INFORMATION TO USERS

The most advanced technology has been used to photograph and reproduce this manuscript from the microfilm master. UMI films the text directly from the original or copy submitted. Thus, some thesis and dissertation copies are in typewriter face, while others may be from any type of computer printer.

The quality of this reproduction is dependent upon the quality of the copy submitted. Broken or indistinct print, colored or poor quality illustrations and photographs, print bleedthrough, substandard margins, and improper alignment can adversely affect reproduction.

In the unlikely event that the author did not send UMI a complete manuscript and there are missing pages, these will be noted. Also, if unauthorized copyright material had to be removed, a note will indicate the deletion.

Oversize materials (e.g., maps, drawings, charts) are reproduced by sectioning the original, beginning at the upper left-hand corner and continuing from left to right in equal sections with small overlaps. Each original is also photographed in one exposure and is included in reduced form at the back of the book. These are also available as one exposure on a standard 35mm slide or as a 17" x 23" black and white photographic print for an additional charge.

Photographs included in the original manuscript have been reproduced xerographically in this copy. Higher quality 6" x 9" black and white photographic prints are available for any photographs or illustrations appearing in this copy for an additional charge. Contact UMI directly to order.

U·M·I

University Microfilms International
A Bell & Howell Information Company
300 North Zeeb Road, Ann Arbor, MI 48106-1346 USA
313/761-4700 800/521-0600

Order Number 9001634

Determinants of the level of manufactured exports of developing countries

Grobar, Lisa Morris, Ph.D.

The University of Michigan, 1989

U·M·I
300 N. Zeeb Rd.
Ann Arbor, MI 48106

DETERMINANTS OF THE LEVEL OF MANUFACTURED EXPORTS OF DEVELOPING COUNTRIES

by

Lisa Morris Grobar

A dissertation submitted in partial fulfillment
of the requirements for the degree of
Doctor of Philosophy
(Economics)
in The University of Michigan
1989

Doctoral Committee:

Assistant Professor Aquiles A. Almansi, Chairman
Associate Professor William G. Moller
Professor Richard C. Porter
Professor Robert M. Stern



RULES REGARDING THE USE OF

MICROFILMED DISSERTATIONS

Microfilmed or bound copies of doctoral dissertations submitted to The University of Michigan and made available through University Microfilms International or The University of Michigan are open for inspection, but they are to be used only with due regard for the rights of the author. Extensive copying of the dissertation or publication of material in excess of standard copyright limits, whether or not the dissertation has been copyrighted, must have been approved by the author as well as by the Dean of the Graduate School. Proper credit must be given to the author if any material from the dissertation is used in subsequent written or published work.

This dissertation is dedicated to my parents, Frank and Geraldine Morris, and to my husband, George Grobar.

ACKNOWLEDGMENTS

I would like to thank my committee members, Professors Aquiles A. Almansi, Richard C. Porter, Robert M. Stern and William G. Moller, for the many hours they have spent helping me to develop and write this dissertation. I would also like to thank members of the Seminar in International Economics, and of of the Seminar in Economic Development at The University of Michigan, for helping me to formulate the ideas in this dissertation, and for giving me helpful comments, many of which are embodied in this text.

TABLE OF CONTENTS

DEDICATION ii

ACKNOWLEDGMENTS iii

LIST OF FIGURES vi

LIST OF APPENDICES vii

INTRODUCTION 1

CHAPTER

1. BREAKING INTO FOREIGN MARKETS: THE DIFFICULTIES FACING EXPORTING FIRMS IN DEVELOPING COUNTRIES . 6

    1. Characteristics of the LDC Exporter's Environment and the Role of the Foreign Buyer
    2. The Optimal Level of Importer's Buying Expenditures
    3. Export Promotion Policies in East Asia
    4. The Infant-Export-Industry Subsidy

