THE TECHNOLOGICAL EFFECTIVENESS OF TRADE POLICIES, WITH AN APPLICATION TO ARGENTINA

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A B S T R A C T

THE TECHNOLOGICAL EFFECTIVENESS OF TRADE POLICIES WITH AN APPLICATION TO ARGENTINA

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Technological change can be an important contributor to the standard of living, and trade policies and market structure are increasingly seen as factors influencing the pace of technological development. The thesis develops a model of the relationship between trade policies and productivity and it provides a framework for the analysis of the relationship between trade policies, market structure and productivity.

We model a small open economy consisting of sectoral producers supplying the domestic and foreign markets in competition with foreign suppliers, and of domestic and foreign consumers. Competition is imperfect. Technological change is endogenously determined and it responds to trade policies such that changes in the relative price of tradables can be associated to changes in the technology. The model identifies three potentially major factors in the relationship: the relative dominance of domestic and foreign producers in markets, the elasticity of demand for products and factors of production. It predicts diminishing returns to the import substitution strategy and increasing returns to export subsidization.

The relationship between trade policies, market structure and technology is established by relating changes in structure as measured by industrial concentration and productivity growth, and by relating these to trade policy regimes.

The model and the analytical framework are applied to Argentine manufacturing industries covering the 1950 to 1979 period. A consistent trade-production database is constructed and parameter estimates of demand elasticities and productivity are obtained from static and dynamic econometric models. We found that tariffs and export subsidies improve or reduce technological progress, depending on the industry and time period. For all industries and the entire time period, a tariff reduction is technologically superior to an export subsidy and, therefore, the technological development of the Argentine manufacturing sector could have been improved by a movement towards free trade. However, a higher productivity growth would have been obtained by selectively targeting trade policies to individual manufacturing sectors and time periods.

The empirical evidence on the market structure-productivity relationship indicates that increases in industrial concentration were accompanied by increases in productivity, and vice versa.

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A multifactor productivity (gross output model).

a change in the price of imports of a sector once all interindustry price transmissions are taken into account.

A_1, A_2.. parameter estimates (partial adjustment model, Houthakker-Taylor model).

a_i share of intermediate inputs in gross output.

a_v share of value-added in gross output.

B multifactor productivity (value-added model).

b_{ij} a constant.

C relative price matrix.

$C_{Q,M}$ diagonal elements in matrix **C**.

D sectoral domestic apparent consumption volume.

$D(.)$ sectoral domestic demand function.

d depreciation coefficient (Houthakker-Taylor model).

d_i elasticity of substitution in the market for good i.

DPI_i composite price of domestic output market prices.

E final demand.

E_D final demand price elasticity.

E_{DP} domestic demand price elasticity.

E_{DY} domestic demand income elasticity.

E^{FT} tradable input elasticity of the input aggregator.

E^{FN} non-tradable input elasticity of the input aggregator.

E_{MP} import demand price elasticity.

E_{MY} import demand income elasticity.

E_{NN} non-tradable input price elasticity of the demand for non-tradable inputs.

E_{NQ} output price elasticity of the non-tradable input demand function.

E_{NT} tradable input price elasticity of the demand for non-tradable inputs.

E_p demand price . lasticity (generic).

ER_i industry-specific exchange rate between Argentine currency and the US dollar.

ER_i exchange rate for the goods industry i.

er_{ij} exchange rate corresponding to industry i and section j of the Brussels Trade Nomenclature.

E_{TT} tradable input price elasticity of the demand for tradable inputs.

E_{TN} non-tradable input price elasticity of the demand for tradable inputs.

E_{TQ} output price elasticity of the tradable input demand function.

E_{XP} export demand price elasticity.

E_{XY} export demand income elasticity.

E_Y income elasticity (generic).

f(.) input aggregator function.

G average output per plant.

g adjustment coefficient (flow adjustment model).

H Herfindahl concentration index.

H matrix of non-tradable input per unit of gross output.

I intermediate inputs.

I identity matrix

$\mathbf{J}$ matrix of tradable input per unit of gross output.

K sectoral capital input.

L sectoral labour input.

M sectoral import volume.

M(.) sectoral import demand function.

N non-tradable input volume.

n number of sectors in the economy (number of industries).

N(.) sectoral demand for non-tradable inputs.

P^i price of good i.

P^I price of intermediate inputs.

PI_i world price index of the goods of industry i, in U.S. dollars.

P^{ij} price of product j produced by country i.

P_M sectoral relative price of imports.

P_{mi} price of imported goods relative to the price of domestic products for industry i.

$P^m{}_i$ implicit import price index of industry i in domestic currency after duties and levies.

P^N sectoral absolute price of non-tradable input.

P^Q sectoral absolute price of output.

$\mathbf{P^T}$ diagonal matrix of tradable input prices.

P^T sectoral absolute price of tradable input.

PVA sectoral price of value-added.

P_X sectoral relative price of exports.

P^{xi} price of domestic export goods of industry i in domestic currency.

P_{xi} relative price of domestic export goods of industry i relative to the world price of similar commodities, in domestic currency.

Q diagonal matrix of sector output volumes.

Q sectoral gross output volume.

$\dot{Q}$ equilibrium quantity demanded.

q_i output of plant i.

S shares matrix of imported inputs in total traded input.

S_N non-tradable input cost share.

S_T tradable input cost share.

T tradable input volume.

T_{ni} volume of tradable input T purchased by sector i from sector n.

T(.) demand for tradable inputs.

t time

U consumer's utility function.

u diagonal matrix of ratios between domestic demand to domestic plus import demand.

V sectoral gross output.

v adjustment coefficient (partial adjustment model)

VA real value-added.

V_i demand for good i.

V_{ij} volume of product type j and country of origin i.

W vector of non-tradable input services values.

W	intermediate demand.
X	sectoral export volume.
X_i	world demand for good i.
X(.)	sectoral export demand function.
Y	domestic real income
Y_W	world income.
Z	tradable input matrix.
Z_{TM}	matrix containing marginal price ratios between the price of tradable inputs and the price of imports.
z	number of plants in an industry.
α	a constant (distributed lag model).
β	price elasticity (log-linear demand model).
β_0, β_1..	structural demand parameters (partial adjustment model).
τ	income elasticity (log-linear demand model).
δ	effect of past consumption on present consumption.
Δ	increment.
α, β, τ, τ', Γ, Γ'	parameters of the Houthakker-Taylor model.
ε, Γ, Φ	parameter of the flow adjustment model.
σ^2	industry concentration.
∂	partial differential.
o	growth rate.

INTRODUCTION

INTRODUCTION

In a fundamental sense, economic development is intimately related to the determinants of the growth of economic activity and the standard of living of nations. This study begins with the observation that, to a country, increasing the technological level of domestic industries is a critical factor in economic development and in raising the standard of living of its citizens. This is not to say that it is the only one. Other factors having an effect are, for example, natural resources, the saving rate and capital accumulation, the terms and the volume of trade, and demographic changes that increase the participation rate of the population in labour markets. But in a hierarchy of determinants of economic growth, technological improvements in the industrial sector occupy a prominent place.

Economic literature is rich in models that attempt to answer questions concerning the growth mechanism and policy recommendations aimed at applying theoretical results to general, and particular, situations. These are contained in a large body of theoretical models and empirical propositions. One of these propositions is so universal and profound as to be at the centre of an old controversy. The proposition in question is the use of trade policies to influence patterns of production and trade, with the immediate goal of increasing domestic output in strategic sectors, and the ultimate goal of fostering economic development.

A pertinent question to ask is why would there be an interest in trade policy when theoretical literature clearly shows the welfare superiority of non-intervention. The answer to this question is to be found in the social preferences of countries favouring a diversified, as opposed to specialized, economic structure. Specialization would be the natural result of relative factor abundance, but some societies prefer a skilled and diversified labour force in an attempt to be economically, socially and culturally advanced. Policy recommendations specifically designed to attain economic diversification that fosters economic development cannot be analyzed from the point of view of first-best optimality and additional factors must be introduced.

This research begins with an analysis of the reasons why technological progress is an important determinant of a country's ability to develop and to increase its standard of living. We examine the traditional view that economic growth flows from natural resources and factor abundance and ask whether these types of comparative advantage can be relied upon for sustainable and rising standards of living. We consider factors such as demographics and employment to be for the most part transitory in nature and not an important source of increases in per capita income over long periods of time. We instead focus the research on the nexus between trade and technology and, in so doing, depart somewhat from the classical growth and trade models as tools of analysis in favour of a model where technological progress and trade are viewed as the engine of growth and development.

This departure from traditional models raises new fundamental questions. If technological progress and trade are dominant factors in the economic environment, what are the factors influencing trade and technological progress? What is the role of factor prices, capital, knowledge and market structure? What are the links between technological progress and sustainable comparative advantage? These are important questions that should be answered in the context of the role of government and its trade policies as instruments to encourage the growth of domestic productivity.

A particular goal of our inquiry is to explore and evaluate the efficacy of trade policies in fostering higher rates of productivity. In the thesis, we attempt to answer the following questions:

a) Do changes in tariffs and subsidies increase or decrease productivity growth?

b) What are the important factors in the relationship between tariffs, subsidies and productivity?

c) What is the relationship between tariffs, subsidies, industrial concentration and productivity?

In the analysis of policy effects that flow from the above relationships, we are concerned with the underlying causes of productivity such as R&D spending, the rate of patenting and process-product innovation, although we do not model these directly. We are concerned with the impact of trade policies on the growth rate of productivity over the levels achieved in the past as determined by the behavior of the relative economic agents. This includes the R&D intensity of firms and their technological capabilities indirectly, to the extent that these are reflected in the observed behavior of industries.

Productivity improvements usually appear to be small compared to the growth of other economic variables. Such gains are usually in the order of 1% to 3% per year for slow growth industries and 3% to 6% for dynamic ones. Yet even small percentage changes in productivity yield substantial differences in overall economic performance over time. Consider the following example: in an economy with fixed endowment of resources and constant terms of trade, income increases are due mainly to productivity increases. If population growth is 2% annually and productivity gains are 3% per year, the per-capita standard of living increases by 1% annually. Suppose that productivity increases to 4% per year due to efficiently designed trade policies. The effect of the 33% increase in productivity doubles output growth per person in the economy, in this case, to 2% per year. The addition of a one percentage point productivity gain will, in 35 years, double per-capita real income. It would take 70 years to achieve the same result if no measures were taken to improve productivity.

The above does not mean that domestic productivity can be the sole source of income growth. Other factors are important. Opening the economy to trade will increase welfare even without changes in the factors of production or technologies. Technological progress abroad increases domestic welfare by allowing for the purchase of imports at lower cost. But the ultimate outcome for an economy that fails to increase its level of productivity is a decrease in the growth of real wages relative to that of the more technologically advanced nations.

The rate at which productivity can be increased depends in part on the initial productivity level of the country. A country with a relatively low initial technological level is more likely to adopt technologies at a faster rate than a country which is already a technological leader. By the same token, the technological progress of the leading nation is generally slower, since it is difficult to upgrade its skill above an already high level.

Some countries attempt to accelerate their technological development by means of trade policies. While this strategy has been rewarding for some countries, in others, expected developments did not materialize. In fact, the fundamental contributing factors behind high rates of technological development seem to have eluded systematic enquiry for a number of reasons. At the theoretical level, many growth models do not attribute a central role to technical progress. International trade models tend to explain trade flows on the basis of relative factor abundance, product prices and production characteristics. From our perspective, technological change is seen as the fundamental source of both economic growth and international trade flows. The intensity of investments, so crucial to growth models, and the characteristics of goods and services such as price, cost of production and factor use, critical in the explanation of trade flows in basic models, are the effect, not the cause, of economic growth and trade. There are more fundamental forces at work such as the technological advantages and disadvantages of trading partners in the domestic and foreign markets. It is not possible to explain the success of a product only in terms of its price, its market share and features such as convenience, safety, warranty and after-sale service, without first explaining improvements made in the design and engineering of the product. Product specification and price are the result of current and past innovations. Even though trade flows can be explained in terms of factor prices and factor intensity, such models do not explain the sources that create the basic conditions of comparative advantage. These are rooted in innovations which are implemented to the point where new wealth is created. These new ideas are the very essence of technological progress.

Research on the relationship between trade policies and technological progress has suffered from the well-known difficulties in modelling technological progress itself. In the economic theory of production, and in most macroeconomic models, technological progress is treated as exogenous. But is technological change really exogenous to the firm, and to the industry, as assumed? Are productive ideas not shaped by market forces, the degree of competition and the desire to increase profits and gain market share? In this thesis, technological progress is made endogenous in the sense that technological progress is traced to trade patterns which themselves are influenced by economic and policy variables.

We find that even though the existence of the relationship between trade policies and productivity is generally recognized, few estimable models have been presented to formally analyze it. There appears to be a general perception that tariff regimes do little to foster rapid technological progress and that a regime in favour of export promotion and generally liberalized trade is more likely to accelerate productivity. The results of our evaluation of 30 years of Argentine trade and industrial policies in a formal and estimable model refute these arguments in some cases and support them in others.

Our results do not provide full support to certain normative aspects of neoclassical economics well-summarized by John K. Galbraith (1974): "Neoclassical economics has a strong adverse attitude towards tariffs, price supports, suppression of technological innovation and anything that suggests government assistance to, or acquiescence in, monopoly" (page 20). Out of neoclassical economic theory, with its emphasis on non-intervention, grew the perception that the free play of markets ought to be the guiding principle of public policy. It was, therefore, straightforward to advance the notion that technological progress will take place at an optimal rate if markets were unperturbed by governments. This dictum is not, however, universally accepted.

One important theoretical exception is the notion that protection can be justified in the case of industries with initially high production costs and where such costs are expected to decline to international levels as a result of technological progress, economies of scale or externalities (the infant industry argument). In addition, when market imperfections are introduced into trade theory models, as in Helpman (1989a) and Helpman and Krugman(1985), trade policy intervention is found to be welfare increasing in some cases. These particular cases do not detract from the overall optimality of free trade; they simply suggest support for trade policy intervention in second best situations.

We broaden our study by linking trade policies and productivity to the market structure of the industrial sector which both influences and it is influenced by technological growth and hence productivity. The number of firms in an industry, its economic size and the distribution of industry output among firms determine the structure of the industry. The structure of particular industries determines, to a large extent, the intensity of competition among domestic and foreign firms. Such competitive pressures are crucial in determining the industry's possibilities for technological progress. A relevant question for research is the identification of industry structure most conducive to maximum technological progress.

Plan of Presentation

The material is arranged in four chapters. The first chapter contains an overview of the issues pertaining to trade policies for economic development with particular emphasis on the trade policy-technology link. It surveys the literature and lays the foundation for the analysis of the two crucial elements in the trade policy-productivity relationship, that is to say, the output creation effect, and the market structure effect. Chapter II is intended to provide the reader with an evaluation of Argentine trade policies and industrialization efforts. It details particular aspects essential to understand the timing and direction of the import substitution, export promotion and trade liberalization policies.

Chapter III forms the core of the study. It contains the analytical models and derives the theoretical framework for evaluating trade policy impacts. Chapter IV brings together the results of Chapter III and the empirical evidence. It discusses the theoretical and empirical implications derived from the models and it answers the questions raised in this introduction. Appendix A provides a detailed account of data sources, the methods of aggregation and assumptions used in the construction of the database. Appendix B presents alternative demand and production function models and the numerical results of econometric estimation. Appendix C describes the estimation of the tariff effect without capital stock data.

CHAPTER I

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TRADE POLICIES AND TECHNOLOGICAL PROGRESS: THE MAIN ISSUES

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INTRODUCTION

Despite the normative teaching of neoclassical economics that non-intervention would maximize economic welfare, casual observation suggests that trade policy intervention is the norm rather than the exception in developing and developed countries alike. How can government economic intervention be justified and what are the consequences of trade intervention? These are questions we attempt to answer in this first chapter by surveying the relevant literature, with a selective focus on the technological aspects of trade theory and of trade intervention as practised in less developed countries during the last 40 years.

Our understanding of the link between trade policy and technology is derived from three broad areas of economic research: trade theory, industrial organization and empirical research on developing countries. While traditional trade theory has, for the most part, abstracted from the technological determinants of trade, some recent theoretical developments have incorporated market structure in a promising way. In the last 15 years, the literature on industrial organization has enriched considerably the depth and scope of trade theory. This has enhanced our understanding of the factors that shape market structure, the degree of competition and the innovation performance of firms and industries. We are at a stage where tentative "stylized facts" can be established for the relationship between R&D and firm rivalry, and between firm size, the degree of concentration and technological performance of the industry in question.[1]

But a large part of the empirical evidence points to our lack of understanding of important technological relationships, causality channels and directions. For example, we do not fully understand why infant industries sometimes fail to achieve world price competitiveness even with the best circumstances for technological development. Yet considerable literature on the subject suggests that trade liberalization is likely to induce higher rates of productivity growth compared to either import substitution or export promotion. Moreover, the industry structure most conducive to technological growth is not well determined, although it appears to be the one with predominantly large firms and relatively high concentration, and not pure monopoly.

The frontier of knowledge as surveyed in this chapter is rich in insights and in possibilities for further research. New lines of enquiry are evolving that will ultimately result in building of trade policy models in which technological progress is endogenous and which will add explanatory variables to the trade policy-technology relationship.

TRADE THEORY AND TECHNOLOGY

Most of the modern analysis of trade flows is based on the Heckscher-Ohlin model of international trade in which relative factor abundance plays a central role. The basic model exhibits constant returns to scale and it assumes that perfect competition prevails in all markets. It is further assumed that trading countries utilize identical production technologies and have identical preferences. Because the model

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[1] See Scherer and Huh (1992).

assumes identical technologies in both countries, the country with a relatively abundant factor will produce commodities that are intensive in that factor, thereby having a cost advantage in relation to the other country. The model predicts that the pattern of trade depends on the geographical distribution of factor abundance which gives rise to different countries having comparative advantage in different commodities. It also predicts that trade will lead to factor price equalization in the absence of factor mobility.

The Heckscher-Ohlin model in its factor-content version is capable of explaining net trade volumes, i.e., it predicts that net exports of a country use factor inputs in a proportion which reflects its relative abundance of some factors while net imports of a country use factor inputs in a proportion which reflects the relative shortage of some factors. Evidence based on the patterns of international trade confirms the expectations of the model. However, the basic model is less apt at explaining the fact that the largest volume of trade actually takes place among countries with similar factor endowments (OECD countries, for example) and it does not provide insights into the changing composition of intraindustry and interindustry trade.

Research in the last 15 years has expanded considerably the basic model of international trade in which the pattern of trade is dictated by factor endowments. Recent trade models, the so-called new trade theory, have branched into the direction of explaining not only net trade flows, but also trade flows between similar countries and intraindustry trade. This was made possible by incorporating various forms of imperfect competition (monopoly, duopoly and monopolistic competition) and differentiated products, as in Helpman and Krugman (1985).[2]

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[2] See also Harris (1984), Helpman (1989a) and Brander and Spencer (1983).

The incorporation of imperfect competition into trade models adds important realistic features, often found in empirical trade analysis, that cannot be explained by competitive market models. Models of imperfect competition have the common characteristic of temporary economic profits for entrepreneurs that succeed in differentiating their products, and that exploit market power and engage in R&D, Grossman (1989). Product differentiation is essential to explain trade flows in similar product classes. This results from dissimilar demand patterns across countries and brand specific product qualities which ensure that differentiated products will find markets in many countries, even those with similar factor endowments. This type of trade flow is essentially intraindustry. Thus, imperfect competition models can explain trade patterns not explainable by perfect competition ones. These aspects of the new trade theory are summarized in Helpman (1989b).

A fundamental difference between new trade theory models and the basic neoclassical trade model is in the area of trade policy. While in neoclassical theory trade policy intervention is generally welfare-reducing except when there are potential terms of trade gains, imperfectly competitive models give rise to a number of trade policy implications. The basic reason is that any form of imperfect competition is not consistent with Pareto optimality, and therefore, new trade models are not optimizing in general, and welfare gains can be realized by trade policy intervention. This possibility arises from the fact that, contrary to the perfect competition model in which countries are assumed to be "price-takers", there are elastic demand curves in imperfect competition which means that in order to export more, a country must lower its export price, and it can import more only at a higher price. If, in addition to non-linear offer curves, there is one domestic producer and one foreign producer exporting to a third country and the domestic producer takes the volume of the competing country as given (Cournot behavior) in its output decision, a policy of export subsidies is welfare increasing compared to non-intervention (Baldwin, 1992). On the other hand, Eaton and Grossman (1986), argue that in Bertrand-type price competition duopoly, optimal intervention may consist of a product or export tax, rather than a subsidy. The welfare effect of trade policy is highly sensitive to the reaction function of domestic and foreign producers and to market structure, with the result that it is possible to show that trade intervention can be welfare increasing in some forms of market structure and behavior. The contributions of the new trade theory clearly show that it is no longer the case that domestic welfare can be increased only by free trade (Krugman, 1987).

The new trade theory explains welfare gains in terms of the realization of economies of scale and externalities. These factors are also important in explaining productivity since productivity growth can be decomposed into at least two components: the contribution of economies of scale and a residual component usually identified with technological change, which includes the externality effect of technological spillovers on the growth rate of output. Thus, economies of scale and externalities establish a relationship between the new trade theory, trade policy intervention and productivity. This is a welcome development. It incorporates empirical realism and the long-neglected role of technology in theoretical trade models. Important as these developments are, the technological implications of the new theory are rather weak and much remains to be done in understanding not only the role of technology in trade and its implications for policy, but more fundamentally, how trade policies may affect technological changes. The current state of trade theory suffers from the limitation that it does not explain technological change but rather, assumes it as exogenous to the model.[3]

THE TECHNOLOGY FACTOR IN TRADE INTERVENTION

While trade theory is clear about the Pareto optimality of free trade, substantial intervention is common in many less developed countries. Some of these countries, particularly in Latin America, have long advocated and used trade policies[4] to induce and accelerate industrialization and development. They have applied these policies to solve problems of structural transformation, believing that such policies lead to the development of industries with relatively high productivity. In the initial phases of intervention, protection is introduced in order to foster the establishment and growth of new domestic industries or what has come to be known as infant industries.

Infant Industry Protection

The literature has traditionally viewed infant industry protection as addressing a problem of domestic distortions due to imperfect product or factor markets. In

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[3] Exogenous technological change is also assumed in general equilibrium models and Input-Output models with trade. New developments in growth models include the possibility of endogenous technological change. See for example Romer (1990).

[4] Trade policy often embraces one of two main types: Import Substitution (IS) and Export Promotion (EP). For lack of a common definition we will refer to IS as a set of policies implemented by a sovereign government to create opportunities for entrepreneurs, or the government itself, to produce profitably and locally what has hitherto been imported. Similarly, EP is a set of government policies designed to create opportunities to export profitably what has hitherto been unprofitable to export.

particular, the market for capital inputs may not permit firms to raise sufficient risk capital in domestic markets to finance the long learning period necessary for infant industries to mature. Other arguments for infant industry protection are based on the realization of production externalities in protected industries that would extend to other industries (Bhagwati, 1971) and as the means to promote dynamic factors such as technological progress that have the potential to create dynamic comparative advantage. Some of these arguments were challenged by trade theorists and found lacking. In particular, if infant industry protection is granted to compensate for a domestic distortion such as, for example, in the capital market, protection may not be optimal. Protection distorts the marginal rate of transformation while a production subsidy does not. Protection is likely to result in a lower level of domestic consumption relative to a production subsidy and is, therefore, welfare inferior. Thus, a direct production subsidy to infant producers is likely to result in a higher level of domestic consumption.

Recently, and perhaps in response to a general awareness of the central role of technological progress in industrial development, Westphal (1981) has redefined the infant industry argument as follows: "An infant industry is any newly established type of activity for which the economy's existing endowment of skills and human capital does not provide technological mastery". By this new definition, the protection of infant industry becomes the solution to the problem of technological progress. Current thinking seems to uphold this view. For example, Krueger and Tuncer (1980) expect high productivity growth rates in protected infant industries. Such expectations are based on the notion that protection affords the opportunity to "learn by doing" and consequently it could result in rapid technological advance. These factor are also part of the new trade theory argument for protection. In fact, an important contribution of the new theory is the explicit recognition of externality factors such as the spillover of knowledge from high technology industries and external economies of scale, which were neglected in the old theory.

Identifying the underlying reasons for infant industry protection is important because, if the argument for protection is based on market imperfections, the appropriate policy response would be the elimination of such imperfections, and not the introduction of compensating distortions in some other markets (Bhagwati, 1985). However, if the argument is cast in terms of the initial level of technology in infant industries, it now rests on theoretically sound factors such as economies of scale and minimum efficient scale.

The word "infant" leads us to think of protection as conducive to industrial "maturity". Implicitly, it is assumed that intervention is for a finite length of time, suggesting that protection might be discontinued at the end of some specified period when unit production cost declines to world levels and the industry becomes competitive in world markets. However, even though economic literature attempts to portray the infant industry argument as merely a stage of development, proponents of protectionist policies often do not have a timetable in mind. They argue that the protection of infant industries may extend for a considerable time suggesting that externality effects to competing and upstream industries may be more important than the efficiency gains of the protected industry.

Krueger and Tuncer (1982) conducted an empirical test of the timetable and externalities features of infant industries. The test rested on the notion that infant industry protection would be justified if it passes the following criteria: 1) the initial high unit costs of production decline through time, 2) there are externalities accruing to other industries, and, 3) the cumulative value of benefits from the establishment of infant industries covers the cumulative initial high costs and provide a reasonable rate of return. A necessary condition for the three criteria to hold is that unit costs in protected industries fall more rapidly that unit costs in non-protected industries. This proposition was tested by comparing the growth rate of multifactor productivity[5] between protected and unprotected industries in Turkey. The authors found that these conditions were not satisfied for a sample of firms and two-digit manufacturing industries during the 1963-76 period. They concluded that a case could not be made for infant industry protection in Turkey, and in particular, found the externality benefits to be small, and not sufficient to compensate for efficiency losses.

The study cannot be considered satisfactory evidence for a number of reasons. First, as pointed out by Lucas (1982), Krueger and Tuncer did not test sufficient conditions. Second, by comparing the productivity growth rate of a protected firm or industry with that of unprotected ones, it is implicitly assumed that the observed differences in productivity growth are due entirely to protection, or the lack of it. This ignores that factors other than protection may influence industry productivity. These other factors may not correlate well with the degree of protection. As a test, we apply the Krueger and Tuncer criteria to two Canadian manufacturing industries with diametrically different productivity behavior: the Meat and Poultry industry, and the Office Store and Business Machines industries. The index of value-added multifactor

[5] Multifactor productivity (or total factor productivity) refers to the ratio between output volume and combined input volume. Productivity gains takes place when more output can be produced with fixed inputs (less inputs are needed per unit of output). Growth in multifactor productivity results in the lowering of unit production costs for fixed factor input prices (the price of output declines relative to the price of combined inputs), everything else constant.

productivity in the Meat and Poultry Products industry increased 47% between 1961 and 1975 and only 1% between 1975 and 1988. Among high-technology activity, all of the 1961-88 productivity gains in the Office, Store and Business Machines industries (which includes computers) took place after 1975. Because Canadian protection rates were low and constant during the 1961-1988 period, the change from high productivity gains in the Meat and Poultry industry during the 1961-1975 period to low productivity gains in 1975-1988, and the change from low to high productivity gains in the Office, Store and Business Machines Industries for these same periods (we choose periods of approximately the same length as Krueger and Tuncer) show little correlation with protection. The lack of correlation also extends to the long term (1961-1988), indicating that industry productivity is strongly influenced by factors other than protection and that these factors are important in Canada. Such factors may be even more important in developing countries given their generally less efficient markets, which imply greater variability of productivity gains across industries.

One significant drawback of protectionist policies seems to be their failure to create the conditions necessary for the most promising infant industries to mature. Granting protection against foreign goods, without a gradual reduction in protection, and without selecting firms and industries most likely to develop comparative advantage in the shortest period of time, can lead to the expansion of domestic production without the creation of comparative advantage.

Balassa (1975) argued that high tariffs may be a reason preventing the maturity of infant industries. He proposed a two-tier system consisting of a low protection rate of 10% to 15% for all industries, and an infant industry protection rate up to twice the rate for other industries. The infant industry rate would be temporary and would decline to the lower level after a period of eight years. Balassa's recommendations are generally valid since they are based on the experience of a large sample of developing countries, but we note below an exception to these rules and some further considerations.

The issue of whether infant industry protection may be instrumental in attaining high productivity has been empirically analyzed by Westphal for South Korea. The findings indicate that the country "appears to have used quite high initial rates of infant industry protection with successful results, success here being indicated by rapid achievement of international competitiveness by a number of industries that have been so promoted" (Westphal, 1981). Westphal and Kim (1977) observed that the tariff protection granted to successful Korean infant industries was much higher than that suggested by Balassa. Furthermore, it can be argued that setting an arbitrary rate at which protection to infant industries should decline may not be appropriate for technological development. If the reduction of protection is to be a function of time, the degree of protection should be made inversely proportional to the expected level of technological development and competitiveness achieved by the industry over time. Since protection does not always imply a given rate of unit cost decline, as the productivity results for Canada show, the most suitable degree of protection may be more properly analyzed in terms of the likelihood of technological developments that it sparks.

The Failure of Infant Industries

The reasons why some industries succeed and others fail to reach world competitiveness are diverse, but the technological evolution during infant industry maturation has been considered an important critical factor. Bell, Ross-Larson and Westphal (1984), in a survey of the infant industry literature, found some degree of ambiguity about the causes of infant failure and could not arrive at definite conclusions. Admitting the dearth of evidence about the productivity performance of these industries, they suspected such industries failed to reach international competitiveness due to a lack of technological capability, specifically, the inability to use technologies effectively: "The evidence shows that maturation is not automatic or instant: reaching and maintaining international competitiveness is not simply a matter of developing the right industry or industries, given the existing (aggregate) relative factor endowments. It takes more than effortless learning-by-doing and requires the capability to manage continuous technological change". They hypothesized that other causes for the failure of infant industries may lie in their choice of inappropriate techniques. Often, imported technologies employ factors in a proportion which minimizes cost in the country where the technology was developed. In economies where factor prices are different than in the country where the technology originates, the imported technology may have a cost of production higher than the cost of production in the country of origin. Thus, a developing country with an inadequate technology may never be able to achieve international competitiveness given factor endowments and factor prices.

Bell et al. speculated that another cause of infant industry failure is that the positive effect of technological externalities may be offset by a low incentive to generate their own technologies: "Particularly important in relation to the growth of productivity are externalities involving transfers of technological capabilities across firms through various means of information diffusion. These externalities may lead firms to allocate too few resources to technological capability through training." Although the authors did not disagree with the low level of infant industry externalities reported by Krueger and Tuncer (1982), their findings confirm restrictions to the diffusion of proprietary technological information in developing countries. We will return to this subject later in the chapter.

Import Substitution

In circumstances where import substitution is used, the policy is based on the notion that industrial modernization can be encouraged by creating a domestic industrial sector that raises the capital intensity of production, increases productivity and creates externalities. Consistent with the objective of rapid industrialization is the emphasis on first substituting those goods that require relatively simple technological know-how, small scale of production and low capital intensity. Such a preference is reflected in the structure of protection established by developing countries, where effective protection is highest for consumption goods and diminishes gradually for intermediate, capital and primary products.

Often, trade policies succeed in achieving initial industrialization. In many cases, a significant proportion of domestic growth is due to import substitution. However, the relative ease of importing capital goods to create domestic capacity does little to reduce the foreign exchange constraint and, as the process is carried to more complex, capital intensive activities, balance of payments difficulties and dependence on foreign goods (especially capital goods with embodied technology) tends to increase.

The failure of infant industries protection in many developing countries raises the question of the rationality of tariff protection as an strategy for technological development in general. Bhagwati (1985), citing a number of empirical studies on the advantages of the export promotion (EP) strategy relative to import substitution by Balassa (1982), Little, Scitovsky and Scott (1970), Bhagwati (1978) and Krueger (1978), points out that IS as an appropriate trade strategy has been largely dismissed some years ago. However, proponents of import substitution argue that the good economic performance of Latin America between 1950 and 1980 can in large part be attributed to its industrialization policies implemented mainly by trade protection. Teitel (1992, p. 382) argues that "the onus of proof of the proposition that growth could have been attained much more efficiently over those three decades must rest with those now characterizing the period as inefficient and wasteful". The debate is far from settled. Protectionist arguments resurface from time to time in developing countries, often reinforced by balance of payments difficulties as a result of heavy debt burden. In other cases, domestic political pressures may be traced to fears of growing protectionism in developed countries that may limit developing countries' export growth, as Bhagwati (1985) suggested.

Exports

In most cases the expected high productivity gains from protected industries failed to materialize. This, coupled with limited export success in many developing countries, gave rise to the export promotion (EP) drive common during the 1960's and 1970's in Latin America as a strategy to increase output growth beyond that dictated by markets forces.

Often overlooked in the logic of EP is the fact that it is normally after a long gestation period and a previous and substantial IS effort that countries succeed in expanding manufacturing exports. Such is the experience of Brazil. A consequence of a long gestation period is an increase in the economic cost of the transition as current growth is reduced for the sake of future expansion. The transition from import substitution to exporting is seen as sequential. Setting aside special cases where trade policies were specifically designed to promote exports, two factors seem to be important: time, and a sufficiently large domestic demand. The rationale is that capacity cannot be developed without the existence of domestic demand and that it is the capacity built to satisfy domestic demand that permits the subsequent export of manufactured products (Ahmad, 1976, Baldwin and Krugman, 1986).

An aspect of IS industrialization is its distortion of the internal terms of trade between protected and unprotected industries. Such a distortion arises from higher profitability in the protected sector, causing resources to shift to that sector at the expense of unprotected ones. This shift of resources is said to deteriorate the main source of export earnings which, in many countries, is the agricultural sector.[6]

It seems that although IS policies are detrimental to exports of traditional products, it fosters the expansion of manufactured exports. This has important consequences for technological development because, if a reduction in traditional exports is more than offset by an increase in the export of manufactures, aggregate productivity growth could rise above the growth rate offered by the traditional sector. An expansion of net exports would accelerate domestic productivity since manufacturing is one of the main contributors to aggregate productivity performance.

The export success experienced by Southeast Asian countries seems to confirm the positive relationship between exports and productivity growth. Havrylyshyn (1990) compared the share of productivity in output growth for Hong Kong, Japan, the Republic of Korea, Singapore and Taiwan and concludes that "the share of the residual on the growth rate of GDP is clearly much higher for East Asian economies than the 30% to 35% for other countries." A similar result has been found earlier by Nadiri (1972) who, in a survey of the sources of output growth in developing countries, found that about a third of output growth is due to productivity growth. Balassa (1978) found that export-oriented industries had higher productivity growth, a result also consistent with that found by Chen and Tang (1987): "Using observations from multinational firms in Taiwan's electronics industry, we find that firms that are constrained to export all their products in the world market (namely, the export-oriented) tend to be more efficient than those allowed to sell their products on the protected local market (namely, the import-substitution oriented)." Support for a

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[6] In the case of Argentina, there is evidence of higher profitability in manufacturing in relation to agriculture, suggesting a capital resource flow towards the manufacturing sector (Reca and Verstraeten, 1981).

positive technological effect of EP is widespread among recent empirical studies.

Import Substitution and Export Promotion

The empirical evidence on the effect of trade policies on productivity growth that we have presented so far does not take into account the fact that the relationship may depend on the degree of development of the economy. If it is relatively easier for low-income countries to adapt foreign technologies and to increase their capital-labour ratio at a fast rate, as suggested in the literature on development, then one should observe a negative correlation between the stage of development and productivity growth; higher rates of productivity growth could be expected at lower levels of development, decelerating gradually as countries approach the income levels of the more advanced countries. A cross section of high-, middle- and low-income countries should therefore serve as a test of this relationship. Kavoussi (1984) provided partial evidence on the relationship between economic development and multifactor productivity for a sample of 73 developing countries during the period 1960-1978. The test was based on a linear relationship between the rate of growth of real domestic output Y (the independent variable) and the growth rates of capital stock K (investment growth used as proxy), the labour force L and a constant term,

$$\dot{Y} = a + b\dot{K} + c\dot{L} \qquad (1)$$

where the constant term is an estimate of the average productivity growth rate during the sample period. Kavoussi divided the sample into low-income and middle-income countries and found that the average rate of productivity growth in low-income countries was of the order of 0.3% per year (not statistically different from zero) while the productivity of middle-income countries was higher, at 3.47% per year and statistically significant. He thus found a positive relationship between productivity growth and the level of development. Given the large sample size, it is unlikely that the results are biased on this account (oil exporting countries, those with a 1960 population of less than one million and countries for which no data were available are excluded). However, the regression results account for about half the variability of output, suggesting important omitted factors. One such factor is export growth. The inclusion of exports in the regression improves the fit, and leads to the conclusion that the contribution of exports to productivity growth is higher for the more developed countries. Since exports of middle-income countries contain more manufactured goods than the exports of low-income countries, Kavoussi included the share of manufactured goods in exports as an explanatory variable to test the hypothesis that manufactured good exports rather than total exports may better explain productivity growth. It is concluded that "in the more advanced developing countries, the effect of export expansion on the growth of total factor productivity is very sensitive to the share of manufactured goods in total exports. If a country continues to depend completely on exports of primary commodities as it reaches higher income levels, the positive impact of export expansion on factor productivity practically disappears"(page 248). This conclusion supports the notion that the positive correlation between productivity and the level of development depends heavily on whether development is accompanied by growth in the manufacturing sector. This finding also agrees with the finding for Canada that productivity in the manufacturing sectors is at the centre of technological development (Statistics Canada, 1991).

A direct assessment of the relationship between trade policies and productivity growth is provided by Nishimizu and Robinson (1984) for the manufacturing sector of Korea, Turkey and Yugoslavia, using Japan as a comparison. Their method of analysis was to regress the growth rate of multifactor productivity of each manufacturing industry in each country on a linear combination of the growth of domestic output due to import substitution, the growth of domestic output due to export expansion, and a constant term. The parameter values associated with the allocation of domestic output to IS and EP in this single-equation model is used to test the hypothesis of a positive correlation between productivity growth and IS and EP. Productivity growth is exogenous and calculated for each industry from data on output and inputs. The allocation of domestic output growth between the part that is due to IS and the part due to EP is calculated from a linear approximation,

$$\Delta Q = \mathbf{u}_t \, \Delta E + \mathbf{u}_t \, \Delta W + \Delta E + \Delta \mathbf{u} \, (X_{t+1} + W_{t+1}) \qquad (2)$$

where Q is output, E, W and X are final demand, intermediate demand and export demand respectively and **u** is a diagonal matrix of ratios between domestic demand to domestic plus import demand. The third and fourth terms in this equation give the part of the change in output due to EP and IS respectively. The decomposition is such that the sum of the growth of domestic demand, export expansion and import substitution equals the growth in domestic output as required by market equilibrium.

Regression results showed a high correlation between productivity growth and the IS and EP parameters in all countries except Japan, suggesting that output growth arising from trade policies is an important explanatory variables in the productivity growth of developing countries. The signs of the IS and EP coefficient changed from country to country and from industry to industry but, by and large, the sign of the EP parameter was more often positive while that of the IS parameter was negative. When industries were grouped according to their import competing and export orientation, it was found that import substitution industries had a negative correlation with productivity growth while export oriented industries had a positive correlation.

Nishimizu and Robinson also indirectly tested Verdoorn's Law. Verdoorn (1949) was one of the first to observe and analyze a positive association between the growth rate of output and the growth rate of productivity. The authors found that "The results do not support the simple version of Verdoorn's Law which implies that any expansion in the market, regardless of source, should improve productivity performance." We disagree with the reason for their rejection of Verdoorn's Law. An explanation of the Law is the effect of economies of scale in the relationship between output growth and productivity growth. Assume there is no technological progress and that output increases. Because of scale economies, output grows faster than inputs and the productivity residual will be positive even in this case of no technological change. With technological progress, the productivity residual measures both technological progress and the effect of economies of scale. Since in the presence of scale economies, productivity always increases with output, the contribution of economies of scale to growth in multifactor productivity must be independent whether output expansion is due to IS or to EP. The authors found the signs of the IS and EP effects to be different. Thus, the different policy effects found by Nishimizu and Robinson must be explained by reasons other than the increase in output. In their analysis, they reasoned that the productivity effect of EP is larger than that of IS because of competitive incentives. Indeed, this is the argument they invoked in explaining the negative correlation between IS and productivity: "The results are also consistent with the converse hypothesis that increased import substitution (import liberalization) leads to lower (higher) TFP growth, perhaps through reducing (increasing) competitive cost-reduction incentives." Their hypothesis of the relationship between productivity and competition is consistent with the widely held notion that competition reduces profitability and provides incentives to innovate. As we shall see in the discussion of the literature on industrial organization below, productivity[7] is not always positively related to the degree of competition. The relationship may be non-linear, having concave as well as convex portions.

Liberalization

In a more general context than the one so far considered in this survey, the question has risen as to whether technological progress resulting from IS protectionism and export promotion is inferior to that which is likely to result from liberalized trade regimes. At the theoretical level, there is almost unanimous support for non-intervention and for the optimality of movements towards freer trade. At the empirical level, research on the performance of protected industries support the free trade argument that any form of protection, such as IS, or promotion, such as EP may be contrary to productivity growth. As Krueger and Tuncer (1980) noted: "One might also conjecture that countries with more liberalized trade regimes experience higher rates of TFPG (total factor productivity growth) in their manufacturing industries than do countries with restrictive trade regimes." In a survey of the relationship between trade

[7] The industrial organization literature refers mainly to labour productivity while the studies referred to above are concerned with total, or multifactor productivity. Given the high degree of correlation between the two productivity measures it is possible to draw general conclusions by comparing studies using either type of productivity measures.

policies and productivity, Havrylyshyn (1990) reported a number of empirical studies indicating that liberalized trade regimes have a propensity to exhibit higher rates of productivity growth compared to different forms of intervention. A 12-country study by the World Bank found the share of total factor productivity in output growth increased from the least to the most outward-oriented country, indicating a positive correlation between liberalization and productivity growth. Clague (1970) for U.S. and Peruvian industries and Pack (1984) for Philippine, Israeli and U.S. industries found a negative correlation between labour productivity[8] and protection. Kim and Pack (1985) looking at Korea, and McCarthy, James, Hanson and Kwon (1985) looking at Colombia arrived at similar conclusions as did Chenery (1983) for a broad cross section of industrial, semi-industrial (East Asia, Israel and Spain) and middle-income developing countries. The results of Handoussa, Nishimizu and Page (1986) examining Egyptian manufacturing confirmed the positive relationship between liberalized trade and productivity growth: "We view the rapid overall rates of productivity change as indicative of the success of the liberalization efforts undertaken following 1973." But there are exceptions. A case where this negative relationship does not hold has been found by Chen (1977)[9] in Korea. Further, high output growth created by either IS or EP or by movements towards more liberal trade does not necessarily lead to technical progress, as Tsao (1985) observed in Singapore manufacturing during the period between 1970 and 1979.

[8] Labour productivity is the ratio between real output and real labour input (employment or person-hours worked). Labour productivity is related to multifactor productivity and normally exceeds the latter in absolute value. The growth rate of labour productivity exceeds the growth rate of multifactor productivity by the growth rate in the capital-labour ratio weighted by the share of capital in value added.

[9] In Havrylyshyn (1990), op. cit.

Technical Efficiency Studies

It has been observed that protection in developing countries allows the existence of low and high cost producers in the same industry while employing different productive technologies. Some producers opt for higher profits behind tariff barriers while others take advantage of protection to accelerate the pace of technological change. The removal of protection results in increased competition among domestic producers and changes in industry structure that may lead to higher rates of industry productivity. An empirical assessment of this possibility is provided by Bergsman (1974). The study aimed at measuring the costs and benefits of a move from protection/export promotion to liberalization in Brazil, Malaya (sic), Mexico, Pakistan, the Philippines and Norway. The model contains a set of supply-demand equations with finite elasticities and distinguishes between the welfare gains and losses resulting from three main effects: 1) the domestic cost of producing at prices which are higher than international prices, 2) the gains in consumer surplus that would result from lowering the tariff, and, 3) the efficiency gains and monopoly profits that would result from liberalization. The concept of efficiency gains employed by Bergsman is Leibenstein's (1966) X-efficiency.[10] This concept of efficiency is to be contrasted with allocative efficiency, i.e., the efficiency gains resulting from optimally allocating factor inputs in competing uses. Bergsman's results show that large efficiency gains[11] can be realized by liberalizing trade. The effect of X-efficiency is larger than allocative efficiency in all six

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[10] X-efficient firms are those on the production possibility frontier while X-inefficient ones are those anywhere inside the frontier.

[11] The effect of X-efficiency includes an element of monopoly gains which could not be quantified by Bergsman. He suggested the relative importance of this component is small.

countries (in the order of 2% to 6% of GDP), and the size of the effects seems to depend only on the level of protection. The result that liberalization increases X-efficiency found by Bergsman is supported by a study of Taiwan's multinational firms in the electronics industry by Chen and Tang (1987) who found that "the export oriented firms are 6% to 11% closer to the production frontier than import substitution-oriented firms".

Bergsman's method has some limitations. One is that the evaluation does not permit separate assessment of efficiency gains and monopoly returns in the measured gains. However, most would agree with the author about the importance of X-efficiency because it corresponds to the observation that indiscriminate protection results in the establishment of some inefficient firms operating at less than minimum efficient scale, and perhaps with inappropriate technologies. The second observation made by Bergsman is more contentious; in addition to the level of protection, the size of the effect may also depend on the degree of competition created by protection as well as by other structural factors. We will consider the effect of inappropriate technologies, the degree of competition and of industry structure in the next section. Here we focus on the importance of economies of scale and capacity utilization.

The technological effect of liberalization on industries may originate from increases in their rate of capacity utilization and in the exploitation of economies of scale which are made possible by the expansion of output of the firms not eliminated by the reduction in protection. Handoussa, Nishimizu and Page (1986) have utilized the capacity utilization hypothesis in interpreting evidence of productivity in a sample of Egyptian public sector industrial firms. They noted that "high rates of measured TFP changes in Egypt's public sector basically occurred in the import substituting firms whose output expansion was very rapid [due to liberalization], while traditional export firms show no improvement or deterioration in TFP and stagnant output growth. The analysis of this difference led us to propose that much of the measured TFP in Egypt public sector may be due to improvements in capacity utilization among import substituting firms." Empirical support for the importance of capacity utilization and economies of scale in productivity growth is provided by Kwon (1986) for South Korean manufacturing industries. He decomposed the observed growth in multifactor productivity into three components: economies of scale, technical efficiency and capacity utilization, and found that while economies of scale accounts for 38% of productivity growth and technical change 45%, capacity utilization explains a significant 17% of the observed residual.

It may be that the observed productivity gains of liberalization are due simply to the elimination of the most inefficient firms in the industry without the remaining firms having accelerated their technological levels as a result of the reduction in protection. It may also be that liberalization results in a rapid technological development of the remaining firms in the industry, in particular, firms far from the frontier may augment their level of technology and reduce the average difference between them and best practice frontier firms. This aspect of trade liberalization was analyzed by Tybout, de Melo and Corbo (1991) in a microeconomic analysis of the efficiency effects of liberalization at the plant level for Chile. Their methodology is based on the notion that liberalization may have three overall impacts: the elimination of some inefficient firms from the industry which increases overall productivity, an increase in the efficiency of some firms due to economies of scale resulting from their larger share of domestic output after liberalization; and the increase in the efficiency of firms due to incentives to innovate created by liberalization (increased X-efficiency). Using industrial Census data for 1967 and 1979, they found "no evidence of overall improvements in productive efficiency for the [entire] manufacturing sector", but a cross-industry analysis showed that "...relatively large reductions in protection are associated with marked declines in the estimated returns to scale", indicating an increase in scale efficiency.[12] The authors cautioned that the econometric estimates are rather weak due to data limitations; in particular, the estimates of plant level capital stock rely on book value data and have missing observations. Nevertheless, they concluded tentatively that there have been "...movements towards the efficiency technology across a wide range of plant sizes." Thus, the productivity implications of trade liberalization appear to go beyond the mere elimination of inefficient plants and include incentives to utilize available economies of scale and to adopt best practice technologies.

