence of deflation again means that this elasticity overestimates one based on real quantities.

8 When the change was negative, $DIMP_{ij}$ was set equal to zero, because the logic of the mechanism of intraindustry trade changes pertains only to positive changes (apart from the non-existence of logarithms of negative numbers).

9 This expansion includes but is not confined to intrafirm trade and international specialization within these enterprises.

10 Neither *FSH* nor *RND* shows a positive interaction with *SUPPLY*, indicating that the positive roles of these two factors in the expansion of exports were specifically associated with international factors and not just with the general growth of domestic supply capability.

11 The model also includes the product of concentration and initial protection as an additive regressor. Its coefficient is negative but also not significant.

12 Recall the highly significant positive coefficient of *K/L* in equation 7.4.

Chapter 8

1 An effort was made to discriminate among bases for differentiation by distinguishing information-based differentiation (empirically associated with advertising) from attribute-based differentiation (complexity of the product). This was not particularly successful, but the evidence is consistent with information-based differentiation imposing more of a drag on speeds of adjustment than does attribute-based differentiation.

2 Another piece of supporting evidence is the fact that the exports-inducing power of a given increase in imports is smaller, the higher the initial tariff over which the imports must climb.

3 Although, given the large amount of interaffiliate trade, such an effect is plausible.

4 The effect of tariff reductions on rationalizing investment is statistically significant for the construction outlays of domestically controlled establishments but not for their outlays on machinery and equipment.

5 The documented sensitivity of multinational enterprises to factors affecting the choice between exporting and direct investment abroad helps to explain this pattern. The prevalence of multinational enterprises is correlated with the concentration of an industry's producers, which suggests that subsidiaries' presence could also be associated with ES-type collusive behaviour. However, the data seem to link rationalization processes to differentiation but not to concentration, which is why we tie the foreign subsidiaries to the former element of their ambient market structures. Reasoning and evidence behind these propositions concerning multinationals is summarized by Caves [1982].

6 One piece of statistical evidence specifically supports this interpretation. Although the decade-long change in the Canadian tariff did not directly affect an industry's exports across the board, a significant interaction with the subsidiaries' share indicates that tariff reduction (apart from the change in imports that it induced) did promote more extensive exports by the subsidiaries.

7 Notice that we found subsidiaries' share of shipments to be a positive predictor of the share of the industry's output that is exported.

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