2. AN ARGUMENT FOR THE USE OF INFANT-EXPORT-INDUSTRY SUBSIDIES BY DEVELOPING COUNTRIES . 17

    1. The Production Possibilities Frontier
    2. Perception of "Break-in" Costs: Firms vs. a Social Planner
    3. Competitive Equilibrium
    4. Firms' Aggregate Export Supply Function
    5. The Social Planner's Optimal Export Supply Function
    6. The Problem of Time-Consistency and the Optimal Export Promotion Policy
    7. Simulation Analysis
    8. Relevance of the Model: the Experience of East Asia
    9. GATT Restrictions on the Use of Export Subsidies by Developing Countries

3. THE EFFECT OF REAL EXCHANGE RATE UNCERTAINTY ON THE MANUFACTURED EXPORTS OF LESS DEVELOPED COUNTRIES 48

1. Introduction
2. The Sources of Uncertainty for Exporting Firms in Developing Countries
3. Export Contracts and the Exporter/ Foreign Buyer Relationship
4. A Model of Exporting and Real Exchange Rate Uncertainty
5. The Effect of Uncertainty on Exporting Behavior
6. Changes in the Relative Cost of Spot Market Production
7. Contingent Contracts
8. Forward Exchange Contracts
9. Simulation Analysis
10. Conclusion

4. EMPIRICAL EVIDENCE OF THE RELATIONSHIP BETWEEN REAL EXCHANGE RATE UNCERTAINTY AND TRADE . . 77

1. Introduction
2. Method
3. Previous Related Empirical Work
4. Empirical Evidence
5. Conclusion

APPENDICES 115

BIBLIOGRAPHY 131

LIST OF FIGURES

Figure

2.1 Exporting Activity and Subsidies . . . 41

3.1 Uncertainty and Exporting Activity . . . 72

LIST OF APPENDICES

Appendix

A. Solving Difference Equations 116

B. Chapter 2 Simulations: Sensitivity Analysis . 118

C. Simulation Analysis for Uncertainty Model: Sensitivity Analysis 122

D. Countries in the Sample and their Major Trading Partners for 1960-81 124

E. Regressions Results: Two-Stage Weighted Least Squares 127

INTRODUCTION

Recent development literature favors export-promotion over import-substitution as a strategy for generating rapid economic growth in developing countries. The current enthusiasm for export-oriented growth strategies reflects the relative success that a number of export-oriented countries have achieved in reaching development goals. Specifically, the East Asian countries of Hong Kong, South Korea, Singapore and Taiwan have experienced very high levels of economic growth in the past twenty years, and many economists attribute this to the export-oriented growth strategies they followed. In addition, these countries have also been able to generate rapid rates of growth in employment creation, and have been able to maintain or improve equity in income distribution.

A number of empirical studies have found a strong empirical association between export-orientation and economic growth. Studies by Michalopolous and Jay (1973), Tyler (1981), Feder (1983), and Balassa (1978, 1985), Krueger (1978), and Lal and Rajapatirana (1987), have all pointed to export-orientation as an important variable in explaining inter-country differentials in growth rates.

While these results do not prove the existence of a causal link between export-orientation and higher economic growth many economists have interpreted them in this way. For example, Balassa (1985) states that his results "... further indicate the possibilities for low-income countries to accelerate their economic growth through the application of modern technology in an appropriate policy framework as well as the advantages of relying on manufactured exports" (p.34).

This view has become increasingly popular among trade and development economists, as is evidenced by the following statement by Krueger (1985) concerning the experience of the East Asian countries: "there is, by now, fairly general agreement that the export-oriented strategy and export growth were integrally associated with the achievement of high overall rates of growth" (p.197).

Krueger cites a number of reasons why export-oriented countries might be expected to grow faster than countries following import-substitution strategies. First, she argues that export orientation allows countries to take better advantage of the technological opportunities that are available to them. Since domestic markets are small in many LDCs, only firms that export can operate manufacturing facilities of efficient size and take advantage of economies of scale. Export-oriented countries can specialize in the production of labor-intensive goods which better suit their factor endowments, while import-substituting countries must

produce the whole range of manufactured goods. In addition, since domestic markets are small, import-substituting firms often enjoy monopoly power and are not forced to be as efficient as exporting firms, that must face international competition.