TRADE POLICIES AND MARKET STRUCTURE

One expectation of trade policies is the creation of new linkages among economic sectors. Protecting one sector helps the development of other interrelated ones. It follows that the combined effect produces increased trade between industries and within industries resulting in economic benefits over and above the individual direct benefit. As Ahmad (1978) noted with reference to import substitution:

> "Once established, an import substitution regime acquires an internal logic of its own. On the

[12] In perfect competition firms operate at constant returns to scale, i.e. at optimal scale. Any departure from this optimal scale equilibrium point is indicative of scale inefficiency Thus, the higher the returns to scale, the higher is scale inefficiency.

> positive side, the single most powerful element of its logic stems from the inter-industrial repercussions of a set of import substitution activities and vibrating to other sectors. This spill-over depends on the degree of articulation within the economy. In several important cases, initial import substitution in final goods sectors prompted further import substitution and has fostered industrialization on a broad front. In other cases, a group of import substituting industries, such as the fuels-metals-machines complex, were jointly able to support their mutual profitability, when any of them in isolation would not have been viable."

Contrary to expectations, however, in some cases the development of domestic linkages failed to materialize. A number of firms that were granted some degree of monopoly power by IS concentrated merely on "finishing touches" type of manufacturing activities. Increases in the use of domestic intermediate inputs did not occur due to quality and availability problems, despite the fact that the structure of protection grants highest effective protection to final products, thus increasing the demand for many intermediate inputs. In other cases, the results were as expected. In an empirical study of the interindustry effects of IS policies in Brazil, Weisskoff (1979, 1980) found substantial interindustry linkages for the period 1953-1970. These linkages tended to vary with the protective structure (higher protection for consumer goods, gradually declining for metallic intermediate, capital goods, non-metallic intermediates and fuels). Sectors such as capital goods and durable consumer goods were found to have strong and positive policy-induced interindustry effects. Sectors such as non-durable consumer goods and two intermediate goods showed either deepening import dependence or negligible substitution.

Import Substitution, Exports and Monopoly

Protection overvalues the domestic currency and discourages exports, creating an anti-export bias caused by lower profitability in the exporting activity compared to selling in the domestic market, since the domestic currency equivalents of foreign prices are lower. This bias has been found in cross-country comparative research indicating that export performance is adversely affected when protection is carried over to intermediate imported inputs. However, the anti-export bias of protection may not always be present, depending on the degree to which domestic producers can exercise market power. IS grants protection to all domestic producers, regardless of firm size, and in so doing creates a structure in which producers as a group have some degree of market power. This occurs over the portion of the domestic demand curve where product price is bounded from above by the import price plus the tariff, and bounded from below by the domestic price (assuming that domestic producers do not mark up prices to the level of the tariff). In situations characterized by some degree of monopoly power in domestic markets, it can be shown that, despite overvaluation of the domestic currency, it may be profitable to sell part of the domestic output at world prices; the industry can consequently engage in export activity, even though the international price is lower than the price prevailing in the domestic market (Pomfret, 1976). Profit-maximizing producers can expand output beyond domestic consumption up to the point where marginal revenue in all markets (domestic and export) equals marginal cost. Thus, if the market structure created by IS protection resembles a monopolistic or cartelized structure, export performance is not necessarily hindered by protectionist policies, but may in fact favour it. The possibility that domestic producers do not mark up to the level of the tariff has been confirmed in some instances, but the exercise of market power abroad has not been confirmed by empirical research. The virtual absence of collusive behavior by domestic producers in countries protected by tariffs can be attributed to the use, or potential use, of antidumping enforcement by foreign countries which has effectively reduced this possibility.

Industry Structure

One of the most notable consequence of IS policies has been the creation of a large number of small-scale firms not operating at minimum efficient scale,[13] and consequently, having a high average cost. Brodersohn (1970) suggested that IS industrialization in Argentina produced an unusually large number of small plants in the automotive industry in relation to domestic demand. This development is typical of the initial stages of IS policies and may be inevitable in the growth of infant industries. A similar experience was recorded by Johnson (1967) for Chile. But not all industries subject to protection developed in an inefficient way. Other IS experiences resulted in the creation of large, efficient scale firms able to satisfy the domestic and foreign markets simultaneously, as in the case of Korea (Krueger, 1979).

Firms may not operate at the minimum efficient scale, and consequently produce at a high unit cost for basically two reasons. One is that firms may be producing at the

[13] Minimum efficient scale is defined as the pla. . .ize at which unit production cost equals the C.I.F. import price of the same output unit converted at the appropriate shadow exchange rate.

lowest possible average and marginal cost point (at constant returns to scale) of the technology they employ, but there may exist an alternative technology with a lower unit cost for the output level of current production. Alternatively, firms may have selected an efficient larger scale technology but the small size of the domestic market results in the firm operating at higher than minimum cost. Unit cost can therefore be reduced by increasing output since average cost decreases as output increases. In other words, production takes place to the left of the minimum point on the average cost curve, i.e., in that portion of their production function where average cost is declining. If, as Caves (1980) showed for Canadian manufacturing industries and Katz (1969) for Argentinean manufacturing, there are increasing returns in protected manufacturing, import substitution or export promotion policies that increase domestic output would equally result in the lowering of unit production cost. In this instance, and if the degree of scale economies is unequal across firms in the industry, IS may gradually transform industry structure into one of a small number of large firms, thus implying that protection leads to an increase in concentration. This result also corresponds to the evolutionary perspective which suggests that industrial dynamics create unequal incentives among producers that lead asymptotically to an increase in concentration and monopoly (Aoki, 1991). It should be noted that this industry structure has different implications for innovation, employment and comparative advantage than the original multi-firm structure created by protection.[14]

It may be that short-run restrictions to output expansion noted in the development literature may not be due to such factors as the unavailability of physical capital stock.

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[14] It is conceptually possible that scale economies may accrue to the industry and not to any individual firm within the industry, in which case the argument is not valid.

In fact, the evidence points to a chronic underutilization of both capital equipment and labour in developing countries. These elements are commonly viewed as another negative side of IS industrialization, but ones which reinforce the dynamics of IS to increase industry concentration over time. Theoretical developments that consider the dynamic optimization of an objective function posit that temporary overcapacity may be the rational result of producer behavior. Chenery and Westphal (1979) showed that the optimum investment path for production processes with economies of scale in the use of scarce resources leads to optimal overcapacity. A similar point was raised earlier by Winston (1974) who argued that transaction costs and lumpiness of investment decisions result in underutilization of capacity. It has also been observed that practical considerations may force producers in developing countries to expand capacity during periods when foreign exchange is more readily available. Capacity expansion usually takes place after the introduction of some specific line of credit or subsidy that industrialists judge to be temporary. The case in support of the capacity utilization effect of IS on industry concentration is therefore similar to the case of economies of scale. An increase in output may result in an increase in the capacity utilization rate and it may also result in an increase in the measure of industry concentration. The fact that low capacity utilization is significant in protected industries, and that changes in capacity utilization are important components of the relationship between trade policies and productivity, are supported by the studies of Page (1980) for Ghana, Page (1984) for India and others as surveyed by Havrylyshyn (1990). This suggests that the dynamics of technological progress would benefit firms with excess capacity as output increases : firms with large excess capacity would achieve higher reduction in unit cost as output expands. An implication of excess capacity is that EP, IS and liberalization may have similar impacts on the degree of concentration of industries since policy-induced output growth would result in unequal cost reductions across firms due to different degrees of capacity utilization. The impact on concentration would depend on the degree to which the utilization of the excess capacity translate into an unequal distribution of profits and, therefore, on the number of firms in the industry. To our knowledge, this proposition has not been empirically investigated.

Liberalization and R&D

The industry structure created by protectionist measures may be important for the technological success of subsequent trade liberalization policies. If industries that open up to import competition are competitive and with a low degree of concentration, the possibilities for accelerated technological development available to them may be different from the possibilities available to more mature concentrated industries in which large firms play a technologically dominant role. The innovative reaction of firms to trade liberalization may be expected to depend on the degree of concentration in the industry and the degree of competition among producers.

To verify the extent of such dependence, Scherer and Huh (1992) tested an oligopoly model with R&D in which the reaction function of firms with leader/follower behavior plays a central role in the outcome. In an empirical verification of the model, the authors evaluated the R&D intensity of firms at different levels of industry structure employing data for U.S. corporations covering 17 years (1971-1987) and 308 manufacturers. The results provide an insight into the relationship between R&D and concentration which seems to indicate that higher concentration would result in increased R&D spending. They observed that "reactions [to import competition] tended to be more aggressive the more concentrated the markets were in which the firms operated." These results indicate that industry structure and industry behavior may be relevant to the ability of individual firms to accelerate technological growth under different trade policy regimes.

Does Import Substitution Lead to Monopolistic Structure?

Bhagwati (1978), Bhagwati and Krueger (1973) and Krueger (1974) have shown that the indiscriminate nature of IS policies not only allows firms with high and low domestic resource cost to coexist, but that such an industrial structure is liable to result in low productivity growth. Bhagwati and Krueger (1973) hypothesized that a cause of the observed low productivity performance in protected industries may, in some cases, be the monopolistic industry structure created by trade policies which provide little incentive for innovation. These studies have the common characteristic of postulating that trade policies have a direct influence on market structure, and that market structure is, in turn, a factor in the growth rate of productivity. We have so far investigated the relationship between trade policies and market structure. There remains the investigation of how market structure may influence the rate of technological development of industries.

MARKET STRUCTURE AND TECHNOLOGICAL CHANGE

Understanding the relationship between trade policies and market structure, and between market structure and technological change, is crucial to the growth strategy, since one aim of trade policy is to create the necessary conditions for industries to become technologically viable. Yet the dynamics of the relationship between industrial structure and technological progress are only now beginning to be understood. Whether technological change responds to industry structure is an issue receiving much theoretical and empirical attention in the literature of industrial organization. A better knowledge of this issue is both important and timely to the development process because technological progress, recognized as a driving force in increasing the standard of living, may be hindered by the policies frequently intended to improve it.

Schumpeter (1950) suggested that the industry structure most appropriate for rapid technological development is not a competitive one but rather the opposite: monopoly and big firms. Perfect competition may not lead to an optimum industry structure for promoting technological advancement if the innovation process is characterized by externalities, uncertainties and scale economies.[15]

A competing hypothesis about the structure-innovation nexus has been presented by Arrow (1962), who showed that under a different but realistic set of assumptions, the structure most favourable to innovative activity is, in fact, perfect competition. Arrow showed that, in the case of process innovation and the firm's ability to appropriate the full benefit of innovation, a competitive industry provides higher

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[15] In addition, a competitive market structure diminishes the value of research to any one firm, as it reduces the right to appropriate benefits of innovation by the ease of imitation and adaptation of new processes or products by competitors.

incentives to be innovative than a monopoly. This result follows from the model's assumption that competing firms cannot acquire the new technology without incurring costs. The lower incentive to innovate by the monopolist, when both it and the competitor have equal innovation property rights, is due in this model to the monopolist's positive profit compared to the competing firms. A key difference between Arrow's and Schumpeter's results is the assumption concerning the right to appropriate innovations. For Arrow, the benefit accrues totally to the innovator (the firm). For Schumpeter, innovations have the nature of a public good with no cost to any firm except the innovator; thus the lack of incentive for competitors to innovate.

The Schumpeter hypothesis leads to two main propositions about the role of industry structure and innovations. One is that innovations respond to seller concentration. The second is that innovative activity responds to absolute firm size rather than to relative size, as suggested by the first proposition. Both of these hypotheses has been thoroughly tested by means of theoretical models and simulations, as well as empirically on an alternative database for developed country firms.

Concentration and Innovation

Theoretical support for a positive concentration-innovation relation (where R&D expenditures is a proxy for innovative activity) was found by Dasgupta and Stiglitz (1980) in a model in which there are varying degrees of competition not only in the market for output but also in the market for R&D. They found that "...if the present market is dominated by a monopolist, there is likely to be more R&D than when the present market structure is competitive: the reason is simply that in the post-invention market, there will be, as a result, less competition and therefore more profits." Levin, Cohen and Mowery (1985), and many others, found empirical support for this assertion, although they showed that the relationship weakens if interindustry differences in technological opportunities and the suitability of the technological innovation are brought into the analysis. The two factors to which Levin et al. refer are highly relevant to developing countries as we shall see below. Nevertheless, it is important to note at this stage that the studies so far surveyed consider the direction of causality to run from industry structure to innovations, on grounds that higher concentration increases the potential to appropriate the benefits of innovations created by R&D.

The Schumpeterian direction of causality has been challenged by Nelson and Winter (1978). The essence of their argument is as follows: if successful innovators are those firms that search through R&D to generate economic profits, they are likely to grow faster than less successful innovators in the same industry. A natural consequence of technological success is an increase in industry concentration of successful innovators, with the implication for causality in a direction opposite to that postulated by Schumpeter. This possibility is by no means trivial. It is based on the observation that large firms spend more on R&D than small firms. Given the assumption of the Nelson and Winter model that the probability of a firm to innovate is proportional to its share of R&D spending in the industry, the authors were led to conclude that "...there is a tendency for concentration to develop even in an industry initially composed of many equal-sized firms." To support their argument, Winter and Nelson mentioned the study of the airline industry by Phillips (1971). The industry is one of infrequent major technological innovations with considerable strategic advantages for firms to be the first to innovate and therefore, for concentration to be permanently high. Other evidence cited by Nelson and Winter is a study of antitrust cases by Williamson (1972) indicating that technological leadership by a firm can be used to block entry and prevent a reduction in concentration. In a more recent investigation, Levin, Klevorick, Nelson and Winter (1987) concluded that the direction of causality can be either way, since the arguments supporting both directions of causality are equally plausible.

Firm Size and Innovation

The second Schumpeterian hypothesis, namely that R&D is correlated to firm size, also has strong empirical validity. Support for the relationship between firm size and R&D intensity was given by Scherer (1980), and by Kamien and Schwartz (1975).[16] Some found that R&D expenditures tended to increase over a broad range of firms of a certain firm size and then decline for a few, very large firms (Kamien and Schwartz, 1982). But Scherer (1984) and Levin, Cohen and Mowery (1985) had some reservations about earlier studies confirming the hypothesis that firm size and innovations increase simultaneously, basically for the same reasons why they found limited support for the first Schumpeterian hypothesis: the influence of technical opportunity and suitability of the innovation. But not all agree that there is a positive relationship. Bound, Cummings, Griliches, Hall and Jafee (1982), in a study on the relationship between sales, R&D and patents, found higher R&D intensity in small and

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[16] For a recent survey of the literature, see Griliches (1990).

large enterprises and lower intensity in medium-size U.S. firms. Similar results were also found by Cremer and Sirbu (1978) for French firms, and by Pavitt, Robson, and Townsend (1985) for British firms. Audretsch and Acs (1991) found support for a U-shaped relationship and pointed to the fact that previous researchers used a truncated database which eliminates small firms from the sample, and were therefore unable to detect the declining portion of the U-shape relationship.

By itself, the observation that R&D and firm size are correlated cannot be interpreted as linking firm size with firm innovations. The link is established by the efficiency with which R&D expenditures translate into more efficient production processes and lead to unit cost reduction and product innovation. The research in this area "...indicates that by and large there is no economies of scale with respect to firm size in the invention process" and that "... the largest firms generally appear to be far less efficient innovators than smaller rivals" (Kamien and Schwartz, 1975) as reflected in a smaller number of patents per dollar spent on R&D.

Structure and Innovative Output

The use of R&D as a measure of innovation activity suffers from a number of limitations that may blur the validity of general conclusions. One of these limitations is that R&D is an input, not the output of the innovation process. A second is that R&D may not completely reflect innovation activity in so far as it only measures formal effort, ignoring many other forms of innovative activity taking place within the firm. For these reasons, a number of investigators prefer to study the relationship between market structure and innovations by focusing on measures of innovative output, such as patenting activity and the profitability of licensing agreements to the innovator.

In the case of patenting, firms may have other incentives to apply for patent protection, in addition to the profit motive, that would depend on firm size and market structure. The propensity of firms to patent may not vary with firm size because firms that have large market shares may prefer secrecy to patenting since competitors may find profitable information in the patent application and may adapt or imitate the original patent without incurring licensing costs (Horstmann, MacDonald and Slivinsky, 1985). Alternatively, patents may also be instrumental in preventing entry by competitors, in which case the larger the firm, the higher the incentive to innovate. The extent to which one behavior dominates the other may be observed empirically. Schmookler (1966) found a positive linear relationship between patenting activity and sales at the firm level. Similar conclusions were also arrived at by Scherer (1983, 1965), Hausman et al. (1984), Pakes and Griliches (1984) and Bound et al. (1982). These studies would seem to support the Kamien and Schwartz (1975) finding of little or no economies of scale in the innovative process when using the R&D concept, but not their other finding that innovative activity declines at very large firm size.

But, in general, researchers using patenting data as a proxy for innovation activity are likely to arrive at similar conclusions as those employing R&D data. This is due to the close correlation between the two variables found by Bound et al. (1982), Pakes and Grilliches (1984), and Hausman, Hall and Grilliches (1984). Similarly, the positive association between R&D and concentration mentioned above has also been found to hold for the relationship between patenting and industry concentration by Gilbert and Newberry (1982).

A potential shortcoming of the findings based on patent data is that not all patents have the same economic significance as evidenced by the number of patents that are not implemented (or renewed) and by those patents which imply minor design modifications. A better understanding of the patenting-concentration and the patenting-firm size relationships may therefore be gained by subsamples of patents referring only to process innovations. For a sample of 24 U.S. chemical products, Lieberman (1987), confirmed the finding that "... the volume of patenting is related to firm sales." It was also found that "Producer patenting increased with firm size and market share but decreased with market concentration and the total sales of rival producers", and that "Patenting by non-producers was positively related to market size but negatively influenced by producer concentration." Thus both producer and non-producer patenting were found to be negatively related to industry concentration.

These contradictory findings once more raise questions about the validity of patenting as a proper indicator of innovative output. The study by Lieberman mentioned above did not treat patents as homogeneous commodities, i.e., it made a distinction on the basis of the relative importance of patents. An interesting aspect of patenting, and one which reflects their heterogeneity, is that the reward to the innovator is not constant for all patents, thus providing a measures of the relative market importance of the innovation activity. Kamien and Schwartz (1982) in an extended version of Arrow's model in which the industry behaves as a Cournot oligopoly, showed that the reward to the innovator increases with the number of firms that license the innovation. If firms in the industry behave in a game-theoretic fashion, Kamien and Tauman (1985) showed that the relationship between rewards and the number of licensed firms is not linear. Rather, the ability of the innovator to extract higher rents is maximized when there are many but not an infinite number of producers. These theoretical results do not support the Lieberman's (1987) conclusion of a negative relation between concentration and patenting.

Innovative Output and Productivity

The process of innovation activity may not by itself give rise to increases in the productivity of the firm or the industry. In some instances, innovation activity is directed at product innovations that. while having the potential to temporarily increase profitability, do not necessarily result in cost reduction. For most of the first half of this century, lower unit costs were the result of technical change that increased the size of production runs in such a way to attain lower cost at higher levels of output. More recently, technological improvements have been oriented toward qualitative changes and product diversity, i.e., to product innovation. In Canada, for example, R&D expenditures are by and large product-oriented rather than process-oriented (Economic Council of Canada, 1983). Canadian firms which traditionally had short production runs and higher product diversification in relation to their U.S. counterparts have relied on specialized production as a source of competitiveness while protected by tariffs. Successful industries in other countries also attest to the importance of unique product characteristics. Italian steel producers were not able to compete internationally after the Second World War, but regained domestic market share by specializing in specialty steel products made possible by the development of the mini-mill technology.

While quality improvements may be accompanied by development of new technologies with obvious implications for productivity growth, the general relationship between product innovations and productivity is more subtle. Consider a firm whose output consists of a product with a bundle of characteristics valuable to consumers. Product innovation may result in the incorporation of one or more new characteristics to the product. For technological progress to take place as a result of the innovation, the unit cost of producing the old characteristics should have declined. This may or may not be the case for all product innovations unless there are economies of scope in the production of some or all original characteristics with the existing technology. In a dynamic sense, productivity growth resulting from product innovations may take place if the new characteristics are subject to accelerated cost reductions resulting from future process innovation.

Learning by Doing and Patenting

The empirical study of the link between innovation and productivity has suffered from the lack of estimates of multifactor productivity at both the industry and the firm levels. In developing countries this problem is aggravated by lack of data, particularly, the capital stock data. Due to this limitation, many growth and trade models employ cumulative output as a proxy for productivity growth, on the grounds that it represents the accumulated knowledge of the firm or the amount of human capital gained as a result of "learning by doing". A related analytical tool common in the industrial organization literature for the analysis of market structure is the learning curve. The concept is analogous to that of cumulative output, representing the accumulated stock of knowledge of the firm resulting from past experience in producing the output. A basic assumption of the learning curve is that knowledge will accumulate forever and that none of the acquired knowledge will depreciate over time or become obsolete.

The learning curve concept has been applied to the theoretical analysis of concentration and the number of firms in industries with increasing demand for their output in order to test if the number of firms in an industry will expand or contract with increases in demand. A demand increase would reduce concentration and possibly shift the industry learning curve downwards. At a theoretical level, Hall (1984) showed that this expectation is warranted only if the increase in demand is unanticipated. If, however, there is perfect foresight and the increased output demand is fully anticipated, the optimal industry response would result in a reduction in the number of firms. With anticipated growth, the cost-minimizing reaction of firms is to overexpand in order to capture as large a share of output as possible to realize cost reductions due to learning and thus to increase their competitiveness. Thus, where foresight prevails, industry concentration may increase rather than decrease as a result of an increase in demand.

At the empirical level, the influence of cumulative output on productivity has been analyzed in a number of studies that confirm its explanatory powers in several industries [Lieberman (1984), Stobaugh and Townsend (1975), Alchian (1963), Rapping (1965) and Preston and Keachie (1964)]. Lieberman (1987) tested the relationship between learning by doing and patenting and found that "Producer patenting was stimulated by growth in cumulative industry output" and that rapid productivity growth was "...strongly linked to industry cumulative output", thus confirming the validity of the cumulative output concept found by many others.

In another line of research, a few authors have attempted to analyze the effect of patenting on productivity directly by means of production functions. Griliches (1990) surveyed previous research and pointed to almost insurmountable difficulties at both the conceptual and measurement levels. His own conclusion showed scepticism about the production function approach to properly analyze the relationship: "At the moment, the lack of relevant data and the conceptual poverty of our models are the major impediments to progress in this area."

Do These Results Apply to Developing Countries?

In concluding this chapter, we consider the extent to which results of economic research into the nature of technological progress are comparable among countries. In particular, we are interested in the relevance to developing countries of conclusions drawn from research on developed countries. In a study of 200 largest manufacturing firms in Argentina reporting R&D outlays, accumulated R&D per employee for the period 1960 to 1968 was found to be positively correlated to productivity performance (Katz, 1976). A similar relationship between R&D and productivity in manufacturing has also been observed for the U.S. by Nadiri (1979). There is further Argentine evidence that resembles developments in the U.S.. Katz (1976) studied the link between patenting by multinational corporations and their sales. Using regression analysis on a sample of 12 large foreign subsidiaries, a positive and statistically significant relationship was found in eight of the firms. Similar results for the U.S. were found by Schmookler and Griliches,[17] which provides some support for similarity between developed and developing countries as far as technological behavior is concerned. But the similarity seems to end with these studies.

The industry structure of the Argentine manufacturing sector resulting from long

[17] In Katz (1976), page 168.

periods of import substitution is now characterized by a small number of relatively large firms of foreign origin (or foreign control) which accounts for a large share of the domestic market, and a large number of indigenous firms with a smaller share of the market. Together with this, we observe a rather moderate rate of productivity growth, with foreign firms having larger R&D expenditures. If one were to draw a parallel between the empirical results for other countries and those for Argentine manufacturing, one may conclude that, while the larger size of foreign firms explain their relatively higher R&D, they and the middle-size domestic firms in sectors afforded a protected environment fail to show a substantial innovation effort.

In view of the above, we suspect that while IS industrialization has created the necessary conditions for rapid technological progress, these conditions appear to be insufficient to produce above-average technological advance. Witness, for example, the proliferation of EP policies in a number of countries, including Argentina, as evidence of the failure to attain world market competitiveness by means of substitution alone.

In developing countries, technological knowledge has a dimension not shared with developed countries: its availability. Developing countries can obtain technological know-how either by developing their own indigenous techniques or by acquiring foreign technological knowledge via a number of well-known mechanisms. Opting for the foreign alternative may inhibit the creation of domestic technologies and hinder indigenous innovation. We may mention two possible repercussions of technological availability from abroad. First, availability may curtail the learning-by-doing process, or even eliminate it altogether, thus perpetuating the technological superiority of foreign firms. Second, foreign holders of technology have a vested interest in minimizing domestic technological development with a view to maintaining their monopoly power and leadership. The Argentine experience of foreign technology imports and foreign patenting laws provides some evidence in support of both the above repercussions. Many transfer-of-technology contracts contain clauses that effectively restrict domestic technological development. Copper (1980) cites the case in which Argentine plastic fabricators with foreign process agreements were prevented from buying locally developed equipment. Further evidence of contractual clauses limiting domestic technological improvements have been found by Vitelli (1979). In addition, Argentina's adherence to the Paris Agreement on intellectual property rights has been criticized as being contrary to domestic interests since the Agreement allows foreign firms to patent their inventions in Argentina, thus making it difficult for domestic inventors to adapt or modify existing technologies (Katz, 1972a,b).

Importing technology, generally encouraged in IS regimes, may not only diminish domestic technological development, but may also adversely affect the export performance of firms willing to export products produced with the imported technology. A detailed analysis of licensing contracts of technology in a number of countries indicate that a large proportion of them contain special clauses which effectively prohibit or restrict the export of products manufactured under license. Diaz (1972) observed that in Colombia, Chile, Perú, Ecuador and Bolivia, such restrictive clauses appear in between 66% to 83% of all transfer of technology contracts. Argentina shows a similar pattern, although restrictions are not as common as in other Andean Group countries. Katz (1976) observed that "approximately 30% of licensing contracts in Argentina explicitly prohibit the exporting activity of domestic firms."

Slow technological development may also be due to the lack of technological opportunity, i.e., the extent to which basic scientific knowledge affects the innovation process. If technological opportunity is an important factor in innovations, as often suggested, trade policies may be judged as detrimental to technological development because hey encourage import of process/product technologies, i.e., technologies at the very end of the innovation process, as opposed to basic knowledge which may be central to the innovation process.

The essence of the technological opportunity argument lies in the causal relationship between knowledge, innovation and the market for final products. ./e can explore this causality by posing the following question: does the oevelopment of basic scientific knowledge create opportunities for innovation at the process/product level? If this is the case, there may not be a strong relationship between human needs and innovations since basic scientific research is, in many ways, removed from market forces. Or is it that acquisition of basic knowledge responds to economic incentives originating in the market place, to the extent that firms engage in basic research to develop new processes and products? On the one hand, basic scientific research with no immediately apparent commercial application is pursued not only by universities and government agencies, but also performed by large commercial enterprises as part of their ongoing R&D program into basic sciences. On the other hand, some evidence that basic knowledge is largely exogenous though essential for high levels of innovation was provided by Scherer (1984).[18] Schmookler (1966) showed that the availability of basic knowledge does not provide an incentive to create inventions leading to patenting; rather, the intensity of patenting activity responds to economic stimulus from market forces. These results suggest that, by and large, there is little

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[18] See also Scherer (1980) and (1965).

economic rationale for private firms to engage in basic scientific research. This leaves us with the conclusion that the bulk of basic scientific research is to be carried out by government institutions and/or financed by public funds, a conclusion which accords with the nature of basic knowledge as a public good.

The relevance of these results to developing countries is as follows: reliance on the market mechanism created by IS industrialization and the expansion of output created by EP may not be sufficient for domestic technological progress unless it is complemented by parallel inflows of basic knowledge transfer and development that may act as a catalyst in domestic technological growth. Cibotti and Lucangeli (1980) suggested that the "follower" or "adaptive" type of indigenous technological development might be the result of the lack of sufficient basic scientific knowledge in Argentina. Such basic knowledge development may have to be undertaken by government for subsequent diffusion to the ultimate user in private industry. The Argentine case seems to follow these lines.[19]

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[19] The country has government-run research establishments for the development and transfer of basic knowledge. the most important ones being INTI (Instituto Nacional de Tecnología Industrial) and the INTA (Instituto Nacional de Tecnología Agropecuaria). For a critical evaluation of the role of INTA, see De Janvry (1978) and references therein.

CHAPTER II

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INTRODUCTION

Argentina has a long history of government intervention in the economy. The central government has exercised control over tariffs, foreign investment and domestic credit ever since the independence in 1810. Different political regimes have implemented economic policies that varied the intensity of intervention, but not its essential nature. Chapter II will provide the reader with an overview of the main economic regimes that have influenced foreign trade and the growth and development of domestic manufacturing industries. The objective in this chapter is to evaluate the main economic forces as a backdrop for estimating the models and interpreting their results. Concurrently, consideration will be given to the influence of policy instruments in determining trade flows and changes in the structure of manufacturing industries.

THE TARIFF AND THE DEGREE OF PROTECTION

Although Argentina has traditionally been considered an agricultural country, the manufacturing sector has grown in importance during most of this century. By the year 1900, agriculture contributed one-third of gross domestic product while manufacturing made up only 14%. Mainly because of protectionist measures, manufacturing was able to grow rapidly, and by 1930, its share in GDP was almost as important as that of agriculture. By the 1960's, the importance of manufacturing relative to agriculture was the reverse of the situation in 1900. Table I shows this reversal as well as the contribution of other sectors to the Argentine domestic product.

In terms of foreign trade, agriculture and agriculture-based products have continued to dominate exports. In 1910-1914, agricultural products represented 98% of all merchandise exports, a share that remained substantially unchanged until recently. As of the 1960's, agriculture accounted for as much as 96% of total exports. In terms of growth, however, manufactured goods out performed other exports by a wide margin, even though they were affected by substantial cyclical variations. Table II illustrates the growth experienced in the main export sectors.

The growth of the manufacturing sector has largely been the result of long-standing protectionist policies. Since about 1930, a highly protectionist system has existed in Argentina to accelerate domestic industrial production and to displace manufactured imports. The philosophy behind the protectionist regime was that the rest of the world markets cannot provide sufficient opportunities for sustained long-term economic growth.[20] This perception was derived from intermittent difficulties in foreign markets for agricultural exports and the virtual impossibility of expanding industrial production by any alternative other than import substitution.

In addition to tariff, the protectionist regimes had four main characteristics:

a) the control of international capital flows for purposes of industrial investment;

b) the fixing of interest rates by the central bank;

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[20] The "export pessimism" of the 1930's. See De Pablo, 1977.

TABLE I

STRUCTURE OF ARGENTINE GDP, 1935-1976
(Percentage of total at 1960 prices)

	1935	1945	1955	1965	1973
GDP at factor cost	100.0	100.0	100.0	100.0	100.0
Agr.,Livestk.,Fishing	29.0	23.0	19.2	16.0	12.3
Mining and Quarry	.4	0.7	0.7	1.4	1.6
Manufacturing	25.7	30.4	29.2	33.9	37.9
Construction	2.9	3.6	3.8	3.2	4.0
Public Utilities	0.7	0.8	1.1	1.8	2.6
Transp., Stge., Comm.	6.2	6.7	8.0	7.7	7.3
Commerce	19.2	16.5	18.5	18.1	17.5
Financial Services	3.7	3.9	4.1	3.6	3.5
Other Services	12.1	14.4	15.4	14.3	13.3

Sources: Columns 1, 2 - BCRA, Cuentas Nacionales de la República Argentina, Series Históricas, Vol.III, 1976, pp. 148-149.
Columns 3, 4 and 5 - BCRA, Sistema de Cuentas del Producto e Ingreso de la Argentina, Cuadros Estadísticos, Vol. II, 1975, pp. 120-121.

TABLE II

GROWTH OF EXPORT VOLUME
(Average annual percentage growth rate)

	1953-60	1960-66	1966-73
Primary Products	0.2	6.3	7.8
- Traditional	0.7	6.7	6.9
- Nontraditional	- 3.4	3.6	14.0
Manufactured Goods	- 11.7	14.6	33.5
Total Exports	- 0.6	6.7	10.8

Source: Balassa (1982), p. 45.

c) the implementation of credit rationing and;

d) a redistribution of wealth from the agricultural to the industrial sector via tax legislation.

During the years after the Second World War, the structure of protection was reinforced. Building on the basic structure of the 1930's, tariffs were set at prohibitive levels for some imported final goods and a system of import licenses was implemented, resulting in a wide dispersion of effective protection rates for the manufacturing sector. Unlike the 1930's and the early 1940's, when protection consisted primarily of import duties and exchange control, the authorities imposed quantitative restrictions in the second half of the 1940's. These were kept in place until 1959. Import restrictions were often based on past experience and, as a result, hindered the creation and expansion of new industrial establishments with no previous import record. During the second part of the 1950's, some bilateral trade agreements were terminated, and in 1958, import restrictions were vigorously imposed to contain domestic inflationary pressures and balance of payments problems that were associated with an aggressive expansionary policy. There was, however, an overall liberalization of imports between 1956 and 1958, in particular of intermediate and capital goods, as a result of duty exemptions and corporate income tax concessions.

The first attempt to estimate the structure of protection in Argentina was made by Balassa for 1958, after a decade of intensive import substitution efforts by the Peronist regime. Balassa's findings indicated that industries such as textiles, clothing and shoes, food and beverages, and lumber, were granted the highest effective tariff: more than 400%. This is illustrated in Table III.

TABLE III

NOMINAL AND EFFECTIVE TARIFFS
Argentina, 1958

	Nominal Tariff		Effective Tariff	
	Weighted	Unweighted	Weighted	Unweighted
Agriculture	0	0	-6	-6
Livestock	0	0	-8	-8
Hunt., Fishing	52	52	45	45
Mining	32	32	27	26
Fuels and Electr.	49	49	40	40
Food and Bev.	73	78	531	788
Meat and Prep.	0	0	-4	-4
Tobacco	0	0	-3	-4
Textiles	284	235	3186	1024
Clothing, Shoes	302	288	472	806
Lumber	186	196	448	538
Paper, Cardboard	88	126	121	235
Printing, Publ.	77	80	73	65
Chemical Products	119	129	270	313
Rubber	151	153	278	316
Leather & Skins	0	0	-18	-16
Stones, Ceramics	87	84	94	84
Metals	128	155	264	371
Vehicles, Mach.	134	149	165	185
Electrical Mach.	154	146	256	193
Other Industries	202	189	279	251

Source: Balassa (1970) p. 76.

The effective tariff rates of Table III may be considered typical of the post-war years, although individual industry variation is to be expected for different years. This is especially true for machinery and equipment, which were granted variable protection "as imports of these goods were regarded by authorities as the margin to be cut or expanded according to the exchange left after imports of raw materials and intermediate goods were taken care of." (Diaz-Alejandro, 1970, p. 256)

The period between 1958 and 1962 may be considered "structuralist" years.

Economic policy makers were concerned with the process of long-term growth and showed a relative disregard for short-term measures that had, in the past, an adverse impact on the long-term process of industrialization. They made efforts to overcome development crises such as recurring balance of payment difficulties and the stop-go cycles characteristic of previous political regimes. Fundamental changes in the tariff structure took place. The economic strategy that began in 1958 benefited from previous foreign investment legislation that attracted substantial foreign capital and new technologies. The inflow was directed primarily towards import substitution activities, and secondarily to the establishment of new firms in the rest of the economy. At the domestic level, competition increased between producers who benefited from the capital and technology inflow and those who did not. A duality in the production structure developed. On the one hand, a number of establishments were equipped with more efficient financial, administrative and production techniques while other manufacturers had to resort to some form of association among themselves, namely increasing corporate concentration along vertical lines, or ceasing production. In general, structuralist policies were concerned with strengthening the process of industrialized growth which in Argentina was not restricted to the expansion of the import substituting sector. However, structuralist policies may have conferred higher benefits to import substituting firms, but the effect that the production duality may have had on the performance of domestic firms according to their trade orientation (import substitution or exporting) is not known.

Argentina did not undertake substantial reform of the tariff structure for a number of years, although other policy instruments had an important effect on foreign trade. In 1966, mainly because of the currency devaluation after the military came to power, the tariff was reduced once again, but its effect was not sufficient to fully compensate for the devaluation and imports fell.

The philosophy of the new economic authorities differed substantially from that of their structuralist predecessors. Between 1967 and mid-1969, economic policy was dominated by the monetarist school of thought. The authorities attempted to stabilize the economy by controlling inflation, eliminating the fiscal deficit and increasing reliance on market mechanism for the allocation of resources.

In March of 1967, the government introduced a new economic package aimed at removing economic obstacles to capital accumulation and growth: legislation included an initial 29% devaluation of the peso. The price of traded goods was modified at the margin by applying an export tax and reducing tariffs; the tariff itself was thoroughly revised and its structure simplified. The 1967 tariff reform lowered the overall effective protection rate. This is reflected in the 1969 estimates of the degree of protection made by Berlinski and Schydlowsky[21] shown in Table IV.

Although the Berlinski and Schydlowsky results are not comparable by industry to Balassa's 1958 estimates, the overall pattern indicates a general reduction in average protection and, in particular, a tariff reduction for capital goods. This last change in the tariff structure was designed to take advantage of the sector's capacity to unblock the foreign exchange bottleneck, after all previous attempts to lower the import coefficient had failed.

Following the devaluation of the peso in 1971, a 15% surcharge was imposed on the exchange rate applicable to imports, which was equivalent to a further devaluation

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[21] A detailed presentation of their estimates, as well as a description of the economic environment in Argentina as of 1969, may be found in Balassa (1982), Ch. 5.

of the import peso. In 1972 and subsequent years, successive devaluations led to increased pressure from trade unions to maintain the real purchasing power of wages.

TABLE IV

NOMINAL AND EFFECTIVE PROTECTION RATES BY INDUSTRY, ARGENTINA, 1969

Industry	Nominal Protection	Effective Protection to Value-added: Balassa	Effective Protection to Value-added: Corden
Agriculture, Forestry and Fishing	-10	-13	-13
Mining and Energy	30	32	26
Primary Activities	-6	-9	-9
Processed Foods	2	24	35
Beverages and Tobacco	50	87	70
Construction Materials	29	31	27
Intermediate Prods. I	51	132	109
Intermediate Prods. II	67	122	96
Non-d. consumer Goods	56	48	42
Consumer durables	88	144	112
Machinery	87	117	105
Transport equipment	109	207	148
Manufacturing, less Beverages & Tobacco	51	98	78
Manufacturing	51	97	78
All Industries, less Beverages & Tobacco	35	46	40
All Industries	36	47	49

Source: Berlinski and Schydlowsky, in Balassa (1982).

The resulting conflict between the unions and the government led to a spiralling inflation and balance of payment difficulties. In response to the latter, the government reintroduced a series of administrative procedures designed to limit imports, such as the "Certificate of Need" (required prior to importation) and other ad hoc restrictions.

The tariff structure remained virtually unchanged from 1970 to 1976. A clear discrimination existed against import of goods for which there were domestic substitutes, especially for consumer goods. According to Berlinsky,[22] the highest protection was given to textile fibres and threads, iron and steel and minor items such as motorcycles and scientific instruments. However, there is evidence that an important proportion of imports was exempt from duty as they were brought into the country under special concessions. Sourroville noted that despite a nominal protection rate as high as 90%, total imports had in fact an average tariff rate of between 20 and 30%.[23] It was mentioned that in Argentina, imports of capital goods for large industrial complexes (whether under private or public ownership) were allowed into the country under special legislation exempting them from tariffs and other levies. Thus, estimates derived from the tariff structure tend to bias sectoral estimates, especially in capital goods sectors.

THE EXCHANGE RATE AND BALANCE OF PAYMENTS MANAGEMENT

The Argentine government has controlled exchange rates since 1931. At that time, government intervention took the form of fixing, through the central bank, the exchange rate applicable to certain imports and to most exports.

There have been periods of strict control and periods of liberalization. The former consisted mainly of rate fixing by the authorities, which created a peripheral market in foreign currencies at a higher peso rate in relation to the dollar. On occasion, the

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[22] In Canitrot (1981), p. 138.

[23] Also in Canitrot (1981), p. 138, footnote 3.

market was allowed to find its own level, the government's role limited to eliminating speculative fluctuations and ensuring the orderly functioning of the foreign exchange market.

A system of multiple exchange rates based on types of foreign transactions has existed since 1934. Under the system, the central bank sets the so-called "free rate" (which, incidentally, was not so), and the special rates for imports and exports. Preferential exchange rates were given to imports of raw materials and intermediate products. According to Diaz-Alejandro (1970), "this subsidization of some imported inputs was specially marked during 1948-53 and less important in earlier and later periods."

Immediately after the Second World War, Argentina had an unusually high level of foreign exchange reserves due to the accumulation of food export earnings during the conflict, and the simultaneous unavailability of industrial imports. Some of these reserves were channelled explicitly towards industrialization. However, by the late 1940's Europe's recovery in food production had adversely affected Argentine agricultural exports. In addition, the purchase of British investments in Argentina and industrial expansion projects had exhausted the reserves, leading to a balance of payment crisis in 1951. The crisis was averted by managing the multiple exchange rate and imposing wage and price controls. A mild recession that followed affected domestic manufacturing demand because of the increase in the relative price of domestic food.

Substantial government intervention in the economy and a policy of subsidies distorted the relation between the official and the free market value of foreign exchange. By 1950-51 the official peso was substantially overvalued, a situation that led inevitably to the December 1958 devaluation of the official peso from 18 to 83 pesos per dollar, that is, to a level similar to the free market value at the time.

However, it was not until 1960-61 that the free and the official exchange levels reached parity at approximately 83 pesos to the dollar. Nevertheless, by April 1962 the peso had to be devaluated a further 65% as central bank reserves were depleted. The move created a decline in the level of domestic demand and a severe (by the standards of the time) inflation rate in the order of 26% annually.

One of the causes of the 1962 devaluation was Argentina's reliance on short-term capital inflows to finance the expansion of the industrial base. The origin of this policy may be traced as far back as 1953, when Congress enacted foreign investment Law 14222. The "desarrollista" government of the time embarked on an ambitious program to attract foreign investment, using new legislation and an aggressive campaign in Europe and the U.S.. Talks were held with foreign investors on the construction of automobile and tractor plants in Argentina and of oil and gas exploration and production. This process continued throughout 1956 and 1957 and reached its peak in 1958-1961. By then, repaying and servicing previous debt had substantially influenced the balance of payments, a situation that was further aggravated by the import content legislation that restricted new industrial activities. Table V illustrates this point.

Balance of payments difficulties were recurrent in Argentina during the 1950's. Between 1955 and 1965, the country renegotiated payment of foreign debt with major creditors three times. During the 1960's, the service of all foreign debt (public and private) strained the balance of payments and forced policy makers to apply short-term solutions such as devaluation and exchange and trade controls, as occurred in 1955, 1958 and 1962.

TABLE V

ARGENTINE BALANCE OF PAYMENTS, 1951-1965
(Yearly Averages in Million U.S. Dollars)

	1951-55	1956-58	1959-61	1962-64	1965
Merchandise Exports	988	1971	1017	1331	1541
Merchandise Imports	-1121	-1224	-1234	-1138	-1160
Trade Balance	-131	-253	-217	193	381
Net Profits & Interest	-18	-20	-66	-81	-120
Net Other Services and Transfers	19	42	23	-113	-43
Net Private Capital	53	82	229	-48	-182
Net Long-term Financial Capital	13	-49	68	-43	-21
Official Short-term Capital and Monetary Gold	65	207	-36	91	-11
Errors & Omissions	0	-10	-2	1	-3

Source: Diaz-Alejandro (1970), p. 354.

During 1963, the exchange rate fluctuated and the annual average value of the peso increased to 139 pesos to the dollar. In relation to its real value, the peso began to show a growing tendency toward overvaluation. By the end of 1964, the overvaluation of the domestic currency was difficult to sustain and a new devaluation to 172 pesos to the dollar was announced in April 1965.

The government that took power in 1966 introduced a dual foreign exchange regime consisting of a "financial" and a "commercial" exchange rate. The financial rate was allowed to fluctuate in a crawling peg fashion to reflect true market conditions, while the commercial rate was subject to official control. The new market segregation afforded the government greater flexibility in its conduct of foreign trade initiatives. Service transactions such as travel and tourism were channelled through the higher financial market, while imports and exports of goods were diverted for the most part to the commercial market. By allowing variable proportions of foreign trade transactions to be negotiated in one or the other market, a finely segregated system of foreign exchange rationing was created, one that could be easily tuned so as to obtain desired results in a specific trade category with a minimum of distortion in other categories.

Since then, central bank intervention in the market and exchange controls have been tightened. These, once again, accelerated the overvaluation of the peso. In March 1967, it was devaluated to 250-350 pesos to the dollar. This devaluation did not place the peso at equilibrium with the dollar in real terms; the overvaluation continued up to 1969.

At the beginning of 1971, the peso was devalued again to 350-400 per U.S. dollar, mainly as a result of accumulated domestic inflation over the previous three years not matched by growth in foreign exchange reserves. To offset the devaluation, the authorities introduced compensating trade taxation measures, but by the end of 1971 they were abandoned. A similar situation was the main cause of the 140% devaluation that took place in mid-1975. During the period between the two devaluations, foreign exchange reserves rose due to the increase in world prices of Argentine exports. However, by the second half of 1974, the terms of trade began to deteriorate and the overvaluation of the peso continued to rise.

The management of the foreign exchange market in Argentina may be characterized by ad hoc response to short-term economic constraints. The market was influenced by the desire to compensate for disequilibrium in foreign exchange (such as balance of payment crises, export difficulties or import increases) rather than by the desire to act as a mechanism for long-term economic growth. On occasion, the authorities seemed willing to create and maintain prolonged overvaluation of the peso in relation to the U.S. dollar. In a study by Organización Techint (1979), it was found that, except for short periods of time, the peso was substantially overvalued from 1935 up to the end of 1978. It was not until attempts at liberalization began in March 1976 that the situation reversed, resulting in an unprecedented undervaluation of the domestic currency.

CREDIT POLICIES FOR INDUSTRIALIZATION

One of the instruments used to nurture Argentine industrialization has been the selective granting of bank credit by official and private banks and financial intermediaries. The Central Bank, founded in 1935, exerted control over credit and interest rates through the main commercial banks such as the Banco de la Nación (founded late last century) and the Banco Industrial (founded in 1944). These banks plus other national, provincial and municipal banks accounted for close to two-thirds of all loan activity in the country; other private banking and financial companies made up the remaining.

During the years immediately after the Second World War, the Banco Industrial actively supplied credit to industry. Between 1944 and 1953, it concentrated primarily on small establishments in industries like food, beverages, tobacco, textiles and clothing. The Banco Industrial's share of all banking loans and credit advances to industry rose from 22% in 1946 to 78% in 1949. In later years, its importance declined, providing 53% of loans to industry in 1951-55, and 10% in the early 1960's.

Credit was crucial to the development of industries in Argentina since, as a rule, it was available at negative rates of interest. The cost of credit was one of the fundamental parameters in entrepreneurs' decisions to expand capacity and accumulate inventories. The easy availability of credit was an important source of funds: a survey of 285 major manufacturing corporations during the 1956-60 period indicates that bank credit represented 35% of all sources of funds. Smaller firms acquired a larger proportion of their funds from other non-bank sources since, unlike the 1940's, credit was rationed in the 1950's and 1960's. The ensuing practice of granting credit on the basis of historical record or ad hoc favouritism, according to Diaz-Alejandro, (1970, page 262): "...strengthened established firms and delayed the entry of new entrepreneurs into either new or already existing activities hampering both backward linkage and efficiency in old activities."

Extending credit also benefited exporters of nontraditional products, such as manufacturers. In 1963, exporters of nontraditional goods were provided with credit of up to one year and 60% of the F.O.B. value at an interest rate of 8%. Similar terms were established for financing export sales. Capital goods exports were financed up to 85% of their F.O.B. value and for terms of up to eight and a half years. Foreign sales of durables and semi-durables had an 80% ceiling and a three year term maximum, while other nontraditional exports had a maximum of 80% and a shorter term, of up to 18 months. In 1965, a special line of credit to exporters of nontraditional goods was available at a rate of 12% for up to 180 days and 30% of export value, at a time when the prime bank rate was as high as 19%.