Krueger also argues that an export-oriented strategy is superior to an import-substitution strategy because it relies on incentives rather than controls. Import-substitution controls often fight market pressures where incentives work with the market. Also, in export-oriented countries, the stop-and-go macro-policies associated with periodic foreign exchange crises are largely avoided.

The most influential development institutions have largely accepted these conclusions. The 1986 World Development Report of the World Bank states that:

> There is a strong link between an economy's international trade and exchange regime and the flexibility required to maintain growth. A competitive exchange rate and a fairly neutral trade and tax system tend to limit excessive foreign borrowing and encourage exports and efficient import-substitution. Countries which sell on world markets can exploit economies of specialization, size and scale. This helps to create efficient producers who are competitive both at home and abroad (p.41).

Developing countries are now being encouraged to "open up" their economies by reducing tariffs and other trade barriers and allowing their exchange rate to better reflect market conditions. By eliminating import barriers and improving export incentives, it is hoped that other low income countries might experience the same kind of rapid

growth that brought the East Asian countries into the ranks of the "newly industrializing countries."

While there is no doubt that heavily protected domestic markets, overvalued exchange rates and other conditions associated with "inward-oriented" growth strategies discourage exporting activity, it is not clear that these factors alone explain the reluctance of manufacturing firms in many LDCs to enter the export markets.

It is the purpose of this dissertation to examine this question. The chapters that follow will focus on the factors determining the success of LDC manufactured goods exporters. The first chapter describes aspects of the economic environment in which LDC manufactured export producers operate, and the difficulties they face in breaking into export markets. The export-promotion measures (including subsidies) used by East Asian countries in their efforts to expand exports in the 1960s will also be discussed.

The second chapter presents an argument for the use of such export-promoting subsidies by LDC governments. This argument is based on a model that incorporates the aspects of the environment in which LDC exporters operate that were discussed in the first chapter. Potential problems in implementing such subsidies will also be discussed. The theoretical conclusions will be examined in light of the recent economic history of the East Asian "super-exporters".

The third chapter is concerned with the effect of real exchange rate uncertainty on LDC firms producing manufactured exports. It will be argued that in developing countries, a high degree of real exchange rate uncertainty will reduce exporting activity by manufacturing firms. And it will be shown in the final chapter, that this hypothesis is consistent with cross-sectional data on manufactured exports and real exchange rate uncertainty.

CHAPTER 1

BREAKING INTO FOREIGN MARKETS: THE DIFFICULTIES FACING EXPORTING FIRMS IN DEVELOPING COUNTRIES

1. Characteristics of the LDC exporter's environment and the role of the foreign buyer

In order to understand the factors that are important in determining the success of LDC manufactured exports it is first necessary to look more closely at the production and exporting processes themselves. Listed below are some important characteristics of the environment in which LDC manufacturing exporters function.

1. Manufacturing firms in LDCs face obstacles to entering foreign export markets that are costly to overcome.

Firms face these "break-in" costs for a number of reasons. Because manufactured goods are highly differentiated, exported goods may be required to meet specifications that are different from those produced for sale at home, and so the production process may have to be changed. In some industries, such as textiles or clothing, consumer tastes may vary from country to country and exporters must study these differences. A prospective

exporter must gain knowledge of ports and methods of transport and customs. And finally, the exporter must market the good abroad, and this involves advertising, sending sales personnel abroad and other costs.

2. Foreign buyers can reduce these break-in costs for the exporting firms.

To understand the role that foreign buyers (importers, foreign wholesalers and retailers, foreign trading companies, etc.) can potentially play in the development of LDC manufactured exports, it is revealing to look at the experience of East Asia. In the case of Korea, Rhee, Ross-Larson and Pursell (1984) found that foreign buyers played an important role in the development of that country's manufactured exports.[1]

They found that for a firm considering entry into foreign markets, the costs involved in terms of selecting a product, producing the product to foreign specifications and marketing the product abroad were substantial and in some cases deterred would-be entrants from exporting. However, they also found that, in the case of Korea, buyers from abroad were willing to take over many of these tasks under the right conditions. In addition, buyers were often found to provide exporters with technical information including the provision of blue-prints and specifications, information on production techniques and technical specifications of competing products, and feedback on design and quality.

In a survey of 113 Korean exporting firms, Rhee, Ross-Larson and Pursell found that almost half of the firms said they had directly benefited from technical information that foreign buyers provided, and that direct contacts with foreign buyers were important for the adaptation of product design and styling to market requirements, and for the development of new products or product varieties.[2] In addition, three-quarters of the firms said foreign buyers influenced the design, style, packaging or technical specifications of the products exported, two-fifths said contacts with foreign buyers were important for improved techniques in quality control and production methods, and one-fifth for improved cost accounting and control.

Clearly, the establishment of direct relationships with foreign buyers can yield substantial benefits for the producers of manufactured exports from LDCs. As indicated above, foreign buyers are often willing to invest substantial resources in LDC exporters in terms of providing the kind of assistance and information described above.

3. Access to foreign buyers is easiest for firms in countries that have relatively high export levels.

In the section below, it will be demonstrated that foreign buyers, in their own effort to maximize profits, will tend to locate buying offices and to send buyers on trips to those countries that already have a fairly large export capacity. This phenomenon has been noted by Morawetz

(1978) in his study of clothing exporters in Colombia. According to Morawetz:

> ...success breeds success. Because Seoul, Taipei and Hong Kong are the garment-exporting centers of the developing world, thousands of foreign buyers and national and foreign trading companies maintain full-time purchasing offices there. In less-successful Colombia, by contrast, only one full-time foreign buying office specializing in garments was in operation in late 1978 (p. 108).

The Korean study found that foreign buyers will typically invest in business trips abroad, the establishment and maintenance of buying offices abroad, and technical production advisors in countries where they buy manufactured goods. I will refer to these kinds of expenditures with the term "buying expenditures."

Since buyer-exporter relationships can clearly benefit the exporter, LDC exporters will benefit when a foreign buyer decides to incur "buying expenditures" in their country. The following is a model of how a buyer will decide to set the optimal level of "buying expenditures" in the countries that export the good that the buyer imports.

2. The Optimal Level of Importers' Buying Expenditures

For an importing firm, production can be represented by a production function just as for any firm. The inputs to the "production" of an importer are the "buying resources" used by the firm for the purpose of purchasing goods abroad. These will include capital (in the form of buying offices abroad, plane trips for buyers, etc.) and labor (the buyers

themselves). Buying expenditures will include wages of buyers, rentals on foreign buying offices, etc. For simplicity, all buying expenditures will be referred to as R.

An importer of a manufactured good, or buyer, will make buying expenditures in some or all of the N countries that produce the good. The price obtained at home for the imported good is p, the price paid for the good in country n (in the importer's currency) is p_n, and unit transportation costs from country n are t_n, leaving unit import revenues as $(p-p_n-t_n)$.

The buying production function will also be affected by the export capacity of country n, since it will be easier for buyers to find goods of the quality and quantity required in a country where there are many firms producing those goods for export, rather than in a country where few of those goods are produced.

The buying production function can thus be described by the function:

(1.1) $$Q_n = Q_n(E_n, R_n)$$

where Q_n is the total quantity of the good purchased in country n, E_n is the export capacity of country n, and R_n is the total amount of buying expenditures in country n. The following properties of this function are assumed:

(1) $\frac{\partial Q_n}{\partial E_n} > 0$, and $\frac{\partial Q_n}{\partial R_n} > 0$.