Credit policy was also influenced by the need to control cost inflation and, in periods of slack demand, to obtain full employment. Consequently, credit authorities often sought to stimulate private sector activity by augmenting the flow of credit for acquisition of capital goods by the industrial sector, as well as for domestically-produced consumer durables. Other special arrangements consisted of special credit to companies that agreed to participate in price restraint programs in times of high inflation. As of 1969, bank credit was available to promote basic industries such as steel, aluminum, petrochemicals, paper and chemicals. A cross-sectional analysis of the availability and use of credit at subsidized rates in the industrial sector of Argentina indicated that it was not uniformly available (Balassa, 1982). On the contrary, substantial variations existed and they mainly favoured industries like processed foods, leather and non-electrical machinery. This is illustrated in Table VI.

In assessing the extent to which industry was subsidized in Argentina, it should be noted that both the commercial rate and the extra-bank credit rate referred to in Table VII were also subsidized. If one compares the nominal rate of interest to either the consumer price index, a substantial negative rate of interest emerges. A study of the real interest rate in Argentina for the period 1935 to 1979 (Organización Techint, 1979) compared the most representative rates of interest[24] with credit rates for different time periods. In real terms, substantial negative rates held for most of the 44 years.

"Official" credit to industry was available, for the most part on a long-term basis,

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[24] These pertain to deposit rates between 1935 and 1945, fixed-term deposits between 1950 and 1966, commercial discount rates of financial intermediaries for low-risk companies between 1967 and 1975, 180 day fixed-term transferable deposit rates in 1976 and 30 day fixed-term deposits thereafter.

although there were periods like the years between 1976 and 1979 when short-term lending was the rule. With the acceleration of inflation and with a long history of stop-go cycles in industrial production, lending institutions, particularly privates ones,

TABLE VI

SOURCES OF CREDIT BY TWO-DIGIT INDUSTRY GROUP, 1969
(Percent)

SIC	Industry	Bank Credit Subsidized	Bank Credit Commercial	Extra-Bank Credit
20	Processed Foods	10.3	57.4	32.3
21	Beverages	1.5	72.4	26.1
22	Tobacco	3.6	73.9	22.5
23	Textiles	3.9	67.0	29.1
24	Shoes & Apparel	.6	70.3	29.1
25	Wood & Wood Prods.	2.2	50.3	47.5
26	Furniture	.6	51.9	47.5
27	Pulp & Paper	2.3	50.4	47.3
28	Printing & Publ.	2.2	39.2	58.6
29	Leather	27.3	44.4	28.3
30	Rubber	.6	58.6	40.8
31	Chemical Products	3.6	69.7	26.7
32	Petroleum & Coal Products	.1	16.0	83.9
33	Non-metall. Minerals	.6	41.0	58.4
34	Basic Metals	3.8	71.5	24.7
35	Metal Products	1.1	74.2	24.7
36	Non-electrical Machinery	12.7	51.4	35.9
37	Electrical Mach.	.6	60.3	39.1
38	Transport Equipment	1.5	62.6	35.9
39	Miscellaneous Manufactures	1.3	39.1	59.6

Source: Balassa (1982), p. 95.

concentrated on short-term lending in more recent years. The unavailability of long-term financing for needed industrial growth worsened after 1976. The financial reform of June 1977 liberalized credit restrictions, a move responsible for a further reduction in available long-term credit. As a result, capital investment in the private sector was largely financed by foreign sources and denominated in foreign currency.

FOREIGN INVESTMENT POLICIES

From the 1930's to the mid-1950's, the amount of new private foreign investment in Argentina was minimal which, incidentally, coincides with negligible growth of labour productivity in the domestic manufacturing sector. The reasons for this limited foreign investment activity were mainly political. Foreign private investment was not considered welcome in the country, a view which received considerable support during the Perón regime of the post-war years, when Perón's policy consisted of nationalizing a large segment of the Argentine industrial base: railways, telephones, electric utilities, and many other foreign assets, mainly of Western European and British ownership.

The beginning of the 1950's marked a reversal of this attitude towards foreign investment. Law 14222 of 1953 institutionalized a more open attitude to foreign investors. This first legal instrument for the control of foreign investment activities guaranteed foreigners the right to participate in certain domestic industrial activities (utilities and national security sectors were excluded) and the right to repatriate profits and depreciated capital. In terms of the new flow of investment generated, Law 14222 did not substantially reverse the trend of previous years, but it was important since it laid the foundation for a number of other reforms which followed. Its spirit was not altered by subsequent governments, although its coverage was broadened.

In October 1955, the creation of the free foreign exchange market made investors' legal guarantees concerning repatriation of funds redundant, as any type of transaction could be negotiated in the free market. This system operated until April 1959, when Central Bank Circular 2324 authorized foreign investment in the form of new machinery, provided the machinery was used in the manufacture of domestic goods competing with imports or destined for the export market. A similar circular (No. 2881) concerning industrial machinery was introduced in 1957.

A new economic regime was created in 1958 by Law 14780. Under the legislation, foreign capital was given rights and guarantees equal to those for domestic capital, i.e., foreign investors were granted custom exemptions, tax exemptions, special credit and foreign exchange identical to the treatment given to domestic producers benefiting from import substitution, or special industrial promotion regimes. The scheme resulted in a steady increase in foreign investment activity which continued until 1970 when the legislation was cancelled. The new regime was based on Law 18587 of 1970, which established a legal framework for industrial promotion and foreign investment, although there were no innovations concerning investors' rights and guarantees.

In July 1971, another legal instrument (Law 19151) was created whereby foreign investment was not allowed in circumstances where exports might be curtailed or related to military activities. The use of domestic bank credit by foreigners was limited and a registry of foreign investors was created to control individual activities. In 1973, Law 19151 was replaced by Law 20557, which remained the main legal instrument governing foreign investment until 1976.

Most foreign investment during the post-war period was channelled towards the industrial sector of the Argentine economy, with minor activity in the agricultural and construction sectors. The sectorial allocation of foreign investment for the period between 1954 and 1972 is shown in Table VII. The flow of investment funds during

TABLE VII

AUTHORIZED FOREIGN INVESTMENT BY SECTOR 1954-1972

Classification by activity	Thousand U.S. dollars			Percentage	
	Total	Local	Foreign	Local	Foreign
I. Agr. & Fish.	5.069	1.669	3.420	32,8	67,2
1. Agriculture	4.787	1.367	3.420	28,6	71.4
2. Fishing	301	301	--	100,0	-
II. Mining	1.937	1.648	289	85,1	14,9
1. Nonmetal	150	68	81	45,5	54,5
2. Oil & Gas	1.787	1.579	207	88,4	11,6
III.Manuf.	749.991	681.883	68.107	90,9	9,1
1. Food	14.792	7.613	7.179	51,5	48,5
2. Beverage	605	605	--	100,0	--
3. Tobacco	1.800	1.098	702	61,0	39,0
4. Textiles	4.793	4.473	320	93,3	6,7
5. Shoes,Clot.	220	220	--	100,0	--
6. Wood,Cork	2.025	2.025	--	100,0	--
8. Paper	3.268	2.063	305	90,8	0,3
9. Print.	1.963	589	1.373	30,0	70,0
10. Leath.	646	594	51	92,0	8,0
11. Rubber	5.972	5.972	--	100,0	--
12. Chemicals	195.334	182.999	17.334	93,7	6,3
13. Petrochem.	87.303	85.843	1.460	98,3	1,7
14. Nonmetallic	5.965	4.282	1.682	71,8	28,2
15. Metallurg.	40.077	33.895	6.182	84,6	15,4
16. Metal Pr.	82.138	76.120	6.016	92,7	7,3
17. Machinery	44.698	34.387	10.310	76,9	23,1
18. Elect.	15.412	14.291	1.120	92,7	7,3
19. Transp.	225.456	209.226	16.230	92,8	7,2
20. Misc.Ind.	17.515	14.680	2.836	83,8	16,2
V. Constr.	12.076	5.498	6.578	45,5	54,5
VI. Services	5.590	5.048	541	90,3	9,7
Total	774.684	695.748	78.936	89,8	10,2

Excludes authorized investment by Circular Letters of the B.C.R.A 2324/55 and 2881/57.

Source: Schoeder, N.J., in Llosas (1976).

the period covered by Table VII was not uniform, as different governments significantly affected Argentine attitudes towards foreign investors. The regime operating since 1953-55 authorized the inflow of 12.3 million U.S. dollars, or an average of 6.1 million U.S. dollars annually. Subsequent regimes introduced Laws 2324 and 2881 (in 1955 and 1957, respectively) and significantly increased the flow to an average of 14.2 million U.S. dollars per year. An important impetus to industrial expansion took place in 1958 with the passage of the Industrial Promotion Law 14781, which coincided with Law 14780 concerning foreign investment (see previous table). This was a period of enlightened "desarrollismo", as may be deduced from average annual foreign investment activity totalling 97.6 million dollars between 1958 and 1963.[25]

The period between 1964 and 1966 showed a reduction in foreign investment activity mainly as a result of policy changes that imposed controls on the transfer of dividends and capital abroad. Average annual investment declined to 14.2 million U.S. dollars, returning to the levels once registered in the early years of the 1950's.

Beginning in 1967 a new philosophy towards foreign investment was evident. Its success rested on the creation of favourable conditions as the means to attract investment, rather than on direct negotiations by government officials. Nevertheless, foreign funds inflow did not increase significantly, leaving the average inflow at 22 million U.S. dollars annually between 1967 and 1972.

Although no data are available, the years that followed were not particularly important in terms of foreign investment. The country was torn by social and political unrest, particularly in 1975. The liberalization attempt that began in 1976 did not

[25] Statistics exclude important oil exploration and drilling contracts signed between the state oil monopoly and foreign firms.

fundamentally alter the basic economic tenets of the previous civilian government, but concentrated on creating an environment suitable for long-term growth and freer of government intervention. In April 1979, the "new program" introduced a free foreign exchange but it was accompanied by a new tax on the inflow of foreign capital in an attempt to limit short-term flows attracted by Argentina's high interest rates. The tax was discontinued in January 1979.

THE EXPORT PROMOTION REGIME

It had become evident to policy makers of the 1950's that continued reliance on an import substitution regime could not be expected to maintain an acceptable per-capita growth rate of income. The regime was strongly biased against imports and, with substitution already at an advanced stage, the import coefficient was not expected to decline any further. The idea of making special concessions to promote exports of manufactures did not take hold in the minds of officials until the late 1950's. Such concessions were thought necessary for domestic industries to compete in world markets in the light of two factors: higher relative unit production costs, and no history of industrial exports in any important foreign market.

Such concessions, however, addressed only some of the concerns of the exporters. High among their priorities was the fluctuating nature of official intervention, which made it difficult to plan for growth because of the high uncertainty about the direction of future policy. For example, exporters wanted to be shielded from variations in exchange rates and import restrictions imposed as a result of internal and external balance adjustments. Sometimes, governments responded favourably to this concern.

Such was the case of the military junta that took power in 1955. Faced with impending balance of payments crisis, the authorities devalued the peso from 8.8 to 22 per U.S. dollar and applied an offsetting export tax. By 1956, because real wages increased, export taxes were reduced as the economy expanded.

However, the first conscious attempt to fully establish an export promotion regime took place in 1959. The Central Bank, through the Banco de la Nación and the Banco Industrial, began to finance letters of credit for non-traditional exports. The new measures included financing a maximum of 80% of the F.O.B. value of exports on a long-term basis (up to five years) at a rate of 6%; this credit was reduced in 1963 to a maximum of 60% and one year at a rate of 8%. After the initial legislation was implemented, other measures followed. In 1960, decree 3696 legislated a 100% corporate income tax exemption for manufacturers producing non traditional exports. Also in 1960, an important mechanism, the duty drawback, was introduced, which allowed exporters to receive refunds for all tariffs and customs charges paid on the imported component of manufactured exports.

This series of measures was complemented by the "reintegro" introduced in 1962. The reintegro, established by decree 8051, reimbursed payments of domestic direct and indirect taxes applicable to imported inputs, up to a maximum of 18% of the F.O.B value of merchandise exports. The value of the reintegro varied with the level of manufacturing. Low level manufacturing such as food products and certain textiles was granted a maximum of 6%. Intermediate level manufacturing such as tobacco, textiles and steel had a ceiling of 8%. A maximum of 18% was granted to a category which included capital goods and consumer durable goods such as chemicals, plastics, cotton fabrics, clothing, glass products, machinery automobile and electrical products.

Even though the export promotion system was designed as a long-term strategy, short-term macroeconomic disequilibria forced the authorities to modify the original legislation. Following the 1959 devaluation of the peso and the 1960 expansion of credit, export taxes were lowered in 1961 to maintain traditional export competitiveness in the face of an increase in nominal wages the previous year. By 1963, the export promotion strategy was intensified, in part because of a recession that followed the 1961 devaluation of the peso.

In 1966 the subsidy for non traditional exports was removed but inflationary pressures during 1968 and 1969, without compensatory devaluation (the result of a fixed exchange rate policy), forced the authorities to reduce export taxes and reintroduce the export subsidy.

The 1967 tariff reform, which affected most import tariffs, also affected exports. Decree 9610 allowed exporters to deduct 10% of the F.O.B. value of exports from total corporate income tax, a subsidy which amounted to 31% of the F.O.B. export value if a 33% corporate tax rate is assumed. The export promotion regime for non traditional manufactures, except those with a high grain or meat content, was changed by decree 9588, which instituted a 12% subsidy on the F.O.B. value of all non traditional exports. In addition, the subsidy was exempted from income tax, making it the equivalent of 18% before-tax (if a 3% tax rate is assumed).

Argentina's export promotion policies were met by strong opposition from large segments of the rural and industrial circles and from the powerful trade unions. The nub of the problem was their redistributive nature, common to export promotion regimes, which gave preference to a small number of industrialists. The rural establishment was concerned that the transfer of wealth from their sector to the industrial exporters would accelerate should the government impose new taxes on traditional exports to make up revenues lost in tax concessions to non traditional exporters. The trade unions were not ready to accept a stable ratio of the exchange rate to real wages that would infringe on their efforts to increase the relative well-being of their members. According to Beccaria and Carciofi (1982), these circumstances were sufficient by the end of 1969 to undermine the effectiveness of the export promotion regime.

By the end of 1971, after failing to devalue the peso to fully compensate for its loss of purchasing power, the government resorted to export promotion through a crawling exchange rate for the financial peso and a fixed rate for the commercial peso. To make export activity more attractive, exporters were allowed to convert a greater proportion of their foreign exchange earnings through the higher rate financial market. In addition, special subsidies and drawback provisions were legislated, a system that lasted until the end of 1973.

The new administration that took power in 1976 unified the dual foreign exchange markets and began to reduce government intervention in the economy as a first step in the liberalization of the economy. For exporters, the unification of the exchange rates reduced export profitability as the unified rate was lower than the financial rate. In subsequent years, other markets were liberalized and exporters faced increased difficulties in reaching foreign markets and the increased competition at home due to the lowering of tariffs.

THE LIBERALIZATION OF THE LATE 1970'S

The year 1976 marked the beginning of an important chapter in the economic history of the country. The third Peronist government was overthrown in March of that year and the military regime that replaced it came to power with an economic philosophy that substantially altered the functioning of many markets. The philosophy was one of liberalization of the economy and the exposure of domestic producers, mainly in the industrial sector, to foreign competition.

To obtain this relatively liberal market economy, the main strategy consisted of substantial tariff reductions and liberalization of the financial markets. Taxes were reduced, subsidies eliminated, maximum pricing policies and price controls dismantled, traditional export tax retention cancelled and all credit advantages to industrial exporters lifted. Simultaneously, the financial market was liberalized, ending all preferential credit subsidies to industry. This resulted in the indexation of all corporate borrowing, with the subsequent resumption of positive real returns to private investors.

The economic policies adopted to implement the process of liberalization were not uniformly applied. We may distinguish two periods, one between March 1976 and May 1978, where the main policy instrument was the reform of the tariff system; and the second from June 1978 to December 1980 when, in addition to a further reduction in the tariff, a series of devaluations more than compensated for domestic inflation and increased real purchasing power with respect to the U.S. dollar.

The financial markets were not liberalized until June 1977. At that time, interest rates were freed from Central Bank control and most subsidized credit was eliminated. Other measures were not implemented until later. Quantitative restrictions and minimum foreign borrowing terms were maintained. For example, beginning in 1978, advance deposits for foreign borrowing was required and truly unrestricted international capital flows were not permitted until the third quarter of 1980.

TABLE VIII

INDUSTRIAL TARIFFS DURING LIBERALIZATION
(percent)

October 1976	93.7
December 1977	52.7
October 1978	43.8
October 1979	34.4

Excludes items subject to a 25% or lower tariff before 1976.

Source: Canitrot (1981), p. 138.

The first tariff reform came into effect in November 1976 and initiated an ongoing process. The original plan called for the gradual reduction of tariffs to 20% by 1984, with no tariff for capital goods and reduced dispersion across import categories. In reality, the lowering of tariff proceeded at a slower rate, as Table VIII indicates.

The return to a free financial market marked the end of subsidized credit to industry and agriculture that had been made possible by interest-free demand deposits at commercial banks.[26] The extent of credit liberalization may be evaluated by observing the real interest rate of 30-day maturity, calculated by deflating the nominal rates by the wholesale price index (excluding agricultural products). This "real" rate is presented in Table IX.

It can be observed from the table that positive interest rates prevailed during the

[26] After the financial reform, in June 1977, commercial banks began to participate in interest-bearing demand deposits.

years of financial liberalization, as was to be expected. Comparing Table VIII with Table IX, it can be noted that the high positive rates in some quarters reflect the degree of uncertainty prevailing in the financial markets, in particular, inflationary expectations, although the tendency to lower real interest rates observed throughout the period is perhaps due to lower average inflation rates (the consumer price index averaged 25% per quarter from the third quarter of 1976 to the third quarter of 1979 and 17% per quarter thereafter until the first quarter of 1981).

TABLE IX

REAL INTEREST RATES, 1977-1981

		Nominal Interest Rate	Wholesale Price Index	Real Interest Rate
1977	III	26.0	31.1	-3.9
	IV	43.4	31.0	9.5
1978	I	36.8	28.1	6.8
	II	26.4	26.3	0.1
	III	24.6	19.3	4.4
	IV	24.2	27.7	-2.7
1979	I	23.2	31.4	-6.2
	II	22.4	26.9	-3.5
	III	25.6	27.3	-1.3
	IV	23.6	11.0	11.4
1980	I	19.4	14.2	4.6
	II	18.1	15.5	2.3
	III	20.2	9.8	9.5
	IV	18.0	14.3	3.2
1981	I	28.3	14.1	12.4

Source: Canitrot (1982), p. 145.

The tariff reform may or may not have immediately affected corporate decisions concerning imports and exports. It has been noted by some Argentine writers that in many cases, tariffs were redundant, i.e., the actual market clearing price was below the value of the imported good plus the tariff. Attaining a lower-than-protected price for certain Argentine manufactured products may have been due to domestic competition, technological cost-reducing innovations, quality and output decisions of monopolistic firms that may have maximized profits at a lower price. Consequently, a reduction in protected prices as a result of the reform may not have had an immediate impact on corporate decisions. This is presumably what happened in the general economy following the 1976 reform. There is evidence to suggest that the gradual convergence of the after-tariff price to the domestic market clearing price ended by 1980

The balance of payments during this period reflected in large part the influence of the two business cycles after 1976 and the impact of the trade and capital flow liberalization that followed. Exports expanded throughout the 1976-1980 period as export taxes on agricultural products were lifted and domestic producers were encouraged to sell manufactured goods abroad (the latter helped by a falling wage rate that, at its trough had dropped 33% in real terms). Imports were restricted between 1976 and 1978 as a result of the slow speed of implementation of the tariff reform and a lower real wage. But after 1978, imports expanded vigorously, mainly due to a lag in the crawl of the exchange rate of the peso. The balance of payments reflected these negative events towards the end of the decade. Table X illustrates the evolution in total imports, exports, services balance and the net effect on the balance of payments during these years. The policy of liberalizing the economy in general did preclude the government from controlling the foreign exchange market via open market operations from time to time. Helped by a positive current account in the years after 1976, and of substantial official foreign borrowing thereafter, the authorities managed to sustain the devaluation of the last days of the Peronist government. A complete liberalization of the foreign exchange market was announced in December 1978. Government

TABLE X

BALANCE OF PAYMENTS
(Million U.S. dollars)

Period	1975	1976	1977	1978	1979	1980
Current Acc.:						
Exports	2961	3925	5652	6144	7810	8000
Imports	3946	3035	4162	3834	7600	10500
Net Serv.	-300	-233	-203	-746	-1599	-2190
Balance	-1285	657	1287	1834	-489	4690
Capital Infl.	494	538	940	165	1894	-
Reserve Chge.	-791	1192	2227	1999	4442	-2796
Reserves end of Period	620	1812	4038	6038	10480	7684

Source: B.C.R.A.,INDEC, and Canitrot (1981).

intervention was limited to protecting the market from strong destabilizing expectations about the peso value to the U.S. dollar. To reduce speculation activity in the exchange market, the government adopted a policy of pre-announced changes in the exchange rate, so that rates were known with certainty several month in advance, a move that considerably contributed to stability.

CONCLUDING REMARKS

As economic policies changed in response to changing circumstances, some macroeconomic trends are clearly visible that reveal the goals and aspirations of economic policies. An assessment of these changes is crucial to the evaluation of the technological effectiveness of Argentine trade policies attempted in Chapter IV .

One of the fundamental findings of this chapter is the existence of three basic policy regimes during the post-war period: IS, EP and liberalization. A clear pattern of protection is evident from a period prior to the Second World War to approximately the mid-1970's. Even though there was overall protection, the IS regime was characterized by a long-term gradual reduction in the level of protection, with periods of increasing, stable and decreasing protection. The EP period began in 1959 and increased in importance in subsequent years, the export incentives to some extent compensating producers for the declining protection offered by tariffs. Liberalization officially began in 1976 and it consisted of the elimination of both tariff protection and export subsidies. However, the policy was introduced and implemented on a gradual basis, its effects not being felt until 1978 and subsequent years.

In addition to tariffs and subsidies on industries, the instruments of protection and promotion extended to the banking system and foreign exchange markets. The latter reinforced, but did not replace, the former in the implementation of policy. The tariff was the core instrument of protection, the subsidy the main tool of promotion.

It is interesting to note that import substitution did not end when export promotion began, and that neither of these vanished with the introduction of the liberalization regime. Rather, as the policy emphasis shifted through the years, protection diminished at the time EP was introduced and continued to do so even after liberalization took hold. Similarly, promotion continued its existence well into the liberalization period, albeit at a much reduced rate. The vestiges of protection and promotion were still being felt at the end of the period under study.

CHAPTER III

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INTRODUCTION

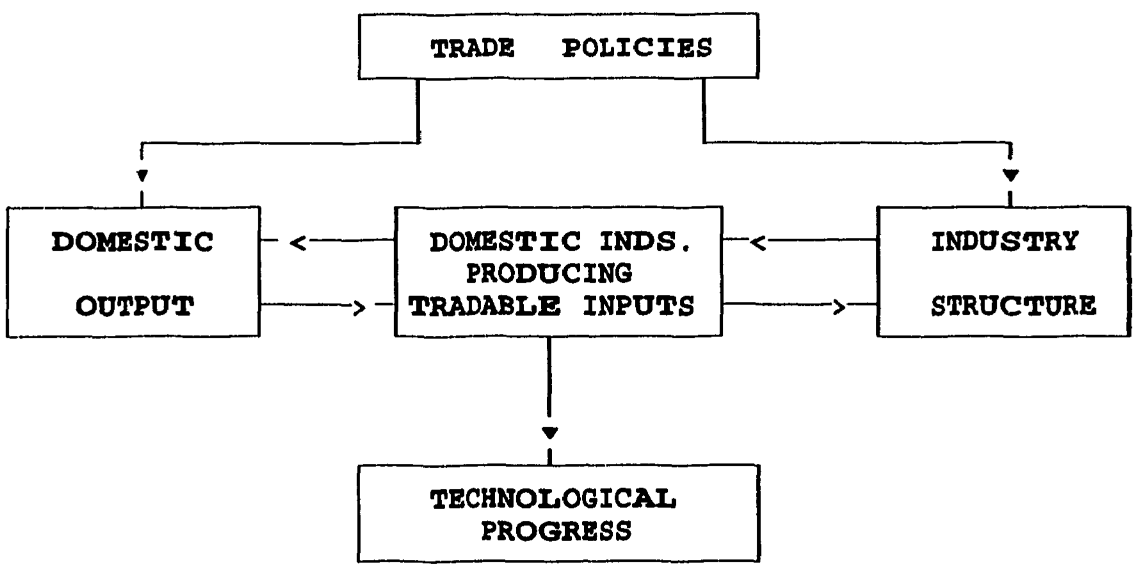
It was argued in Chapter I that trade policies can have an effect on the technological progress of the economy in two different but interrelated ways. The first is the direct effect that trade polices have on the level of domestic production and, indirectly, on the technological progress of the industry producing that output. This may be termed the "output effect". The second is the effect of trade policies in determining the structure of domestic industries which, in turn, has a bearing on technological developments in industries in question. This effect, which may be termed the "industry structure" effect, arises from the fact that technological progress in industries is related to the strategic interactions among firms within the industry.

The output effect makes possible higher rates of technological progress because the new investment necessary to produce higher levels of domestic output usually brings with it new, more productive technologies. Higher output levels allow for economies of scale, increases in capacity utilization and the increased specialization of labour and other inputs, such as machines, equipment and materials, all of which may further increase technological progress. These purely technical factors may be accompanied by managerial pressures to achieve cost reduction via rationalization and adaptation of more efficient productive techniques and "process" innovations that can be successfully applied only at higher output levels. This direct output effect of trade policies on technological progress is accompanied by an indirect but similar effect arising from interactions in the market for the production of inputs. Changes in tariffs and/or quantitative restrictions on intermediate product industries affect the price of domestically produced inputs relative to imported inputs, and may lead to a substitution between the two. This input substitution in industries employing domestic and foreign intermediates may bring about technological improvements in much the same way as increases in final products. The interindustry repercussions of tariffs on tradable inputs may, therefore, imply that the new equilibria in input markets occur at higher technological levels and may further enhance the growth of productivity.

The basic premise in our overall theoretical framework is that trade policy interventions in tradable markets offer technological opportunities to the firm not generally available in a steady state equilibrium. We propose to incorporate the technological implications of trade policies in various sectors of the economy by specifying a model in which equilibrium sectoral output and input volumes are determined by sectoral market clearing, and equilibrium sectoral prices are determined by the clearing of all markets in the economy.

With respect to the industry structure effect, we begin with the hypothesis that the structure of a "protected" (by means of trade barriers) or "promoted" (by means of export subsidies) industry is determined, in part, by the incentives created by trade policy. Thus, the number of firms, their size and scale of production and, in general, the degree of competition within an industry are governed to a significant degree by the particular trade policy affecting that industry. The effect of industry structure on technological progress is less clear-cut because of the controversy surrounding the question of whether perfect competition or some forms of monopoly foster technological progress. But there is little doubt that particular forms of market structure influence technological progress through such factors as the strategic positioning of one firm against its rivals in the industry, attempts to increase market share, product differentiation through innovation, and the degree of vertical integration. These factors, either singly or in combination, may not necessarily increase the output of the industry in question but may, nevertheless, have a significant impact on the technological developments of the industry. Technological progress in this latter case may arise from a redeployment of assets, improvements in managerial and marketing techniques and, in general, the adoption or development of new production processes that reduce unit costs but leave output levels unchanged.

The broad objectives of our enquiry on the technological consequences of trade policies may be illustrated by means of the following chart.



In the schematic diagram, trade policies influence both domestic output and domestic industry structure. The effect on domestic output and structure is concentrated in, but not limited to, domestic industries producing tradable products. Both domestic output and structure are seen as affecting domestic producers independently. From the causality point of view, this implies the existence of two independent cause-effect relationships both separately influencing the technological progress of industry.

We begin by specifying a static model representing consumer and producer behavior in each sector of the economy. Consumers maximize a utility function subject to a budget constraint, while producers maximize profits subject to the technology. Market interactions between producers and consumers determine the prices and volumes traded in all markets at a given point in time. Such prices and volumes are given by the solution to a system of equations and represent a state of equilibrium. The level of technology is determined endogenously and maintains the simultaneous equilibrium in the input and output markets. The model is specified to represent a small open economy such that world prices and world income are not influenced by domestic considerations. The model considers sectoral non-tradable inputs (the services of capital and labour) and domestic income to be exogenous. In order to allow for trade policy analysis, we specify the price of imports and the price of exports to be exogenous.

Given that our interest is the rate of change of technology (technological progress) over time and not its absolute value at a point in time, the static model is made dynamic by making all variables a function of time. This results in a model with a dynamic equilibrium solution tracing the time change of all endogenous variables, which include the time change of technology in each domestic sector for a given set of exogenous values.

The application of trade policy to any one sector results in marginal price disturbances affecting sectoral dynamic equilibrium between supply and demand. As the new equilibrium is reached after the disturbance, the original equality between sectoral supply and demand volumes is altered. If dynamic equilibrium is to be maintained, such a balance should exist at all points in time. Given post-disturbance total demand, post-disturbance supply must satisfy the new demand. Total supply originates, in part, by changes in the use of factor inputs and in part by changes in sectoral productivity. It is the identification of the contribution of domestic supply volume that can be ascribed to changes in the technology that establishes the relationship between trade policies and technological change at the sectoral level.

To analyze the industry structure effect, we focus on the relationship between trade policies and technological change by means of an analysis of the historical relationship between trade policies, changes in industrial concentration and productivity growth by sector. A historical analysis determines the relationship between actual policy changes and actual changes in sectoral concentration and productivity (as a proxy for technological change).

Chapter III concludes with an assessment of the direction of causality between trade policies and technological progress.

OUTPUT EFFECT

We model each sector of the economy separately to take account of the sectoral impact of trade policies. The complete model for all sectors of the economy contains three basic building blocks:

- sectoral product market equilibrium conditions linking each sector's output volumes to sectoral imports, exports and domestic demand,
- sectoral production functions linking sectoral input volume to sectoral output volume for a given technological level and,
- an economy-wide price model linking all sectors' input and output prices.

Product market equilibrium requires that sectoral supply equals sectoral demand, i.e., the sum of domestic and import supply equals the sum of export and domestic demands. Each productive sector of the economy has a technology which is modelled by a constant returns to scale neoclassical production function with one output and two inputs.[27]

Each production sector uses tradable inputs (intermediate inputs), non-tradable inputs[28] (capital and labour services) in the production of output. Producer behavior is characterized by profit maximization at the sectoral level subject to the technology. Producers take the prices of inputs and outputs as given and competition produces zero profit in all sectors.

Prices are determined at the economy-wide level by a price sub-model. The price sub-model links output prices of all sectors to tradable input prices, import prices and non-tradable input prices from all sectors. It takes into account intersectoral price

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[27] If economies of scale are present, higher output will result in higher measured productivity as our model defines productivity to include the effect of economies of scale.

[28] Even though capital goods are traded in international markets, capital input is considered not traded. There is usually a time lag between their acquisition and the beginning of the flow of productive capital services. Large projects have long gestation lags, in the order of several years, while small projects may have lags shorter than one year. For lack of detailed knowledge of investment lags, we assume that capital goods begin producing the year after they are acquired.

transmission so that changes in the price of imports in one sector affect the "own" price of output of that sector and the price of tradable inputs in all sectors of the economy. In turn, such new output prices affect producers' decisions concerning the optimal input combination for profit maximization, as the output of some sectors is used as inputs by many other sectors. In the price sub-model, the exogenous price of imports and of non-tradable factors of production entirely determine the endogenous price of tradable inputs and the price of output. In the economy, each sector determines equilibrium volumes of its inputs and output, while the economy determines equilibrium prices.

It is assumed that national real income is not affected by marginal changes in the price of tradable commodities at the sector level. Similarly, the world price of products and world real income are not affected by domestic trade policy decisions (the small country assumption). Thus, domestic income, world income and world prices are assumed exogenous.

Non-tradable inputs are assumed to be in perfectly elastic supply while tradable inputs have a positively sloped supply curve. The volumes of tradable and non-tradable inputs are determined by the model (are endogenous) as is the price of tradable inputs. The price of non-tradable inputs is exogenous since its supply curve is assumed to be perfectly elastic.[29] The assumption implies that the supply of inputs places no restrictions on maximization of profits This feature of the model recognizes that there may be changes in capacity utilization due to trade policy intervention and, therefore, a trade policy may increase the ex post rate of return to capital and induce investment.

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[29] Some of the implications of this assumption are discussed below.

The effectiveness of trade policies to foster productivity growth is evaluated by disturbing the equilibrium by a marginal change in the price of imports in the analysis of import substitution, and in the price of exports in the analysis of export promotion.[30] The empirical measures of effectiveness of trade policies are presented separately for the import substitution and export promotion regimes.[31]

First, at the sector level, product market equilibrium is disturbed by a marginal change in the price of imports (or of exports). Following the price change, domestic supply, imports, exports, and domestic quantity demanded are affected. The price disturbance is used to evaluate the supply response by domestic producers which are assumed to supply the volume of post-disturbance quantity demanded. The change in the price of imports (or exports) also affects producer input decisions, as some inputs may be imported and as the price of domestically produced tradable inputs from other sectors may be affected by the change in relative prices in the sector under consideration. The relative price changes are evaluated by the price sub-model and determine producers' input reaction to the disturbed situation. Finally, the effect of a change in the price of imports (or of exports) in the product and input markets are brought together to determine the policy effect on producers' level of technology. As a result of the marginal price disturbance, producers react by changing output as well as

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[30] In addition to tariffs and subsidies having an effect on trade volumes, most trade policy regimes include a variety of other features that restrict or encourage trade. Such policy measures include subsidized credit, preferential tax treatment and others such as "buy domestic " campaigns. In the case of Argentinean manufacturing we found no support for the effect of non-price variables in the estimation of trade demands. Import demands estimated including foreign exchange as a measure of non-price import restrictions did not support this assumption in all but one sector. Similarly, use of the same variable on export demand equations had not explanatory power. It should be noted, however that non-price variables can be incorporated into the model by adding an extra term to each of the import and export demand functions.

[31] Trade liberalization may be viewed as a simultaneous reduction in the tariff and a decrease in exports subsidies.

input volumes. To derive the effect of these changes on the producers' level of technology, we evaluate the changes in technology that would occur should producers be faced with the disturbed situation. The effectiveness of a trade policy on technological progress is then evaluated by relating post-disturbance output and input volume growth rates which, in order for dynamic equilibrium to be maintained, may be accompanied by a change in the growth rate of productivity. Therefore, the productivity gain or loss obtained from the model for a given sector is indicative of trade policy impacts consistent with the behavior of all consumers and producers at a given point in time. The result is interpreted as the effectiveness of trade policies in influencing the growth rate of sectoral productivity given the assumptions of the model.

A Static Model

a) Determination of Volumes

Consider an economy with n sectors (or industries), each producing a single product. Some of these products can be exported and products similar to domestic products can be imported. In each sector, the sum of domestic production and import of the sector's product equals the sum of domestic and export demand of the sector's product, all expressed in volume terms. Denoting domestic quantity supplied by Q, imports by M, domestic apparent consumption by D and exports by X, the equilibrium condition for each sector are given by,

$$Q_i + M_i = D_i + X_i \qquad i = 1 \ldots n \qquad (1)$$

Equation (1) simply equates sectoral supply to sectoral demand for the products of each sector in volume terms.[32] Likewise, the value of supply equals the value of demand in each sector.

Government intervention in setting the tariff on imports and the tax or subsidy on exports influence, but does not entirely determine, the level of an industry's import and export volumes as well as the volume of domestic production. The influence of policy-set prices on the volumes of equation (1) depends on the behavior of domestic and foreign consumers as dictated by their utility maximizing demand function that determine domestic demand and export demand, and the behavior of domestic and foreign producers that determine domestic and import supply.[33] We will elaborate on these behavioral relationships.

Domestic products compete with foreign products of different characteristics in the domestic and foreign markets. Foreign products are assumed imperfect substitutes for domestic products and, as a result, foreign producers have some degree of monopoly power in the markets they supply (they face downward slopping demand curves). Similarly, domestic exports compete with foreign products in world markets with some degree of monopoly power.[34]

If producers in a country having n sectors and supplying n products trade with m different countries, there are nm markets for domestic products. Denote by V_{ij} the

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[32] Volumes are measured in constant prices.

[33] The supply of imports can be viewed as the supply response of foreign producers or, alternatively, as the residual demand of domestic consumers not satisfied by the supply of domestic producers. We model import supply by the excess demand function.

[34] If foreign and domestic products were perfect substitutes, the law of one price would prevail. See, for example, Helpman and Krugman (1985), page 124.

volume of product i produced in country j. The utility function of consumers will be a function of the quantities consumed of all products available to them and it is of the form,

$$U = U(V_{11}, \ldots, V_{1m}, V_{i1}, \ldots V_{im}, V_{n1}, \ldots, V_{nm}) \qquad (2)$$

We would like to reduce the number of parameters in the utility function by relying on the similarity of different products. We do so by defining n markets for goods in which products of different origins compete.[35] In the above utility function, we may recognize that products of countries 1 to m compete in the market for good 1, products of countries 1 to m compete in the market for good 2, etc. The demand for good V_i is assumed to be a function of the products V_{ij} participating in the market for that good i. Thus, we may write the demand for good i as,

$$V_i = V_i(V_{i1}, \ldots, V_{im}) \qquad i = 1 \ldots n \qquad (3)$$

which reduces considerably the number of demand functions associated with the utility function (2), from nm demand functions to n demand functions.

Armington (1969) showed that the necessary and sufficient conditions for the existence of a well behaved demand function for good i are:

- the marginal rate of substitution between any two products of the same kind must be independent of the quantities of the products of all other kinds and ,

- the aggregator function $V_i(.)$ must be homogeneous of degree one.

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[35] A distinction is made between a product and a good. A product recognises place of origin, while a good refers to the general characteristic of products. Examples of products are domestic and foreign chemicals. An example of a good is chemicals. Products of different origins are traded in markets for goods, e.g., domestic and foreign chemicals trade in the domestic chemicals market.

Under these assumptions, it can be shown that the demand for each good i depends on the price of each competing product and income. Thus, equation (3) can be written as,

$$V_i = V_i(P^1, P^2, \ldots, P^n, Y) \qquad (4)$$

where P^i, the price of good i, is only a function of the absolute prices of the products participating in the market for good i.

Equation (4) still contains too many parameters to be empirically useful. We assume further that each category of good i consists of two general product types, those produced domestically and those imported, which are imperfect substitutes for each other. To allow for substitution between products, we specify the import demand function for goods, M_i, as a function of domestic and foreign products prices in each composite category, and domestic income, as follows,

$$M_i = M_i(P^{iM}, P^{iQ}, Y) \qquad i = 1 \ldots n \qquad (5)$$

where P^{iM} is the absolute price of imported products and P^{iQ} the absolute price of domestic products. Domestic real income or activity is represented by Y.

The domestic demand for goods is, similarly, a function of domestic and foreign product prices, i.e.,

$$D_i = D_i(P^{iM}, P^{iQ}, Y) \qquad i = 1 \ldots n \qquad (6)$$

The demand for exports is likewise specified as,

$$X_i = X_i(P^{iX}, P^{iW}, Y_W) \qquad i = 1 \ldots n \qquad (7)$$

where P^{iX} refers to the domestic absolute price of exports and P^{iW} to absolute world price. Y_W represents world income.

We assume these demand functions satisfy the usual well behaved conditions.[36] Written in relative prices the demand functions are of the form (as of now, not showing sector identification),

$$M = M(P_M, Y) \tag{8}$$

$$D = D(P_M, Y) \tag{9}$$

$$X = X(P_X, Y_W) \tag{10}$$

where P_M and P_X are the relative price of imports and of exports, respectively, and Y and Y_W refer to domestic and world incomes or activity variables. The relative price of imports and of domestic apparent consumption P_M is defined as the ratio between the absolute price of imports P^M and the absolute price of domestic output, defined as P^Q. The relative price of exports P_X is defined as the ratio between the absolute price of domestic exports P^X and the absolute price of world products of similar characteristics P^W,[37] as follows,

$$P_M = \frac{P^M}{P^Q} \qquad\qquad P_X = \frac{P^X}{P^W} \tag{11}$$

We assume relative prices to have a negative effect on quantity demanded, and income to have a positive effect. Thus, a tariff that increases the relative price of imports reduces demand for imports, and an export subsidy that decreases the relative price of exports in the world market increases foreign demand for exports. In other words, we expect the price elasticities of demand to be negative, and the income

[36] See, for example, Green (1976).

[37] Specifications similar to those employed here were used in project LINK [Basevi (1973), Houthakker and Magee (1969), Taplin (1973) and Hickman and Lau (1973)]. For a discussion of the theoretical foundations, see Leamer and Stern (1970). A survey of theoretical issues and empirical findings employing this specification may be found in Kennen (1975), page 178.

elasticities of demand to be positive. [38] [39]

The supply of output of each domestic sector is the result of producer behavior which, we assume, maximizes profits, given input and output prices and the technology. We represent producer behavior by the production function relating output supply volume Q to input use volume f(x) and the level of technology A, specified as follows,[40]

$$Q = A\ f(x) \qquad (12)$$

The input function f(x) represents the total volume of inputs used in the production of output. We call this function the input aggregator function. The arguments of the input aggregator function are two input volumes, tradable and non-tradable inputs, denoted by T and N, respectively. Thus, the production function can be written as,

$$Q = A\ f(T,N) \qquad (13)$$

where f(.) is an homogeneous-of-first-degree function with continuous first and second order derivatives satisfying the usual neoclassical properties, T is the volume of intermediate inputs and N is the volume of capital and labour inputs.

The demand equations (8), (9), (10) and the supply equation (13) complete the

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[38] In some cases of very rapid import substitution, it may be possible to observe negative income elasticities of import demand. For a discussion of this possibility, see Magee (1975).

[39] To maintain the presentation in this chapter to its most essential parts, the discussion of elasticity estimation as well as their reduced forms and econometric results are presented separately in Appendix B. The appendix also contains a discussion of theoretical and empirical validity supporting our choice of demand models. We consider the linear and logarithmic specifications of the static model as well as similar alternatives of the partial-adjustment and flow-adjustment models as particular cases of distributed lag models. Where appropriate, we relate them to the Houthakker-Taylor model.

[40] An analysis of productivity and production function issues as well as econometric estimates is presented in Appendix B.

specification of the sectoral market clearing equation (1). It remains to be shown how tradable and non-tradable input volumes are determined. These volumes are determined by input demand functions relating input volumes to input prices and are obtained from the first order conditions for profit maximization. If the production function is homogeneous of degree one, and producers are price takers, the input demand functions are of the form,

$$T = T(Q, P^T, P^N) \tag{14}$$

$$N = N(Q, P^T, P^N) \tag{15}$$

The sectoral input demand functions T(.) and N(.) are homogeneous of degree zero in prices. Replacing in (13) we obtain,

$$Q = A\ h(P^T, P^N) \tag{16}$$

We have shown that the sectoral level of output, imports, exports and domestic demand volumes depend on the behavior of consumers and produces, which in turn by means of the respective supply and demand functions, depend on a set of prices and incomes. To see this, replace equations (8) (9) (10) and (16) in the sectoral market clearing identity (1),

$$A\ h(P^T, P^N) + M(P_M, Y) = D(P_M, Y) + X(P_X, Y_W) \tag{17}$$

In this equation, all outputs are determined by prices, incomes and the level of technology A. We must, therefore, explain how such prices, incomes and technology are determined. Incomes refer to the incomes of domestic and foreign consumers and will be assumed exogenous to the sector. The level of technology A is endogenously determined given all other prices and incomes. The price of imports, exports and non-tradable inputs are considered to be exogenous, but the price of domestic output and tradable inputs are endogenous. These endogenous prices are specific to each sector, but because intermediate inputs are made up of domestic and imported products originating in many sectors, the price of intermediate inputs (tradable inputs) of a sector depends on the output prices of many domestic sectors (many domestic products) and the import prices of many foreign products. Thus, the price of tradable inputs of a sector depends on the output prices and import prices in all sectors. In other words, the sector's tradable input price depends on the domestic price and import price of many products in the economy. To model these price relationships we specify an economy-wide price model.

b) Determination of Prices

Denote any of the n domestic sectors as sector 1. The value of its output can be represented by the product of a price P^Q_1 times a volume Q_1. Similarly, the value of tradable inputs the sector purchases may be represented by the product of a tradable input price P^T_1 and a volume T_1. The value of non-tradable services inputs the sector uses can similarly be represented by the product of a non-tradable service price P^N_1 times a volume N_1.

At zero profits, the value of output of the sector equals the sum of its input costs, i.e.,

$$P^Q_1 Q_1 = P^T_1 T_1 + P^N_1 N_1 \qquad (18)$$

Tradable inputs may be of domestic or foreign origin. The price of tradable inputs P^T_1 is a weighted average of the prices of imported and domestically produced commodities purchased by the sector. It should be apparent from the cost equation (18) that a price change in the output of any other sector will affect the price of output of sector 1. This occurs because, in general, sector 1 uses tradable inputs which are the output of other sectors of the economy. A change in the price of imports of the sector increases sector cost directly because the sector uses imported inputs. In turn, the change in import price affects the cost of all other sectors using such an import. The output price of those other sectors will reflect the higher import cost and, through inter-industry repercussions, will further increase the cost of sector 1 tradable inputs. In order to adequately measure these direct and indirect cost-price relationships among sectors, it is necessary to link the cost of all sectors to the prices of all sectors.

Define the vector of sectoral output values as **V**,

$$\mathbf{V} = \begin{vmatrix} P^Q_1 \; Q_1 \\ \vdots \\ P^Q_n \; Q_n \end{vmatrix} \qquad (19)$$

Define the matrix **U** of tradable input transaction values,

$$\mathbf{U} = \begin{vmatrix} P^T_1 \; T_{11} & \cdots & P^T_1 \; T_{n1} \\ \vdots & & \vdots \\ P^T_1 \; T_{1n} & \cdots & P^T_n \; T_{nn} \end{vmatrix} \qquad (20)$$

where T_{ij} is the volume of tradable input purchased by sector i from sector j. The row sum of matrix **U** gives the value of tradable inputs bought by each of the n sectors of the economy. Notice that each sector of the economy purchases tradable inputs from other sectors at the same unit prices.

The price of non-tradable inputs is determined entirely in the domestic economy. Non-tradable inputs are composed of capital and labour services rendered during a year. We assume the price of non-tradable inputs to be independent from all other prices. Define the vector of non-tradable input services values **Y** as,

$$\mathbf{Y} = \begin{vmatrix} P_1^N N_1 \\ \vdots \\ P_n^N N_n \end{vmatrix} \qquad (21)$$

We can now represent the cost equations for all sectors of the economy in matrix notation,

$$\mathbf{V} = \mathbf{U}\,\mathbf{i} + \mathbf{Y} \qquad (22)$$

where **i** is a unit vector of length n needed to sum over the rows of matrix **U**.

The value matrices **V**, **U** and **Y** can be decomposed into their unit price and volume components, as follows,

$$\mathbf{V} = \hat{\mathbf{Q}}\,\mathbf{P}^Q = \begin{vmatrix} Q_1 & \cdots & 0 \\ \vdots & \ddots & \vdots \\ 0 & \cdots & Q_n \end{vmatrix} \begin{vmatrix} P_1^Q \\ \vdots \\ P_n^Q \end{vmatrix} \qquad (23)$$

$$\mathbf{U} = \hat{\mathbf{T}}\,\mathbf{P}^T = \begin{vmatrix} T_{11} & \cdots & T_{n1} \\ \vdots & & \vdots \\ T_{1n} & \cdots & T_{nn} \end{vmatrix} \begin{vmatrix} P_1^T & \cdots & 0 \\ \vdots & \ddots & \vdots \\ 0 & \cdots & P_n^T \end{vmatrix} \qquad (24)$$

$$\mathbf{Y} = \mathbf{N} \blacksquare \mathbf{P}^N = \begin{vmatrix} N_1 \\ \vdots \\ N_n \end{vmatrix} \blacksquare \begin{vmatrix} P_1^N \\ \vdots \\ P_n^N \end{vmatrix} \qquad (25)$$

where the symbol ▲ indicates a vector whose elements are placed in the diagonal of a matrix (all off-diagonal elements are zero) and the symbol ■ refers to tho Schurr (element-by-element) matrix product.

Each element of the tradable input price vector is a weighted average of domestic and import prices. In matrix notation, this can be written as,

$$\mathbf{P}^{T} = \mathbf{M}\,\mathbf{P}^{M} + (\mathbf{I} - \mathbf{M})\,\mathbf{P}^{Q} \tag{26}$$

where $\mathbf{P}^M$ is the matrix of sectoral import prices and matrix $\mathbf{I}$ is the identity matrix of dimension n x n. The matrix $\mathbf{M}$ is defined as,

$$\mathbf{M} = \begin{bmatrix} \frac{M_{11}}{T_{11}} & \cdots & \frac{M_{1n}}{T_{1n}} \\ \vdots & & \vdots \\ \frac{M_{n1}}{T_{n1}} & \cdots & \frac{M_{nn}}{T_{nn}} \end{bmatrix} \tag{27}$$

The elements of matrix $\mathbf{M}$ are the volume shares of imported inputs in total traded input. The weights of the domestic tradable inputs are, therefore, given by the matrix ($\mathbf{I}$ - $\mathbf{M}$). Replacing equations (23), (24) and (25) into (22) we obtain,

$$\hat{\mathbf{Q}}\,\mathbf{P}^{Q} = \left|\mathbf{T}\,\hat{\mathbf{P}}^{T}\right|\,\mathbf{i} + \left|\mathbf{N} \blacksquare \mathbf{P}^{N}\right| \tag{28}$$

Pre-multiplying by $\hat{\mathbf{Q}}^{-1}$,

$$\mathbf{P}^{Q} = \hat{\mathbf{Q}}^{-1}\left|\mathbf{T}\,\hat{\mathbf{P}}^{T}\right|\,\mathbf{i} + \hat{\mathbf{Q}}^{-1}\left|\mathbf{N} \blacksquare \mathbf{P}^{N}\right| \tag{29}$$

Define,

$$\mathbf{B} = \hat{\mathbf{Q}}^{-1}\,\mathbf{T} \tag{30}$$

$$\mathbf{H} = \hat{\mathbf{Q}}^{-1}\,\mathbf{N} \tag{31}$$

where **B** and **H** are volume coefficient matrices containing ratios between tradable inputs and outputs and between non-tradable inputs and output respectively.

Therefore,

$$\mathbf{P}^{Q} = \mathbf{B}\,\hat{\mathbf{P}}^{T}\,\mathbf{i} + (\mathbf{H} \blacksquare \mathbf{P}^{N}) \tag{32}$$

But,

$$\hat{\mathbf{P}}^{T} = \mathbf{M}\,\hat{\mathbf{P}}^{M} + (\mathbf{I} - \mathbf{M})\,\hat{\mathbf{P}}^{Q} \tag{33}$$

Replacing in equation (32),

$$\mathbf{P}^{Q} = \mathbf{B}\left[\mathbf{M}\,\hat{\mathbf{P}}^{M} + (\mathbf{I} - \mathbf{M})\,\hat{\mathbf{P}}^{Q}\right]\mathbf{i} + (\mathbf{H} \blacksquare \mathbf{P}^{N}) \tag{34}$$

$$\mathbf{P}^{Q} = \mathbf{B}\,\mathbf{M}\,\mathbf{P}^{M} + \mathbf{B}(\mathbf{I} - \mathbf{M})\mathbf{P}^{Q} + (\mathbf{H} \blacksquare \mathbf{P}^{N}) \tag{35}$$

and isolating the price of output yields,

$$\mathbf{P}^{Q} = [\mathbf{I} - \mathbf{B}(\mathbf{I} - \mathbf{M})]^{-1}\,[\mathbf{B}\,\mathbf{M}\,\mathbf{P}^{M} + (\mathbf{H} \blacksquare \mathbf{P})^{N}] \tag{36}$$

We show that the industry output prices in all sectors of the domestic economy P^{Q} are functions of the prices of imports and the price of non-tradable service inputs. In the price sub-model, output prices and tradable input prices are endogenously determined given exogenous import and non-tradable service prices.

The price model completes the specification of the sectoral model which contains the following set of equations,

$$
\begin{aligned}
&Q + M = D + X \\
&M = M(P_M, Y) \\
&D = D(P_M, Y) \\
&X = X(P_X, Y_W) \qquad (37) \\
&Q = A\ f(T, N) \\
&T = T(Q, P^T, P^N) \\
&N = N(Q, P^T, P^N) \\
&\mathbf{P}^T = \mathbf{M}\ \mathbf{P}^M + (\mathbf{I} - \mathbf{M})\ \mathbf{P}^Q \\
&\mathbf{P}^Q = [\mathbf{I} - \mathbf{B}\ (\mathbf{I} - \mathbf{M})]^{-1} [\mathbf{B}\ \mathbf{M}\ \mathbf{P}^M + (\mathbf{H} \blacksquare \mathbf{P}^N)]
\end{aligned}
$$

The static model is composed of nine equations and contains nine endogenous variables for each sector (Q, M, X, D, A, T, N, P^Q, P^T). Given the exogenous sectoral absolute prices of imports P^M, the absolute price of non-tradable inputs P^N, the relative price of exports P_X, and the domestic and world incomes Y and Y_W , the model can be solved for the values of the nine endogenous variables per sector. The solution of the model in all sectors provides sectoral equilibrium values for all variables in the economy. The level of technology A is endogenously determined and results from the discrepancy between the volume of output determined in the market for products and the volume of inputs determined by equilibrium in the market for inputs.

A Dynamic Model

The equilibrium values of the endogenous variables for each and every sector of the economy are valid at any moment in time. Since in static equilibrium the endogenous variables are all related, they must also be related in dynamic equilibrium. This means that at any point in time the set of 9n sectoral model equations generate a new set of 9n equilibrium endogenous variables. We will now consider the specification of the model when all variables depend on time and develop a dynamic specification of the static model described above.

Totally differentiate the market clearing sectoral identity equation (1) with respect to time,

$$\frac{dQ}{dt} + \frac{dM}{dt} = \frac{dD}{dt} + \frac{dX}{dt} \tag{38}$$

multiplying and dividing the first element by Q, the second element by M, the third element by D and the fourth by X, and considering that the growth rate of a variable is its time derivative divided by its value, we obtain,

$$\frac{\overset{\circ}{Q}}{Q} + \frac{\overset{\circ}{M}}{M} = \frac{\overset{\circ}{D}}{D} + \frac{\overset{\circ}{X}}{X} \tag{39}$$

where a dot over a variable denotes growth rate. This is the dynamic market clearing equation.

Totally differentiate the import demand function equation (8) with respect to time,

$$\frac{dM}{dt} = \frac{\partial M}{\partial Y}\frac{\partial Y}{\partial t} + \frac{\partial M}{\partial P_M}\frac{\partial P_M}{\partial t} \tag{40}$$

Dividing by M and multiplying and dividing by appropriate terms to obtain elasticities for each independent variable,

$$\frac{dM}{dt}\frac{1}{M} = \frac{\partial M}{\partial Y}\frac{Y}{M}\frac{M}{Y}\frac{\partial Y}{\partial t}\frac{1}{M} + \tag{41}$$

$$\frac{\partial M}{\partial P_M}\frac{P_M}{M}\frac{M}{P_M}\frac{\partial P_M}{\partial t}\frac{1}{M}$$

and eliminating terms we obtain,

$$\overset{\circ}{M} = E_{MP}\overset{\circ}{P}_M + E_{MY}\overset{\circ}{Y} \tag{42}$$

where E_{MP} is the price elasticities of demand and E_{MY} the income elasticity of demand. Similarly, the growth rate of sectoral exports and domestic apparent consumption may be written in terms of the respective price and income elasticities of demand as follows,

$$\overset{\circ}{X} = E_{XP}\overset{\circ}{P}_X + E_{XY}\overset{\circ}{Y}_W \tag{43}$$

$$\overset{\circ}{D} = E_{DP}\overset{\circ}{P}_M + E_{DY}\overset{\circ}{Y} \tag{44}$$

where E_{XP}, and E_{DP} are the respective price elasticities and E_{XY} and E_{DY} the income elasticities.

Differentiating totally the production function with respect to time and rearranging, one can express the growth rate of output as the sum of the growth rate of technology (total factor productivity) and the growth rate of the input aggregator function f(.),

$$\overset{\circ}{Q} = \overset{\circ}{A} + \overset{\circ}{f}(T, N) \tag{45}$$

Differentiating the input function equation with respect to time and dividing by Q we obtain,

$$\overset{\circ}{f}(x) = \frac{1}{f(x)}\frac{\partial f(x)}{\partial T}\frac{\partial T}{\partial t} + \frac{1}{f(x)}\frac{\partial f(x)}{\partial N}\frac{\partial N}{\partial t} \tag{46}$$

In turn, the time differential of the tradable and non-tradable input demand functions T(.) and N(.) given by equations (14) and (15) are

$$\frac{\partial T}{\partial t} = \frac{\partial T}{\partial P^T}\frac{\partial P^T}{\partial t} + \frac{\partial T}{\partial P^N}\frac{\partial P^N}{\partial t} + \frac{\partial T}{\partial Q}\frac{\partial Q}{\partial t} \quad (47)$$

$$\frac{\partial N}{\partial t} = \frac{\partial N}{\partial P^T}\frac{\partial P^T}{\partial t} + \frac{\partial N}{\partial P^N}\frac{\partial P^N}{\partial t} + \frac{\partial N}{\partial Q}\frac{\partial Q}{\partial t} \quad (48)$$

Define the elasticities of the input function and of the input demand functions as follows,

$$E_{FT} = \frac{\partial f(x)}{\partial T}\frac{T}{f(x)} \qquad E_{FN} = \frac{\partial f(x)}{\partial N}\frac{N}{f(x)}$$

$$E_{NT} = \frac{\partial N}{\partial P^T}\frac{P^T}{N} \qquad E_{TT} = \frac{\partial T}{\partial P^T}\frac{P^T}{T} \quad (49)$$

$$E_{NN} = \frac{\partial N}{\partial P^N}\frac{P^N}{N} \qquad E_{TN} = \frac{\partial T}{\partial P^N}\frac{P^N}{T}$$

$$E_{TQ} = \frac{\partial T}{\partial Q}\frac{Q}{T} \qquad E_{NQ} = \frac{\partial N}{\partial Q}\frac{Q}{T}$$

Subscripts FT and FN denote the elasticities of the input aggregator with respect to its arguments T and N. E_{TN} and E_{TT} denote the price elasticities of the demand for tradable inputs, and E_{NT} and E_{NN} the price elasticities of the demand for non-tradable inputs. Replacing above, one obtains the rate of growth of the input aggregator and the input demand functions in terms of their respective elasticities,

$$\mathring{T} = E_{TT}\,\mathring{P}^T + E_{TN}\,\mathring{P}^N + E_{TQ}\,\mathring{Q} \quad (50)$$

$$\mathring{N} = E_{NT}\,\mathring{P}^T + E_{NN}\,\mathring{P}^N + E_{NQ}\,\mathring{Q} \quad (51)$$

$$\mathring{f}(x) = E_{FT}\,\mathring{T} + E_{FN}\,\mathring{N} \quad (52)$$

From the Euler theorem on homogeneous functions, the sum of the elasticities of the input aggregator E_{FT} and E_{FN} add up to one and the price elasticities of the input demand functions add up to zero. Producer equilibrium requires the input aggregator elasticities to equal the input cost shares[41] which we denote by S_T and S_N respectively. Incorporating these restrictions into equations (50), (51) and (52) yields,

$$\mathring{T} = E_{TT}(\mathring{P}^T + \mathring{P}^N) + E_{TQ}\,\mathring{Q} \tag{53}$$

$$\mathring{N} = E_{NN}(\mathring{P}^N - \mathring{P}^T) + E_{NQ}\,\mathring{Q} \tag{54}$$

$$\mathring{f}(x) = s_T\,\mathring{T} + s_N\,\mathring{N} \tag{55}$$

The prices of tradable inputs and the prices of output given by equations (33) and (36) are linear functions of the prices of imports and the price of non-tradable inputs. We can represent the growth rate of these prices as given by the following linear functions,

$$\mathring{\mathbf{P}}^T = g(\mathring{\mathbf{P}}^M,\ \mathring{\mathbf{P}}^Q) \tag{56}$$

$$\mathring{\mathbf{P}}^Q = j(\mathring{\mathbf{P}}^M,\ \mathring{\mathbf{P}}^N) \tag{57}$$

This completes the specification of the dynamic model. To summarize, all its equation are,

$$\frac{\mathring{Q}}{Q} + \frac{\mathring{M}}{M} = \frac{\mathring{D}}{D} + \frac{\mathring{X}}{X}$$

$$\mathring{M} = E_{MP}\,\mathring{P}_M + E_{MY}\,\mathring{Y}$$

$$\mathring{X} = E_{XP}\,\mathring{P}_X + E_{XY}\,\mathring{Y}_W$$

[41] See Gollop and Jorgenson (1980), page 19.

$$\mathring{D} = E_{DP}\,\mathring{P}_M + E_{DY}\,\mathring{Y} \qquad (58)$$

$$\mathring{Q} = \mathring{A} + s_T\,\mathring{T} + s_N\,\mathring{N}$$

$$\mathring{T} = E_{TT}(\mathring{P}^T + \mathring{P}^N) + E_{TQ}\,\mathring{Q}$$

$$\mathring{N} = E_{NN}(\mathring{P}^N - \mathring{P}^T) + E_{NQ}\,\mathring{Q}$$

$$\mathring{\mathbf{P}}^T = g(\mathring{\mathbf{P}}^M, \mathring{\mathbf{P}}^Q)$$

$$\mathring{\mathbf{P}}^Q = j(\mathring{\mathbf{P}}^M, \mathring{\mathbf{P}}^N)$$

The dynamic model contains the same number of equations, endogenous and exogenous variables as the static model and it has a unique solution at all points in time. We now ask the following questions: by how much would productivity growth change as a result of a marginal increase in the price of imports and as a result of a marginal increase in the price of exports? We will elaborate separately for both output and input markets.

The Effectiveness of Trade Policies - Import Substitution Effect

To analyze the effectiveness of import substitution policies, we proceed by disturbing the equilibrium in the output market of a sector by changing the absolute price of imports of the sector at the margin (corresponding to the imposition of a tariff) and evaluate the resulting impact on quantity supplied by the import-competing domestic sector. Following this, we evaluate how the change in the price of imports at the sector level affects equilibrium in the sector's input market. We do so by evaluating the extent to which a marginal disturbance in the price of imports affects the price of traded inputs at the sector level, and how it affects the resulting input volume. Finally, we relate changes in output and input volumes to derive the policy effect on productivity growth.

a) Market for Outputs

Consider the output market and fixed inputs. From equation (1), totally differentiating Q with respect to time,

$$\frac{\partial Q}{\partial t} = \frac{\partial D}{\partial t} + \frac{\partial X}{\partial t} - \frac{\partial M}{\partial t} \tag{59}$$

and dividing by Q to obtain the growth rate of output,

$$\overset{\circ}{Q} = \frac{1}{Q}\frac{\partial D}{\partial t} + \frac{1}{Q}\frac{\partial X}{\partial t} - \frac{1}{Q}\frac{\partial M}{\partial t} \tag{60}$$

The change in the growth rate of domestic output resulting from a marginal change in the absolute price of sectoral imports is given by the partial derivative of this equation with respect to the absolute price of sectoral imports,

$$\begin{aligned} \frac{\partial \overset{\circ}{Q}}{\partial P^M} = &(-1)Q^{-2}\frac{\partial Q}{\partial P^M}\frac{\partial D}{\partial t} + \frac{1}{Q}\frac{\partial^2 D}{\partial t \partial P} + \\ &(-1)Q^{-2}\frac{\partial Q}{\partial P^M}\frac{\partial X}{\partial t} + \frac{1}{Q}\frac{\partial^2 X}{\partial t \partial P} - \\ &(-1)Q^{-2}\frac{\partial Q}{\partial P^M}\frac{\partial M}{\partial t} - \frac{1}{Q}\frac{\partial^2 M}{\partial t \partial P} \end{aligned} \tag{61}$$

considering a first order approximation and re-arranging,

$$\frac{\partial \mathring{Q}}{\partial P^M} = - \frac{1}{Q^2} \frac{\partial Q}{\partial P^M} \left(\frac{\partial D}{\partial t} + \frac{\partial X}{\partial t} - \frac{\partial M}{\partial t} \right) \tag{62}$$

and noting that the term in brackets is simply $\frac{\partial Q}{\partial t}$,

$$\frac{\partial \mathring{Q}}{\partial P^M} = - \frac{\mathring{Q}}{Q} \frac{\partial \mathring{Q}}{\partial P^M} \tag{63}$$

Equation (63) gives the effect of a tariff on the growth rate of sectoral domestic output. It indicates that the acceleration of output as a result of import price changes depends on the output reaction to import price changes. Because the output response to import price is a complex relationship involving many parameters, the following paragraphs explore this in detail.

The partial derivative term on the right hand side of equation (63) can be written as,

$$\frac{\partial Q}{\partial P^M} = \frac{\partial D}{\partial P^M} + \frac{\partial X}{\partial P^M} - \frac{\partial M}{\partial P^M} \tag{64}$$

In this equation we view the change in domestic quantity supplied to be determined in a way as to satisfy the change in demand dictated by the initial disturbance. A tariff is, in principle, capable of affecting the volume of domestic demand, the volume of exports, as well as import volume. A tariff thus affects the entire output market.

The partial derivative $\partial D/\partial P^M$ in equation (64) refers to the demand change as the result of changes in the absolute price of imports.

From the demand equation (9),[42]

---

[42] Notice that demand elasticities are derived from relative prices and policy effect are derived for absolute price changes.

$$\frac{\partial D}{\partial P^M} = \frac{\partial D}{\partial P_M} \frac{\partial P_M}{\partial P^M} + \frac{\partial D}{\partial Y} \frac{\partial Y}{\partial P^M} \qquad (65)$$

In this equation, domestic apparent consumption and the price of imports are sectoral variables while the income variable refers to national income. We postulate that income is not substantially affected by a sectoral trade policy (exogenous domestic income) and, therefore, we concentrate on the first term in the above equation.

The partial derivative of the relative import price with respect to the absolute import price in equation (65) can be derived from the definition of relative import price given in equation (11), which yields,

$$\frac{\partial P_M}{\partial P^M} = - {P^Q}^{-2} \frac{\partial P^Q}{\partial P^M} P^M + \frac{1}{P^Q} \qquad (66)$$

The marginal relationship between the relative and absolute import prices depends on the change in the absolute price of output resulting from a change in the absolute price of imports of the sector (the ratio in the first right hand side term). This price reaction by domestic producers has two consequences. One is in the market for output where producers compete with imports. The other is in the market for inputs of other sectors (the effect on the inputs of the sector is considered separately below) where the price of imports of the sector under consideration affects the price at which other sectors buy imported inputs of the sector under consideration, such that a change in the price of imports of a sector affects the price at which other sectors sell their output. The behavior of domestic producers of a sector in response to a given change in the tariff of the sector thus depends on the price-cost behavior of the entire economy, and not just in the sector under consideration.

The price of sectoral output is a function of the price of imports and of non-tradable inputs and independent of any other price as equation (36) shows. The value of the marginal price ratio above is given by the partial derivative of equation (36) with respect to the absolute price of imports. The value of the partial derivative is the coefficient of equation (36), which we denote by **C**,

$$\mathbf{C} = [\mathbf{I} - \mathbf{B}(\mathbf{I} - \mathbf{M})]^{-1} \mathbf{B} \mathbf{M} \tag{67}$$

The percentage change in the output price i resulting from a change in input price j is given by the ij element of matrix **C**. The change in the output price of a sector resulting from a change in the price of imports of the "own" sector once all interindustry price transmissions are taken into account is given by the diagonal elements of matrix **C**. For the sector under consideration, denote the diagonal value of **C** as C_{QM}. Replacing in equation (66) above,

$$\frac{\partial P_M}{\partial P^M} = - \frac{P^M}{{P^Q}^2} C_{QM} + \frac{1}{P^Q} \tag{68}$$

Replacing in equation (65) and considering the definition of price elasticity of domestic apparent consumption,

$$\frac{\partial D}{\partial P^M} = E_{DP}\, D \left[\frac{1}{P^M} - \frac{C_{QM}}{P^Q} \right] \tag{69}$$

Equation (69) indicates the domestic apparent consumption response to an import price change. Its sign is likely to be negative. The value of C_{QM} is usually positive and less than one, reflecting the fact that at zero profits the price of output is a weighted average of the prices of imported and non-tradable inputs. Because D is positive, the sign of the derivative is determined by the sign of the price elasticity. Returning to equation (64), we elaborate on the tariff effect on exports.

$$\frac{\partial X}{\partial P^M} = \frac{\partial X}{\partial P_X} \frac{\partial P_X}{\partial P^M} + \frac{\partial X}{\partial Y_W} \frac{\partial Y_W}{\partial P^M} \tag{70}$$

Equation (70) shows the dependence of export volumes on the absolute price of imports. This dependence occurs because import prices affect domestic output and input prices which in turn affect producers' decisions concerning their export prices and, ultimately, export volumes. We assume that world income is independent of domestic trade policies (exogenous), thus eliminating the second term on the right-hand side. From the definition of relative export price in equation (11), the marginal price ratio in equation (70) can be written as,

$$\frac{\partial P_X}{\partial P^M} = - {P^W}^{-2} \frac{\partial P^W}{\partial P^M} P^X + \frac{1}{P^W} \frac{\partial P^X}{\partial P^M} \tag{71}$$

In this equation, the partial derivative of sectoral world price of exports with respect to the sectoral absolute import price is zero as the world price is assumed invariant to changes in import prices (exogenous world price). The dependence of the price of sectoral exports on the price of sectoral imports is similar to the one discussed above for the output price. This occurs because domestic producers compete with imports of the sector, and the price of exports of the sector in question is related to the market clearing price of domestic output which is related to the price of imports. In other words, the question arises: when the price of competing imports rises, do domestic producers raise or lower their export price? A rise in import prices will likely raise both, the price at which domestic producers sell in the domestic market as well as the export price. A reason is that production cost is higher after the tariff increase as a result of the inter-sectoral price dependence discussed earlier. One may model the dependence of the price of exports on the price of imports by postulating the following relationship,

$$\frac{\partial P^X}{\partial P^M} = \frac{\partial P^X}{\partial P^Q}\frac{\partial P^Q}{\partial P^M} = \frac{\partial P^X}{\partial P^Q} C_{QM} \tag{72}$$

where C_{QM} is the relative price between absolute domestic output price and absolute import price, derived in equation (67). If each sector produces a single homogeneous product, producers will demand the same higher price for the product of the sector in the domestic as well as in the export markets. If, on the other hand, two outputs are produced, with their own distinct characteristics such as quality attributes for the domestic and foreign markets, the tariff increase is likely to induce an increase in both domestic and export prices. But the actual price increase for each product may be different depending on the relative elasticities of demand between export and domestic markets. We make the assumption that producers set their prices such that the percentage increase in the price of exports equals the percentage increase in the price of output destined for the domestic market. Which is to say,

$$\frac{\partial P^X}{\partial P^Q} = \frac{P^X}{P^Q} \tag{73}$$

Replacing equation (73) into equation (72) and its result into equation (70) and (71) yields,

$$\frac{\partial X}{\partial P^M} = \frac{\partial X}{\partial P_X}\frac{1}{P^W}\frac{P^X}{P^Q} \tag{74}$$

In terms of the price elasticity of import demand, equation (74) can be written as,

$$\frac{\partial X}{\partial P^M} = E_{XP} \frac{X}{P^Q} \; C_{QM} \tag{75}$$

The likely sign of equation (75) is negative. The marginal price C_{QM} is positive. In this case, the sign of the equation is given by the sign of the price elasticity of export demand which is normally negative. The impact of a tariff on exports is likely to be large since the product of the price elasticity and the marginal price ratio C_{QM} may exceed 0.5 in absolute value. Thus, the effect of a 1% increase in the price of exports could decrease exports by 0.5%.

Returning to equation (64), its third right-hand side term can be written as,

$$\frac{\partial M}{\partial P^M} = \frac{\partial M}{\partial P_M} \frac{\partial P_M}{\partial P^M} + \frac{\partial M}{\partial Y} \frac{\partial Y}{\partial P^M} \tag{76}$$

As before, domestic income is not affected by sectoral import price variations, thus eliminating the second term. Changes in import volume resulting from import price changes can be related to the own price elasticity of the import demand function. Rearranging, one obtains

$$\frac{\partial M}{\partial P^M} = E_{MP} \; M \left[\frac{1}{P^M} - \frac{C_{QM}}{P^Q} \right] \tag{77}$$

The sign of equation (77) is likely to be negative. For a value of C_{QM} less than one, the term in brackets is positive and, therefore, the sign of the equation is the sign of the import price elasticity, usually negative.

Replacing equations (69), (75) and (77) into equation (64) and its result into (63) completes the impact of a change in import prices on the growth rate of domestic output,

$$\frac{\partial \overset{o}{Q}}{\partial P^M} = \frac{\overset{o}{Q}}{Q} \left[E_{DP}\ D\ \left(\frac{1}{P^M} - \frac{C_{QM}}{P^Q} \right) + E_{XP}\ \frac{X}{Q_P}\ C_{QM} - E_{MP}\ M\ \left(\frac{1}{P^M} - \frac{C_{QM}}{P^Q} \right) \right] \qquad (78)$$

The sign of equation (78) is not known a priori. Each term within the square bracket is expected to be negative as these are the signs of equations (69), (75) and (77) discussed above. The last term might be larger than the first, as the absolute value of the import price elasticity may exceed the absolute value of the price elasticity of domestic demand. Because the third term is preceded by a negative sign, it is the only positive term in the bracket. However, due to the preceding negative sign before the square bracket, the first two terms are likely to have a positive contribution while that of the third term is likely to be negative. It is not known if this positive term could more than compensate the negative one. Therefore, it is not possible to predict the sign of the term in brackets, with the result that the effect of an increase in the price of imports on the growth rate of domestic output volume cannot be determined a priori.

b) Market for Inputs

We will now explore the behavior of the market for inputs in detail. Our goal is to analyze the effect of an increase in the tariff on input volumes of the sector while keeping output constant. To do so, we derive the effect of a tariff on the equilibrium input volumes by evaluating the partial derivative of the input volume growth equation with respect to the price of imports. The partial derivative indicates the change in the growth rate of aggregate input volume of the sector associated with a marginal change in the sectoral price of imports. The effect of an increase in the price of imports on the growth rate of the input aggregator is given by the partial derivative of input aggregator equation (46) with respect to the absolute price of imports,

$$\begin{aligned}\frac{\partial \overset{\circ}{f}(x)}{\partial P^{M}} = & - f(x)^{-2}\,\frac{\partial f(x)}{\partial P^{M}}\,\frac{\partial f(x)}{\partial T}\,\frac{dT}{dt} + \\ & \frac{1}{f(x)}\,\frac{\partial^{2} f(x)}{\partial T \partial P^{M}}\,\frac{dT}{dt} + \\ & \frac{1}{f(x)}\,\frac{\partial f(x)}{\partial T}\,\frac{\partial^{2} T}{\partial t \partial P^{M}} - \\ & f(x)^{-2}\,\frac{\partial f(x)}{\partial P^{M}}\,\frac{\partial f(x)}{\partial N}\,\frac{dN}{dt} + \\ & \frac{1}{f(x)}\,\frac{\partial^{2} f(x)}{\partial N \partial P^{M}}\,\frac{dN}{dt} + \\ & \frac{1}{f(x)}\,\frac{\partial f(x)}{\partial N}\,\frac{\partial^{2} N}{\partial t \partial P^{M}} \qquad (79)\end{aligned}$$

taking a first-order approximation and rearranging,

$$\frac{\partial \overset{\circ}{f}(x)}{\partial P^{M}} = - \frac{1}{f(x)^{2}}\,\frac{\partial f(x)}{\partial P^{M}} \left[\frac{\partial f(x)}{\partial T}\,\frac{dT}{dt} + \frac{\partial f(x)}{\partial N}\,\frac{dN}{dt} \right] \qquad (80)$$

The term in brackets is the differential of the input aggregator with respect to time which reduces the expression to,

$$\frac{\partial \overset{\circ}{f}(x)}{\partial P^{M}} = - \frac{\overset{\circ}{f}(x)}{f(x)}\,\frac{\partial f(x)}{\partial P^{M}} \qquad (81)$$

The value of equation (81) depends on the value of the partial derivative of the input function with respect to the price of imports. We now consider this derivative. Input volumes T and N are determined by input demand functions of the form,

$$T = T(Q, P^T, P^N) \tag{82}$$

$$N = N(Q, P^T, P^N) \tag{83}$$

Since the production function is homogeneous of degree one, the sectoral input demand functions T(.) and N(.) are homogeneous of degree zero in prices. The partial derivative in equation (81) can be written as,

$$\frac{\partial f(x)}{\partial P^M} = \frac{\partial f(x)}{\partial T}\frac{\partial T}{\partial P^M} + \frac{\partial f(x)}{\partial N}\frac{\partial N}{\partial P^M} \tag{84}$$

and, from the input demand functions and fixed output,

$$\frac{\partial T}{\partial P^M} = \frac{\partial T}{\partial P^T}\frac{\partial P^T}{\partial P^M} + \frac{\partial T}{\partial P^N}\frac{\partial P^N}{\partial P^M} \tag{85}$$

$$\frac{\partial N}{\partial P^M} = \frac{\partial N}{\partial P^T}\frac{\partial P^T}{\partial P^M} + \frac{\partial N}{\partial P^N}\frac{\partial P^N}{\partial P^M} \tag{86}$$

The supply of non-tradable inputs is assumed perfectly elastic, i.e. there is no price change associated with the hiring of additional units of capital and labour inputs by the sector. This assumption can be justified in situations of unemployment and excess capacity, both of which are typical occurrences in developing economies.[43] Therefore, the terms containing the partial derivative between the price of non-tradable inputs and the price of imports are zero. The price of tradable inputs in the sector (the price of intermediate inputs) depends on the price of imported inputs used by the sector as well

[43] If the price of tradable inputs increases with the price of imports, the value of equations (85) and (86) would be smaller, implying smaller values of equations (91), (92) and a smaller input term in the policy effect equation (95). Given that the contribution of the input term to productivity may have either sign (see below) , it is not possible to establish the a priory impact of the assumption that the price of tradable inputs is not perfectly elastic.

as on the price of output of other sectors, as the sector purchases commodities from these other sectors. In turn, the price of outputs of other sectors depends on the import price of the sector under study to the extent that other sectors use imported inputs from the sector. From equation (26),

$$\mathbf{P}^T = \mathbf{M}\ \mathbf{P}^M + (\mathbf{I} - \mathbf{M})\mathbf{P}^Q \tag{87}$$

and replacing the value of P^Q from equation (36),

$$\mathbf{P}^T = \mathbf{M}\ \mathbf{P}^M + (\mathbf{I} - \mathbf{M})\left[\ [\mathbf{I} - \mathbf{B}(\mathbf{I} - \mathbf{M})]^{-1}\mathbf{B}\ \mathbf{M}\ \mathbf{P}^M + (\mathbf{H} \blacksquare \mathbf{P}^N)\ \right] \tag{88}$$

Elaborating,

$$\mathbf{P}^T = \left[\mathbf{M} + (\mathbf{I} - \mathbf{M})[\mathbf{I} - \mathbf{B}(\mathbf{I} - \mathbf{M})]^{-1}\ \mathbf{B}\ \mathbf{M}\ \right]\mathbf{P}^M + (\mathbf{I} - \mathbf{M})(\mathbf{H} \blacksquare \mathbf{P}\ )^N \tag{89}$$

and designating the terms in large brackets by Z,

$$\mathbf{P}^T = \mathbf{Z}\ \mathbf{P}^M + (\mathbf{I} - \mathbf{M})(\mathbf{H} \blacksquare \mathbf{P})^N \tag{90}$$

This marginal price ratio between the price of tradable inputs and the price of imports is given by the partial derivative of equation (90) with respect to the price of imports, i.e., by the matrix **Z**. Denote the elements of **Z** by Z_{TM}. Replacing above yields,

$$\frac{\partial f(x)}{\partial P^M} = \frac{\partial f(x)}{\partial T}\frac{\partial T}{\partial P^T} Z_{TM} + \frac{\partial f(x)}{\partial N}\frac{\partial N}{\partial P^T} Z_{TM} \tag{91}$$

Writing equation (91) in terms of the elasticities defined in (49), and replacing in equation (81) yields,

$$\frac{\partial \overset{o}{f}(x)}{\partial P^M} = -\ \overset{o}{f}(x)\frac{Z_{TM}}{P^T}\ (s_T\ E_{TT} + s_N\ E_{NT}) \tag{92}$$

The sign of equation (92) is indeterminate. An increase in the price of imports may increase or decrease the growth rate of aggregate input. The growth rate of aggregate input terms in the right-hand side of the equation can be interpreted as the input growth rate prior to the disturbance and we, therefore, consider it to be positive. The marginal price ratio Z_{TM} is likely to be positive and less than one. The own-price elasticities of the input demand functions are always negative but the cross price elasticities may have either sign with the result that the relative magnitude of the terms in parenthesis cannot be determined a priori. Thus, the value of the terms in the bracket may have either sign.

c) Combined Effect

We are now in a position to consolidate the policy effects of import price changes on technological change. This is the result of combining the effect of the tariff on both output and factor inputs. The growth rate of technological change has been defined as the growth rate of outputs not accounted for by the growth rate of inputs, i.e., the growth rate of technological change (productivity growth) is the difference between the growth rates of output volume and input volume. The change in productivity associated with a change in tariff can then be measured by the partial derivative of the growth rate of productivity with respect to the price of imports. This partial derivative is given by the value of the partial derivative of output volume growth with respect to import price minus the partial derivative of input volume growth with respect to import price, as follows,

$$\mathring{A} = \mathring{Q} - \mathring{I}(x) \qquad (93)$$

$$\frac{\partial \overset{o}{A}}{\partial P^M} = \frac{\partial \overset{o}{Q}}{\partial P^M} - \frac{\partial \overset{o}{f}(x)}{\partial P^M} \tag{94}$$

The value of these partial derivatives are given by equations (78) and (92), respectively. Replacing in equation (94) and elaborating yields,

$$\frac{\partial \overset{o}{A}}{\partial P^M} = - \frac{\overset{o}{Q}}{Q} \left[E_{DP} D \left(\frac{1}{P^M} - \frac{C_{QM}}{P^Q} \right) + E_{XP} \frac{X}{P^Q} C_{QM} - \right.$$

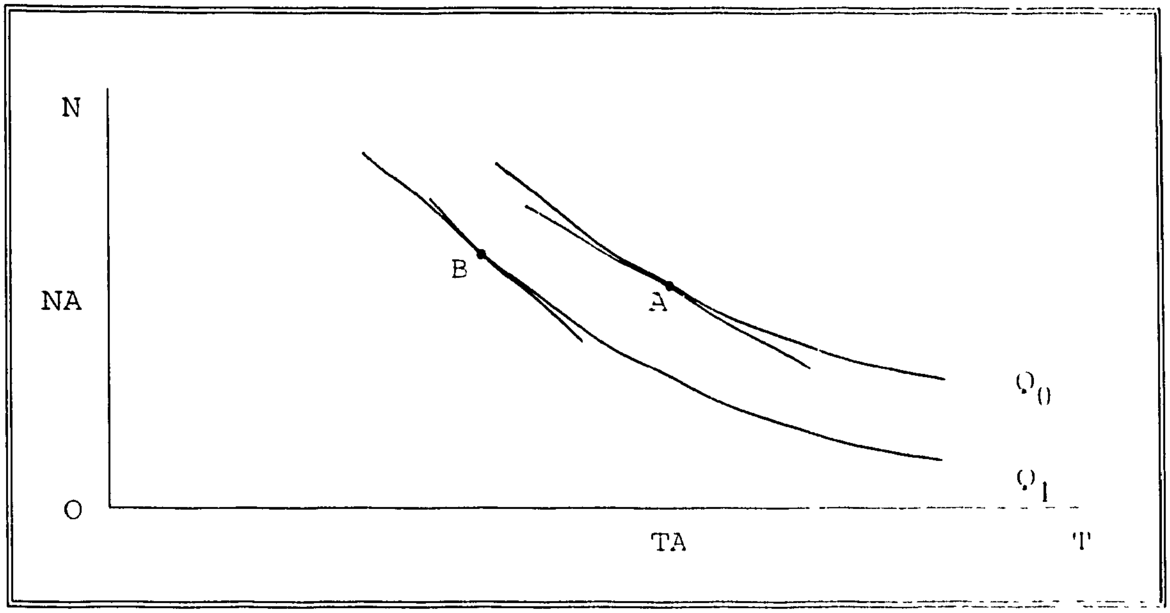
$$\left. - E_{MP} M \left(\frac{1}{P^M} - \frac{C_{QM}}{P^Q} \right) \right] +$$

$$+ \overset{o}{f}(x) \frac{Z_{TM}}{P^T} (S_T E_{TT} + S_N E_{NT}) \tag{95}$$

The numerical value of equation (95) gives the effect of a tariff on technological progress. The parameters of the equation can be obtained from observed data and elasticity estimates. Relative price terms can be derived from the price model. The equation summarizes the sectoral disequilibrium response to a sectoral marginal import price change.

The nature of the sector response to a change in the price of imports is depicted in Figure I. Point A indicates initial equilibrium input volumes T_A and N_A at output level Q_0. The tangent line at A represents the input price ratio. The imposition of a tariff on the product of the sector (an increase in P_M) raises the cost of production to the sector to the extent that the sector uses some quantities of imported intermediate inputs belonging to the same sector, and also to the extent that imports of the sector are used by other sectors to produce inputs to the sector under consideration.

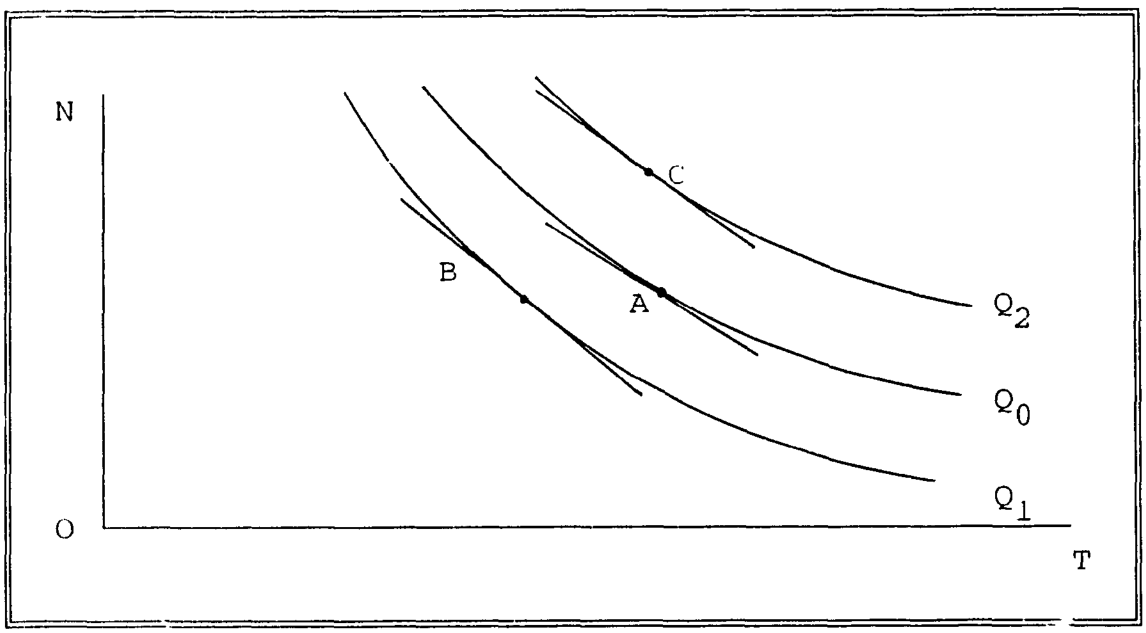
FIGURE I - OUTPUT MARKET EQUILIBRIUM



The rise in import prices has two consequences for domestic producers. On the one hand, the price of imported inputs increases the average price of traded inputs relative to that of non-traded inputs. The change in the relative input price is shown in Figure I as a steeper relative price line to the left of the original relative price line. The new relative price encourages domestic producers to substitute away from imported inputs. Despite input substitution, however, total input cost is higher and the producers' profit maximizing equilibrium occurs at a lower output level, such as at the intersection of the steeper price line and the isoquant Q. at point B. This is not a true equilibrium, however, as explained below.

The transition from point A to point B in Figure 1 is, in fact, the result of two related moves, one along the ray OA (not drawn) due to a decrease in output brought about by higher input cost, and a movement along the isoquant Q_1 as a result of input substitution caused by relative price changes. Because tradable inputs became more expensive, less of them are used in production at B compared to A. A tariff increase is likely to increase the sector's output level. A higher import price reduces import volumes giving domestic producers the possibility to increase their output volume, i.e., to move along their supply curve. This higher output level is shown as point C in Figure II. Point C is obtained by a move along a constant factor proportions line at B,

FIGURE II - INPUT AND OUTPUT MARKET EQUILIBRIUM



the new input combination choice. Under the constant returns to scale assumption, the expansion takes place along a ray from the origin. The distance BC measures the output increase resulting from a change in output prices after substitution has taken place. Observed data refer to points A and C. Point B cannot be observed.

Export Subsidy Effect

We will now evaluate the effectiveness of export promotion regimes as a policy to raise domestic productivity. In a way analogous to the import substitution, we analyze the effect of export subsidies on domestic outputs and inputs separately. Export promotion policies result in the lowering of the foreign price at which domestic exports are sold, while domestic producers receive higher prices thus creating a difference between the price received by producers and the price at which goods are sold in world markets. A lower export price in world markets increases export volumes, while a higher export home price has the effect of increasing the production of exportable commodities.

Even though the sectoral production functions were specified as having one output, one must take into account the competing nature of the domestic and export markets from the viewpoint of domestic producers. An export promotion policy that increases the relative domestic price of exports induces an increased production of exportable goods. This results in a larger export volume and a correspondingly lower volume for the domestic market if only relative price changes are taken into account. But the price received by producers is a weighted average of the export and the domestic prices for their output. Therefore, increases in the export price raise the price of output proportionately to the share of exports in total output. It is this weighted output price increase that increases total output, i.e., a movement along the domestic supply curve.

A second consideration is the likely impact of export subsidies on the price of inputs. We assume an elastic supply curve for non-tradable inputs and, therefore, export subsidies do not affect relative input prices. The effect of export subsidies is therefore to increase the domestic production of inputs along the pre-subsidy ray in input space, but no input substitution takes place.

The dynamic market clearing equation (39) gives the equilibrium output growth rate as a function of imports, exports and domestic demand. The effect of an export subsidy on equilibrium output growth rate is given by the partial derivative of this equation with respect to the absolute price of exports.

$$\begin{aligned}\frac{\partial \mathring{Q}}{\partial P^X} = & - Q^{-2}\ \frac{\partial Q}{\partial P^X}\ \frac{dD}{dt} + \frac{1}{Q}\ \frac{\partial^2 D}{\partial t \partial P^X} - \\ & - Q^{-2}\ \frac{\partial Q}{\partial P^X}\ \frac{dX}{dt} + \frac{1}{Q}\ \frac{\partial^2 X}{\partial t \partial P^X} + \\ & Q^{-2}\ \frac{\partial Q}{\partial P^X}\ \frac{dM}{dt} - \frac{1}{Q}\ \frac{\partial^2 M}{\partial t \partial P^X}\end{aligned} \qquad (96)$$

and taking a first-order approximation,

$$\frac{\partial \mathring{Q}}{\partial P^X} = - \frac{\mathring{Q}}{Q}\ \frac{\partial Q}{\partial P^X} \qquad (97)$$

From the static equilibrium identity equation (1) and taking partial derivatives for a change in the price of exports,

$$\frac{\partial Q}{\partial P^X} = \frac{\partial D}{\partial P^X} + \frac{\partial X}{\partial P^X} - \frac{\partial M}{\partial P^X} \qquad (98)$$

The first term on the right-hand side can be written as,

$$\frac{\partial D}{\partial P^X} = \frac{\partial D}{\partial P_M}\ \frac{\partial P_M}{\partial P^X} + \frac{\partial D}{\partial Y}\ \frac{\partial Y}{\partial P^X} \qquad (99)$$

Considering that domestic income is not affected by changes in sectoral export prices, the second term vanishes. The relative price of imports P_M in the first term of equation (99) is the ratio between the absolute price of imports and the absolute price of output.

As the price of exports changes, this price ratio is not likely to be affected in circumstances where exports absorb a small proportion of domestic output. Therefore, an increase in the absolute price of exports does not affect the relative import price and, as a result, export price changes do not affect domestic demand D. The value of equation (99) is therefore zero.

Returning to equation (98), the partial derivative of output of exports with respect to the price of exports is,

$$\frac{\partial X}{\partial P^X} = \frac{\partial X}{\partial P_X} \frac{\partial P_X}{\partial P^X} + \frac{\partial X}{\partial Y_W} \frac{\partial Y_W}{\partial P^X} \tag{100}$$

World income is unaffected by changes in the domestic price of exports by virtue of the small country assumption. Writing the partial derivative of the export demand function in terms of its price elasticity yields,

$$\frac{\partial X}{\partial P^X} = E_{XP} \frac{X}{P^X} \tag{101}$$

The sign of equation (101) is negative, i.e., a decrease in the price of exports in world markets increases export volume.

The last terms in equation (98) can be expanded as,

$$\frac{\partial M}{\partial P^X} = \frac{\partial M}{\partial P_M} \frac{\partial P_M}{\partial P^X} + \frac{\partial M}{\partial Y} \frac{\partial Y}{\partial P^X} \tag{102}$$

Changes in the sectoral price of exports do not affect domestic income, and therefore, the second term is zero. The relative price of imports is not affected by export price changes and, thus, eliminates the first term as well. In the market for output, export volume increases, domestic demand volume and import demand volume are unaffected. As a result, domestic output increases solely due to the increase in export volume. The observed output price increase is due to an increase in one of its components (the price of exports), while the other component (the price at which producers sell domestically) has not changed. Replacing equation (101) into equation (97) one obtains,

$$\frac{\partial \mathring{Q}}{\partial P^X} = - \frac{\mathring{Q}}{Q} E_{XP} \frac{X}{P^X} \tag{103}$$

The sign of equation (103) is likely to be positive. We take the output growth rate on the right-hand side to be the pre-subsidy growth rate which we assume to be positive. The export price elasticity is expected to be negative and, therefore, the likely sign of the equation is positive.

We now concentrate on the effect of export price changes on inputs. From equation (46), calculate the partial derivative of the input growth rate for changes in the price of exports,

$$\begin{aligned} \frac{\partial \mathring{f}(x)}{\partial P^X} = &- f(x)^{-2} \frac{\partial f(x)}{\partial P^X} \frac{\partial f(x)}{\partial T} \frac{\partial T}{\partial t} + \\ &\frac{1}{f(x)} \frac{\partial^2 f(x)}{\partial T \partial P^X} \frac{dT}{dt} + \\ &\frac{1}{f(x)} \frac{\partial f(x)}{\partial T} \frac{\partial^2 T}{\partial t \partial P^X} - \\ &f(x)^{-2} \frac{\partial f(x)}{\partial P^X} \frac{\partial f(x)}{\partial N} \frac{dN}{dt} + \\ &\frac{1}{f(x)} \frac{\partial^2 f(x)}{\partial N \partial P^X} \frac{dN}{dt} + \\ &\frac{1}{f(x)} \frac{\partial f(x)}{\partial N} \frac{\partial^2 N}{\partial t \partial P^X} \end{aligned} \tag{104}$$

Considering first-order terms, it reduces to

$$\frac{\partial \mathring{f}(x)}{\partial P^X} = - \frac{\mathring{f}(x)}{f(x)} \frac{\partial f(x)}{\partial P^X} \tag{105}$$

The partial derivative on the right-hand side can be written as,

$$\frac{\partial f(x)}{\partial P^X} = \frac{\partial f(x)}{\partial T} \frac{\partial T}{\partial P^X} + \frac{\partial f(x)}{\partial N} \frac{\partial N}{\partial P^X} \tag{106}$$

but, from the demand for input functions and considering output fixed,

$$\frac{\partial T}{\partial P^X} = \frac{\partial T}{\partial P^T} \frac{\partial P^T}{\partial P^X} + \frac{\partial N}{\partial P^N} \frac{\partial P^N}{\partial P^X} \tag{107}$$

$$\frac{\partial N}{\partial P^X} = \frac{\partial N}{\partial P^T} \frac{\partial P^T}{\partial P^X} + \frac{\partial N}{\partial P^N} \frac{\partial P^N}{\partial P^X} \tag{108}$$

By assumption, the price of non-tradable input is independent of the price of exports. These considerations eliminate the second right-hand side terms of equations (107) and (108).