(2) $\frac{\partial^2 Q_n}{\partial R_n^2} < 0$.

$$(3) \quad \frac{\partial^2 Q_n}{\partial R_n \, \partial E_n} > 0.$$

The first assumption reflects the idea that the total quantity of goods purchased by the importer in country n will be positively related to the amount of buying expenditures in country n, and on the export capacity of country n. Assumptions (2) and (3) imply that the marginal productivity of buying expenditures in any country n is diminishing, but is positively related to the export capacity of that country.

For example, an extra buying office in country n will be more productive, in terms of the volume of goods it can purchase, the larger the export capacity of country n. However, that office will be less productive, ceteris paribus, the greater the number of other offices the importer has located there.

The importer's profit maximization problem can then be represented by the problem:

$$(1.2) \quad \max_{R_n} \; (p-p_n-t_n)Q_n(E_n,R_n) - R_n$$

the first-order condition is:

$$(1.3) \quad Q_{nR}(\underset{(+)}{E_n}, \underset{(-)}{R_n}) = 1/(p-p_n-t_n)$$

The optimizing importer will commit resources to the N countries that produce the good in such a way that this equation will hold for each country. What this implies is that given any set of purchase and home prices and transport costs, an increase in the export capacity of any country

will cause an importer to increase buying expenditures in that country, thus maintaining an equality between $Q^n_R(E_n,R)$ and the ratio $1/(p-p_n-t_n)$.

The first-order condition also implies that any comparative static increase in p_n and t_n will reduce the optimal level of buying expenditures for country n, and an increase in p will increase the amount that the importer finds optimal to spend in every country.

This model suggests that buyers will find it in their own interest to spend more on buying in countries that already have relatively high export levels. Since foreign buyers can reduce the break-in costs for new exporters in LDCs, this implies that firms operating in countries with relatively high levels of exports will find it less costly to enter export markets than firms operating in countries with little export activity. Thus a vicious/virtuous cycle suggests itself, whereby firms in countries with very low export levels will be less likely to enter export markets than firms in countries with high export levels.

For countries with very low export levels, therefore, the switch from an import-substitution regime to export-promotion may be very difficult. A policy package composed of devaluing real exchange rates and liberalizing import restraints may not be sufficient to induce manufacturing firms to enter export markets.

3. Export Promotion Policies in East Asia

The difficulties facing exporting firms in entering into foreign markets were recognized by policy-makers in East Asia in the 1960s, when those countries were beginning to move toward outward-oriented growth strategies. For example, in Korea, a number of measures were introduced by the government to spur exports. Some of these measures, such as the rebates on taxes paid on imported inputs, were designed to neutralize the incentive structure in order to remove any bias against exporting, and to allow exporters to compete on world markets. However, many of these measures went much further than this, in that they tended to bias the incentive structure towards the export market. These included direct subsidies to exporters, low interest loans for exporting firms, exemption from corporate taxes for exporters, and other measures not afforded firms producing for the domestic market.

Of all East Asian countries, the governments of Korea and Taiwan were the most active in promoting exporting activity. The total value of these measures, expressed in terms of a percentage of gross export receipts, has been estimated at 10.7 percent for Taiwan during the years 1962-76, and 8.2 percent for Korea in 1968.[3] In addition, all four of the East Asian "super-exporters" established organizations (such as Hong Kong's Trade Development Council) to assist exporting firms with marketing their goods abroad, and with market research.

That the East Asian governments recognized the difficulties facing firms trying to break into foreign markets, and responded by introducing the measures described above probably accounts, at least in part, for the successful expansion of exports by those countries. However, the question remains as to whether the kind of export-promoting subsidies used by Taiwan and Korea can be justified on the basis of economic theory. The discussion that follows will address this question.

4. The infant-export-industry subsidy

Mayer (1984) has argued that subsidization of infant-export industries may be necessary to encourage entry into export markets. His argument rests on the assumption that foreign buyers lack information on the quality of infant-exporter goods, and can only gain complete information by consuming the good. In his paper, the price that exporters receive for their goods is a function of the level of "product familiarity" on the foreign consumer's part, which is related to past consumption of the good.