The partial derivative of tradable inputs T with respect to the price of exports can be obtained from the price of tradable input equation (87), as follows,

$$\frac{\partial P^T}{\partial P^X} = (\mathbf{I} - \mathbf{M}) \frac{\partial P^Q}{\partial P^X} = (\mathbf{I} - \mathbf{M}) \frac{P^Q}{P^X} \tag{109}$$

because of (73). Denote (109) by Z_{TX} to facilitate notation. Replace equations (109) into (107) and (108) into (106),

$$\frac{\partial f(x)}{\partial P^X} = \frac{\partial f(x)}{\partial T} \frac{\partial T}{\partial P^T} Z_{TX} + \frac{\partial f(x)}{\partial N} \frac{\partial N}{\partial P^T} Z_{TX} \tag{110}$$

which can be written in terms of elasticities of the input function and of the input demand functions,

$$\frac{\partial f(x)}{\partial P^X} = Z_{TX} \frac{f(x)}{P^T} (s_T E_{TT} + s_N E_{NT}) \tag{111}$$

Replacing in equation (105),[44]

$$\frac{\partial \mathring{f}(x)}{\partial P^X} = - f(\mathring{x})(\mathbf{I} - \mathbf{M}) \frac{P^Q}{P^X} (s_T E_{TT} + s_N E_{NT}) \tag{112}$$

The result of an export subsidy is a likely increase in input growth. This can be illustrated in terms of Figure II. If, as the result of export promotion, output increases from isoquant Q_1 to Q_2 and the initial equilibrium point is B following the disturbance, production will take place at C, on a linear expansion ray OB. This linear expansion is the result of the homogeneity of the input aggregator and of unchanged relative input prices.

The effect of the export subsidy in promoting productivity growth can be derived from the fact that,

$$\frac{\partial \mathring{A}}{\partial P^X} = \frac{\partial \mathring{Q}}{\partial P^X} - \frac{\partial \mathring{f}(x)}{\partial P^X} \tag{113}$$

Thus, from equations (103), (112) and (109),

$$\frac{\partial \mathring{A}}{\partial P^X} = - \frac{\mathring{Q}}{Q} \frac{X}{P^X} E_{XP} + \frac{\mathring{f}(x)}{P^T} Z_{TX} (s_T E_{TT} + s_N E_{NT}) \tag{114}$$

The numerical value of equation (114) gives the growth rate of productivity attributed to a marginal increase in export subsidy. Its sign is likely to be positive, as the export demand elasticity is expected to be negative and, in normal circumstances,

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[44] An alternative derivation based on knowledge of the price elasticity of the product is presented in Appendix C.

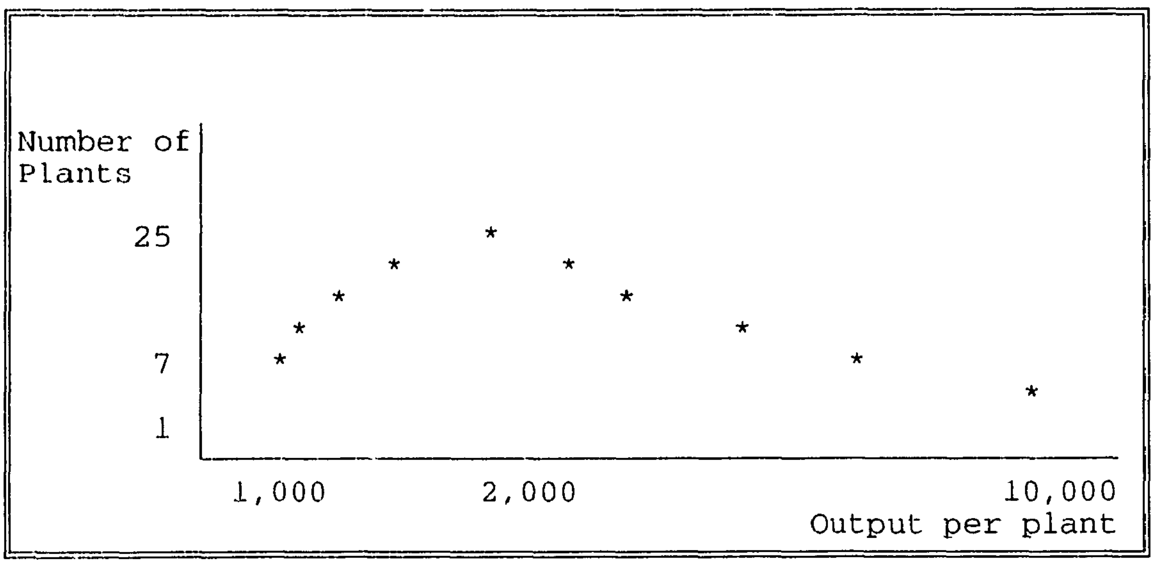
output growth exceeds input growth.

INDUSTRY STRUCTURE EFFECT

We now turn to the analysis of how trade policies are related to the way in which the domestic industry is organized, and in turn, how changes in industry structure may affect technological progress. The reason for doing so is, as explained in Chapter I, to incorporate into our analysis certain known relationships between trade policies and structure as well as between structure and technological progress, although the precise nature of these relationships is unclear.

The interrelationships among these elements are crucial to our understanding of the development of industries and the way in which they are affected by trade policies, in particular, in semi-industrialized countries. In this part, an analysis is presented of the ex post relationship between trade policies and technological change working through the industry structure. We begin by observing that, during a given period, the output level of plants in an industry has an uneven distribution, i.e., there are both plants with high and low output levels. Normally one would expect that an industry has few large plants producing a large proportion of industry output, and smaller plants making up the balance of output. We may visualize this by plotting the number of plants that have specific output levels, i.e., by drawing the frequency distribution of output in the industry. This is illustrated in Figure III. In Figure III, there are seven plants with an output level of 1,000 units, 25 plants with an output level of 2,000 units and one large plant producing 10,000 units. Industry structure is such that medium-sized plants with, say between 1,000 to 4,000 units per year, account for most industry output. The curve illustrates the frequency distribution of output; the distribution has a variance which depends on the particular shape of the curve for the year under consideration.

FIGURE III - DISTRIBUTION OF OUTPUT BY PLANT SIZE



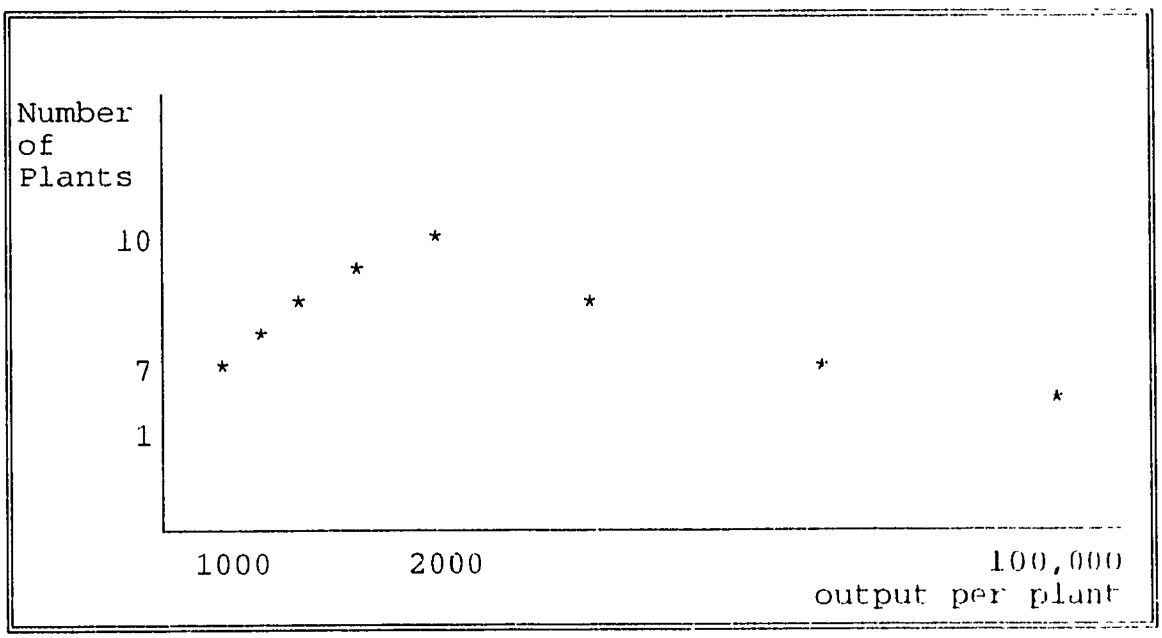
Output variance will differ under a different industrial structure. An industry witn high-seller concentration might have a frequency distribution as illustrated in Figure IV. The peak of the distribution in Figure IV coincides with that of Figure III, but proportionately less output is contributed by plants in the 1,000 to 4,000 unit range. Thus, Figure IV shows an industry with greater monopoly power, other things being equal, relative to the industry depicted in Figure III. The largest plant producing 10,000 units now accounts for 27% of output compared to 15% before.

A measure of variance is given by the coefficient of variation, or standardized variance measure,

$$\sigma^2 = (1/N)\ (1/Q)\ \Sigma\ (q_i - Q) \qquad (115)$$

where N is the number of plants in the industry, q_i the output of the individual plants and Q the average industry output. This measure of variance is not affected by the unit of measurement and, if output is measured in current prices, the variance measure

FIGURE IV - HIGH CONCENTRATION INDUSTRY STRUCTURE



is inflation-free. The measure is closely related to the commonly used Herfindahl concentration index given by the relationship,

$$\sigma^2 = N H - 1 \qquad (116)$$

where N is the number of plants in the industry and H is the Herfindahl index calculated as,[45]

$$H = (\Sigma \ q_i^2) \ / \ (\Sigma \ q_i)^2 \qquad (117)$$

The coefficients of variation for the two industry distributions in Figures III and IV are .52 and .93, respectively. As we have seen, Figure IV shows a higher degree of monopoly power in relation to the industry structure of Figure III and we also observe, as expected, that concentration increases with increased monopoly power. We make use of this below in the interpretation of policy effects.

As part of our empirical evaluation, we measure the variance of output of different industries at different times and relate changes in this variance to changes in trade policies. Such a comparison should yield an insight into how and to what extent trade policies influence domestic industrial structure.

In a second stage of the investigation we focus on the evidence that should uncover the link between industrial structure and technological progress. Important elements in this relationship are the degree of concentration, as well as institutional forces such as patenting agreements and research and development expenditures.

Some a priori expectations may be derived from available information. Concerning the relationship between trade policies and industrial structure, we expect an increase in the tariff to result in a decrease in concentration. This expectation is based firstly on the nature of Argentinean manufacturing during the import substitution period when indiscriminate protection increased the profitability of existing firms. Secondly, because of the low level of technology and low capital intensity of unsophisticated

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[45] A description of the Herfindahl index as a measure of concentration may be found in Koch (1974).

manufactures, protection also made possible the arrival of new entrants in the industry. This relationship between a tariff increase and a reduction in concentration may be less pronounced at higher levels of import substitution because advanced substitution is likely to impose a higher cost of entry compared to early and easier substitution.

Other factors may, however, invalidate or even reverse our expectation of a reduction in concentration as a result of a tariff increase. If, as has been the case in Argentina, tariff protection is perceived as being temporary, the protection provides the incentive for domestic industry to consolidate and therefore results in an increase in concentration.

As for the impact of export subsidies on industrial concentration, one would expect a positive relation to hold, i.e., increases in the subsidy would increase concentration. This is because the commodity-specific nature of EP subsidies is usually geared to existing export activities and, therefore, to existing firms. Potential entrants in the subsidized industry face additional costs not only in terms of investment in productive capacity, but also costs associated with the foreign network necessary for successful exporting. As these costs are likely to be high and the risks involved many, export subsidies may not decrease industrial concentration. Besides the relative high cost of exporting, potential entrants would be more inclined to enter import competing sectors since tariff protection was maintained during the period of export promotion. Thus, it may well be the case that an increase in export subsidies either maintained or increased industrial concentration.

Turning now to the probable relationship between industry structure and technological progress, we have several factors to consider. As noted in Chapter I, we do not yet have a model that fully explains this relationship but there are, nonetheless, a number of indicators that could be utilized to draw some tentative conclusions. Such indicators are, among others, the comparative levels of R&D expenditures of large versus small firms, and the degree of rivalry among firms within the industry. Other factors include, in our case, the distinction between domestic and foreign ownership and the nature of domestic technological development as opposed to "imported" technologies.

A plausible hypothesis that may be advanced from discussions in Chapter I is that higher productivity levels may accrue to medium-size firms, and smaller levels to larger and smaller firms. Smaller firms in an industry are price takers and their source of profitability is likely to be in product differentiation rather than process differentiation. Even though product differentiation involves innovative activity, and it may include R&D spending and patenting, its impact on industry productivity is likely to be small given that unit cost reduction is not an important factor in profitability. Medium size firms have relatively lower formal R&D but, we hypothetise, are more likely to engage in process innovation given the dependence of profits on the size of production runs. Large firms are typically price setters and their profitability is likely to originate in mass production as well as product diversity. Having dominant market shares, these firm's R&D may have a more balanced allocation between process and product innovations with the result that part of the innovative effort does not lead to increases in productive efficiency. Based on these conjectures, we would expect a reduction in concentration to reduce overall productivity because such a reduction usually means the entry of small firms. In the Argentinean case, it would also mean domestic ownership with little access to foreign technologies.

By the same reasoning, an increase in concentration would lead us to expect an increase in productivity since it would be difficult to argue that the concentration in Argentinean manufacturing at any time during the 30 year period under review was at a level that would have induced maximum technological progress. Furthermore, increases in concentration are likely to be accounted for by large firms with access to improved technologies and R&D budgets.

An empirical investigation of these aspects of trade polices is presented in Chapter IV where we will show the estimated values of concentration and relate them to trade policies and indices of measured productivity (as a proxy for technological progress) in a systematic way.

DIRECTION OF CAUSALITY

The analysis of the relationship between trade policy and productivity in this thesis may provoke questions regarding the direction of causality. Although this question is outside the scope of our thesis, the following points are worth mentioning. In our presentation, the direction of causality implicitly runs from trade policies to productivity through two different "intermediate" variables, namely, the output and the industry structure effects. However, it would be incorrect to interpret our work as an estimation of causality. The methodology that we employ attempts to measure the technological consequences of changes in trade policy in a one-way sequence. The procedure seems reasonable if we consider changes in tariffs or subsidies as policy-generated "shocks" which produce effects on factor productivities in the economy. The main justification for this one-way sequence from trade policies to productivity is that in the context of our model, the prices of tradable outputs (and inputs) are determined by trade policy and are, therefore, exogenous to the model. Productivity, on the other hand, is determined endogenously, i.e., explained by the model. But exogeneity of a variable does not necessarily mean that it is a "cause", or for that matter, an effect.

On other contexts, it is indeed possible to argue that trade policy may cause changes in technology through a variety of channels. On the other hand, it has been frequently argued in the development literature that the cause-effect relationship runs the other way around, i.e., productivity changes are the cause of changes in trade policy (see, for example, the survey by Havrylyshyn, 1990 and De Meza, 1986). This is plausible, but to our knowledge no formal tests of causality have been presented. As a general proposition, other possibilities cannot be ruled out. In addition to a uni-directional causality from trade policy to productivity and vice versa, the two may have a bi-directional ("feedback") causality, i.e., causality may run both ways. In other plausible cases, the two variables may have the general tendency for co-movement over time, i.e., if the time series are co-integrated. In such a case, the "direction" of causality no longer remains an important consideration.[46] In still other cases, the two variables may be statistically independent of each other. In sum, the possible directions of causality between trade policy and productivity are varied and complex and require different methodological tools than those used in our analysis. Given the focus of our thesis, however, the chain reaction from trade policy to productivity (technology) seems warranted.

[46] For recent developments in the estimation of causality, see A. Zellner (1988).

CHAPTER IV

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THE EMPIRICAL EVIDENCE, CONCLUSIONS AND POLICY IMPLICATIONS

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INTRODUCTION

The purpose of this chapter is to test the trade policy-productivity relationships presented in Chapter III with reference to a data set in order to illustrate the applicability of the model. In the process we analyze the size and sign of policy effects, the magnitude and sign of the components of policy effects and draw general conclusions about the underlying factors influencing the effectiveness of trade policies.

We have chosen Argentina for the example. Two basic criteria were considered in the selection of this country as a suitable case for analysis. One is the unique experience of three policy regimes (import substitution, export promotion and trade liberalization) with identifiable characteristics such as beginnings, ends, and intensity. The second is the availability of data which include detailed commodity trade statistics linkable to the various production sectors, production data and input-output tables with imported intermediate inputs by sector, which are essential for the price model and the estimation of the elasticity of substitution between tradable and non-tradable inputs by sector.

The estimates of trade policy effects on Argentinean technological development pertain to eight manufacturing sectors as well as total manufacturing. The reconciliation between production and trade data at the sector level is explained in

Appendix A. Estimates of demand elasticities, elasticities of substitution between factor inputs and multifactor productivity employed in the policy effect calculations are the result of econometric estimations which are presented in Appendix B.

The chapter begins by considering the output effect separately from the industry structure effect. Conclusions on the sign, intensity and appropriate timeliness of IS and EP are first presented for each policy regime separately and, later, for the combined effect of the three policies. Next, we analyze the evidence on the industry structure effect and derive pertinent conclusions. Towards the end of the chapter, a general evaluation of trade policies is presented by assessing the effectiveness of past policy regimes as well as the relevance of trade policies in shaping long-term comparative advantage. The chapter concludes with suggestions for further research.

TRADE POLICIES AND OUTPUT

The impact of trade policies on technological change working through the output effect yields two equations which indicate the ceteris paribus impact of a change in tariffs or export subsidies on the rate of growth of domestic technological progress. The policy effects were derived in equations (95) and (114) of Chapter III, and are reproduced here as equations (1) and (2),

$$\frac{\partial \mathring{A}}{\partial P^M} = - \mathring{Q} \left[E_{DP} \frac{D}{Q} \left(\frac{1}{P^M} - \frac{C_{QM}}{P^Q} \right) + E_{XP} \frac{X}{Q} \frac{C_{QM}}{P^Q} - \right.$$

$$\left. - E_{MP} \frac{M}{Q} \left(\frac{1}{P^M} - \frac{C_{QM}}{P^Q} \right) \right] +$$

$$+ \mathring{f}(x) \frac{Z_{TM}}{P^T} (S_T E_{TT} + S_N E_{NT}) \qquad (1)$$

$$\frac{\partial \mathring{A}}{\partial P^X} = - \frac{\mathring{Q}}{Q} \frac{X}{P^X} E_{XP} + \frac{\mathring{f}(x)}{P^T} Z_{TX} (s_T E_{TT} + s_N E_{NT}) \qquad (2)$$

Equation (1) gives the effect of a change in the tariff on the growth rate of technological progress and contains four terms: the contribution of the imports, exports, domestic demand and input market. The value of the policy effect depends on some key factors. The import component depends on the ratio between imports M and domestic production Q (the degree of import penetration); the value of the export component depends on the ratio between exports X and Q (the degree of export exposure); and the value of the domestic apparent consumption component depends on the ratio between domestic consumption D and Q (the degree of domestic product consumption). The D/Q and M/Q ratios may vary between zero and infinity. The X/Q ratio is limited to between zero and one. These ratios play a critical role in the effectiveness of the import substitution strategy as they ultimately define the degree of policy effectiveness due to their relatively dominant numerical importance. Other factors influencing the policy effects are the values of the price elasticities of demand for imports, exports and domestic demand and the price and output elasticities of the input demand functions. In addition, the numerical value of the policy effect depends on the price of imports, exports and domestic goods, as well as on the terms $C_{Q \cdot M}$ and $Z_{T \cdot M}$ representing the relationship between the price of outputs and the import price and between the price of tradable inputs and the import price, respectively.[47]

[47] The sign of the terms in equations (1) and (2) were discussed in Chapter III.

Because the strength of the tariff effect is influenced by the degree of import penetration, export exposure and domestic consumption, we will further analyze this aspect of the equation. Assume for simplicity that the price terms and the effect of the input market are negligible, so that we can concentrate on the effect due to output variables. In this case, the first and second terms of the equation connote a positive and the third a negative contribution to the tariff effect. If, in addition, the economy has production and no exports, X/Q is zero. Since it must be the case that D/Q is higher than the M/Q ratio, ceteris paribus, the technological effect of a tariff is positive since the first term containing the D/Q ratio is larger than the third term containing the M/Q ratio. Thus, an increase in the tariff increases technological progress in this particular case.

Consider now the case in which a tariff is applied in a circumstance where domestic output satisfies most of domestic demand. The D/Q ratio must still dominate the M/Q ratio but their absolute values are now both smaller, with the result that the value of the policy effect is reduced. The efficacy of a tariff is, therefore, inversely proportional to the success of the import substitution strategy in enlarging domestic industrial production. This effect is subject to a deceleration in the sense that a successful import substitution effort leads, as a consequence, to a decrease in the impact of subsequent tariff increases on productivity. This result is in line with the generally held view of diminishing returns to import substitution strategy postulated by development economists.

Export exposure (the X/Q ratio) positively affects the capacity of a tariff to promote technological progress. As more domestic output is exported, i.e., X/Q raises, the differential between the effects of D/Q and M/Q diminishes. Thus, the overall impact of exports on productivity depends on the value of domestic output in relation to the other ratios. If all domestic output is exported, the M/Q ratio equals the D/Q ratio. Given that the terms containing the M/Q and D/Q ratios have opposite signs and of the same order of magnitude when these ratios are equal, the influence of domestic demand term tends to compensate the influence of the import term. In this case, the value of the tariff effect is dominated by the export term.

An increase in export exposure (a rise in X/Q) can be effected either by a reduction of domestic consumption (an increase in X without a corresponding increase in Q), or by an increase in the production of the exportable (an increase in both X and Q). If the increase in X/Q ratio occurs at the expense of declines in the domestic consumption of exportable, the effectiveness of the tariff is unchanged. This occurs because the M/Q ratio remains constant, and therefore changes in the D/Q ratio must match changes in the X/Q ratio. Since the first ratio has a positive influence on productivity while the second a negative influence, the total policy effect is unaffected. In a situation where the increase in exports originates in increased domestic output, the higher the degree of export exposure, the higher the efficacy of a tariff in this particular case.

As equation (1) indicates, the policy effect depends on the values of the own price elasticities of imports, exports and domestic demand functions. Due to the signs in the equation, the effectiveness of a tariff increases with increases in the absolute value of the price elasticity of exports and domestic demand, and with decreases in the import price elasticity. Thus, the technology effectiveness of an import substitution regime will be more successful the higher the degree of product differentiation among the commodities of the sector and, in particular, between imported and domestic products.

The implications of the term relating to inputs in equation (1) are of importance because the term is expected to be negative and, hence, its contribution is subtracted from the effect of terms containing the output components discussed above. The expected negative sign of the input term follows from the sign of the input demand elasticities which must be negative. In absolute value, the magnitude of this term may be smaller or larger than that of the output terms and, therefore, input terms may in fact reverse the sign of the policy effect dictated by other terms.

The term containing input variables captures whether domestic producers are able to take advantage of productivity-enhancing opportunities generated by tariff protection such as, for example, the adoption of innovations. A large productivity growth implies that input growth is much smaller that output growth. Thus, a relatively small input growth translates into a small input term in industries with historically high rates of productivity growth. This suggests that protection is more likely to induce higher productivity growth, and, therefore, succeed as a policy to foster technological advance, in industries which already exhibit large productivity gains.

Of importance in the value of the input term is the magnitude of the relative price term $Z_{T,M}$ which represents the marginal tradable input price resulting from a change in the price of imports used as intermediate inputs. The value of the term is determined by the extent to which imports are used in domestic production, which suggests that minimizing its value might be achieved by minimizing the use of imported inputs.

The price elasticities of demand E_{TT} and E_{NT} in equation (1) are weighted by the cost shares of tradable and non-tradable inputs. Given negative elasticities, the sign of the last term in equation (1) is likely to be negative. Thus, the effectiveness of a policy may be enhanced by minimizing the size of this term which can be accomplished by protecting those industries in which high shares of tradable and non-tradable inputs correspond to small values of the E_{TT} and E_{NT} elasticities.

It must be recalled that the sign of equation (1) may be positive or negative. If it is positive (negative), i.e., if an increase in the tariff increases (decreases) technological change, it is of interest to identify sectors and analyze circumstances that would maximize (minimize) the effect of the policy.[48] We will return to this subject below.

We turn now to the determinants of productivity growth as a result of an export subsidy (equation 2). The efficacy of an export subsidy depends on the degree of export exposure (the ratio X/Q) which means that an export promotion regime that successfully increases the part of domestic output destined to exports has a technologically accelerating effect. Such an export promotion leads to higher technological efficacy of subsequent export promotions due to the increase in the export exposure ratio.

A consideration in the export promotion strategy is that its policy effectiveness depends on the export price elasticity of demand; effectiveness increases with the absolute value of the export price elasticity. Export promotion policies should, therefore, be pursued more diligently in circumstances of both high export exposure and high export price elasticities.

It should also be noted that the higher the productivity growth of the domestic industry, the lower the growth rate of input in equation (2) and the higher the efficacy of an export subsidy in raising productivity. This result parallels that of the tariff effect.

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[48] Writing equations (1) and (2) in terms of the absolute prices makes the numerical values of the policy effects dependent on the unit of measure for quantities. The price of value added was taken as the numeraire in the empirical evaluation.

We thus find further support for the argument favouring the selection of industries based on their own historical record of productivity growth. The relative value of the input growth term in equation (2) in relation to the value of other terms is not known a priori, but its importance cannot be underestimated, for equation (2) might reverse sign if there is technological regress. With negative productivity growth the growth rate of inputs is larger than the growth rate of output. Thus, the second term of the equation may be numerically larger than the first term and, since the second term deducts from the first, it might render the policy effect negative.

We have so far analyzed the implications of each policy in isolation from the others. More often than not, one finds countries and sectors where export promotion is implemented simultaneously with some degree of tariff protection. It is therefore necessary to turn to a realistic special case where export subsidies are granted simultaneously with changes in the tariff. Because the sign of equation (1) is indeterminate, a tariff reduction may have a negative effect on productivity, while an export subsidy may have a positive effect arising from equation (2). There may, therefore, be a policy conflict between tariff reduction and export subsidization as far as their technological implications are concerned. A strategy contemplating the simultaneous application of export promotion and tariff increases or decreases risks technological neutrality and lost opportunities for the development of domestic comparative advantage.

The conflict among trade policies may arise in practice. As we shall find for Argentina, the sign of equation (1) is negative for some industries, indicating that an increase in tariff decreases productivity; and when this is combined with a positive impact from equation(2), the tariff and the subsidy have opposite effects. For these sectors, the best strategy for technological growth consists of a tariff reduction combined with increases in export subsidies.

In concluding the theoretical analysis of the tariff and subsidy effects on productivity, it is useful to focus on the sources of productivity that directly or indirectly follow policy intervention. The fact that technological change is endogenously determined in our model suggests the need to investigate this aspect in some detail. In particular, we are interested in establishing the endogenous sources of technological change as determined by the model.

Policy effects are evaluated in circumstances of equilibrium which is assumed to hold for all sectors and all times. Disturbances from equilibrium at the margin imply adjustments which take place in the markets for inputs and outputs separately, according to the equilibrium rules in each of these markets. If the magnitudes of policy disturbance on sectoral input and output differ, the divergence between the two must be accommodated by the production function of the sector since it provides the link between the input and output markets. Within the production function, input and output volumes, as well as factor proportions, respond to the disturbance, all in accordance with the characteristics of the technology. In the disturbed situation, any excess of outputs over inputs, after taking into account input substitution, must be reflected by a rise or decline in productivity. The change in productivity brings the production function into an ex post balance required by the equilibria in input and output markets at all times. The required change in productivity must be obtained by the sector from inside or outside sources in order for equilibrium to be maintained.

In a sense, the rise, or fall, in productivity in the model arises from the established behavior of the output and input markets. Such a behavior is represented by the price elasticities of the various demand functions, and by the characteristics of the technology at a given point in time. The behavioral parameters are unaltered by marginal disturbances from equilibrium. It is this assumed behavioral constancy from one period to the next which forces the production function to absorb part of the imbalance, giving rise to changes in productivity, since producer and consumer behavior does not typically change significantly over short time periods. The resulting change in productivity indicated by the model is consistent with the observed behavior of consumers and the technological behavior of producers in the various markets.

The economic behavior of the entire productive economy as well as of trading partners enters in the determination of trade policy effects for any one sector. This consideration restricts the general applicability of the conclusions, which may be considered a disadvantage when one's interest is in the micro-determinants of productivity of a single sector. But it has the advantage of bringing into play interindustry relationships and the interacting circumstances of all sectors as immediate determinants of trade policy effectiveness.

In order to quantitatively evaluate the effectiveness and appropriateness of Argentinean trade policies, we begin by evaluating the nature of trade policies themselves. We need to know when tariffs were increased or decreased, when export subsidies were introduced and if they varied over time. Thus, in general, we should establish the time periods in Argentina's history during which tariffs and export subsidies varied. Once this is ascertained, we also establish the direction of change. To assess these facts, we summarize the information presented in Chapter II which provides a detailed account of the history of tariffs and subsidies in Argentina during the period under study.

An analysis of the Argentinean tariff history indicates that:

- During the years after the Second World War, tariffs were set at prohibitive levels for some imported goods, and a system of import licenses was implemented. The prevailing level of protection was reinforced from that prevailing in the 1930's.
- Quantitative restrictions were raised during the second half of the 1940's, and were kept in place until 1959.
- The import restrictions introduced in 1958 were of a temporary nature.
- There was an overall liberalization of imported inputs between 1956 and 1958, in particular of intermediate and capital goods.
- A substantial reduction in tariffs took place between 1958 and 1969 as documented by Balassa (1970), and by Berlinsky and Schydlowsky (see Balassa, 1982).
- There were no substantial tariff modifications between 1958 and 1965, and between 1970 and 1976.
- The overall effective protection rate granted by tariffs was lowered in 1967.
- Between 1976 and 1979 there was a further gradual reduction of tariffs.

The overall picture that emerges is one of a gradual decline of tariffs during the 30-year period. The most important decrease in the tariff took place between 1950 to 1967, being less pronounced in later years.

As for the EP regime we recapitulate the following important facts:

- In 1959, the Central Bank began financing non-traditional export letters of credit, usually at negative real rates of interest.
- In 1960 the government granted 100% corporate income tax exemption on the

export of non-traditional products.

- The drawback and "reintegro" (see Chapter II) rebates on the import of intermediate products used for exports were introduced in 1960 and 1962, respectively.
- The competitiveness of exports was maintained during periods of high wages and domestic recessions.
- Beginning in 1967, exporters were allowed to deduct 10% of the FOB value of exports from corporate income tax. A further 12% subsidy on the FOB value of exports was granted later.
- Between 1971 and 1973, exporters were allowed to convert foreign exchange in the financial market at a higher rate, and to use special subsidies and drawback provisions.

In general, the behavior of export subsidies is one of substantial increase between 1959 to 1962, followed by a slower rate of increase beginning in 1967 and continuing through 1971-1973. Thus, in broad terms, subsidies were generally increasing during the EP years (1960 to 1975).

The liberalization attempt of the 1970's had the following added features:

- The unification of the two foreign exchange markets in 1976 significantly reduced export profitability.
- Liberalization of the financial markets that began in 1977 ended the real interest rate subsidy to industry, and eliminated other forms of subsidies as well.
- The domestic currency which remained overvalued since 1950 returned to parity after 1976 and was undervalued by 1979.

Overall, tariffs and export subsidies both declined during the trade and financial liberalization years of the 1970's.

To summarize: between 1950 to approximately 1959, Import Substitution (IS) was the dominant trade policy, although accompanied by a gradual decline in the level of tariffs. The years 1960-1961 were the beginning of Export Promotion (EP) in manufactured goods. With the introduction of EP, Import Substitution (IS) was relegated to a secondary role, but protection continued during the EP regime, lasting until approximately 1975, while subsidies increased. Beginning in 1976, trade began to be liberalized. Many import restrictions and export subsidies entered a period of gradual reduction which continued until the end of our time series in 1979.

Having established the main characteristics of the trade policy regimes, we proceed to evaluate the numerical values of the policy effects given by equations (1) and (2). Given the policy effect's dependence on the absolute value of prices, we deflate all prices by the price of output, a numeraire price. The interpretation of the policy effect thus refers to the change in the growth rate of productivity resulting from changes in the price of imports and exports relative to the price of domestic output. We have also introduced to the policy effect equations a modification to take into account the assumption of proportionality between the price of tradable inputs and the price of value-added employed in the construction of the Argentinean database. Details of both these modifications to the policy equations are explained in Appendix C.

The numerical value of policy effects for the manufacturing sectors between 1950 and 1979 is shown in Table XI.[49] The signs of Table XI show that an increase in the

[49] Miscellaneous manufacturing industries are excluded.

tariff would have decreased the growth rate of productivity of Argentinean manufacturing and that an increase in export subsidies would ha e increased manufacturing productivity during the 1950-1979 period.

TABLE XI

TRADE POLICY EFFECTS ON TECHNOLOGICAL PROGRESS TOTAL MANUFACTURING, 1950-1979

	IMPORT TARIFF EFFECT	EXPORT SUBSIDY EFFECT
ALL SECTORS	- 0.005	0.0008

The Argentinean evidence suggests that trade policies can influence[50] the technological development of manufacturing industries and that both, tariffs and subsidies, can be employed to effect technological changes in the manufacturing sector.[51] Because the sign and magnitude of policy effects in Table XI correspond to total manufacturing, it is of interest to evaluate the sign and magnitude of tariff and subsidy effects at the level of individual manufacturing industries. This is shown in Table XII.

[50] The magnitude of the policy effect indicates the numerical value of the slope of the curve relating the growth rate of productivity to the relative price of imports and of exports. The impact of a 1% increase in the tariff on the growth rate of productivity is the product of the change in the relative price of imports (0.01) and the value of the policy effect (-0.005), or 0.00005. If the actual growth rate of productivity is 0.01 (a typical annual growth rate in gross output productivity), the imposition of a 1% tariff decreases productivity to 0.00995, or a 0.5% decline in the growth rate of productivity. Policy effects are valid for small relative price changes. Large price changes would introduce additional effects which are not taken into account by the model, such as income effects.

[51] The results presented are in terms of the 1970 valuation of prices. The choice of a different base year changes the value of policy effects.

TABLE XII

TRADE POLICY EFFECTS ON TECHNOLOGICAL PROGRESS BY INDUSTRY, 1950-1979
(percent)

INDUSTRY	IMPORT TARIFF EFFECT	EXPORT SUBSIDY EFFECT
FOOD	1.32	0
TEXTILES	0.15	-0.02
WOOD	0.18	0
PAPER	-0.77	0.59
CHEMICALS	-7.62	0.07
NON-METALLIC MINERALS	0	0.05
BASIC METALS	0.11	0.20
METAL PRODUCTS	0	0.12

As Table XII shows, there is considerable variability in the size and sign of policy impacts across manufacturing sectors. Because most magnitudes are small, this and subsequent tables show policy effect in percentage terms. For most manufacturing sectors, large (small) tariff effects do not coincide with large (small) subsidy effects and the sign of the effects are not well related, such that no general pattern between the tariff and subsidy effects is evident. There is, however, an important conclusion that can be derived from Table XII. Trade policies that indiscriminately increase tariffs and subsidies to all sectors would not benefit all industries; it would be detrimental to two industries in the case of tariffs and to one industry in the case of subsidies. Given the relative size of policy effectiveness across sectors and the lack of policy response in a number of sectors, the results of Table XII lends support to the use of discriminatory, or sector specific, trade policies.

The finding from Table XII that trade policy may increase or decrease the growth rate of productivity in a manufacturing sector can be explained in terms of producer behavior. The introduction of a tariff is normally accompanied by an increasing proportion of domestic consumption satisfied by domestic production and the introduction of an export subsidy by an increase in domestic output destined for foreign markets. In both cases output expands. The reaction of producers to the increase in output is crucial to the technological effectiveness of the policy. Productivity increases if a larger domestic output is produced with additional inputs of a higher technological level. But if the output expansion created by the tariff or subsidy is not satisfied in this progressive manner, productivity may stagnate or even decrease if the additional inputs necessary for a higher level of production are less productive than current ones. Thus, while trade policies create a favourable climate for technological change, the ultimate outcome depends on the reaction of producer to the new environment. In the case of tariff and subsidy reductions, the reasons why productivity may increase or decrease are quite different. A tariff or subsidy reduction typically implies a decline in output. The productivity enhancing effect of tariff and subsidy reductions is twofold: the elimination of inefficient producers from the industry and increased technological efficiency of the remaining firms due to greater competitive pressures. However, if producers perceive the tariff or subsidy changes as temporary macroeconomic corrections or if the cost of adjustment to a new equilibrium does not allow for an efficient reduction in the volume of inputs, firms will operate with excess capacity and productivity would decline as a result of the policy.

As mentioned in Chapter III, the magnitude of policy effects are influenced by the degree of import penetration, export exposure and domestic consumption. We will now analyze the importance of these ratios in the value of policy effects at the sector level. The value of policy effects for each of the terms in equations (1) and (2) are presented in Table XIII and correspond to the 1950-1979 period. The Food sector has by far the largest export exposure, on the order of 20%, in contrast to all other sectors where exports are a very small proportion of domestic production (the second largest exposure value is for chemicals at 6%, declining to 2% or less for the other sectors). Table XIII shows that the export component of the export subsidy effect is relatively large for Food as one might expect on the basis of the exposure ratio. The degree of import penetration varies between 55% in Basic Metals to 1% in Food, while the D/Q ratio is highest in Basic Metals at 150% and lowest in Food at 81%. These ratios suggest that the domestic market effect given by the first term of equation (1) should dominate the total policy effect, followed in importance by the import effect (the third term) and the export effect (the second term). However, as Table XIII shows, the numerical contribution of each of these terms in individual manufacturing sectors does not always conform to the order of magnitude predicted by the size of the ratios. The reason is the low value of the export demand and domestic demand price elasticities in some industries. As a result, Argentinean tariff policy effects are dominated by either the value of import, export or domestic exposure or the value of price elasticity of the demand for output or inputs. In a similar line of reasoning, we have shown that the first term of the export promotion policy effect depends on the export exposure ratio. In the case of Argentinean manufacturing sectors, because of low export exposure ratios and low export demand elasticities, the policy effects are dominated by the input term, as Table XIII shows. An important finding in Table XIII is that there is no uniform policy response in the various markets, a knowledge that may be further exploited in the design of sector-specific policies.

TABLE XIII

COMPONENTS OF POLICY EFFECTS, 1950-1979
(percent)

Sector	Tariff Effect				Subsidy Effect	
	Domest.	Expts.	Impts.	Inpts.	Exports	Inputs
FOOD	1.56	0.03	-0.09	-0.18	0.31	-0.31
TEXTILES	0.18	0	-0.02	-0.02	0	-0.02
WOOD	0.21	0	-0.03	0	0	0
PAPER	0	0	-0.77	0	0.59	0
CHEMICALS	0	0	-7.62	0	0.07	0
NON-MET.	0	0	0	0	0.05	0
BASIC MET.	0	0	0.11	0	0.20	0
METAL PRS.	0	0	0	0	0.12	0

We obtain further insights into the effectiveness of trade policies by analyzing their intensity during each of the three trade policy regimes: IS, EP and liberalization. The magnitude of policy effects by manufacturing sectors and by trade policy regime is presented in Table XIV. The results indicate that the effectiveness of trade policies was not constant over the 30-year period, with large variations between sub-periods.

What is interesting in Table XIV is that policy effects change sign from period to period. In most cases, there is no single dominant term in the policy effect equation that causes the effect to change signs; the change in sign is caused by a combination of factors.

We now ask whether, from a technological point of view, the Argentinean authorities pursued the right policies at the right time. For example, was IS the appropriate policy in the 1950's? Was EP the appropriate policy in the 1960's and up to 1975? And was liberalization an appropriate policy at the time of its implementation? Table XIV provides an assessment of past policies at the sector level by policy regime.

As pointed out earlier, the tariff levels were gradually declining during the 1950's and, hence, a negative tariff effect would signify that declining tariffs would have increased the growth rate of productivity. Therefore, one concludes that tariff reductions would be the correct policy in industries with negative tariff effect during the IS period. This is the case only in the Paper and Chemicals industries. On the other hand, tariff reductions would have decreased the growth rate of productivity in the Food, Textiles and Wood industries. Therefore, it is far from clear that the correct policy was followed for the entire manufacturing sector during the IS period. To clarify this question further we calculated the tariff effect for all manufacturing sectors during the IS period. Table XV shows the results of this calculation. Because the magnitude of the sector's policy effects is negative (-1.83%), we conclude that a uniform tariff decline in all sectors would have been an appropriate trade policy during the 1950's even though it would be detrimental to three out of eight sectors.

Was EP the appropriate policy for the technological development of the manufacturing sector in the 1960's? The subsidy effect for the eight industries combined during the 1960-1975 period is a positive 0.13% (Table XV), indicating that

TABLE XIV

TRADE POLICY EFFECTS BY INDUSTRY AND POLICY REGIME
(percent)

INDUSTRY	POLICY REGIME	IMPORT TARIFF EFFECT	EXPORTS SUBSIDY EFFECT
FOOD	IS	2.10	-0.09
	EP	1.07	0.04
	LIB	0.55	0.02
TEXTILES	IS	0.23	-0.03
	EP	0.14	-0.02
	LIB	0.02	-0.01
WOOD	IS	0.24	0
	EP	-0.19	0
	LIB	1.55	0.04
PAPER	IS	-0.65	0
	EP	-1.05	1.06
	LIB	0.08	0
CHEMICALS	IS	-22.92	0
	EP	-0.79	0
	LIB	-0.50	0.51
NON-MET. MINER.	IS	0	0
	EP	0	0.04
	LIB	0	0.18
BASIC METALS	IS	0	0.01
	EP	0	0.33
	LIB	0.80	0.08
METAL PRODUCTS	IS	0	0.08
	EP	0	0.16
	LIB	0	0.07

IS: Import substitution period, 1950-1959.
EP: Export promotion period, 1960-1975.
LIB: Liberalization period, 1976-1979.

TABLE XV

POLICY EFFECTS ON TOTAL MANUFACTURING BY POLICY REGIME
(percent)

	TARIFF EFFECT	EXPORT SUBSIDY EFFECT
IS PERIOD	-1.83	-0.02
EP PERIOD	0.14	0.13
LIB PERIOD	0.19	0.11

export subsidies positively affected the growth rate of productivity during the EP period. The relative magnitude of the export subsidy effect during the EP period compared to that of the IS and liberalization periods indicates that the 1960's was the period of highest possibilities for technological advance through export promotion and, therefore, the introduction of EP policies was timely. However, during the EP period, the tariff and subsidy effects are of the same order of magnitude. Since tariffs were declining and subsidies rising during the period, the productivity reducing effect of tariff reductions during the EP period worked in the opposite direction to the productivity enhancing effect of the increase in subsidies. This suggests a technologically neutral effect during the period if all sectors had been protected and promoted to the same degree.

The answer to the question whether liberalization was the appropriate policy beginning in 1976 can also be established. Table XV shows that the tariff effect for all sectors 0.19%, and the export subsidies effect is 0.11%. The positive sign of both policy effects indicates that tariff and subsidy reductions during the liberalization period both contributed to decrease productivity. Given that the actual liberalization period in Argentina extends well beyond 1979, the finding of unfavourable policy effects should be interpreted with caution: they are simply indicative of a possible decrease in productivity at the early stages of the liberalization process.

We now raise a further question: what would have been the optimum timing of policies if the impact of trade policies on technological growth were the principal criteria for their appropriateness? Would a tariff reduction have been more effective in the earlier part of the period when tariffs were high? Would EP have been more effective if it commenced earlier than it did? Did liberalization begin too early for some industries and too late for others?

The answer to these questions can be deduced by examining the changing values of the policy effects through time. If the effectiveness of a tariff had a larger negative value during the 1950's than at any other time in our sample, a tariff reduction would have induced highest productivity growth. Similarly, if the effectiveness of subsidies were at a positive maximum during the 1960's, one could conclude that the timing of export subsidies was appropriate then. In the case of liberalization period, a presumption of correct timing requires the tariff and subsidy effects to be both at their negative minima and maxima, respectively, if maximum technological benefit were to be derived from trade liberalization.

Table XV indicates that as far as the entire manufacturing sector is concerned, the most appropriate period for tariff reductions was the 1950's and the most appropriate period for export subsidies was the 1960's. Both these findings lend considerable support to the timing of actual trade policies of Argentina. However, tariffs should have been increased in the 1960's and 1970's and subsidies should have been increased during the second part of the 1970's.

Discriminating trade policies with respect to individual sectors might have been technologically more effective than indiscriminate policies. The evidence presented in Table XIV suggests that 1950's was the appropriate time for tariff reductions in the case of Paper and Chemicals industries, and that similarly, the 1960's was the appropriate time for the Wood, Paper and Chemical industries. Tariff increases might have increased productivity in all other industries. A comparison of the size of the subsidy effect in the IS, EP and liberalization periods suggests that subsidies might have been more effective in the 1970's for Wood, Chemicals and the Non-metallic Minerals industries. Concerning the appropriate timing of the liberalizing period, it would appear that it was not the correct policy for any sector given that the tariff and subsidy effects for these sector are positive during the period (see Table XV). Finally, our results suggest that it would have been optimal to liberalize the entire manufacturing sector in the 1950's in order to maximize the productivity acceleration potential of this particular trade policy.

In spite of differences in the optimum technological policy for different time periods and different manufacturing sectors, given the magnitude and sign of policy effects in Table XI, an overall policy conclusion can be reached: since the tariff policy effect is in the order of six times larger than the export subsidy effect, trade liberalization of the manufacturing sector would have maximized technological benefits during the 30 year period of study. This finding indicates clear superiority of a movement towards free trade as an overall best policy for the technological development of Argentinean manufacturing.

TRADE POLICIES AND INDUSTRIAL CONCENTRATION

Chapter III laid the foundation for the approach to be followed in analyzing the impact of trade policies on the market structure of manufacturing, and the impact of such structure on technological progress. In general, the effect of trade policies on market power and concentration manifests itself in increasing profitability of domestic production and a decreasing degree of competition among producers. Increases in profitability may arise from increases in tariffs or in export subsidies. In turn, profitability is likely to attract new firms in the industry if there is ease of entry for firms with lower levels of technology. But at higher levels of technology, entry may be restricted by a host of other factors, in addition to the high capital cost of technology, such as the availability of skilled personnel and the oligopolistic practices of existing firms. The expected higher profitability resulting from higher tariffs and subsidies may in this case cause a reduction rather than an increase in concentration, i.e., a decrease in the monopoly power of existing firms.

Similarly, export subsidies are, in general likely, to increase industrial concentration because they are specific to current production and, therefore, to existing firms. There is, of course, a type of export subsidy with a wider applicability covering commodities not previously manufactured. Argentinean export subsidy policies for the manufacturing sector had provisions of this sort, but in actual fact, the subsidies were conducive to product diversification in existing firms rather than the establishment of new firms whose main activity would be the export markets.

The relationship between market power as measured by the degree of concentration and the growth rate of productivity is considerably more complex. A large number of empirical studies have so far produced only some tentative conclusions about this relationship which was explored in detail in Chapter I and summarized in Chapter III. Again we mention the main conclusion. It would appear that there is a positive relationship between firm size and the growth rate of productivity for small-size firms and a negative relationship between firm size and concentration and the growth rate of productivity for large firms. Accordingly, it is expected that maximum technological progress would take place at an intermediate-size firm. There are, however, some caveats to this proposition. It is not at all clear that the general relationship between firm size and productivity applies equally to all industries, or whether it applies to particular types of industries. The notion of what constitutes an intermediate size firm is not well-defined and there is no rigorous empirical testing to support the validity of this general conclusion at disaggregated levels.

We will proceed with the empirical assessment of the relationship between trade policies and productivity via the industry structure effect in two stages. First, we measure industrial concentration for each of the eight Argentinean manufacturing industries and for total manufacturing as given by the normalized output variance measure (equation 115 of Chapter III), and then we link changes in trade policies over time to changes in concentration over time. Second, we measure the actual growth rate of multifactor productivity for the same manufacturing industries, and for total manufacturing, and infer the relation between concentration and productivity by relating changes in concentration to changes in the growth rate of productivity over time.

There is an important distinction between the industrial concentration effect and the output effect of trade policies. In the case of output effect, as given by equations (1) and (2), the effect refers to the potential gain or loss in productivity when the price of imports or of exports is changed at the margin. In the case of the industry structure effect, we are measuring ex post changes. Our aim is to analyze how changes in trade policies have affected the degree of manufacturing concentration in Argentina over time and then to relate the resulting changes in industrial concentration to actual changes in the growth rate of productivity. In more precise terms, we consider the extent to which changes in tariffs and subsidies are correlated with changes in industrial concentration, and how these changes in industrial concentration are correlated with changes in the observed growth rate of productivity.

Within this framework, the relationship between changes in tariff and concentration should consider a time period during which the tariff was actually changing. Similarly, the evaluation of the effect of subsidies on market structure should refer to a period during which subsidies were changing. Time periods where tariffs and subsidies changed significantly were identified in Chapter II as the import substitution (IS) period from 1950 to 1959, the export promotion (EP) period from 1960 to 1975, and the liberalization period covering the years 1976 to 1979. A summary of the evolution of tariffs and subsidies during these time periods was presented in the previous section of this chapter, and more fully in Chapter II.

The degree of industrial concentration in the manufacturing industries was estimated for the years 1954, 1963 and 1973 that correspond to industrial census. The estimates are presented in tables XVI, XVII and XVIII.[52] The tables also include other statistics for reference purposes, such as the number of establishments,

[52] The 1950 census excludes establishments with less than five employees and it is therefore incompatible with subsequent ones. See CONADE-CEPAL, *Distribución del Ingreso y Cuentas Nacionales en la Argentina*, Buenos Aires, 1965, Vol. I, page 80.

employment, output and effective tariff rates. For comparison, table XIX presents employment and real output as of 1979, but it was not possible to obtain concentration measures due to lack of establishment data. No data on effective protection rates are available after 1969 and no measure of subsidy rates are available.

A comparison of tables XVI and XVII corresponding to the 1954 and 1963 census years yields a number of observations. Between 1954 and 1963, at the total manufacturing level, there is evidence of a reduction in the number of establishments and employees, accompanied by an increase in output. The increase in the degree of industrial concentration is accompanied by a decrease in the effective tariff rate.[53] During this period there was, as we have seen, a gradual reduction in nominal tariffs, in particular between 1956 and 1958 for intermediate and capital goods, even though there were temporary import restrictions imposed in 1958 as part of a policy to reduce inflation. We conclude, therefore, that, at the total manufacturing level between 1954 and 1963, a general decrease in tariff was accompanied by an increase in concentration. The increase in concentration is also evident in seven of the eight manufacturing sectors. In the case of three industries for which effective tariff rates can be compared (Food, Non-metallic Mineral Products and Machinery), there was a tariff reduction, confirming the extensive coverage of the tariff reduction measures described in Chapter II. A possible explanation for the observed increase in the degree of concentration is the fact that a reduction in protection is equivalent to an increase in the degree of competition, in this case between domestic and foreign firms. Those domestic firms that could not improve efficiency when faced with reduced

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[53] The concentration of an industry is a measure of the dispersion of the frequency distribution of the firm's values of production. It is measured by the coefficient of variation or standardized variance measure (equation 115, Chapter III).

TABLE XVI

CONCENTRATION BY INDUSTRY, 1954 CENSUS

Industry	Establs. (1)	Empl. (2)	Output (3)	Tariff (4)	Concentration (5)
Food	23	275	272	531	39.03
Textiles	29	312	505	3186	1.59
Wood	20	136	7	448	.66
Pulp, Paper	5	64	105	121	2.23
Chemicals	3	90	55	270	18.78
Non-metallic Minerals	12	93	88	94	29.29
Metals	18	162	80	264	2.84
Machinery	30	259	279	165	6.09
total	141	1,392	1,912	-	12.56

(1) thousand establishments. (2) thousand employees. (3) billion of 1960 pesos. (4) 1958 effective rates from table III. (5) concentration as per equation 115.
Sources: Establishments and employment: Censo Industrial 1954, INDEC 1960; output and concentration: own estimates.

profitability may have ceased production and exited the industry, resulting in an increase in concentration. Alternatively, inefficient firms may have merged with other firms, thus increasing average firm size and concentration.

There is some evidence to suggest that there were restrictions on the establishment of new firms during the IS period which can be traced to quantitative import restrictions introduced in the 1940's. These restrictions were administered by import permits issued to firms with previous import experience, a policy which created a bias against the entry of new firms. When these measures were abandoned in 1959, tariff reductions had already begun, effectively replacing the high cost of entry with a high risk of entry represented by trade liberalization, a risk that would presumably be greater for new entrants which tend to be small.

Other factors may also have contributed to the increase in concentration during the 1954-1963 period. One such factor is that foreign investment during the period was directed primarily towards import substitution activities of existing firms, and only secondarily to the establishment of new firms. Another contributing factor may have been the implicit subsidy in the form of negative rates of interest which presumably was more easily available to established firms than to new ones. In addition, the availability of government credit to small firms by the Banco Industrial that began in 1944 had ended in 1953 and its importance as a source of credit to manufacturing industries declined thereafter.

If we compare the 1963 and 1973 census data, we find a different sort of change. At the manufacturing level, the number of establishments declined once again, while the level of employment and of real output increased. Manufacturing concentration decreased. There is, however, some variability across manufacturing industries. The metals sector shows a large reduction in the number of establishments. This reduction is largely definitional, however, since the 1963 census follows the UN-ISIC Revision 1, while the 1973 census is based on Revision 2 which defines metals differently. Also, three industries (Wood, Metals and Machinery) show an increase in concentration.

A comparison of the concentration values in tables XVII and XVIII has to be related to two different policy regimes. As explained above and in Chapter II, between 1963 and 1973 there were both a continuation of the trend toward lower tariffs and an acceleration of export promotion activity. There is, therefore, an indication that changes in concentration between 1963 and 1973 are the net result of the effect of tariff reductions and of subsidy increases on concentration.

TABLE XVII

CONCENTRATION BY INDUSTRY, 1963 CENSUS

Industry	Establs. (1)	Empl. (2)	Output (3)	Tariff (4)	Concentration (5)
Food	26	272	1,008	24	72.08
Textiles	18	228	538	-	2.39
Wood	17	76	79	-	1.12
Pulp, Paper	5	65	170	-	3.66
Chemicals	5	99	363	-	41.60
Non-met.Min.	10	78	126	31	95.79
Metals	18	150	183	-	3.86
Machinery	39	321	780	117	1.11
total	139	1,287	3,247	97	41.50

(1) thousand establishments. (2) thousand employees. (3) billion of 1960 pesos. (4) 1969 effective rates from Table IV. (5) concentration as per equation 115.
Sources: Establishments and employment: Censo Nacional Económico, INDEC 1970; output and concent.: own estimates.

In previous paragraphs we argued that a reduction in the level of tariffs corresponds, in general, to an increase in concentration. We have shown this relationship to hold for the 1954-1963 period. If one were to extend the correlation between tariff decreases and increases in concentration to the 1963-1973 period, then one concludes that tariff reductions between 1963 and 1973 would have contributed to increase concentration during this period. Given that concentration actually decreased between 1963 and 1973, and that such a decrease is the net result of tariff reductions and increases in export subsidies, one concludes that the observed decrease in manufacturing concentration during this later period is the result of increase in export promotion subsidies. In other words, the observed decrease in concentration between 1963 and 1973 is the net result of an increase in concentration resulting from a tariff reduction and a much stronger decrease in concentration due to export subsidies. We therefore attribute this reduction in concentration to the rise in export subsidies.

TABLE XVIII

CONCENTRATION BY INDUSTRY, 1973 CENSUS

Industry	Establishments (number)	Employment (number)	Output ($mill*)	Concentration
Food	27,462	320,364	1,377,328	16.34
Textiles	18,310	245,718	712,898	2.04
Wood	19,688	87,621	104,942	3.20
Pulp & Paper	5,444	72,199	285,407	3.49
Chemicals	6,217	147,843	748,543	16.06
Non-met.Min.	14,216	103,754	224,754	5.19
Metals	1,498	80,829	355,272	33.25
Machinery	30,560	451,581	1,583,468	22.67
AVERAGE	123,395	1,509,909	5,392,075	14.03

* Million of 1970 pesos. Sources: Establishments and employment INDEC, 1980; output and concentration; own estimates.

Several factors provide support for this conclusion. First, profitable export opportunities generated by export subsidies benefited firms of domestic control rather than firms of foreign control or ownership. This occurs because the incentive to export on the part of foreign-owned or foreign-controlled corporations was restricted by foreign investment legislation that imposed controls on the transfer of dividends abroad. This policy of restricting the remittance of funds had its largest impact between 1964 and 1966, but was not completely reversed in subsequent years. In

Argentina, foreign firms are typically large while domestic firms are often of medium and small size. The limited incentives to engage in exporting activity by large firms compared to small- and medium-size firms is a factor tending to the decrease in concentration during this period.

TABLE XIX

EMPLOYMENT AND OUTPUT, 1979

Industry	Employment	Output*
Food	335,906	1,559,821
Textiles	170,800	748,675
Wood	68,225	110,150
Pulp and Paper	88,687	314,324
Chemicals	132,350	864,416
Non-met. Minerals	75,602	259,416
Metals	207,242	426,086
Machinery	293,459	1,883,520
AVERAGE	1,372,271	6,166,200

* Million of 1970 pesos.
Sources: employment:"Evolución de la Industria Manufacturera, 1970-1981", INDEC, 1983; output: own estimates.

The period 1973-1979 offers no possibility of measuring concentration and, therefore, of analyzing the impact of trade liberalization on the degree of industrial concentration. This is due to a lack of census data. However, based on the available information in table XIX for 1979 a number of observations can be made. By comparing 1979 data with 1973 data, and taking into account that four of the six intervening years correspond to the liberalization period, we observe reduced manufacturing employment (and probably a decline in the number of establishments).

The employment reduction has a logical explanation. It is most likely due to the closing of small- and medium-size firms unable to compete in an increasingly unprotected and unsubsidized environment created by trade liberalization. Although the liberalization of the economy was achieved in part by the reduction of tariffs and subsidies, it extended to the financial markets with additional implications for manufacturers. Faced with increased competition in the output markets and the loss of subsidized credit, the Argentinean manufacturing sector was seriously affected. The need to rationalize or merge reached a peak during this period. In spite of best efforts to prevent such an outcome and the gradual liberalization of markets, it was reported that the new regime meant the closure of a large number of firms. Large enterprises with access to stock market financing had the opportunity to replace high cost bank credit by lower cost equity financing and/or by short-term foreign funds. Foreign firms may have fared better due to the lower real cost of borrowing in world markets. As a result, smaller firms of domestic control may have absorbed most of the contraction in employment.

Having analyzed the relationship between changes in trade policies and industrial concentration, we turn our attention to the analysis of the link between changes in concentration and the growth rate of productivity. The period of study is restricted to the years between 1954, 1963 and 1973 due to data availability.

Table XX shows the growth rate of productivity and the value of concentration for census years by manufacturing industry and total manufacturing. The data for the manufacturing sectors indicate that between 1954 and 1963 an increase in concentration is accompanied by an increase in the growth rate of productivity.

During the 1963-73 period, one observes a general decrease in manufacturing concentration simultaneously with a decrease in the growth rate of productivity. The evidence, therefore, supports the conclusion that changes in concentration and changes in the growth rate of productivity go together. This conclusion is valid only at the total manufacturing level. At the level of the individual manufacturing sectors, the relationship has much less validity since the opposite can be observed for some industries and for some periods of time.

TABLE XX

PRODUCTIVITY AND CONCENTRATION BY INDUSTRY, 1950-1979

INDUSTRY	PRODUCTIVITY*				CONCENTRATION**		
	1954	1963	1973	1979	1954	1963	1973
Food	3.89	3.54	2.48	-	39.0	72.1	16.3
Textiles	+	2.22	+	-	1.6	2.4	2.0
Wood	4.39	-	3.49	+	.7	1.1	3.2
Pulp & P.	-	+	2.27	+	2.2	3.7	3.5
Chemls.	13.09	5.29	2.97	11.05	18.8	41.6	16.1
N-M Min.	-	2.34	2.23	5.65	29.3	95.8	15.2
Basic Met.	+	4.31	+	+	2.8	3.9	33.3
Metal P.	6.24	13.94	2.42	7.03	6.1	111.5	22.7
AVERAGE	3.45	3.96	1.90	12.91	12.6	41.5	14.0

* annual percentage change in multifactor productivity.
** degree of concentration as per equation 115.
\- negative but not statistically different from zero.
\+ positive but not statistically different from zero.

Between 1954 and 1963 at the total manufacturing level, concentration increased at an average yearly rate of 14.2% per year (from 12.56 to 41.50) concurrent with an average yearly acceleration in productivity of 1.54% (from 3.45% to 3.96%). During the second decade, i.e., 1963 to 1973, we observe a 10.3% average yearly reduction in concentration (from 41.5 to 14.03) together with a 6.7% average yearly deceleration in productivity (from 3.96% to 1.98%). The evidence thus shows that large increases in concentration correspond to relatively small increases in the growth rate of productivity, and that a large reduction in concentration go together with large decreases in productivity growth. This conclusion lends support to the notion that increases in concentration are more conducive to an acceleration of technological development. In fact, a return in 1973 to a concentration level similar to that of 1954 after years of declining protection left the manufacturing sector with a productivity growth rate equal to 60% of the one in 1954.

The acceleration of productivity between 1954 and 1963 may be explained in terms of another important factor: an increase in capital investment needed to accommodate a large increase in output. The liberalization of imports between 1956 and 1958 affected the demand for capital goods as well as intermediate inputs. The foreign investment legislation that began with the enactment of Law 14222 in 1953 was followed by broadening legislation in 1958. Foreign investment legislation favoured the manufacturing sector since one of its main objectives was to channel investment in import substitution activities, most of which consisted of manufacturing. In addition, investment was encouraged by the creation in October 1955 of the free foreign exchange market and by Central Bank circular 2324 of April 1959 authorizing foreign investment in machinery and equipment specifically for the manufacturing sector. Finally, the scope of foreign investment guarantees was enlarged in 1958 by Law 14780. The impact of foreign investment legislation resulted in a steady rise in foreign investment. Between 1953 and 1955, foreign investment averaged 6.1 million U.S. dollars annually. Between 1955 and 1957, foreign investment increased to an average of 14.2 million U.S. dollars per year, to reach a peak of 97.6 million U.S.

dollars per year between 1958 and 1963. The magnitude of these investment flows explain in large part both the increase in the growth rate of productivity and output.

The deceleration of productivity coinciding with a reduction in concentration between 1963 and 1973 remains to be explained. Several factors account for the productivity slowdown. As we have seen, the rise in foreign investment lasted until about 1970, when previous legislation was cancelled and replaced by Law 18587 of 1970 and Law 19151 of 1971, somewhat restricting the flow of funds by reducing the range of activities to which the funds could be applied. For example, foreign investment was not allowed if it resulted in reduction of exports and it was banned in military production.

In addition to a reduction in foreign investment in the last part of the 1963-1973 period, credit availability began to be restricted due to the high expectations about future inflation rates. Argentina experienced a series of inflation cycles each reaching record levels. As the cycles progressed, the availability of long-term investment credit declined and the risk premium increased considerably. This had the effect of a gradual elimination of negative interest rates characteristic of previous periods and of reducing the availability of long-terms funds. Investment was, therefore, affected on two fronts: by the change in the climate offered foreign investors and by the effect of expected higher inflation. The result was reduced investment activity and, therefore, a slowdown in the growth rate of productivity.

SUMMARY AND CONCLUSIONS

In this chapter we investigated several theoretical aspects of the model introduced in Chapter III. In addition, based on direct empirical evidence, we evaluated the trade policy effects implied by the model as well as the technological effectiveness of the overall Argentinean trade policy regimes between 1950 and 1979 with respect to the manufacturing sector and its component industries.

The output effect model postulates that the effectiveness of a tariff increases with the degree of import penetration and that the effectiveness of export promotion regimes depends on the degree of export exposure. In the case of tariffs, their very success at displacing imports and fomenting domestic production diminishes their future effectiveness. In the case of export subsidies, success has a reinforcing effect in the sense that a successful subsidy increases the policy effectiveness of subsequent subsidies. Depending on the price elasticity of import, domestic and export demands, the effectiveness of tariffs and subsidies varies. This suggests that tariffs are more likely to promote productivity when applied to products with high absolute value of domestic demand price elasticity. Similarly, export subsidies aimed at maximizing productivity gains should concentrate on commodities with high absolute value of export price elasticity.

At an empirical level, the output effect model provides an assessment of Argentinean trade policies from two different perspectives. One is the ex ante sign and magnitude of policy effects by policy regime and industry. The second is a retrospective evaluation of the appropriateness of the Argentinean policy regimes. It was found that Argentinean trade policies were, in general, warranted, but that a more precise knowledge of the likely effect by industry and by period of time would have improved their technological impact. For example, the empirical evidence suggests that IS could have achieved higher overall productivity if not applied to certain manufacturing industries. The export promotion regime appears well-timed both in relation to the aggregate manufacturing sector as well as to the individual manufacturing industries. Although difficult to assess, the technological effectiveness of the trade liberalization regime appears dubious and its timing incorrect. In spite of divergent sector-specific policy impacts and the finding of some ill-timed trade policies, a strong overall conclusion can be established. It indicates that the technological development of the Argentinean manufacturing sector would have been improved by a movement towards free trade.

The empirical analysis of the trade policies/market structure/productivity relationship provides further insights into the technological consequences of trade policies in general. The analysis established that a negative relation existed between tariff levels and manufacturing concentration between 1954 and 1963, and of a positive link between concentration and productivity during the same period, confirming a priori expectations on both these relationships outlined in Chapter I. Due to the combined effect of tariff reduction and subsidy increases between 1963 and 1974, it is difficult to isolate the effect of tariffs and of subsidies on concentration. Under the assumption that the negative relation between tariffs and concentration of the 1954-1963 period extends to subsequent years we conclude that there is a negative relationship between subsidies and concentration. In both periods we observe a positive association between concentration and productivity. Unfortunately, the liberalization period could not be evaluated on the same terms as the others due to lack of census data to measure changes in concentration.

This concluding chapter provides some answers to the questions raised in the introduction concerning the likely technological effectiveness of trade policies, the conditions for their effectiveness and the identification of the main factors in the relationship between trade policies and technological progress. It is hoped that this knowledge may inspire further research into this important determinant of economic growth.

SUGGESTIONS FOR FURTHER RESEARCH

One possible avenue for research would be the extension of the model to a general equilibrium framework in which income effects are taken into account both at the sector and economy levels. The importance of the income effect lies in the longer-term impact of policy effects due to the multiplier mechanism which may be positive in circumstances of unemployed resources. A further extension would specify a fully dynamic model incorporating capital accumulation as a source of technological growth, although the lack of capital stock data in many developing countries may limit its applicability. A more ambitious research effort would incorporate the role of money, interest rates and exchange rates to include all financial variables having an impact on producer and consumer decisions.

There are several ways to expand the scope and usefulness of the model. At the level of model specification, and within the framework of competitive equilibrium that characterizes the model, fiscal incentives could be explicitly modelled at the sector level by the inclusion of a government sector. This would permit the inclusion of policy effectiveness of taxes and subsidies, in addition to the tariff. At the level of policy estimation, there is a need to investigate the sign and order of magnitude of second-order terms. Although this may prove difficult for lack of adequate data (actual data not always satisfying theoretical second-order conditions), it has the potential of adding precision to the analysis.

The estimation of demand elasticities at the sector level poses well-known difficulties which were encountered in the estimation of Argentinean manufactured good elasticities. We suspect that a solution lies in the specification of demand functions for individual commodities rather than for the commodities of sectors. There are two main reasons. One is that domestically-produced goods destined for the export market are generally of a higher quality than those for the domestic market, and in some cases, goods are manufactured specifically for exports. A second reason is that manufactured goods of domestic and foreign origin may not compete in the price dimension but do so in the quality dimension. Thus, there is a need to attempt the specification of the import and export demand functions in terms of more precisely defined products. This means that each sector may have many demand equations.

Policy effects were specified in terms of productivity rather than in terms of technological change. Although the empirical separation of productivity into its two main components (technological change and economies of scale) may not be feasible given LDC's data, the model could be expanded to make this possible at the theoretical level. Given the importance of economies of scale in total productivity, the expanded specification has the potential of analyzing policy effects on both scale economies and technological progress.

And finally, a most difficult task, we believe, is ahead in the modelling of the structure effect. At a very basic level, there is a need to develop a theoretical model of ex ante effects. This has proven elusive to researchers in the area of industrial organization. The main difficulty is that little is known about the relationship between structure and technology to allow for satisfactory modelling. Recent studies on stochastic frontier methods show that concentration and technology can be analyzed from the point of view of competitiveness, but competitiveness is a concept that has yet to be defined. Competitiveness could be interpreted in terms of the ex post internal rate of return to capital under the assumption that industries not earning the market rate of return on investment are under pressure either to improve the level of technology, increase the scale of production to realize economies of scale, or to cease production. Perhaps a better competitiveness concept would be in terms of the price and quality dimensions of output, with all the empirical difficulties that concept implies.

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APPENDIX A

APPENDIX A

DATABASE

APPENDIX A

DATA BASE

Introduction

The collection and publication of aggregate statistics on production, imports and exports of manufactured goods in Argentina is mainly the responsibility of two institutions. Production data have been a part of the systematic data processing of the Banco Central de la Republica Argentina (BCRA) since the middle of the 1940's. As part of the National Accounts, the BCRA publishes annual data on manufacturing, such as output volumes, output prices, labour remuneration and number of employees. The institution responsible for trade statistics is currently the Instituto Nacional de Estadísticas y Censos (INDEC) which also publishes data on price indices for the main economic indicators such as consumption and wholesale and retail trade. This appendix provides a brief description of the basic data obtained from official sources and the steps taken to derive the aggregates necessary for model estimation in Chapter III together with a detailed justification of the assumptions and procedures followed.

Production Data

The National Accounts define the product of an industry as the gross value of production free of duplication. Production is measured as gross output (revenues) minus the value of intermediate inputs, i.e. value-added by the industry. In factor costs, value-added is composed of payments to the primary factors of production and gross surplus. Workers' remuneration includes all labour-related payments to employees in the industry, including pension contributions. Gross surplus, i.e., the part of value-added not accruing to employees, includes rental payments such as interest on debt, lease payments, depreciation allowances for the physical stock of capital, stock dividend payments, and owners' remuneration, such as salaries and directors' fees.

After the Second World War, the BCRA and other institutions prepared from time to time consistent series of manufacturing statistics. Unfortunately, statistics from a single source collected at different times and statistics prepared by other institutions such as the Consejo Nacional de Desarrollo (CONADE) and the Economic Commission for Latin America (ECLA) are not compatible for reasons of difference in coverage. There exists, however, a sufficiently long time series of annual data on a consistent basis prepared by the BCRA in 1975, which satisfied most of our production data requirements.

The procedure used by the BCRA to compile the 1975 data for the manufacturing sector differs from period to period according to whether industrial census data are available or not. For each of the census years of 1946, 1948, 1950, 1953, 1957, and 1963, consistent estimates were obtained for gross production, intermediate inputs, value-added, salaries paid and employment covering all industrial establishments. Global results and relationships between production and intervening factors were analyzed, as were changes in the composition of industrial groups. Subsequently, and to the extent possible, activities were regrouped at the level of detail required by the

International Standard Industrial Classification (ISIC) Revision No. 2 of the United Nations.[54]

In the Census, the unit of measurement is the establishment. Establishments are classified by industry groups according to their principal production and, therefore, the value of secondary production by the establishment is also credited to the industry group of the main output. The data published by the BCRA also contain adjustments to census values that, in some cases, were thought to be warranted. Such is the case for cattle slaughter and petroleum derivatives where the census did not include all indirect taxes.

Gross production values for inter-census years were calculated by the BCRA by interpolating data at the five-digit level. After the 1963 census, values were extrapolated using official production statistics collected by INDEC, the capital survey collected by CONADE (1954-1961), the survey of the Secretaría de Industria, the industrial census of the Buenos Aires province and the provincial Dirección de Estadísticas, and BCRA's own investigations, as well as from statistics from several producers' associations and chambers of commerce.[55] Data on gross production are given in constant pesos and in index form with a 1960 base. The method used to compute the constant pesos series corresponds to the Laspeyre's quantity index at the five-digit level of the ISIC. For the less than five-digit level, output in current pesos were simple sums of establishment's value-added, i.e., treating output at that level as homogeneous.

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[54] United Nations Statistical Papers, Series M, No. 4, Rev. 2, 1969.

[55] The data used in our study , as well as all previous production data from various sources, may be found in "Sistema de Cuentas del Producto e Ingreso de la Argentina", Vol. II and III, published by the BCRA in 1975 and 1976, respectively.

Production data after 1975 and up to 1981 are available at the three-digit level from INDEC. Such data are based on 1970 values and contain a discontinuity of the wage index series between 1970 and 1975. The Standard Industrial Classification was kept consistent with BCRA production data but coverage is narrower.

Data from INDEC consist of index numbers at the three-digit level. The method used to aggregate individual index series to the two-digit level corresponds to a Laspeyres aggregator. The formula requires knowledge of base period weights which, in our case, is the year 1970 for production and employment indices, and 1976 for the wage indices.

Because it was not possible to obtain 1970 and 1976 weights, use was made of weights derived from the 1974 census of manufactures. Weights for output aggregation correspond to value-added for the year 1973. Weights for aggregating employment indices correspond to the census number of employees as of September 30, 1974, while the weights of wage indices are based on salaries paid during the month of September 1974 and employment as of September 30, 1974.

After aggregation to the two-digit level, INDEC 1970 based indices were linked to BCRA 1960 based indices. Output and employment indices were linked at the mean of the overlap, i.e., 1970 to 1973. The link of wage series is necessarily more complex due to the unavailability of information for the years 1974 and 1975. Thus, it was assumed that the 1974 and 1975 wages were reflected in the basic real wage of skilled workers in the city of Buenos Aires. Consequently, the 1960 based real wage index was extrapolated on the basis of the year-to-year percentage change in basic real wage of skilled workers up to 1976, at which year the series was linked to the INDEC two-digit real wage index.

The Central Bank has estimated three-digit value-added statistics for the manufacturing industries based in 1970, and has computed implicit price indices. For reasons of continuity with the 1960 based BCRA output series, it was deemed preferable to employ BCRA statistics rather than INDEC for the 1970's. There are, however, a number of limitations in such a choice. On the positive side, we have mentioned BCRA's wider coverage. On the negative side, the drawbacks include a different valuation method (later BCRA valuations refer to market prices while older statistics were valued at factor cost, as it is in INDEC's) and the lack of corresponding employee and wage data. In terms of output prices, later BCRA data contain two-digit implicit price indices for the 1950-1970 period based in 1960 and the 1970-1980 period based in 1970, both at market prices. Because this is the sole source of implicit output (value-added) prices, we have retained price statistics from the Central Bank but used INDEC's output, employment and wages after 1975 in our estimation.

International Trade Data

The collection and publication of foreign trade statistics after the Second World War was assigned to the Dirección General del Servicio Estadístico Nacional (DGSEN). In the 1950's, the task was given to the Dirección Nacional de Estadísticas y Censos (DNEC) which later became the INDEC.

Foreign trade statistics comprise three types of information: quantitie ~~lues in domestic currency and values in U.S. dollars[56] for a large number of items. Data are

[56] These correspond to the average exchange rate at which foreign currency was negotiated Individual item dollar amounts were not reported prior to 1955 although U.S. dollar aggregates are available since 1951.

also available on a country basis and on a "custom post" basis. Trade values are recorded as declared by the exporting or importing unit. Exports are valued FOB at place of shipment (usually an Argentine port), while imports are valued CIF landed within Argentine boundaries. No service trade data are contained in these sources.

The classification of traded commodities up to 1950 was based on a 1939 classification. Imports and exports were assigned a "statistical number"; there were 682 export entries and 1,954 import entries, some of them with sub-entries. The nomenclature was expanded by including new sub-entries and some minor changes in the classification of imports in 1958. In 1959, a new import code was introduced consisting of 1,203 primary entries, and the import classification was enlarged by the addition of sub-entries. The total number of import entries was maintained at 1,954 items while the new export code eliminated all sub-entries of the previous classification.

In 1966, an entirely new classification for trade statistics was adopted, one which considerably expanded the number of entries of previous codes. In view of the availability of international trade classifications by the United Nations and by the Customs Co-operation Council, Argentina implemented a system which permits the identification of items according to the "Brussels Trade Nomenclature" (BTN) and, consequently, to the Standard International Trade Classification (SITC). Imports are classified according to a ten-digit system where the first six digits correspond to the BTN of 1955 [57] and the last four correspond to the Argentine "Nomenclatura Arancelaria y Recargos de Importacion" (NARI). Exports are identified by an eight-digit

[57] It should be noted, however, that the Argentinean breakdown of the BTN into sub-groups did not always coincide with the "letter" classification of the BTN.

number; the first six digits correspond to the BTN and the last two to the new Argentine classification system, which is actually a finer breakdown of BTN entries. Under this system, the fifth and sixth digits correspond to the "letter" of the BTN.

Links Between Production and Trade Data

One of our data requirements consists of a homogeneous classification of domestically-produced and traded goods. Ideally, this would be achieved by a detailed knowledge of the industrial origin of all manufactured goods produced in the country, as well as the industrial origin of imports. In classifying the available Argentine trade and production data, a number of obstacles were encountered. On the one hand, as was noted above, production data are published at the two-digit level and classified according to the ISIC, Rev. 2, between 1950 and 1973 inclusive. On the other hand, trade statistics during the same period do not match the industrial classification, and, in fact, none of the three trade classifications implemented in Argentina are immediately convertible to the ISIC. Consequently, the link between production and trade statistics had to take into account the variation in trade codes through time, as well as inconsistencies between trade and production statistics, as explained in the following paragraphs.

According to the BCRA, the latest and longest time series of production statistics by the manufacturing sector were classified as per the ISIC Rev. 2 originally introduced by the UN in 1969. The choice of these classifications by the BCRA creates at least two difficulties. A minor one is the fact that earlier production data compiled by the

Bank were classified as per the previous ISIC, i.e., its revision 1 of 1958 [58] and it was later reclassified to approximately comply with the second revision of 1968. This procedure may have introduced some distortions. The second difficulty is the lack of an available link between trade and production classifications as per the ISIC Rev. 2. This implies a restriction in the use that could be made of the available UN links between trade and production groupings. The UN Statistical Office has during the years sponsored modifications to the trade and production classifications and published compatibility tables from time to time. The first table was published in 1966 and contained the links between the ISIC Rev. 1 and the International Standard Trade Classification (ISTC) Revised.[59] The second compatibility table was published in 1971 and included the links between the production classification as per the second revision of the ISIC updated as of 1971 rather than as per the original Revision 2 of 1968, and the ISTC Rev. 1.[60] The inconvenience of not having an exact match as desired is not , however, insurmountable. The difference between the 1971 ISIC Rev. 2 and the 1968 ISIC Rev. 2 is minor compared to the differences between the second and first revisions of the Industrial Classification (i.e. between the ISIC Rev. 1 and ISIC Rev. 2). The third linkage between trade and production nomenclatures available from the UN concerns the ISIC Rev. 2 and the ISTC Rev. 2. This latest publication could not be used, as Argentine trade statistics are classified as per the 1955 BTN which is closely

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[58] United Nations Statistical Papers, Series M, No. 4, Rev. 1, New York, 1958.

[59] The ISTC Revised (or Revision 1) is contained in Statistical Papers, Series M, No. 34, 1961. The link between the ISIC Rev. 1 and the SITC Revision 1 was published in "Classification of Commodities by Industrial Origin", UN Statistical Papers, Series M, No. 43, 1966.

[60] Classification of Commodities by Industrial Origin, U.N. Statistical Papers, Series M, No. 43, Rev. 1, 1971.

related to the first revision of the ISTC. Another difficulty encountered was in the particular classification system for trade statistics used by the Argentine reporting agency, because of the fact that trade statistics are not based on the ISTC.

The compilation of trade statistics closest to internationally recognized standards began in 1966 with the adoption of a system which allows entries to be classified as per the BTN. Prior to 1966, trade statistics were classified as per an indigenous system based on the type of traded goods which bears no close resemblance to the BTN.

Thus, in order to build a consistent data set for our purposes, a rather long path was followed. Since production data were already presented in a homogeneous ISIC Rev. 2 class, it was decided to adopt it as our basic classification and to regroup all available trade statistics to comply with this system. The reason for the choice was the fact that it is impossible for us to reclassify production data for lack of detailed five-digit statistics, while a reclassification of trade data is feasible. This occurred because, first, trade data prior to 1966 must be regrouped to production units and, second, use can be made of the UN conversion tables to and from the ISIC Rev. 2 for trade statistics after 1966 even though this is not an exact procedure for reasons noted above. The initial step in the linkage was to identify individual Argentine entries according to the BTN for data after 1966. These items were linked to the ISTC Rev. 1 by means of an available BTN-ISTC Rev. 1 conversion table[61] and then linked to the ISIC Rev. 2 by means of a second ISTC Rev. 1 - ISIC Rev. 2 conversion table. As the BTN is symmetric with respect to imports and exports, the trade-production link was

[61] Nomenclature for the Classification of Goods in Customs Tariffs, Brussels, 1955, Customs Cooperation Council (published in U.N. Statistical Papers, Series M, No. 34, 1961).

performed only once. The procedure adopted for classifying data prior to 1966 was based on the classification of traded goods adopted after 1966. For example, if an after-1966 commodity was classified to ISIC group 32, the same commodity was segregated according to the Argentine statistical number and classified as per the same ISIC group. This procedure was implemented separately for imports and for exports since statistical numbers differ, and performed over the two indigenous classification systems prior to 1966.

The reliability of the obtained data is subject to the underlying weakness of the trade classification systems compared to the production classification. While production data refer to the output of establishments based on the nature of the finished product, in the trade classification, goods are grouped according to the nature of the material from which they are made. In addition, there is an inherent incompatibility between trade and production statistics which should be taken into account. Trade statistics refer to individual commodities while production data are collected on the basis of establishments producing a given class of products. Thus, industries need to be defined in terms of their typical output before the industrial origin of internationally traded goods is identified. The resulting links between trade and production data do not, in general, assign each individual traded commodity to a single industry, reflecting the fact that an individual commodity may be the typical output of more than one industry. In view of this limitation, judgment was used in the classification of traded commodities for which the conversion tables did not indicate a single industrial origin. For example, heavy metal manufacturing, such as railway tracks, sheet steel and plate, tubes and pipes, may be produced by either Group 37 - Basic Metal Industries, or by Group 38 - Manufacturing of Fabricated Metal Products, Machinery and Equipment. In view of our knowledge of Argentine and foreign industries manufacturing these products, it was decided to assign them to Industry Group 37. A similar consideration applies to higher metal manufacturing, such as expanded metal, barbed iron or steel wire, casks, drums and chains, which could originate in either manufacturing group but were assigned to Group 38. In cases of commodities that were imported with no domestic export activity, classification was based on the most likely industrial origin abroad. Thus, for example, aluminum wires, wrought bars, angles, shapes and sections of aluminum (BTN 76.02) were assigned to ISIC Group 37 because of the judgment that such imports originate in foreign producers of primary products and not in foreign producers that had purchased aluminum for processing. This reflects an assumption of a higher degree of vertical integration in foreign production.

An exception to our method of classification of traded commodities to the industrial groups was the case of gold and jewellery. The BTN contains several entries for gold items, such as bullion and coins, but no SITC heading exists for this type of international transactions. Consequently, and considering that Argentina is not a significant producer of gold and jewellery products, such trade transactions were ignored.

The pre-1966 trade classification used by the Argentine reporting agency is not entirely compatible with the BTN employed after that year. The incompatibility makes it difficult to classify trade items by industrial origin and we had once again to resort to informed judgments in cases where this occurred. For example, the industrial origin of lead ingots is Group 37 while lead bars originate in Group 38. Unfortunately, the pre-1966 statistical number (No. 1413) includes both types of bars with the consequence that we are forced to classify the statistical number to either group, or to allocate part of the total to both groups based on knowledge of such allocation. The procedure adopted prior to 1966 was to allocate the total statistical number to the industrial origin that has the largest weight as of 1966, the first year for which the BTN breakdown was available. Thus, imports of lead under statistical number 1413 were assigned to Industry Group 37, since this group dominated imports in 1966. This procedure was followed separately for imports and exports and the relevance of the 1966 industrial origin weights was verified for subsequent years to avoid spurious classification.

In order to minimize the effect of the inaccuracies introduced by the classification methods and the links between traded commodities and their industrial origin, the classification of trade data was performed at the most disaggregated level. Thus, a total of more than 12,000 items were classified to eight manufacturing groups for the 1947 to 1979 period.

Aggregation and Consistency Tests

As previously reported, trade statistics contain highly disaggregated data and consequently a procedure is necessary to aggregate price and quantity statistics for comparability with the two-digit level manufacturing data. In choosing the appropriate procedure certain factors were taken into account, such as the functional form of the aggregator, the base year (if any) and the level at which aggregation should begin.

Concerning the functional form of the aggregator and the base year, it was decided to follow the procedure used in aggregating production data, i.e., a Laspeyres quantity index based in 1970. The reason for this choice has to do with the bias of the

Laspeyres index with respect to the true index under the assumption of homotheticity.[62] Then, if production statistics have an aggregation bias originating in the index formula employed by the compiling agency, it is desirable to have a similar bias in aggregating trade data. Presumably, both biases will move in the same direction creating a smaller estimating error than if a different aggregator was used. A similar consideration determined 1970 as the base year for trade statistics.

The level of disaggregation employed was also based on a compromise solution. Although it is possible to lower the level of aggregation to the item level, such a choice would imply the use of some 28,000 time series which would make computation excessively expensive in terms of manpower and computer time. To attain manageability while maintaining an acceptable quality level, a reduced number of time series was created, which corresponded approximately to import and export data at the chapter level of the BTN. The procedure used is as follows:

a) Trade statistics were grouped according to eight ISIC groups (i.e., groups 31 to 38 inclusive) and each group was further subdivided as per corresponding BTN chapters.

b) Trade quantity and revenue data below the chapter level were added to obtain chapter totals.

c) A Laspeyres quantity index was calculated for each ISIC Group based on chapter level total.

d) An implicit price index was subsequently obtained at the group level.

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[62] The Laspeyres quantity index underestimates the true index if preferences are homothetic. See Samuelson and Swamy (1974).

The total number of quantity indices calculated in this manner amounts to 258, a number that compares favourably with the 172 quantity indices used by the BCRA in obtaining two-digit production data. Chapters for which data are provided in different units of accounts, as is typically the case in machinery and equipment where certain items are given in kilograms and others in units, were treated differently than chapters in homogeneous units. In chapters where one or more units of account were present, two or more chapter totals were obtained, one for each unit of account. This procedure is necessary to avoid adding statistics given in different units to the chapter total. The calculation of the quantity index among chapters of each industry group was performed with an enlarged number of quantity vectors. The aggregate quantity index is then independent of the units of account of the components.

A number of consistency tests were carried out throughout the entire data handling process. To ensure the accurate computer loading of trade statistics, an implicit price index was calculated for each trade item as the ratio between published quantities and revenues. A comparison of unit prices through time was used to identify entry errors. A similar implicit price calculation was done to verify inconsistencies introduced by the classification of traded groups as per chapters of the BTN. Discrepancies in implicit prices across time periods using different trade classification systems, such as between 1947 to 1958, 1959 to 1966, and 1966 to 1979, may indicate possible classification errors. Whenever possible, such errors were corrected by reclassifying trade items to correspond to different BTN chapters prior to 1966.

Relative Price of Exports

The relative price of exports employed in the estimation of export demand elasticities was calculated as,

$$P_{xi} = \frac{P^{x}_{i}}{ER_{i} \quad PI_{i}} \qquad i = 1 \ldots 8 \qquad (A1)$$

where P_{xi} is the relative price of Argentine manufactured goods belonging to two-digit ISIC industry i relative to the world price of similar commodities, expressed in U.S. dollars. ER_i is the industry-specific exchange rate between Argentine peso moneda nacional[63] and the U.S. dollar, and PI_i is the industry specific composite price index of industry i goods in the world market, denominated in U.S. dollars.

P^{x}_{i} represents the industry's export price index which was implicitly derived from the industry's quantity index and current pesos export revenues. The industry exchange rate differs significantly from the official exchange rate in many cases. The availability of multiple exchange rate markets as well as industry and product specific preferential exchange rate regimes implemented by economic authorities from time to time implies that no useful information about the actual exchange rate at which export transactions were negotiated could be derived from quotations of the official, free or several other exchange rate markets. Exchange rates representing true negotiated export transactions were, therefore, obtained from selected export statistics in pesos and U.S. dollars. Thus, between the years 1962 to 1979, the industry specific export exchange

[63] During our sampling period, two currencies were in circulation. Up to, and including the year 1969, the official currency was the "peso moneda nacional". Beginning in 1970 a new peso was introduced equivalent to 100 old pesos and denominated "pesos ley 18188". Our data were uniformly computed in "pesos moneda nacional".

rates were calculated as weighted averages of negotiated export exchange rates according to BTN section groupings. The following relationship between BTN sections and ISIC industries was established:

I.S.I.C. GROUP	B T N SECTION
31 - Food, Beverages and Tobacco	III - Fats and oils (animal and vegetable) and related products, wax. VI - Products of the food industry, beverages, alcoholic beverages, vinegar, tobacco.
32 - Textiles, Wearing Apparel	VIII - Skins, furs, furriery and manuf. of these materials, trimmings and leather work goods, travel goods, hand bags and similar containers, gut manufactures. XI - Textile materials and manufactures. XII - Shoes, hats, umbrellas and sunshades, prepared feathers and feather articles, artificial flowers, hair.
33 - Wood and Wood Products	IX - Wood, vegetable charcoal. wood manuf., cork and its manufactures, esparto goods and basketry.
34 - Pulp, Paper, Publishing.	X - Material used in paper making, paper and paper articles.
35 - Chemicals, Petrochem., Plastics	VI - Products of the chemical and related industries. VII - Artificial plastic mat. cellulosic ethers and esters, art. resins and manuf., natural and synthetic rubber, artif. rubber and rubber manuf.
36 - Non-metallic Mineral	XIII - Stone manuf.,gypsum, Products of cement, asbestos, mica and similar products, ceramic products, glass and glass products.
37 - Basic Metal Industries.	XV - Common metals and their manufactures.
38 - Metal Products, Machinery	XIV - Machinery and apparatus, electrical materials. XVIII - Optical instruments, optical, photographic and cinematographic and measurement apparatus, verification and precision, surgical and medical and surgical instruments and apparatus, watches, musical instruments, app. for the recording or reproduction of sound, app. for the recording or reproduction of images and sound including television sets. XIX - Arms and ammunition.

Aggregation weights for each specific industry were calculated as of 1970, the same base year as export volumes, price and world income variables, For each industry i the exchange rate was calculated as:

$$ER_i = \sum_{j=1}^{n} er_{ij}\ Si_j \qquad i = 1...8 \qquad (A2)$$

where er_{ij} is the exchange rate corresponding to industry i and section j of the BTN nomenclature, and S_{ij} is the share of section j in industry i as of 1970. The number of terms n varies from group to group, depending on the BTN-ISIC classification above.

Export statistics prior to the year 1962 were not classified as per the BTN classification and it was not possible to derive industry specific export exchange rates prior to that date. However, a single exchange rate could be obtained for all manufactured exports between the years 1951 to 1961. Prior to 1950 all trade transactions were published in domestic currency for which reason official exchange rates were used in calculating relative export prices.

The composite price index PI_i of goods belonging to ISIC industry i in U.S. dollars, was derived from US producer price indices published by the Bureau of Labor Statistics. These prices are used here to represent world manufactured goods prices. They are calculated from a basket of goods larger than the number of Argentine export items and, therefore, may be considered as representing not only world prices of Argentine export items, but prices of substitutes as well. From the point of view of the specification of demand, a wider price index may be a substitute for the price of the composite commodity in question and the price of other commodities entering the demand function. We follow the standard approach and specify demand functions with a single relative price variable.

Since the BLS breakdown does not correspond to the two-digit ISIC classification, indices were aggregated by a formula similar to the one used in aggregating exchange rates. BLS indices based in 1967 were normalized to the year 1970 prior to aggregation. Weights (shares) correspond to the Argentine export proportions as of 1970. The normalization procedure is theoretically correct, i.e., it rebases the index number only if the commodity is homogeneous. However, BLS index numbers are Laspeyres indexes of non-homogeneous commodities. Normalization does not, in fact, rebase the index. In practice, data to rebase indices are not normally available and proper rebasing cannot, therefore, be performed. But normalization preserves the original index year-to-year percentage change and, if we take into account the fact that during the 1960's manufactured good price changes were small compared to the 1970's, a normalization between 1967 and 1970 is believed not to unduly restrict the usefulness of the index.

All terms entering the relative price calculation were normalized to 1970, as were the relative prices of exports.

Relative Import Price

Relative import price employed in the estimation of import demand elasticities is,

$$P_{mi} = \frac{P^m_i}{DPI_i} \qquad i = 1 \ldots 8 \qquad \text{(A3)}$$

where P_{mi} represents the price of imported goods relative to the price of domestic products for each manufacturing ISIC industry i. P^m_i is the implicit import price index derived from the group's quantity index and import revenues in Argentine currency after duties and levies. DPI_i is a composite price index selected to represent the market price of domestic output, i.e., factory gate price plus transportation, commercialization and indirect taxes. This level of valuation is represented by the wholesale price indices of domestically produced goods for each of the eight ISIC groups. The following relationship between ISIC import groups and wholesale prices was established:

I.S.I.C. Group	Wholesale Price Index of Domestically Produced Goods
1 - Foods, beverages and tobacco	Food, beverages.
2 - Textiles, wearing apparel and leather industry	Textiles.
3 - Wood and wood products, incl. furniture.	Wood.
4 - Pulp, paper, printing and publishing.	Paper and cardboard.
5 - Chemicals, petrochemicals, rubber and plastics.	Chemical products.
6 - Non-metallic mineral prods.	Stones, glass and ceramics.
7 - Basic metal industries.	Metals, excl. machinery.
8 - Metal products, machinery excluding electrical.	Vehicles and machinery, and equipment.

Wholesale price indices of domestically produced goods include manufacturing as well as non-manufacturing goods classifiable to the same category. Such a wider commodity coverage is consistent with the definition of the relative import price, i.e., the price of imported goods relative to the price of domestic substitutes, and not just to the price of identical domestic products. A wide commodity coverage is noticeable in the basket composition of the wholesale prices of foods and beverages, which includes not only manufactured goods but also products of agricultural industries, such as fresh meats and vegetables. Similar consideration apply to all other groups, with the exception of Paper and Cardboard which excludes Pulp, an important Argentine import, until recently, not manufactured domestically; and Metals, Excluding Machinery, which includes scales and other weight measuring apparatus, bolts, nuts, nails, safety boxes, metallic furniture, stoves and other metallic manufactures belonging to ISIC Group 38.

Wholesale price indices were obtained from three sources. Data for the 1949 to

1956 period are available on two different bases (1939 and 1953) from a supplement to "Boletín Estadístico" of September 1962, published by the Central Bank. Price indices for the years between 1956 and 1972 were obtained from INDEC, "Indices de Precios al por Mayor 1956-1972" and those for the subsequent period were taken from several issues of "Boletín Estadístico Trimestral" by INDEC. Both INDEC indices are 1960-based. Data from BCRA and INDEC have slightly different coverage, a fact which is not considered to be significant.

The domestic wholesale price index of Food and Beverages excludes tobacco which is a minor import item. The price index of Wood includes furniture and cork. The Paper and Cardboard index includes pulp but excludes printing and publishing which it ideally should. However, there are no printing and publishing price data available. The wholesale price index of Chemicals excludes petroleum derivatives as it should, since the import data exclude fuel imports because trade statistics for these items were not available prior to 1966. The index excludes rubber although it should be included to reflect imported rubber which has been classified under the chemical sector. This, however, is not serious, as rubber accounts for slightly over 10% of total chemical imports. The price data between 1947 to 1955 relating to Non-metallic Mineral Products refer to stones, earths and glass, while the data after 1955 refer to stones, glass and ceramics. The price index of Basic Metal Industries refers to ferrous metals only and excludes other metals which, as of 1970, accounted for approximately 20% of import value (much less in terms of volumes). The price index corresponding to the ISIC Group 38 is not available prior to 1956 and data for that period were extrapolated, based on the rate of change of the domestic non-agricultural wholesale price index. The index after 1955 refers to vehicles and machinery, thus excluding electrical machinery and apparatus which accounts for 16% of import value in 1970.

Domestic Apparent consumption and Gross Output

Domestic apparent consumption in nominal terms is defined as the difference between gross output and exports plus imports. Real domestic apparent consumption is therefore obtained by deflating each component by its own price index. Thus, real apparent consumption was calculated as the difference between real gross output and real exports plus real imports at 1970 prices. The ratio between nominal and real apparent consumption defines an implicit price index which is used in the estimation of demand elasticities of apparent consumption.

Argentine statistical agencies do not publish gross output manufacturing data, but rather, production data are made available in terms of value-added. Gross output data at the two-digit level were generated from census data on value-added and intermediate inputs. Real gross output may be obtained by separately deflating value-added and intermediate inputs by their own price.[64] Due to the unavailability of material input price indices, real gross output was calculated as nominal output deflated by the price of value-added in index form. The substitution of the price of output index by the value-added price index is consistent with our previous assumption of considering value-added as a measure of output. Diewert (1978) and Bruno (1971) showed the necessary conditions for a real value-added function to have all the properties of a neoclassical production function. In terms of prices, the condition

[64] This definition is consistent with the concept of real value-added defined as real output minus real material input (the double deflation method). See for example "A System of National Accounts", Studies in Methods, United Nations, Series F, No. 2, Rev. 3, page 63.

requires strict proportionality between intermediate input and output prices. Define gross output as

$$Q = VA + I \tag{A4}$$

where Q, VA and I represent nominal gross output, value-added and intermediate inputs, respectively. Proportionality between output and intermediate input prices imply equality of their respective price indices. Then,

$$P^{Q} = P^{I} = P \tag{A5}$$

and real output may be written as

$$\frac{Q}{P} = \frac{VA}{PVA} - \frac{I}{P} \tag{A6}$$

which implies,

$$PVA = P \tag{A7}$$

If the price indices of output and of intermediate inputs coincide, so does the price of value-added, and deflating nominal gross output by a value-added price index imposes on the data the assumption made concerning the use of value-added as a measure of output.

Real value-added statistics between 1950 to 1973 were linked to data for the period 1970 to 1979. Both data were obtained from Argentina Central Bank publications "Sistema de Cuentas del producto e Ingreso de la Argentina", Cuadro Estadístico. Vol. III, and "Estimaciones Trimestrales Sobre la Oferta y Demanda Global", agosto 1983. The real value-added series between 1950 to 1973 at 1960 prices were revalued to 1970 prices by an implicit price index obtained as the ratio of real value-added at 1970 prices to real value-added at 1960 prices.

Estimates of nominal material inputs were derived from the 1950, 1954, 1963 and

1974 censuses of Manufactures. Data for other years were obtained by three different methods, hence, yielding three different apparent consumption data. Database A was obtained by linearly interpolating material inputs between observation points and extrapolating after 1973 at the same proportion as the 1963-73 period. Database B differs from database A in the extrapolation of material inputs after 1974 following a fitted line to the 1950-73 period. Database C consists of a line fitted to the data for the entire 1950-74 period and extrapolated to 1979.

The first database tends to show increases of material inputs after 1973 unwarranted by the decline in value-added for some sectors. Database B introduces a discontinuity in 1973 which, in some cases, is of importance. Database C produces a constant growth pattern of intermediate inputs which contradicts the observed variations in input/output coefficients derived from census data.

In many cases, domestic apparent consumption demand functions were estimated for only one data set based on sectoral characteristics such as the reasonableness of derived apparent consumption data compared to domestic production, imports and exports. Database A was, therefore, selected for ISIC Sectors 33, 34 and 35. In cases for which high intermediate input growth was unwarranted during the 1970's, use was made of database B. Such was the case for Sectors 31, 35, 37 and 38. Database C was used for the remaining sectors.

Relative Price of Domestic Apparent Consumption

A domestic apparent consumption price index was obtained as the implicit price index between real and nominal domestic apparent consumption, as explained under the heading "Domestic Apparent Consumption". The relative price of domestic apparent consumption should take into account the nature of such consumption which in essence includes the consumption of two types of manufactured goods: goods of domestic origin and goods of foreign origin. Accordingly, we would like to include in such an index the price of close substitutes whether of foreign or local manufacture. One could calculate the relative price of domestic apparent consumption in relation to a composite index taken as a weighted average of the wholesale price index of domestically manufactured goods (which in most cases has a wider coverage than the two-digit level) and the price of imported goods at the two-digit level, where the weights are the volume share of domestic and foreign goods in total apparent consumption. The import index does not represent the price of substitutes, however, and one may question its inclusion in a composite index which should include close substitutes. In the absence of an index of imported manufactured substitutes at the two-digit level, we choose to ignore imported substitutes and to calculate the relative price of domestic apparent consumption as the ratio between its implicit price index and the wholesale price index of domestically manufactured goods.

Activity Variables

Constant pesos national income statistics are available for the 1950-1973 period in "Sistema de Cuentas Nacionales del Producto e Ingreso de la Argentina", cuadros estadísticos, BCRA, Vol. II, 1975, page 117. Due to the unavailability of compatible data for the six remaining years of the sample, national income from this source was extrapolated to 1979, based on the growth of gross domestic product in constant 1970 prices available in the Anuario Estadístico, 1979-80, page 512.

The income data from 1950 to 1953 are in 1960 pesos and differ from GDP at market prices by the effect of variations in income to factors of production from abroad. These items are of minor importance during the period and exhibit almost the same variation as the product account with the consequence that a high correlation is observable between the national income and domestic product statistics. For estimation purposes the income series was normalized to 1970.

Demand for imports and domestic apparent consumption was estimated for a given domestic income variable, depending on the sector. In cases such as Foods, Beverages and Tobacco, Textiles and Wood and Paper products, the use of aggregate domestic income represented by GDP at factor cost was found to be appropriate. In the case of Chemicals, Non-metallic Minerals, Metals and Machinery, better demand estimates were derived by the use of weighted averages of the activity variable of using sectors.

The activity variable used in exports should refer to the world income or expenditure index reflecting the economic activity level of countries purchasing Argentine manufactured products. One such index is provided by the UN Statistical Office and it refers to the world's gross domestic product excluding services.[65]

The UN world index is calculated as a weighted average of GDP at base year prices and includes developed and developing market economies as well as non-market economies. Because non-market economies production indices exclude services, appropriate GDP (less service) indices were estimated for market economies

[65] No other index of comparable coverage and historical length was identified, although regional indexes are available from UN and OECD sources.

prior to aggregation. Centrally planned economies indices refer to gross output or net material product at constant prices. Currencies were converted to U.S. dollars and adjustments were made to sectoral production data in certain cases to compensate for inadequate coverage by the national statistics.[66]

Indices of GDP exclude value-added in (i) general government, (ii) private non-profit organizations, and (iii) industries producing non-material services. Thus, the measure excludes finance, insurance, real estate and business services, community, social and personal services, and public administration and defence.

During the 1950 to 1979 period, four time-series indices are available, each with a different base and a slightly different country coverage. The 1958 based index excludes China, North Korea, Vietnam, Mongolia and Albania. The 1963 and 1970 based indices exclude China, North Korea, North Vietnam and Mongolia, and the 1975 based index excludes China, North Korea and Vietnam.

The world GDP index has some shortcomings which might reduce its usefulness as an activity variable. The first consideration is perhaps the fact that it includes the GDP minus services of Argentina, and that it excludes some of the countries with which Argentina trades. As we shall see, both of these factors are insignificant. As explained above, the world index is calculated as a weighted average of individual country's GDP index minus services. To obtain an approximate valuation of the importance of Argentina in the sample, we calculate the country's weight as of 1970, as follows,

(a) relative weights used in the estimation of world's GDP minus services

[66] A full description is presented in the UN Statistical Yearbook, 1976, pages 15-16.

corresponding to the 1970 based index[67]:

Market economies .794

Centrally planned economies .206

(b) total and per capita GDP at purchaser value (including services) in U.S. dollars for the year 1970:

	GDP (million U.S. dollars)	Per Capita GDP (dollars)
Market economies	2,553,200	1060
Argentina	24,998	1053

(c) the new Argentina weight in world activity is therefore ,

Argentine GDP share in market economies .0098

Argentine GDP share in world markets .0078

The low value of Argentina's share of GDP in world output in 1970 justifies the small country assumption. It also suggest the country's inclusion in the world activity variable is not of serious concern.

A separate issue in demand estimation is whether the activity variable should be specified in per capita terms. The use of per capita income is preferable on theoretical grounds since consumer theory refers to decisions made by individuals. On the other hand, it is preferable to include population effects in our estimated elasticities if our goal is to evaluate the impact of trade policies in their entirety. We follow the second approach.

[67]Statistical Yearbook, 1976, page 10.

Manufacturing Census Data and Concentration Measures

Detailed and consistent data to calculate industrial concentration measures were obtained from the 1950, 1954, 1963 and 1973 censuses. The 1950 Industrial Census was produced by the Dirección Nacional de Estadísticas y Censos, Ministerio de Hacienda de la Nación, Buenos Aires, 1957. The industrial classification is based on the import classification. The estimation of concentration measures made use of 1973 observations. The 1954 Industrial Census was produced by the Dirección Nacional de Estadísticas y Censos in 1960. This census also follows the import classification, but provides only 189 data points. The 1964 census was produced by the Instituto Nacional de Estadísticas y Censos (INDEC) in 1970. It is the first census to adopt an international industrial classification by implementing the UN ISIC, Rev.1. The classification of industries is similar to that of previous census. The level of detail is better, providing 224 data points.

The 1973 census, also produced by INDEC, adopted the ISIC, Rev. 2. It has 187 data points. After 1972, no census was taken until 1985.

In cases where the number of data points available to calculate concentration was less than 15, use was made of more detailed statistics by province and by type of organization.

We calculated employment and output values as of 1979 based on 1970-indexed series published by INDEC in " Evolución de la Industria Manufacturera 1970-1982". Based on these series, we calculated output per employee as of 1979, and compared these values to similar ratios from the 1950, 1954, 1963 and 1973 censuses.

The measure of output from census data refers to gross output, i.e., value of shipments adjusted by changes in inventories, and it includes custom work for others. This output measure agrees conceptually with the output measure used in Chapter III.

APPENDIX B

APPENDIX B

ISSUES CONCERNING THE ESTIMATION OF DEMAND AND PRODUCTIVITY: ECONOMETRIC ESTIMATES

APPENDIX B

ISSUES CONCERNING THE ESTIMATION OF DEMAND AND PRODUCTIVITY

Introduction

The estimation of trade policy effects developed in Chapter III require knowledge of price elasticities of import, export and domestic demand for goods, as well as estimates of the growth rate of multifactor productivity. This chapter discusses the theoretical foundation of the estimation procedures and provides the numerical estimates. The definition of relevant variables used in estimation, such as activity levels, aggregate import, export and domestic apparent consumption volumes and prices are presented in Appendix A.

THEORETICAL CONSIDERATIONS IN DEMAND ESTIMATION

In this first part we shall be concerned with the problems usually encountered in the estimation of demand functions in general, and of traded goods in particular. At a theoretical level, we may in principle treat any good as having a domestic final demand, an export demand and a residual import demand. More generally, consumer or producer demand is an unspecified function of prices of all competing goods and services, and an activity or income variable which may be disposable income in the case of consumer's demand, or the level of output in the case of producer's demand.

The functional form is restricted by theoretical consideration, and its parameters may vary from sector to sector (or from good to good).

At this level of abstraction, there are a number of issues that should be dealt with before the econometric estimation is attempted. We shall focus on the choice of variables and of functional forms (the specification problem), the question of lagged response and the identification of supply and demand schedules. Understanding the issues involved and assumptions made will undoubtedly have implications for our investigation. One positive consequence of addressing these issues is that one obtains a more through understanding of the limitations of our techniques. The other and more important result, is that the manner in which a theoretical or an empirical issue is resolved has a direct bearing on the interpretation and the validity of the results.

Demand functions in general, including demand for a country's imports and exports, are frequently based on static consumption theory.[68] In the static utility maximizing approach, the consumer utility function is specified in terms of quantity consumed at a given point in time, and the demand function is obtained as the solution to a utility maximizing problem subject to a fixed budget constraint.

Dynamic demand models are not usually derived from a dynamic utility function,[69] but are dynamic extensions of the static demand model. These models maintain the

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[68] Other method for the estimation of demand for tradables is the input-output approach of Sundararajan and Thakur (1976). A method that includes dynamic technological characteristics of traded goods may be found in Vernon (1966). A production function approach to import and export demand has been developed by Burgess (1974a, 1974b). See also Kholi (1978) and his Ph.D. thesis (1975).

[69] Phlips (1974) developed a dynamic demand formulation specifically derived from a dynamic utility function.

assumption of constant consumer tastes but take into account the fact that consumption may not respond instantaneously to price or income changes. Delay in response may be due to factors such as consumer habits or a delayed adjustment of the consumer's optimal stock of goods. These assumptions correspond to the flow adjustment and stock adjustment models, respectively. Lagged response may also be due to the presence of adjustment costs.

Lagged responses may by captured by the use of distributed lag models of Koyck (1954) and Almond (1965), or by the habit formation and stock adjustment of Houthakker and Taylor (1970).[70] These models specify the lagged values of the dependent or independent variables, and permit the estimation of short- and long-run elasticities, as well as the time distribution of the adjustments.

Estimates of the demand for tradables commonly specify a lagged response when estimations are performed using monthly or quarterly data, but lagged variables are not generally included in estimations using annual data. This occurs because it has been observed that the adjustment to a new equilibrium usually takes less than one year. In exceptional cases, very long lag responses have been found but these studies are concerned with the estimation of market shares rather than, as in our case, of the demand for tradables.[71] A detailed review of the literature on this aspect is presented below under the heading Dynamic Models.

As mentioned, consumer theory imposes restrictions on certain characteristics of

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[70] For a description of the Koyck, Almond and Houthakker-Taylor models see Phlips (1974), chapter VI.

[71] See, for example, Junz and Rhomberg (1973). For a review of empirical findings of the lag structure of trade, see Magee (1975), page 208. Similarly, the lagged response in consumer demand has been studied by Houthakker and Taylor who provide estimates of response for a large number of consumer goods. See Houthakker and Taylor (1970).

the demand equation. The utility function is assumed free of money illusion, which translates into the homogeneity of degree one of the demand function (homogeneity of degree zero in prices of the derived demand for imports in the case of producers free of money illusion).

To satisfy the homogeneity restriction, prices are usually entered as relative prices in the demand equation, and the income or activity variable is expressed in real terms. However, the inclusion of the no money illusion is not always observed in applied work. Several considerations have been advanced to justify its rejection. Some authors, e.g. Leamer and Stern (1970), argue that money illusion should not be a maintained hypothesis, but rather, that it should be confirmed by the model. Others prefer to impose homogeneity to the data, and adopt the view that the advantage in estimation, i.e. the improvement of the fit, may more than compensate for the less than rational behavior of some decision makers. In our case, though, we shall impose the homogeneity restriction.

With respect to the activity variable, we make a distinction between the activity variable to be used in the demand for final goods as opposed to the demand for intermediate goods. Since many goods are both final and intermediate, we calculate the corresponding activity variables based on the extent to which each commodity is a final or intermediate good, i.e. as a weighted average of user's activity variable where the shares are the output absorbed by final demand and by intermediate demand, respectively.[72]

The estimation of demand parameters is sufficiently dealt with in the relevant

[72] Similar considerations prompted Ripley (1980), p. 288, to use a weighted average procedure in the estimation of manufactured goods imports.

literature, since such knowledge is essential for estimating the effect of currency devaluations,[73] the balance of payments, the effect of export taxes on export volumes, on domestic factors of production, and on domestic stability issues.[74] The effect of non-price factors may also form part of the estimation. For example, the demand for imports by developing countries may depend on the availability of foreign exchange,[75] credit availability and domestic capacity utilization.[76] Our estimates employ the levels of nominal and real foreign exchange reserves but we found these variables to have no explanatory power in explaining Argentina's trade volumes.

In a supply and demand model, the rank and order conditions for identification [77] are usually satisfied by including in one equation an independent variable excluded from the other equation. Based on this criterion, all of our equations are identified. Export demands are specified in terms of the domestic price of exports relative to the world price of the commodity. This price variable is not part of domestic producers' supply function. The export price differs from the domestic producer price due to the "reintegro" and drawback mechanisms and special tax subsidies that enable domestic producers to export at a price lower than that of the domestic market. Concerning the activity variable of export demand equations, due to the small proportion of exports in domestic production, supply is largely related to domestic income rather than to world

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[73] Ridler and Yandle (1972).

[74] Goode, Lent and Ojha (1966).

[75] See, for example, Argentina's import demand functions by Diaz-Alejandro (1970), Ch. 7, and Leamer and Stern (1970), p. 15.

[76] Leamer and Stern (1970), pp. 14-16.

[77] Johnston (1973), ch. 12.

income, and therefore, the use of world income is another source of export demand identification.

The identification of import demands is based on the use of import prices that differ from domestic ones. For industries well into the process of import substitution, domestic supply adds to import supply in satisfying apparent consumption. The domestic demand for imports is a component of total demand and it is specified with a price different from the domestic price of manufactured goods within the same ISIC group. Again, we find that prices of imports and of domestically produced substitutes differ, the main reason being variations in product characteristics such as quality, design and fashion, and the fact that our data are aggregates of non-homogeneous products with a commodity composition different from the commodity composition of domestic producers. The identification of demand equations allows for the estimation of demand in its structural form by single equation methods.

In the basic consumer behavior model, the income coefficient is expected to be positive, unless the good in question is an inferior good, and the price coefficient negative, or the good is a Giffen good. In our import demand model, imports are defined as the excess demand of domestic consumption over domestic production. In the presence of domestically produced substitutes, it is theoretically possible for the income coefficient of the import demand function to be negative. This may be the result of a higher income elasticity of supply in relation to domestic demand income elasticity, even if the latter is positive. Write the import excess demand function as a function of income,

$$M(Y)=D(Y)-Q(Y) \quad (B1)$$

where M, D and Q are import demand, domestic demand and domestic supply respectively, and Y is domestic income. The income elasticity of import demand is obtained by differentiating with respect to income and dividing by appropriate terms to obtain,

$$E_{MY} = \frac{D}{M} E_{DY} \frac{S}{M} - E_{QY} = \frac{D}{M} (E_{DY} - E_{QY}) + E_{QY} \qquad (B2)$$

where the E's are the income elasticities. A negative income elasticity of the demand for imports implies the inequality,

$$\frac{D}{Q} < \frac{E_{QY}}{E_{DY}} \qquad (B3)$$

Usually the supply and demand income elasticities are both positive. A negative import demand elasticity requires that the domestic supply elasticity be higher than the domestic demand elasticity to make the ratio larger than the ratio between domestic demand and supply volumes. The ratio D/Q is positive and greater than one.

In the Rybczynski model, domestic production is assumed to comprise only two goods, one relatively more capital-intensive than the other, and trade takes place with a second country, both with incomplete specialization. There are two factors of production, capital and labour, which are used in different proportions by both industries. It is shown that an increase in the domestic availability of one factor of production, while the supply of the other factors is held constant, results in the decline of the industry using the other factor intensively. This follows from the full employment assumption which requires, for example, that the capital necessary to employ an extra labour unit in the labour-intensive industry be taken from the capital-intensive industry, and therefore, the output of the capital intensive industry must decline.

If, in addition, we introduce income growth to this model, the type of growth taking place in the domestic economy has an effect on the income elasticity of import demand. Assume a labour-intensive, import-competing industry and a constant income growth rate. If the income growth is the result of capital accumulation, the output of the import-competing industry declines relative to the output of the domestic capital intensive industry and therefore, as income grows, so do imports The income elasticity of import demand is positive. If, on the other hand, income growth results from labour accumulation alone, the output of the labour-intensive (and import competing) industry grows at a faster rate than the output of the capital-intensive industry, and the income elasticity of import demand is negative.

A negative import demand may also be the result of technological developments in the domestic industry. If, as the Vernon product cycle theory implies, goods incorporating new technologies are imported by developing countries at the beginning of the cycle and are manufactured in the country and exported at the end of the cycle, income growth in a developing country may have different effects on import demand depending on the technological stage of the good being imported.

Negative income elasticities of import demand functions are not uncommon in empirical import demand studies and one finds this to be the case in countries following import substitution strategies. Khan (1974) found positive income elasticities only in seven out of 15 developing countries. The income elasticity of total Argentine imports was found to be positive, although not statistically different from zero.

Considerations similar to the ones presented above with respect to the sign of the income elasticity can also be raised in relation to the sign of the price elasticity of import demand. Writing import demand as a function of prices,

$$E_{MP} = \frac{D}{M} E_{DP} - \frac{Q}{M} E_{QP} = \frac{Q}{M} (E_{DP} - E_{QP}) + E_{QP} \qquad (B4)$$

where the E's are the price elasticities of import demand, domestic demand and domestic supply. Usually the supply price elasticity is positive and the demand price elasticity is negative while D/S is positive and greater than one. Thus, the import price elasticity is negative, but it may be positive in the unlikely case in which the price elasticity of the domestic demand is positive.

THE STATIC DEMAND MODEL

The static demand model is based on instantaneous price and income demand adjustments. In terms of consumer behavior, the static model may be useful in studying situations in which consumer's reaction to changing economic conditions is very short, a situation which implies the absence of consumer habit or consumer stock adjustment. The single equation static model in its linear form is given by

$$Q_t = \alpha + \beta P_t + \tau Y_t \qquad (B5)$$

where Q denotes quantity demanded, P and Y refer to price and income, and t to time. Price and income elasticities are defined as follows,

$$E_P = \frac{\partial Q}{\partial P} \frac{P}{Q} \qquad (B6)$$

$$E_Y = \frac{\partial Q}{\partial Y} \frac{Y}{Q} \qquad (B7)$$

and are calculated from the price and income coefficients. Therefore, the elasticities are functions of the dependent and independent variables and are not constant. When the estimated coefficients are derived from a time series regression, it is customary to calculate elasticities at the mean value of prices, quantity demanded and income, to reflect average sample period values. Elasticities evaluated at the last data point will be denoted as "current value".

An alternative static demand model of empirical applicability is obtained by considering that prices and income enter the demand equation multiplicatively,

$$Q_t = \tau P_t^{\beta} Y_t^{\tau} \qquad (B8)$$

Taking natural logarithms yields the estimable log-linear form,

$$\ln Q_t = \ln \tau + \beta \ln P_t + \tau \ln Y_t \qquad (B9)$$

The log-linear specification usually results in a better fit to time series data, particularly if the relationship between variables is non-linear. In this specification, the price and income coefficients are the price and income elasticities, and it is not possible to obtain current value elasticities as in the linear model.[78]

If a non-instantaneous consumer behavior is present, for example, in cases where consumption adjusts to price and income variations over a time period longer than the time elapsing between observations, static models will fail to capture the adjustment process and make the erroneous assumption that the observable levels of quantity demanded are equilibrium values. To investigate particular adjustment behavior,

[78] Lagged responses to variables other than prices and income have been investigated in the empirical literature. See, for example, Artus (1970), who considered the Almon distributed lag structure of relative capacity utilization in the estimation of U.K. manufactured exports.

dynamic models are usually employed in empirical demand studies, a subject to be considered next.

DYNAMIC MODELS

Models that allow for a delayed reaction to price and income changes and, therefore, imply that adjustment from one equilibrium to another may take place over a long period of time are classified as dynamic models. One explanation of the lagged response may be due, as noted before, to the presence of habit formation by consumers. Habits may develop when a product has been consumed in the past. Habit formation behavior exists when, after a price or income change, the consumer would exhibit a demand which is larger than the demand level warranted by utility maximization given current (after the change) price and income. Dynamic models consider the possibility that price and income changes may take place in every time period and, therefore, equilibrium may never be reached.

Another source of lagged consumer response to a new equilibrium is the durability of the product in question. Durables are bought as a stock and consumption takes place from the stock in the form of services. After a stock item is purchased, price and income changes may not have an immediate effect on the decision to add to the stock. Thus, one should ascertain as to whether the demand being considered is the demand for a stock or the demand for the services it renders. If it is a stock, demand results from a desire to adjust its level to an equilibrium which is consistent with after-change prices and income.

A third source of delayed response may result from the presence of adjustment costs faced by the consumer in moving from one equilibrium to the next. In this case, the consumer is not irrational during the adjustment process as the habit formation assumption implies, but rather utility maximization and adjustment costs dictate that adjustment may optimally be distributed over time and may not be instantaneous.

In all cases involving habit formation, stock adjustment and adjustment cost, dynamic models consider specific forms of the transition between equilibrium points. The simplest way to incorporate delayed response is to consider a distributed lag model in its most general form,

$$
\begin{aligned}
Q_t = \alpha_0 + \beta_0 P_t + \beta_1 P_{t-1} + \ldots + \beta_n P_{t-n} + \\
\tau_0 Y_t + \tau_1 Y_{t-1} + \ldots + \tau_m Y_{t-m} + \\
\delta_0 Q_t + \delta_1 Q_{t-1} + \ldots + \delta_r Q_{t-r}
\end{aligned}
\qquad (B10)
$$

The sum of the ß's, the sum of the τ's and the sum of the δ's are assumed to be finite, and all ß's, γ's and δ's to have the same sign. The sum of the ß's describe the long-term response of quantity demanded due to price changes, and the individual ß's, the response at all time periods. Similarly, the sum of the τ's is the long-term response to income changes, and the individual τ's, the time period response. The sum of δ's captures the effect of past consumption on present consumption and individual δ's, its time profile. The values of α, ß, and δ determine the shape of the response. Response may be short or long in terms of time. There may be smooth adjustments, abrupt changes or overreaction on the part of consumers.

Distributed lag models cannot be empirically estimated in their most general form due to multicollinearity, and, therefore, there is a need to reduce the number of parameters to be estimated by postulating particular adjustment paths such as the normal, Pascal or Koyck geometric distributions.[79]

In the area of international economics, lagged responses have been investigated in market shares and trade flows. Grimm (1968) studied the lagged response of U.S. imports and exports, using the Almon distribution. Lagged effects of one to two quarters were found for food, beef and beverages, consumer goods and other imports, between three to five quarters for industrial imports, and between three to five quarters for industrial supplies and materials, capital goods and auto parts. Export price lags were considerable, from one quarter for crude materials and manufactures to five and seven quarters for electrical machinery, cars and parts.

Heiem (1968) estimated the response of real imports for 11 countries to lagged values of relative prices and consumption (in place of income). Using annual data and seven fixed lag structures, Heiem analyzed consumption and price responses for up to two years in Western European countries between 1950 to 1964. Although the time response pattern varies significantly from country to country, the mean real consumption response was 75% within a year, 20% the second year and 5% the third year. Relative price response followed approximately the same pattern: a 77% adjustment within a year, 20% the second year and 3% the third year.

Artus and Sosa (1978) investigated the demand for non-electrical machinery in West Germany, the United States and the United Kingdom during the 1969-1973 period using quarterly data. Their specification included a lag of up to 12 quarters for relative prices and up to four quarters for income. Price coefficients were estimated for the first to fourth quarters and for the fifth to twelfth quarters. In all cases, viz, the EEC

[79] See Z. Griliches, (1967).

countries demand, the rest of the OECD and developing countries demand, the coefficient corresponding to the fifth to twelfth quarter was significant and higher than the corresponding coefficient for the first to fourth quarter. The Armington model was used in the estimation and, to avoid the aggregation bias that arises in models of broad categories, Artus and Sosa subdivided the sample into 27 subgroups.

A more general type of dynamic response model was specified by Ahluwalia and Hernandez-Cata (1975) in the estimation of U.S. import demand during 1959-73. The authors employed a quarterly model which included lagged values of domestic prices, import prices, the dependent variable and an index of non-price variables. Reported lagged responses corresponding to the estimated import volume showed that price lags varied from four quarters for import prices to five quarters for domestic prices in both a Koyck type and an Almon second-degree polynomial. The disaggregated import volume demand function indicated that only price lags of up to four quarters were relevant. This occurred in the case of imported foods, feeds and beverages, industrial supplies and materials, and consumer and capital goods other than foods and automobiles. Unfortunately the authors did not report the time response of import and domestic prices, but judging from the length of the lags specified, it would appear that most price adjustments take place within the first year.

Of particular relevance are econometric studies specific to Argentina. Nogués (1982) studied the import demand function of the country using several models. His work covered the period of liberalization 1976-1981 using quarterly data. Three basic models were specified: the log-linear model, the partial adjustment model to analyze lagged import response, and the Goldstein and Khan (1975) model to analyze the effects of price changes on import flows. A total of nine functional forms were specified with the following results:

i - The log-linear model yielded statistically significant price and income coefficients,

ii - The partial adjustment model produced the best fit with statistically significant lagged endogenous, price and income coefficients,

iii - Specifications designed to test the significance of quarter-to-quarter price changes were estimated for one- and two-quarter lags. In terms of quality of fit, a price lag of two periods was favoured over a model specifying a one-period lag and a model with both first and second period lag.

Additional evidence as to the probable lagged structure of the dependent variables in trade flows is provided by Goldstein and Khan (1978). The study considered an equilibrium model and a disequilibrium model for the export trade of eight industrial countries for the period 1955 to 1970 using quarterly data. The disequilibrium model employed the adjustment mechanism of Houthakker and Taylor (1970) on an export quantity and an export price equation, thus specifying two equations each with a lagged endogenous variable for each country. Their result indicated that "the average time lag for the adjustment of exports to changes in the independent variables is estimated to be quite short - the mean time lag ranges from about one quarter for the United Kingdom to a little over five quarters for Germany" (page 283).

An interesting study by Buckler and Almon (1972) found substantially longer price lags for U.S. imports. The best-fit import functions yielded the following time profile: 25% for a one-year lag, 65% for a two-year lag and 10% for a three-year lag. Their results were obtained at the commodity level and lend support to the notion that, although commodity level response may in some cases be long, aggregation tends to reduce the average lag considerably. A second study showing lags longer than one year may be found in the time series-cross section results of Junz and Rhomberg (1973), although the model refers to international market shares and not to import and export demands, and only relative prices, not world income, appear as explanatory variables. The authors found significant price responses for up to five years with a peak at the third year. The reasons explaining long price lags were recognition lags, decision lags, and production and delivery lags.[80]

A trade flow study in which the response follows a declining pattern is found in Houthakker and Magee (1969). The import model was of the partial adjustment type,[81] and was estimated for total imports and five individual import categories using quarterly data for 1947-1966. The model considers a single lagged dependent variable and assumes a constant speed of adjustment. Houthakker and Magee were able to obtain short- and long-term demand elasticities by specifying a model which contained a lag structure for the trade variable, i.e., imports. Six trade categories were included: crude materials, crude foodstuffs, manufactured goods, semi-manufactures, finished manufactures and total trade. They found that in all cases long-term elasticities were larger than short-term, suggesting that habit formation dominates inventory behavior in trade flows.[82] It is interesting to compare their finding with the result of the study by

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[80] The influence of delivery time was extensively investigated by Artus and Sosa (1978) Significant delivery time lags were found, with most response taking place within the first four quarters.

[81] The authors also reported some difficulties with the estimation of U.S. imports using the basic Houthakker and Taylor (1970) model.

[82] The essence of both behavioral types is discussed below.

Houthakker and Taylor (1970), which focused on U.S. domestic demand functions. Houthakker and Taylor found both behavior types in their U.S. samples, but consumption was dominated by habit formation rather than by inventory behavior (inventory behavior occurred in 18 of the 68 consumer demand categories).

Thursby and Thursby (1984) evaluated the comparative validity of nine static and dynamic models in the estimation of aggregate import demand. The model specifications include lagged endogenous variables, lagged prices and income, and Almon polynomials on prices and income. One-year lags were specified on annual data for total import volumes in Canada, the United States, Germany, Japan and the United Kingdom. Their results indicate that the majority of satisfactory models are of the dynamic type which include lagged dependent variables.

In reviewing the literature, a number of facts may be identified that would constrain the estimation of price elasticities of Argentine manufacturing imports and exports. There are two separate issues to consider. In relation to the dynamic specification, we should consider whether the most general lag structure is appropriate. If a dynamic specification is to be used, previous studies might suggest the appropriate lag structure. The issue is whether existing evidence would favour one dynamic pattern over another and whether the same pattern should be specified for prices, income and predetermined variables. A separate issue relates to the cyclical behavior of trade and domestic production/consumption.

Evidence of lagged trade flow response to changes in relative prices and income exists for quarterly data with detailed knowledge of commodity weights (Artus and Sosa, 1978) and, if annual data are used, for highly disaggregated commodities (Buckler and Almon, 1972). A study in which lags of up to five years were found (Junz and Rhomberg, 1973) was based on pooled time series-cross section data. The studies of import demand by Heiem (1968), Ahluwalia and Hernandez-Cata (1975), Nogués (1982) and the study of import and export demand by Grimm (1968) suggest an appreciably large adjustment to prices or income within a year. The evidence on the importance of the lagged endogenous variables is more conclusive. The estimations of import demand by Houthakker and Magee (1969) and Goldstein and Khan (1978), and of imports and exports in developing countries by Khan (1974) indicate the importance of a constant declining pattern. Econometric demand estimation of domestic consumption in which lagged endogenous variables are used are also common.

Returning to the second issue, i.e., cyclical fluctuations, we note a considerable literature mainly in response to concerns for stabilization policies.[83] Although in our context there may be a need to remove cyclical fluctuations from demand elasticity estimates because our interest is in long-run trade policies, there is an impediment on the production side of the model that dictates otherwise. Measures of shifts in the production isoquants derived from a CES technology refer to average technological changes during the sample period. Measured technological change at the industry level includes the effect of the business cycle on domestic productive activity. Therefore, the estimates of demand elasticities should also reflect the effect of variations due to business cycles to be on the same basis as the estimation of technological change. This is achieved by not adjusting demand equations for cyclical variations.

Based on the above considerations, it seems appropriate to specify both static and

[83] For a survey of empirical findings see Magee (1975), pp. 211-214.

dynamic functional form in the demand equations. Given the level of aggregation and periodicity of the data, it is unlikely that lagged price and income variables would produce significant results. The empirical evidence, on the other hand. points to significant lags for the endogenous variable. For these reasons, we specify a linear and logarithmic static model and the partial adjustment and flow adjustment dynamic models. The partial adjustment model has the added advantage of being a special case of the Houthakker-Taylor model. The selected dynamic models have a simple reduced form which can be estimated in linear and logarithmic forms. Such an alternative is not available from the Houthakker-Taylor model.

THE PARTIAL ADJUSTMENT MODEL

Distributed lag models are largely empirical in the sense of not being derived from a particular theory. The partial adjustment model specifies a behavioral assumption with respect to the pattern of the lagged response. It assumes that consumers adjust partially from one equilibrium to another in a manner dictated by static equilibrium conditions. The static model determines the equilibrium quantity demanded corresponding to given prices and income, and deviations from such conditions with respect to observed demand is taken to represent consumers response. Equilibrium, or desired demand is given in linear form as,

$$Q_t^* = \beta_o + \beta_1 Y_t + \beta_2 P_t \tag{B11}$$

where the star indicates equilibrium quantity demanded, and is not observable, and P and Y refer to observable prices and income, respectively. At any point in time observable demand Q_t differs from desired demand by the amount of disequilibrium. The value of actual demand adjusts to the desired demand according to a fixed proportion of the disequilibrium, as follows,

$$Q_t - Q^*_{t-1} = v\ (Q_t - Q_{t-1}) \qquad 0 \cdot v \cdot 1 \tag{B12}$$

where v is the adjustment coefficient measuring the proportion of disequilibrium completed in every period of time. When v = 1, the partial adjustment model reduces to the static linear model. The smaller the value of v, the smaller the adjustment, and the longer the time it takes to reach the new equilibrium. A value of v = 0 indicates no adjustment.

Equations (B11) and (B12) are the structural equations. Substituting (B11) into (B12) to obtain the reduced form,

$$Q_t - Q_{t-1} = v\,ß_o + v\,ß_1\,Y_t + v\,ß_2\,P_t - v\,Q_t \tag{B13}$$

$$Q_t = v\,ß_o + (1 - v)Q_{t-1} + v\,ß_1\,Y_t + v\,ß_2\,P_t \tag{B14}$$

which reduces to the estimable version of the model in its linear form,

$$Q_t = A_o + A_1 Q_{t-1} + A_2 Y_t + A_3 P_t \tag{B15}$$

In the structural model, $ß_1$ is expected to be positive, $ß_2$ negative and v positive and less than one. Therefore, in the reduced form, A_1 is expected to be positive and less than one, A_2 positive and A_3 negative. The structural coefficients are exactly identified from the reduced form coefficients, as follows,

$$\beta_0 = \frac{A_0}{1-A_1} \tag{B16}$$

$$\beta_1 = \frac{A_2}{1-A_1} \tag{B17}$$

$$\beta_2 = \frac{A_3}{1-A_1} \tag{B18}$$

Compare equation (B15) to the Houthakker and Taylor estimable equation which is of the form,

$$Q_t = A_0 + A_1 Q_{t-1} + A_2 (Y_t - Y_{t-1}) + A_3 Y_{t-1} +$$

$$A_4 (P_t - P_{t-1}) + A_5 P_{t-1} \tag{B19}$$

The Houthakker-Taylor model reduces to the partial adjustment model for $A_2 = A_3$ and $A_4 = A_5$ implying a depreciation coefficient of $d = 2$. Since in the H-T model structural parameters may be given a long-term (or equilibrium) interpretation, it is of interest to derive such parameters from the estimated partial adjustment parameters, which are given by,

$$\alpha = \frac{A_0}{A_1+1} \tag{B20}$$

$$\beta = \frac{2(A_1-1)}{A_1+1} + 2 \tag{B21}$$

$$\tau = \frac{A_2}{A_1+1} \tag{B22}$$

$$\tau' = \frac{A_2}{1-A_1} = \beta_1 \tag{B23}$$

$$\Gamma = \frac{A_3}{A_1+1} \tag{B24}$$

$$\Gamma_1' = \frac{A_3}{1-A_1} = \beta_2 \tag{B25}$$

An immediate implication of these results can be derived from the equalities $\tau' = \beta_1$ and $\Gamma' = \beta_2$. The structural parameters of the partial adjustment model have a long term interpretation as they determine the equilibrium level of demand.

ELASTICITY ESTIMATES

	SHORT TERM	MEDIUM TERM	LONG TERM
AT MEANS			
Income	$\tau \frac{\bar{Y}}{\bar{Q}}$	$A_2 \frac{\bar{Y}}{\bar{Q}}$	$\tau' \frac{\bar{Y}}{\bar{Q}}$
Price	$\Gamma \frac{\bar{P}}{\bar{Q}}$	$A_3 \frac{\bar{P}}{\bar{Q}}$	$\Gamma' \frac{\bar{P}}{\bar{Q}}$
AT CURRENT VALUES			
Income	$\tau \frac{Y}{Q}$	$A_2 \frac{Y}{Q}$	$\tau' \frac{Y}{Q}$
Price	$\Gamma \frac{P}{Q}$	$A_2 \frac{P}{Q}$	$\Gamma' \frac{P}{Q}$

Price and income elasticities may be calculated as in the linear model at the means or at current values. In addition, elasticities may be estimated from the reduced form parameters of the partial adjustment model and from the H-T model parameters in its structural and reduced forms. Combining all possibilities gives rise to twelve possible elasticity estimates, as indicated above.

The partial adjustment model can be logarithmically transformed to yield a log-linear estimable equation. Write equations (B11) and (B12) in log form,

$$\ln Q_t = \beta_0 + \beta_1 \ln \overset{*}{Y}_t + \beta_2 \ln P_t \tag{B26}$$

$$\ln Q_t - \ln Q_{t-1} = \overset{*}{v}(\ln Q_t - \ln Q_{t-1}) \quad \text{(B27)}$$

which transforms into

$$\ln Q_t = v\, ß_o + (1-v)\ln Q_{t-1} + v\, ß_1 \ln Y_t + v\, ß_2 \ln P_t \quad \text{(B28)}$$

$$\ln Q_t = A_o + A_1 \ln Q_{t-1} + A_2 \ln Y_t + A_3 \ln P_t \quad \text{(B29)}$$

The structural coefficients of the logarithmic partial adjustment model have the same formulas as the linear model. Since in the log model the coefficients are elasticities, a distinction between means and current values cannot be made. Houthakker-Taylor equivalent coefficients have the usual long-term interpretation.

ELASTICITIES

	SHORT TERM	MEDIUM TERM	LONG TERM
Income	τ	A_2	$ß_1$
Price	Γ	A_3	$ß_2$

THE FLOW ADJUSTMENT MODEL

The flow adjustment model is a variant of the partial adjustment model. As in the case of the partial adjustment model, two structural equations are postulated. The first equation defines the equilibrium demand level as a function of price and income

$$\overset{*}{Q}(t) = \varepsilon + \Gamma\, Y(t) + \Phi\, P(t) \quad \text{(B30)}$$

where the star refers to desired demand and the Y and P variables are specified in continuous time. The second equation describes the adjustment process between actual and desired consumption levels which, unlike the partial adjustment model, is specified in terms of the time rate of change of demand, i.e.,

$$\dot{Q}(t) = g\,[Q^*(t) - Q(t)] \tag{B31}$$

where a dot indicates time derivative, and g is the adjustment factor (or speed of adjustment) which is assumed constant.

Conversion of the model from continuous to discrete time and to its reduced form is based on the following representations

$$X(t) = \tfrac{1}{2}\,(X_t + X_{t-1}) \qquad \text{for } X = Q,\ Y,\ P \tag{B32}$$

$$\dot{Q}(t) = Q_t - Q_{t-1} \tag{B33}$$

Replacing equations (B32) and (B33) into (B30) and (B31) yields the reduced form of the model,

$$Q_t = A_o + A_1 Q_{t-1} + A_2 (Y_t + Y_{t-1}) + A_3 (P_t + P_{t-1}) \tag{B34}$$

In the structural equations we would expect θ to be positive and Φ to be negative. Likewise, in the reduced form, A_2 should be positive and A_3 negative. A_1 is normally less than one, or otherwise the model does not converge. The structural parameters can be obtained as follows,

$$\varepsilon = \frac{A_o}{1-A_1} \tag{B35}$$

$$\Gamma = \frac{2\,A_2}{1-A_1} \tag{B36}$$

$$\Phi = \frac{2\,A_3}{1-A_1} \tag{B37}$$

$$g = \frac{2\,(1-A_1)}{A_1+1} \tag{B38}$$

As in the partial adjustment model, the coefficients of the structural equation represent long-term response, since demand is in equilibrium when the desired level is reached. Thus, Φ and θ are long-term coefficients. Short-term income and price coefficients are defined in terms of period-to-period changes since there is no stock adjustment in the model. Short-term coefficients are calculated by the product of the long-term coefficients and the speed of adjustment,

$$\Gamma' = g\,\Gamma \qquad (B39)$$

$$\Phi' = g\,\Phi \qquad (B40)$$

Price and income elasticities are calculated as before, for current and mean values, as given in the following table.

	ELASTICITIES	
	SHORT TERM	LONG TERM
AT MEANS		
Income	$g\,\Gamma(\bar{Y}_t + \bar{Y}_{t-1})/2\bar{Q}$	$\Gamma(\bar{Y}_t + \bar{Y}_{t-1})/2\bar{Q}$
Price	$g\,\Phi(\bar{P}_t + \bar{P}_{t-1})/2\bar{Q}$	$\Phi(\bar{P}_t + \bar{P}_{t-1})/2\bar{Q}$
AT CURRENT VALUES		
Income	$g\,\Gamma(Y_t + Y_{t-1})/Q$	$\Gamma(Y_t + Y_{t-1})/Q$
Price	$g\,\Phi(P_t + P_{t-1})/Q$	$\Phi(P_t + P_{t-1})/Q$

A logarithmic transformation of the flow adjustment model yields,

$$\ln Q = \ln A_o + A_1 \ln Q_{t-1} + A_2 \ln (Y_t + Y_{t-1}) + A_3 \ln (P_t + P_{t-1}) \qquad (B41)$$

The linear, flow adjustment and partial adjustment models are estimated in both their linear and logarithmic forms.

In concluding the theoretical considerations of demand estimation, one issue remains to be dealt with: whether the income variable should be specified in absolute or per capita-terms. Demand equations in per-capita terms are theoretically justified in that the resulting elasticities refer to the average individual, and therefore, are independent of population shifts. The empirical literature, on the other hand, particularly for trade studies, does not often use per-capita income. It seems natural to specify trade models in absolute income terms if the interest is in policy implications which should include population changes. We have specified absolute income for this and one other reason: the identity establishing market equilibrium between production, consumption, exports and import volumes flows per period of time (equation 1, Chapter III) does not hold if written in per-capita terms.

THE MEASUREMENT OF PRODUCTIVITY

The conceptualization and measurement of productivity is based on the notion of a transformation function whereby quantities of inputs are converted into quantities of output via some known technology. Productivity improves when more output can be produced per unit of inputs. The improvement may be seen as an inward shift of the production isoquant, or as a downward shift of the unit cost function. Under certain assumptions, e.g., constant returns to scale and exogenous technological progress, wages equal to marginal products and productivity changes can be identified as changes in the efficiency of production. In this thesis, we refer to changes in productivity and to technological change or progress as being synonymous.

In effect, technological progress may influence several parameters of the production function such as factor proportions, the degree of homogeneity and the elasticities of substitution. Technological progress that affects the degree of homogeneity and causes shifts in production isoquants is said to be neutral in the sense that, at constant factor prices, this type of technological change does not alter the marginal rate of substitution among factors of production. Technological progress that results in variations of elasticity of substitution and factor proportions is said to be non-neutral since, at constant factor prices, it modifies the marginal product of at least one production factor.

Technological progress may also cause changes in input and output composition without affecting any production function parameters. For example, a product innovation may affect the composition of output by the appearance (or disappearance) of a new products and/or by changing the quality of existing ones. Similar considerations apply to the input mix. To capture these effects, it is necessary to specify a multi-input, multi-output cost or production function where input and output volumes are quality adjusted (the hedonic approach to index numbers). Unfortunately, data limitations prevent us from specifying this type of model. Output data, in our case, consist of real output calculated as the sum of real value-added and real intermediate inputs, i.e., one commodity. In addition, no information on Argentine stock of capital by manufacturing industry is available. Labour input, on the other hand, can be estimated from employment series, but no breakdown by labour type is available.

The econometric estimation of technological change is based on the estimation of a constant-returns-to-scale CES production function. The homogeneity assumption implies that only neutral changes in productive efficiency are captured. These shifts in the isoquants capture most of the effect of education of the labour force, of changes in its sex and age composition, of increases in net output introduced by new capital equipment, of reductions in net output due to the wear and tear on existing capital equipment, of process innovations as well as of improvements in managerial and organizational aspects of production and labour relations. The non-neutral component of technological change which this model does not capture is believed to be minor. This type of technological change takes place when, at constant prices, new technologies are chosen that operate at different factor proportions, usually at a higher capital intensity, than existing technologies. Some progress in resolving this issue has been made by methods employing non-homothetic estimation. Due to data limitations, our estimates are restricted to homogeneous-of-degree-one production functions.

The estimation of productivity in our research is based on the CES production function with one output and two inputs. Output is real gross domestic product by industry (real value-added), and the inputs are capital and labour services. This specification differs from the model of production in Chapter III which is specified in gross output (production) and where the inputs are tradable and non-tradable service inputs. Tradable inputs are intermediate imports, while non-tradable inputs are the services of capital and labour used in production. This last specification cannot be implemented in empirical estimation due to lack of capital stock data at the industry level. There is, however, a stable relationship between the gross output and net output measures of productivity.

Denote by A the measure of productivity from a model corresponding to that of Chapter III, and where the tradable and non-tradable input arguments correspond to capital, labour and intermediate inputs, as follows

$$\mathring{A} = \mathring{Q} - f(\mathring{T},\mathring{NT}) = \mathring{Q} - f(\mathring{K},\mathring{L},\mathring{I}) = \mathring{Q} - a_v(\mathring{K},\mathring{L}) - a_i\mathring{I} \tag{B42}$$

where T and NT refer to tradable and non-tradable inputs, which are equivalent to the services of capital K, labour L and intermediate inputs I. The a's are the value-added and intermediate input cost shares in total input cost. The shares sum to one. The productivity measure B derived from a two-input model is given by,

$$\mathring{B} = \mathring{V} - g(\mathring{K}, L) \tag{B43}$$

where V is real value-added which is obtained by the double deflation method from real output and aggregate capital and labour inputs. Therefore,

$$\mathring{V}_i = (\mathring{Q}_a - a\,\mathring{I})\,\frac{1}{v} \tag{B44}$$

The value-added productivity can be written as,

$$\mathring{B} = \frac{\mathring{Q} - a_v\,(\mathring{K,L})}{a_v}\,(\mathring{K,L}) \tag{B45}$$

The ratio between gross output and net output productivity is, therefore, given by,

$$\frac{\mathring{A}}{\mathring{B}} = \frac{\mathring{Q} - a_v(\mathring{K,L}) - a_i\mathring{I}}{(\mathring{Q} - a_i\,\mathring{I}\,)\,\frac{1}{a_v}\,(\mathring{K,L})} \tag{B46}$$

Rearranging,

$$\frac{\mathring{A}}{\mathring{B}} = a_v \tag{B47}$$

The productivity ratio is the cost share of value-added in total cost. This cost share is, in general, stable in relation to gross output and, therefore, value-added productivity is correlated with gross-output productivity through time. In absolute value, value-added productivity is larger than gross-output productivity, as equation (B47) indicates, depending on the use of intermediate inputs. It is for this reason that productivity estimates from the CES production function based on net output are numerically larger. The constant returns to scale CES production function estimated has the following specification,

$$\ln \frac{V}{L} = \alpha + \sigma \ln w + \tau \ln t \tag{B48}$$

where w is the wage rate, and t is time. The coefficient σ is a time series estimate of the elasticity of substitution between capital and labour, and the coefficient τ permits the estimation of the average annual rate of productivity growth,[84]

$$\overset{o}{B} = \frac{\tau}{1 - \sigma} \quad . \tag{B49}$$

Recall that the production function in Appendix III is a short-run function with capital as a quasi-fixed factor and where the unit cost of capital services to the firm may be different from the market rate of return to capital. Because stocks are fixed in the short-run, the firm equates short-run marginal cost to price in deciding output volume, and the rate of return to its own capital may be different than the market rate. If different, it follows that profits are not zero and that the value of output differs from the cost of all inputs. Therefore, revenue does not equal cost, and the firm does not operate at constant returns to scale as required by our model and by equation (B47).

Berndt and Fuss (1986) and Hulten (1986) show that in short-run equilibrium with fixed capital, it is erroneous to assume that the internal price of capital to the firm equals the price of capital in perfectly competitive markets (long-run equilibrium). If the

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[84] The productivity equation results from the first order conditions for profit maximization given perfectly competitive markets and a CES production function. For its derivation see Katz (1969).

erroneous price is used to calculate the value of capital input, productivity gains will be biased because it ignores the fact that the firm cannot instantaneously adjust its stock without adjustment cost. A solution is to take into consideration the fact that the service cost of capital to the firm is the realized ex post cost of capital. In turn, it implies that ex post, cost equals revenue, and that the firm operates at constant returns to scale. It remains to demonstrate that the specification of productivity in equation (B48) satisfies this requirement. Katz (1966, pp. 70-73) derived equation (B48) from a two-input constant returns to scale CES function where marginal products equal wage rates. Because of constant returns and the condition that wage rate equals labour's marginal product, there is no profit. This implies that the shares of capital and labour add up to one. In other words, the share of capital is the ex post share which is precisely the share needed in the short run production function in Chapter III.

ECONOMETRIC ESTIMATES

This part of the appendix presents the results of implementing the demand and production function models described above on an industry basis. The database was explained in Appendix A.

DEMAND ESTIMATES

Food, Beverages and Tobacco

Export demand estimation for the sector proceeded initially to test whether EP policies and liberalization introduced breaks in the series. A dummy variable was introduced between 1959 to 1970 to represent the EP period and a second dummy was used for the 1976-79 trade liberalization years. In addition, cross effects between the EP and liberalization dummies and the price term were allowed to take into account possible slope changes in the price variable due to trade policy changes. The EP dummy could explain the relatively high export volume in the 1960's and its rise which occurred when prices were not different from those in 1950. Although higher export volumes might have been due to world income growth, such a variable showed a continuous trend with no visible discontinuity over the sampling period, with the exception of the post-1975 years in which a higher growth rate was evident. The liberalization dummy was introduced to determine whether the overall reduction in taxes and subsidies following the March 1976 change in economic policies favourably or unfavourably affected export volume from the sector.

Regression results indicated that the dummy cross-terms performed poorly in all models. In the static model, the liberalization and cross-term dummies were found not significant, and consequently were removed. Subsequent runs used the EP dummy alone.[85] The logarithmic version of the partial adjustment model produced insignificant

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[85] In a separate run, the EP dummy was extended to cover the 1956-1970 period, since there appeared to be a break in export volumes in 1956. The break may have been caused by the October 28, 1955 exchange rate reform which introduced a multiple exchange rate regime for

EP and EP cross-terms dummies. The fit did not improve when the dummies were removed. The linear version of this model, on the other hand, showed significant EP and liberalization dummies with no cross-terms. The flow adjustment models showed no significant EP variables and, in a run with only liberalization variables, both were found to be significant at a 90% level (one-tail test). The best model appeared to be the linear partial adjustment model with significant EP and liberalization dummies and no evidence of first-order autoregressive disturbances. The results of this model are presented in Table B1.

The export demand estimates show that the dummy variables representing EP and liberalization periods had the same influence on export volumes. This is to be expected in the largest agriculture-based manufacturing export sector since the sector, like its agricultural counterpart, has traditionally produced large export earnings. Import of foods, beverages and tobacco shows no explicit evidence of a strong import substitution effect during the period. Trade liberalization, on the other hand, increased relative prices and volumes to record levels. Most import volumes seemed to be explained a priori by price variations, with the exception of the 1976-79 period in which volumes were much larger than those expected to be generated by relative price or domestic income considerations. In view of the above, no IS dummy was introduced, and a liberalization dummy and its cross-price were set to take the years 1976-79. The initial estimates showed some significant liberalization dummies, but lagged endogenous models failed to show evidence of dynamic behavior. The explanatory

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imports and exports and fluctuating exchange rate taxes and subsidies. However, the dummy did not improve results. This probably reflects the fact that the export exchange rate was calculated from actual exchange rate transactions which took into account negotiated rates and, presumably as the results suggest, also reflected the impact of exchange rate taxes and subsidies.

level of the estimates was low. The approach to modelling the import substitution process by means of dummy variables was reconsidered. The difficulty arose from the fact that during the sampling period, IS policies did not vary sufficiently to affect import volumes significantly. To compensate for variations in IS policies, an additional explanatory variable measuring the level of foreign exchange reserves (including gold) was introduced.[86]

Dynamic behavior was absent and, in some cases, the lagged endogenous variable had the incorrect sign. The quality of fit improved as a result of introducing the level of foreign exchange reserves. In subsequent runs, reserves were deflated by the U.S. GNP deflator. Results were slightly poorer, indicating that import restrictions for the sector provided some, but not important, explanatory power, whether in nominal or real terms. The explanatory power of most models was low. Results are shown in Table B II.

The estimation of the demand for domestic apparent consumption of food, beverages and tobacco began with a dummy variable for the 1953-63 period, a second for the 1964-75 period, and a third for the 1976-79 period. Two data sets were used, identified as A and B in Appendix A. Models without dummies performed worse than models with dummies, with the exception of single lagged endogenous models which produced the best fit. Models without dummies also showed a tendency to produce positive price coefficients. Full dummy models, on the other hand, contained periods of insignificant price coefficients. But this type of model is preferable for policy considerations, since in some cases other dummy variables were statistically

[86] The use of foreign exchange as a measure of a constraint determining short-term import policy in Argentina is well-established. See Diaz-Alejandro (1970).

significant and of the expected sign and adequate statistic. On a pure goodness-of-fitness criterion, however, a single-lagged endogenous variable would have been chosen. Results are reported in Table B III and correspond to database A.

Textiles, Wearing Apparel and Leather Industry

Initial export demand estimates contained an EP dummy to cover the period 1959-1971, and a liberalization dummy for 1976-79. Direct and cross effects were allowed. Dummies performed poorly in all models, notably the EP dummy. Subsequent trials with the EP dummy removed deteriorated the fit in all models and the liberalization dummy did not improve. A shortened liberalization period of 1977 to 1979 was imposed to account for the fact that prices and volumes in 1976 corresponded approximately to those of 1974, and this may indicate a retardation of the liberalization effect on exports to 1977, an assumption which was disproved.

Significantly improved results were obtained with an extended liberalization dummy that began in 1972 on the basis of observed volume and price shifts that occurred in 1971-72. In view of this result, the 1959-71 EP dummy was reintroduced, improving the explanatory power of some models. Dynamic models indicated instantaneous adjustment and produced lower quality estimates. The best fit corresponded to the log model with no evidence of first order autocorrelation and had significant coefficients, with the exception of the income variable which was statistically different from zero. The econometric results suggest a valid EP effect and a smooth transition to liberalization. Results are shown in Table B IV.

The estimation of import demand for textiles proceeded first to include the level of foreign exchange reserves as a proxy for quantitative import restrictions and a dummy variable to represent the 1979 discontinuity. There is little evidence either of the reserve variable being significant in static models or in dynamic models. Subsequent experimentation introduced two dummy variables to account for volume levels in 1953 and 1978 not accounted for by similar behavior of the price or income variables. Results were somewhat better, although some cross-price terms were non-significant. The linear partial adjustment model with dummies produced an adjustment factor greater than one (explosive behavior). Overall, the static linear model performed best. Its results are presented in Table B V.

The domestic demand estimation gave superior results with the consumer price index. Initial dummies were set to account for slope and intercept changes in the periods of 1950-58, 1959-63, 1971-75 and 1976-79. The best-fit model is shown in Table B VI and corresponds to the linear partial adjustment model.

Wood and Wood Products, Including Furniture

Initial export demand EP dummies were introduced for the 1963-1974 and 1976-79 periods to account for EP liberalization. The constant term was largely insignificant in most models. The EP dummy and its price cross-term were insignificant in the static model, and in the static log model no dummy term was found significant. Dynamic models performed better with significant constant and lagged endogenous variables. Models with high explanatory power were dynamic models in log form yielding non-significant liberalization and cross-term coefficients.

While retaining the liberalization period unchanged, a shortened EP period 1963-

1970 improved the fit in all models, although linear dynamic models failed to perform. Logarithmic dynamic models, on the other hand, continued to show non-significant liberalization effects and non-significant EP cross-price terms as well. Dynamic models with good fit were re-estimated excluding non-significant terms. A third run used the same 1963-74 EP period as the first run, and run four considered a reduced 1963-70 EP period. Comparing the first and third runs, dynamic models in log form without dummies worsened the fit, but the reverse held for models with a restricted dummy set.

A comparison between the second and fourth runs indicated overall improvement in both dynamic models in log form although the flow adjustment model showed non-significant EP cross-term. To obtain results comparable to those of the third run, in which the flow adjustment had significant dummy terms, a fifth run with EP cross-terms removed was performed. The results were compared to those from run three which, incidentally, had the same explanatory power. Table B VII reproduces the result of the logarithmic partial adjustment model which excludes the constant term and both liberalization price effects. The EP dummy covers 1963-70 with no cross-terms.

Initial import demand models were estimated with a liberalization dummy for 1976-79 and real foreign exchange reserves. Results were unsatisfactory, with no dynamic response. The IS dummy was insignificant and was, therefore, replaced by four IS dummies to account for five steep declines in import volumes which appeared to be structural. Dummies covered the following periods: 1953-57, 1958-70, 1971-77. The liberalization dummy covered 1978-79. Results were significant, as reported in Table B VIII.

The sector's domestic demand showed no evidence of dynamic behavior. Static models without binary variables produced better fit but with positive or zero and statistically significant price coefficients. Among models with binary variables, the autocorrelation-corrected log model was selected over the linear model on the basis of a correct price coefficient rather than on goodness of fit. The results are reported in Table B IX. The exclusion of the 1954-77 price variable indicates a zero price elasticity during the period.

Pulp, Paper, Paper Products, Publishing and Printing

Export demand estimation considered three alternatives. In the first one, policy dummies covered the periods 1963-74 and 1976-79. The static linear model had no significant dummy variables. The static linear model with no dummies had no significant constant term. The static model in log form yielded significant parameters and better fit. The partial adjustment model in its linear form, unlike the flow adjustment model, indicated a significant adjustment factor, but price and liberalization terms were not significant. The log version of both dynamic models produced significant lagged endogenous variables. The partial adjustment model had no significant liberalization terms.

The second alternative deleted both liberalization dummies while maintaining the length of the EP period. Linear models improved their fit and log models reduced their overall significance yielding non-significant price parameters. In the third alternative, non-significant terms were eliminated. The flow adjustment model lost its dynamic behavior and the partial adjustment model produced results similar to the previous alternative. The best model was judged to be the partial adjustment model of the first alternative in its log form. Results are presented in Table B X.

As with other import demands, estimation proceeded first with the real value of foreign exchange reserves as an explanatory variable. The results showed low coefficient of determination and non-significant reserve parameter. The reserves variable was then eliminated and three binary variables introduced: 1950-54, when high price and volume fluctuation took place, 1955-66, a period of relative price stability and moderate import growth, and 1967-76, a period characterized by increasing prices and large volume fluctuations. No account was taken of the post-1976 period since no apparent break occurred within the period and binary variables from the first run of estimations were not significant. Cross-price terms were added as well. Results improved, but the price variable was insignificant in most models, as was the coefficient of the lagged endogenous variable in linear models. With the elimination of non-significant parameters the fit improved. Overall, best results corresponded to the logarithmic partial adjustment model adjusted for autocorrelation which is presented in Table B XI.

Three sets of binary variables were used in the estimation of demand for domestic apparent consumption. In a first set of runs, dummies covered the years 1954-56, 1959, 1962-64, 1967-70, 1974-76 and 1978-79. There was no evidence of dynamic behavior and, in some cases, positive price coefficients were found. Similar results were obtained with dummies covering 1954-56, 1962-64, 1967-70 and 1978-79. Better estimates were obtained by specifying dummies for 1950-53, 1955-60, 1962-67, 1968-69, 1970-71 and 1978-79, the results of which are shown in Table B XII.

Chemicals, Petrochemicals, Rubber and Plastics

The econometric results in the estimation of the sector's exports with an EP dummy for 1965-76 and a liberalization dummy in subsequent years were rather disappointing with largely insignificant price and EP variables and, in some cases, insignificant income coefficients. There was evidence of dynamic behavior. The quality of the estimates improved with the removal of non-significant variables except when it affected the price or income terms. The improvement occurred in the static models but it did not in dynamic models with no dummy terms in which the coefficient of determination improved due to the elimination of irrelevant terms. Dynamic logarithmic models did not show evidence of dynamic behavior. Some demand coefficients remained insignificant and were subsequently removed. This resulted in the loss of the significant lagged endogenous variable in log dynamic specifications and it did not generally improved the fit. The best specification corresponded to the flow adjustment model adjusted for first-order autocorrelation. The previous specification of this model showed higher explanatory power, but its usefulness in our context is limited by the low significance of the price term which showed a "t" statistic of 1.584. Results are shown in Table B XIII.

To reflect the evolution of the IS period in the estimation of import demand functions, real foreign exchange reserves and dummy variable were used. The IS version responded strongly to the level of reserves during the entire period. Coefficients of determination in the order of 81% were observed, with significant and correct sign coefficients in all models. Results improved with the introduction of 1955-66, 1976-79 binary variables (1975 was excluded because of unusually low relative price and high import volumes), but dynamic log models yielded non-significant lagged endogenous variables. The dummies were modified for 1950-55, 1956-60, 1961-66 and 1976-79. Results did not warrant the finer dummy breakdown and the fit worsened considerably for the second run. The best model was the partial adjustment model in linear form adjusted for autocorrelation, as shown in Table B XIV.

Demand for domestic apparent consumption was estimated for data sets A and B. In many cases, the price coefficient was found to be positive and the flow adjustment model had insignificant lagged endogenous variables. Best results held generally for static logarithmic models. Binary variables took the following periods: 1950-51, 1952-54, 1955-60, 1961-62, 1963-69, 1970-75 and 1976-78. Results are reported in Table B XV.

Non-metallic Mineral Products

A first run in which the EP dummy was set for the 1966 to 1974 period and liberalization dummy set to cover the 1976 to 1979 years indicated largely non-significant price terms in all models with the exception of the linear flow adjustment model. A second run considered the possibility of eliminating the year 1975 from the EP period and liberalization period as export volumes in 1975 departed considerably from the trend and may properly be considered an outlier. The coefficient of determination improved in most models during the second set of runs, but declined slightly in the case of the static and logarithmic partial adjustment model. The price term continued to be insignificant as did the EP dummies, indicating an export price response only during the liberalization period.

A third set of runs was performed in which the EP period was extended to include the year 1976 and liberalization covered the remainder of the sample. This became necessary in view of the mixed results obtained after eliminating 1975 from the EP period in the second run and because of the fact that the time plot of export volumes does not clearly show the year in which a break took place. The runs, however, showed no significant improvement over previous ones. The price term remained not significant in all models with the exception of the flow adjustment model in linear form with and without dummies. In the model with dummies, the lagged endogenous variable was now significant. The EP dummies continued to be largely insignificant.

In view of these results, a re-examination suggested that the EP drive may have began in 1960 rather than in 1966 as was previously assumed. Thus, a fourth run considered this possibility, while excluding 1975 from both dummies. Results were once again mixed. Improvements occurred compared to the third run in the case of the linear partial adjustment and flow adjustment models. All other models produced weaker results. As in previous cases, price variables remained not significant and dynamic models failed, with the exception of models where no dummies were used. A comparison between the second and fourth runs showed the effect of extending the EP dummy to 1960 from 1966, and indicated deteriorating results with the exception of the partial adjustment model in its linear form although, as in run three, the coefficients of the price variable, that of the lagged endogenous variable and that of the EP dummies remained insignificant. A comparison between the first and third runs made evident the impact of further extending the EP dummy from the 1966-1974 period to the 1966-1976 period, while liberalization was assigned the remaining years. As in previous cases, the fit improved slightly in some cases and worsened in others. Improvements were recorded in the static linear model with dummy variables and in dynamic models without dummies, although these models, as in all other runs, show no significant dynamic behavior.

The overall best model for the sector was the static linear model adjusted for autocorrelation of the third run. Although the price coefficient was not significant, the dummy-price interactions were significant. The results are presented in Table B XVI. The level of real foreign exchange reserves had low explanatory power in all import demand models. Coefficients were insignificant and low R-squares prevailed in the first attempt. Three subsequent runs employed dummy variables for the years 1953-61, 1962-66, 1967-78 and 1979. Some dummies and cross-price terms were non-significant and low fits were obtained. Dynamic behavior was statistically significant in both the partial and flow adjustment models. The best fit was obtained by the flow adjustment model, as reported on Table B XVII.

Sectoral domestic demand was estimated for database A only. Binary variables were set to cover the periods of 1950-62, 1963-65, 1966-75 and 1976-79. No evidence of dynamic behavior was obtained from the flow adjustment model but some promising results from the partial adjustment model were obtained from a first run. The best specification was the partial adjustment model adjusted for autocorrelation, results of which are shown in Table B XVIII.

Basic Metal Industries

The sector was the most dynamic within the manufacturing exporting sector in terms of volume and revenue growth. Between 1950 and 1979, export volumes expanded from 29 thousand metric tons to 623,350 thousand metric tons, and revenues increased from US $ 20,000 to US $ 7 million.

The effect of the export promotion seems to have begun in 1962 with lower relative prices and higher volumes. The EP dummy was set for 1962-75 and liberalization for 1976-79. Results were compared with a second run in which the EP variable was extended one year and the liberalization shortened one year. The fit deteriorated slightly in the static, partial adjustment and flow adjustment models in logarithmic form. The linear static model improved its coefficient of determination slightly but the price coefficient continued to be insignificant. Given the indeterminacy of the results, a third run considered the year 1975 as a special case, in view of the low export volumes experienced by the sector. This may have been the result not only of the external situation, but also of the unstable political and economic situation of the country. Thus, the third run considered the EP between 1962 and 1974 and liberalization beginning in 1976. The static linear model showed autocorrelation and, when corrected, the fit deteriorated. Similar deteriorations occurred in the static log model and in the linear version of the dynamic models. Logarithmic dynamic models, on the other hand, improved the fit, although, as in the case of previous runs, there were no significant dummy variables. Best results were obtained by the partial adjustment model in linear form in the first run, as reported in Table B XIX.

Argentine imports of the basic metal industries were modelled with and without dummies. Three runs were produced in which dynamic behavior was not significant in both the partial and flow adjustment models. Linear models with dummies performed better than models without them. Dummies covered the periods of 1950-54, 1955-56, 1958-60, 1965-67 and 1976-79. Results are presented in Table B XX.

Demand estimation of domestic apparent consumption was performed on database B. Only two runs were necessary to obtain reasonably good estimates. Some absurd results occurred in the flow adjustment model where it was found that there was either explosive behavior of no dynamic behavior. The static logarithmic model produced best results as reported in Table B XXI.

Metal Products, Machinery and Equipment

To test the hypothesis that EP and liberalization influenced export volumes of the sector during the sampling period, an EP dummy was set to one for the 1966-1975 period, and a liberalization dummy for the remaining years. The results showed no significant own- and cross-term coefficients in models with high explanatory power. Exclusion of non-significant dummies resulted in improved fit. The overall best model was the partial adjustment model with no autocorrelation. Results are shown in Table B XXII.

Considerable difficulties were encountered in the estimation of the sector's import demand function. The level of real foreign exchange reserves as a measure of the IS effort proved not significant, as may be deduced from the variability of the import-volume series. A set of binary variables was used for the following periods: 1950-55, 1956-59, 1960-63, 1964-74 and 1976-79. Preliminary results indicated the statistical equality of the four first variables in the logarithmic partial adjustment model and the possibility of combining them together was considered. The fifth dummy was significant in some functional forms. The combination of binary variables into one did not prove feasible and, because of the general weakness of dynamic models to explain the sector's demand, no further dynamic models were estimated. Although the coefficients of determination were generally low in most runs, no further investigation beyond the fifth run were undertaken at which point the static linear model was selected. Results are reported in Table B XXIII.

Domestic demand for metal products, machinery and equipment showed generally good results in all models; therefore it is rather arbitrary to prefer one model over another. However, the model considered best was the static log-model run with non-significant parameters removed. The binary variables were set at 1950-51, 1952-53, 1954-58, 1959-61, 1962-69 and 1970-79. Results are shown in Table B XXIV.

TABLE B I

EXPORTS OF FOOD, BEVERAGES AND TOBACCO.
PARTIAL ADJUSTMENT MODEL-LINEAR

REDUCED FORM COEFFICIENTS		T-STAT.	OTHER STATISTICS	
Constant	55.92	4.98	R^2	.78
Lagged endogenous	0.31	2.39	DH	.96
Income	0.36	3.29		
Price	-0.36	-2.95		
EP (1959-70)	15.94	3.14		
LIB (1976-79)	15.18	1.79		
STRUCTURAL COEFFICIENTS		H-T STRUCTURAL PARAMETERS		
Constant	81.44	Constant	42.58	
Income	0.52	State	0.95	
Price	-0.52	Income	0.27	
EP	23.21	Price	-0.27	
LIB	22.10			
Adjustment	0.69			
ELASTICITIES				
		Short term	Medium term	Long term
At means	Income	0.28	0.37	0.54
	Price	-0.39	-0.51	-0.75
At current values	Income	0.4	0.53	0.77
	Price	-0.39	-0.52	-0.76

TABLE B II

IMPORTS OF FOOD, BEVERAGES AND TOBACCO.
STATIC LOGARITHMIC MODEL

COEFFICIENTS		T-STAT.	OTHER STATISTICS	
Constant	3.62	2.36	R^2	0.69
Income	0.66	1.87	DH	2.31
Price	-0.91	-6.21		
FX	0.39	2.15		
D1 (1976-79)	-2.85	-1.82		
D1P	0.72	2.45		
FX: nominal foreign exchange reserves (US dollars)				
ELASTICITIES				
At means	Income	0.66		
	Price	-0.91		
At current values	Income	0.66		
	Price*	-1.96		
* not significant				

TABLE B III

DOMESTIC APPARENT CONSUMPTION OF FOOD, BEVERAGES AND TOBACCO. STATIC LOGARITHMIC MODEL

COEFFICIENTS		T-STAT.	OTHER STATISTICS	
Constant	21.12	2.31	R^2	0.90
Income	0.68	3.24	t for rho	19.27
Price	-4.35	-2.19	DW	1.29
D1 (1953-63)	19.26	2.12		
D2 (1964-75)	-17.95	-1.98		
D3 (1976-79)	-18.24	-1.99		
D1P	4.24	2.12		
D2P	4.01	2.00		
D3P	4.08	2.02		
ELASTICITIES				
At means	Income	0.68		
	Price	-0.34		
At current values	Income	0.68		
	Price	-0.27		

TABLE B III

DOMESTIC APPARENT CONSUMPTION OF FOOD, BEVERAGES AND TOBACCO. STATIC LOGARITHMIC MODEL

COEFFICIENTS		T-STAT.	OTHER STATISTICS	
Constant	21.12	2.31	R^2	0.90
Income	0.68	3.24	t for rho	19.27
Price	-4.35	-2.19	DW	1.29
D1 (1953-63)	19.26	2.12		
D2 (1964-75)	-17.95	-1.98		
D3 (1976-79)	-18.24	-1.99		
D1P	4.24	2.12		
D2P	4.01	2.00		
D3P	4.08	2.02		
ELASTICITIES				
At means	Income	0.68		
	Price	-0.34		
At current values	Income	0.68		
	Price	-0.27		

TABLE B IV

EXPORTS OF TEXTILES, WEARING APPAREL AND LEATHER INDUSTRY. STATIC LINEAR MODEL

COEFFICIENTS		T-STAT.	OTHER STATISTICS	
Constant	6.14	4.06	R^2	0.86
Income	0.29	1.1	DW	1.85
Price	-0.67	-2.26		
EP (1959-71)	-3.29	-2.08		
LIB (1976-79)	-4.17	-3.09		
EPP	0.76	1.85		
LIBP	1.2	3.32		
ELASTICITIES				
At means	Income	0.29		
	Price *	0.10		
At current values	Income	0.29		
	Price *	0.54		
*not significant				

TABLE B V

IMPORTS OF TEXTILES, WEARING APPAREL AND LEATHER INDUSTRY. STATIC LINEAR MODEL

COEFFICIENTS		T-STAT.	OTHER STATISTICS	
Constant	751.66	9.07	R^2	0.87
Income	-1.29	-4.36	DW	1.71
Price	-3.95	-5.28		
D1 (1953-55)	-299.23	-5.6		
D2 (1956-78)	-509.16	-6.32		
D2P	3.62	4.07		
ELASTICITIES				
At means	Income	-0.80		
	Price	-0.19		
At current values	Income	-0.61		
	Price	-0.08		

TABLE B VI

DOMESTIC APPARENT CONSUMPTION OF TEXTILES, WEARING APPAREL AND LEATHER INDUSTRY. PARTIAL ADJUSTMENT MODEL-LINEAR

REDUCED FORM COEFFICIENTS		T-STAT.	OTHER STATISTICS	
Constant	14.39	3.16	R^2	0.97
Lagged endogenous	0.66	7.22	DH	1.47
Income	0.22	3.96		
D1P (1959-63)	-0.06	-44.00		
STRUCTURAL COEFFICIENTS		H-T STRUCTURAL PARAMETERS		
Constant	42.71	Constant	8.65	
Income	0.65	State	2.41	
Price	-0.19	Income	0.13	
Adjustment	0.34	Price	-0.04	
ELASTICITIES				
		Short term	Medium term	Long term
At means	Income	0.13	0.21	0.62
	Price	-0.05	-0.08	-0.24
At current values	Income	0.14	0.23	0.67
	Price	-0.03	-0.05	-0.14

TABLE B VII EXPORTS OF WOOD AND WOOD PRODUCTS, INCLUDING FURNITURE. PARTIAL ADJUSTMENT MODEL-LOG.				
REDUCED FORM COEFFICIENTS		T-STAT.	OTHER STATISTICS	
Constant	0.58	7.73	R^2	0.99
Income	1.34	7.84	t for rho	-3.42
Price	-0.75	-7.85	DW	2.22
EP (1963-70)	-0.95	-6.44		
STRUCTURAL COEFFICIENTS		H-T STRUCTURAL PARAMETERS		
Income	3.16	State	1.46	
Price	-1.77	Income	0.85	
EP	-2.24	Price	-0.48	
Adjustment	0.42			
ELASTICITIES				
	Short term	Medium term	Long term	
Income	0.85	1.34	3.16	
Price	-0.48	-0.75	-1.77	

TABLE B VIII

IMPORTS OF WOOD AND WOOD PRODUCTS, INCLUDING FURNITURE. STATIC LINEAR MODEL

COEFFICIENTS		T-STAT.	OTHER STATISTICS	
Constant	273.8	8.85	R^2	0.88
D1 (1952-57)	-56.39	-1.56	DW	2.06
D2 (1958-70)	-107.1	-3.06		
D3 (1959-71)	-200.7	-5.72		
D2P	-0.91	-2.81		
D4 (1978-79)	-419.9	-5.26		
D4P	1.34	8.6		
ELASTICITIES				
At means	Price (1958-70)		-0.32	
	Price (1978-79)		0	
At current values	Price (1958-70)		0	
	Price (1978-79)		1.21	

TABLE B IX

DOMESTIC APPARENT CONSUMPTION OF WOOD AND WOOD PRODUCTS, INCLUDING FURNITURE. STATIC LOGARITHMIC MODEL

COEFFICIENTS		T-STAT.	OTHER STATISTICS	
Constant	3.04	20.31	R^2	0.96
Income	0.33	9.89	t for rho	1.56
D1 (1950-53)	6.51	2.82	DW	1.85
D2 (1978-79)	-0.36	-2.82		
D1P	-1.49	-2.88		
D2P	0.2	3.32		
ELASTICITIES				
At means	Income	0.33		
	Price	0		
At current values	Income	0.33		
	Price	0.20		

TABLE B X EXPORTS OF PULP, PAPER AND PAPER PRODUCTS, PRINTING AND PUBLISHING. PARTIAL ADJUSTMENT MODEL-LOG				
REDUCED FORM COEFFICIENTS		T-STAT.	OTHER STATISTICS	
Constant	-11.52	-6.75	R^2	0.96
Lagged end.	0.22	2.30	t for rho	-0.28
Income	3.10	6.99	DW	1.92
EP (1963-74)	6.11	7.64		
EPP	-1.10	-6.38		
STRUCTURAL COEFFICIENTS		H-T STRUCTURAL PARAMETERS		
Constant	14.72	Constant	-9.47	
Income	3.97	State	0.71	
EP	7.80	Income	2.55	
EPP	-1.41	EP	5.02	
Adjustment	0.78	EPP	-0.91	
ELASTICITIES				
		Short term	Medium term	Long term
Income		2.56	3.11	3.97
Price (1963-74)		-0.91	-1.10	-1.41

TABLE B XI
EXPORTS OF PULP, PAPER AND PRODUCTS, PRINTING AND PUBLISHING.
PARTIAL ADJUSTMENT MODEL-LOG

REDUCED FORM COEFFICIENTS		T-STAT.	OTHER STATISTICS	
Constant	0.30	1.90	R^2	0.99
Income	0.60	4.56	t for rho	-4.44
D1 (1950-54)	-6.14	-4.22	DW	1.28
D2 (1955-66)	4.68	1.99		
D3 (1967-76)	10.49	4.07		
D1P	1.42	4.15		
D2P	-1.00	-1.82		
D3P	-2.19	-4.04		

STRUCTURAL COEFFICIENTS		H-T STRUCTURAL PARAMETERS		
Income	0.86	Income	0.46	
D1	-8.79	State	0.93	
D2	6.70	D1	-4.72	
D3	15.02	D2	3.60	
D1P	2.03	D3	8.06	
D2P	-1.43	D1P	1.09	
D3P	-3.14	D2P	-0.77	
Adjustment	0.70	D3P	-1.69	

ELASTICITIES

	Short term	Medium term	Long term
Income	0.46	0.60	0.86
Price (1963-74)	1.09	1.42	2.03
Price (1955-66)	-0.77	-1.00	-1.43
Price (1967-76)	-1.69	-2.19	-3 14

TABLE B XII

DOMESTIC APPARENT CONSUMPTION OF PULP, PAPER, PAPER PRODUCTS, PRINTING AND PUBLISHING STATIC LINEAR MODEL

COEFFICIENTS		T-STAT.	OTHER STATISTICS	
Income	0.84	37.2	R^2	0.99
Price	4.63	58.64	t for rho	1.56
D2 (1954)	-601.4	-56.77	DW	1.82
D4 (1961)	-8.61	-2.11		
D1P (1950-51)	-4.69	-56.26		
D3P (1955-60)	-4.6	-59.3		
D5P (1962-67)	-4.51	-59.74		
D6P (1968-69)	-4.47	-53.58		
D7P (1970-77)	-4.48	-53.89		
D8P (1978-79)	-4.32	-6.42		
ELASTICITIES				
At means	Income	0.85		
	Price *	0.09		
At current values	Income	0.99		
	Price	0.01		

* not significant

TABLE B XIII
IMPORTS OF CHEMICALS, PETROCHEMICALS, RUBBER AND PLASTICS
PARTIAL ADJUSTMENT MODEL-LINEAR

REDUCED FORM COEFFICIENTS		T-STAT.	OTHER STATISTICS	
Constant	205.2	3.07	R^2	0.88
Lagged endogenous	0.25	1.93	t for rho	-4.16
Income	0.99	2.42	DW	1.56
Price	-2.29	-4.71		
D1 (1950-66)	-159.80	-2.97		
D2 (1967-74)	-279.60	-2.85		
D1P	1.47	2.89		
D2P	2.81	3.10		

STRUCTURAL COEFFICIENTS		H-T STRUCTURAL PARAMETERS		
Constant	275.4	Constant	163.60	
Income	1.34	State	0.81	
Price	-3.07	Income	0.80	
D1	-214.30	Price	-1.82	
D2	-375.20	D1	-127.3	
D1P	1.97	D2	-222.9	
D2P	3.77	D1P	1.17	
Adjustment	0.75	D2P	2.24	

ELASTICITIES

		Short term	Medium term	Long term
At means	Income	0.64	0.81	1.08
	Price	-0.93	-0.58	-1.17
At current values	Income	0.48	0.61	0.81
	Price	-0.93	-1.16	-1.56

TABLE B XIV

EXPORTS OF CHEMICALS, PETROCHEMICALS, RUBBER AND PLASTICS. PARTIAL ADJUSTMENT MODEL-LINEAR

REDUCED FORM COEFFICIENTS		T-STAT.	OTHER STATISTICS	
Lagged endogenous	0.56	6.22	R^2	0.95
Income	0.44	4.96	DH	1.29
LIB (1977-79)	727.8	12.23		
LIBP	-7.77	-10.44		
STRUCTURAL COEFFICIENTS		H-T STRUCTURAL PARAMETERS		
Income	0.99	State	1.44	
LIB	1663	Income	0.28	
LIBP	-17.76	LIB	465.8	
Adjustment	0.44	LIBP	-4.97	
ELASTICITIES				
		Short term	Medium term	Long term
At means	Income	0.39	0.89	0.25
At current values	Income	1.12	0.49	0.31
	Price	-8.35	-3.65	-2.34

TABLE B XIV

DOMESTIC APPARENT CONSUMPTION OF CHEMICALS, PETROCHEMICALS, RUBBER AND PLASTICS. STATIC LINEAR MODEL

COEFFICIENTS		T-STAT.	OTHER STATISTICS	
Income	3.11	8.36	R^2	0.99
Price	-4.91	-5.49	t for rho	-1.89
D1 (1950-51)	-7.61	-2.32	DW	2.20
D2 (1952-54)	-4.99	-2.95		
D3 (1955-60)	-11.67	-6.75		
D4 (1961-62)	-10.04	-3.96		
D5 (1963-69)	-10.79	-5.07		
D6 (1970-75)	-10.70	-5.37		
D7 (1976-79)	-10.44	-5.53		
D1P	4.66	4.13		
D2P	4.02	4.56		
D3P	5.46	5.86		
D4P	4.97	4.64		
D5P	5.16	5.96		
D6P	5.12	5.38		
D7P	5.24	5.33		
ELASTICITIES				
At means	Income	3.11		
	Price *	0.25		
At current values	Income	3.11		
	Price *	0.33		

* not significant

TABLE B XVI

EXPORTS OF NON-METALLIC MINERAL PRODUCTS. STATIC LINEAR MODEL

COEFFICIENTS		T-STAT.	OTHER STATISTICS	
Constant	-134.9	-1.84	R^2	0.92
Income	2.64	2.90	t for rho	5.90
EP (1966-76)	323.7	4.71	DW	1.37
LIB (1977-79)	2035.00	13.00		
EPP	-2.91	-6.05		
LIBP	-18.77	-11.86		
ELASTICITIES				
At means	Income	1.48		
	Price	-2.34		
At current values	Income	0.85		
	Price	-2.00		

TABLE B XVII

IMPORTS OF NON-METALLIC MINERAL PRODUCTS.
FLOW ADJUSTMENT MODEL-LOG.

REDUCED FORM COEFFICIENTS		T-STAT.	OTHER STATISTICS	
Lagged endogenous	0.80	7.19	R^2	0.99
Income	0.16	1.77	t for rho	-2.53
D2 (1962-66)	43.43	6.75	DW	2.16
D2P	-10.28	-6.57		
STRUCTURAL COEFFICIENTS				
Income	1.60			
D2	216.70			
D2P	102.60			
Adjustment	0.22			
ELASTICITIES				
	Short term	Long term		
Income	0.36	1.60		
Price *	-22.85	-102.50		

* Imports during then 1962-66 period were highly unusual. The value of the price elasticity outside this period is zero

TABLE B XVIII

DOMESTIC APPARENT CONSUMPTION OF NON-METALLIC MINERAL PRODUCTS. PARTIAL ADJUSTMENT MODEL-LOG.

REDUCED FORM COEFFICIENTS		T-STAT.	OTHER STATISTICS	
Lagged endogenous	0.70	5.14	R^2	0.99
Income	0.31	2.31	t for rho	2.41
			DW	1.80
STRUCTURAL COEFFICIENTS		H-T STRUCTURAL PARAMETERS		
Income	1.03	State	1.64	
Adjustment	0.30	Income	0.18	
ELASTICITIES				
	Short term	Medium term	Long term	
Income	0.18	0.31	1.03	

TABLE B XIX
EXPORTS OF BASIC METAL INDUSTRIES
PARTIAL ADJUSTMENT MODEL-LINEAR

REDUCED FORM COEFFICIENTS		T-STAT.	OTHER STATISTICS	
Constant	-94.40	-3.65	R^2	0.95
Lagged endogenous	0.73	6.81	t for rho	-4.64
Income	1.75	4.09	DW	2.24
Price	0.05	1.46		
EP (1962-74)	62.04	2.96		
LIB (1976-79)	172.20	3.36		
EPP	-0.91	-4.53		
LIBP	-1.54	-6.51		
STRUCTURAL COEFFICIENTS		H-T STRUCTURAL PARAMETERS		
Constant	-343.4	Constant	-54.72	
Income	6.36	State	1.68	
Price	0.19	Income	1.01	
EP	225.7	Price	0.03	
LIB	626.5	EP	35.96	
EPP	-3.31	LIB	99.83	
LIBP	-5.62	EPP	-0.53	
Adjustment	0.27	LIBP	-0.89	
ELASTICITIES				
		Short term	Medium term	Long term
At means	Income	1.03	1.78	6.48
	Price	-10.90	-1.87	-6.88
At current values	Income	0.44	0.75	2.76
	Price	-0.17	-0.30	-1.09

TABLE B XX

IMPORTS OF BASIC METAL INDUSTRIES.
STATIC LINEAR MODEL

COEFFICIENTS		T-STAT.	OTHER STATISTICS	
Income	1.00	14.16	R^2	0.88
D1 (1950-54)	-34.72	-1.87	t for rho	3.35
D2 (1955-56)	163.50	2.00	DW	1.92
D1P	1.05	2.36		
D2P	-3.90	-1.97		
D3 (1976-79)	-102.3	-4.09		
D3P	0.88	1.73		
ELASTICITIES				
At means	Income	1.11		
	Price	0		
At current values	Income	1.99		
	Price	0.53		

TABLE B XXI

DOMESTIC APPARENT CONSUMPTION OF BASIC METAL INDUSTRIES. STATIC LOGARITHMIC MODEL

COEFFICIENTS		T-STAT.	OTHER STATISTICS	
Income	1.39	15.22	R^2	0.98
D1 (1950-61)	-2.11	-4.21	DW	2.13
D2 (1962-64)	-1.89	-4.99		
D3 (1965-75)	-2.11	-3.98		
D4 (1976-79)	-2.09	-4.71		
D1P	0.13	2.19		
D3P	0.07	1.42		
ELASTICITIES				
At means	Income	1.39		
	Price *	0.07		
At current values	Income	1.39		
	Price *	0		
* not significant				

TABLE B XXII

EXPORTS OF METAL PRODUCTS, MACHINERY AND EQUIPMENT. PARTIAL ADJUSTMENT MODEL-LINEAR

REDUCED FORM COEFFICIENTS		T-STAT.	OTHER STATISTICS	
Constant	-9.83	-6.55	R^2	0.97
Lagged endogenous	0.24	2.83	DH	0.67
Income	3.39	8.88		
Price	-1.06	-6.40		
STRUCTURAL COEFFICIENTS		H-T STRUCTURAL PARAMETERS		
Constant	-12.99	Constant	-7.91	
Income	5.20	State	0.49	
Price	-1.40	Income	5.20	
Adjustment	0.76	Price	-1.40	
ELASTICITIES				
		Short term	Medium term	Long term
Income		5.29	3.93	5.20
Price		-1.43	-1.06	-1.43

TABLE B XXIII

IMPORTS OF METAL PRODUCTS, MACHINERY AND EQUIPMENT. STATIC LINEAR MODEL

COEFFICIENTS		T-STAT.	OTHER STATISTICS	
Income	1.12	8.15	R^2	0.77
D1 (1950-55)	-364.39	-1.97	t for rho	4.82
D3 (1960-63)	51.02	2.89	DW	1.91
D1P	16.70	2.11		
ELASTICITIES				
At means and at current values	Price		0.89	
	Income		0	

TABLE B XXIV

IMPORTS OF METAL PRODUCTS, MACHINERY AND EQUIPMENT. STATIC LINEAR MODEL

COEFFICIENTS		T-STAT.	OTHER STATISTICS	
Income	0.99	164.60	R^2	0.99
D2 (1952-53)	2.61	1.73	t for rho	4.72
D2P	-0.67	-1.82	DW	1.43
ELASTICITIES				
At means and at current values	Price		0.99	
	Income		0	

APPENDIX C

APPENDIX C

EMPIRICAL ESTIMATION OF POLICY EFFECTS

The empirical estimation of policy effects of Chapter III necessitates knowledge of the price elasticities of input demand functions for tradable and non-tradable inputs. The Argentinean database does not permit the estimation of these elasticities directly due to the assumption of equal price for tradable and non-tradable inputs (see Appendix A). We present an alternative derivation of policy effects which does not require knowledge of these price elasticities. In their place, the value of the price elasticity for the product is required.

Under constant returns to scale and competitive equilibrium, the own- and cross-price elasticities of the demand for factor inputs are linearly dependant on the price elasticity of the product and the elasticity of substitution between factors of production, as follows, [87]

$$E_{TT} = S_T E_D - (1 - S_T) s \tag{C1}$$

$$E_{NT} = S_T (E_D + s) \tag{C2}$$

where E_D is the price elasticity of the demand for the final product, and s the elasticity of substitution between tradable and non-tradable inputs and other terms were defined in Chapter III. The price elasticity of demand for domestically-produced goods is not known, but it can be approximated by the price elasticity of demand for domestic

[87] Layard and Walters (1978), p. 270.

apparent consumption with the proviso that either the export demand elasticity is similar to the domestic elasticity or, alternatively, exports are a small proportion of domestic output. Both of these cases are confirmed by our data.

Substituting equations C1 and C2 in equation (92) of Chapter III yields,

$$\frac{\partial f(\overset{o}{x})}{\partial P^M} = - f(\overset{o}{x}) \frac{Z_{TM}}{P^T} E_{DP} (S_T^2 + S_T S_N) \qquad (C3)$$

Replacing equation (C3) into equation (95) yields the new policy effect equation (95')

$$\frac{\partial \overset{o}{A}}{\partial P^M} = - \frac{\overset{o}{Q}}{Q} \left[E_{DP} D \left(\frac{1}{P^M} - \frac{C_{QM}}{P^Q} \right) + E_{XP} \frac{X}{P^Q} C_{QM} - E_{MP} M \left(\frac{1}{P^M} - \frac{C_{QM}}{P^Q} \right) \right] + \overset{o}{f}(x) \frac{Z_{TM}}{P^T} E_{DP} (S_T^2 + S_T S_N) \qquad (95^*)$$

The export promotion trade policy effect equation (114) can also be written in terms of equations (C1) and (C2), as follows,

$$\frac{\partial \overset{o}{A}}{\partial P^X} = - \frac{\overset{o}{Q}}{Q} \frac{X}{P^X} E_{XP} + \frac{\overset{o}{f}(x)}{P^T} Z_{TX} E_{DP} (S_T^2 + S_T S_N) \qquad (114^*)$$

As indicated in Appendix A, lack of Argentinean intermediate input price data implies the need to assume that the price of industry output coincides with the price of intermediate inputs and with the price of value-added. In addition, the production function of Chapter III defined tradable inputs as intermediate inputs. This means that in the case of Argentinean data, the price of tradable inputs is identical to the price output and value-added.

In addition to the above data constraints, the policy effect equations make the value of the policy effect dependent on the absolute value of prices. Given large inflationary price changes in the Argentine economy during the period of analysis, the interpretation of policy effect at each data point would need to be related to the price level in order to obtain a more precise assessment of the effects. It would be more useful to obtain policy effects that do not depend on the absolute level of prices in order to derive a general conclusion that could be applicable to all periods of time and that would permit a comparison of policy effects between these periods. This can be achieved by selecting one price as a numeraire price. We select the price of output as the numeraire and divide all terms by this price. The policy effect equations, taking into account the equality between the prices of output and intermediate inputs, and the price of output as a numeraire, are:

$$\frac{\partial \overset{o}{A}}{\partial P^M} = - \frac{\overset{o}{Q}}{Q} \left[E_{DP}\, D \left(\frac{P^Q}{P^M} - C_{QM} \right) + E_{XP}\, X \;\; C_{QM} - E_{MP}\, M \left(\frac{P^Q}{P^M} - C_{QM} \right) \right] + \overset{o}{f}(x)\, Z_{TM}\, E_{DP} \left(S_T^2 + S_T S_N \right) \qquad (95^{**})$$

$$\frac{\partial \overset{o}{A}}{\partial P^X} = - \frac{\overset{o}{Q}}{Q} \frac{P^Q}{P^X}\, X\, E_{XP} + \overset{o}{f}(x)\;\; Z_{TX}\; E_{DP} \left(S_T^2 + S_T \;\; S_N \right) \qquad (114^{**})$$

These equations are employed in the empirical estimation of Argentinean trade policy effects presented in Chapter IV.

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