In this context, Mayer argues that an externality arises, in that each firm's efforts at developing foreign "product familiarity" benefit not only itself but all other firms trying to sell the same good in the same market. Because of this externality, he argues that infant-export

industry subsidization can be recommended as a first-best policy measure.

Implicit in Mayer's work is the assumption that product quality differs among producers from different countries - but does not differ among producers from the same country. It is on the basis of this assumption that one firm's exporting activity may benefit another's by increasing foreign consumer's "product familiarity" index.

Grossman and Horn (1986) show that when product quality differs between firms in a country, export subsidies will lower a country's welfare by encouraging the entry of lower-quality producers. Therefore, Mayer's argument for a first-best export subsidy for infant-exporters rests on the rather unrealistic assumption that product quality differs among producers from different countries, but does not differ among producers from the same country.

The argument that will be presented in the next chapter will justify the use of an infant-export-industry subsidy in the context of a model where foreign buyers have perfect information concerning product quality (or one can also think of it as a model where all firms produce the same quality). This argument will be based on the above discussion of the role of the foreign buyer in trade with LDC manufactured export producers.

Notes to Chapter 1

1. The Republic of Korea, or South Korea, will be referred to in this dissertation as Korea.

2. Rhee, Ross-Larson, and Pursell, p.129.

3. Scitovsky, p. 160.

CHAPTER 2

AN ARGUMENT FOR THE USE OF INFANT-EXPORT-INDUSTRY SUBSIDIES BY DEVELOPING COUNTRIES

This chapter will present a model of developing country exporting behavior based on the description of the problems and conditions faced by exporting firms in developing countries discussed in the previous chapter. The model will be used to present an argument for the use of infant-export-industry subsidies by developing countries, and will also be used to analyze potential problems that would be faced by a government in implementing such subsidies. The relevance of the model and its implications will be explored in the light of the recent economic history of East Asia.

1. The Production Possibilities Frontier

The previous chapter outlined some of the important characteristics of an LDC exporting firm's environment. One of these is that breaking into new export markets is costly for firms. This would imply that the production possibilities frontier for a developing country that produces home goods (H_t) and manufactures for export (X_t)

will have a dynamic component. The rate at which the economy will be able to transform home goods into export goods will depend on technological production possibilities as well as "break-in" costs associated with any higher level of exporting activity. The term "break-in" costs refers to this notion that expanding export production involves an initial cost to exporting firms.

However, while firms in developing countries do face obstacles in breaking into foreign markets, it was shown above that foreign buyers can provide assistance to exporting firms that will reduce these costs. Unfortunately, though, foreign buyers themselves (as the model in the previous chapter illustrates), have an incentive to expend their resources in countries that already have a relatively high level of exports. In other words, these "break-in" costs will be smaller in magnitude, the larger a country's level of previous exports, since high exporting activity attracts foreign buyers to the country, who assist firms in entering into foreign markets.

The intertemporal production possibilities frontier for such a country will then take the following form:

$$(2.1) \qquad H_t = \left[\alpha - \beta/2X_t^2\right] - \left[\gamma/2[X_t - X_{t-1}]^2 + \delta/2X_{t-1}^2\right] ,$$

where the first term in brackets represents the typical, static transformation curve, the second term in brackets represents break-in costs, and α, γ and δ are parameters of

the function.[1] The break-in cost term has two components. The first represents the cost of adjusting the level of exports for firms as they try to break into new markets. The second term accounts for the fact that as the country's total export production rises, the break-in costs that firms face will tend to fall.

2. Perception of "Break-in" Costs: Firms vs. a Social Planner

Firms perceive break-in costs, in that, as they move to expand their exporting activity they face additional costs. These costs, to any firm, are considered as exogenous with respect to the firm's own behavior. This is because exporting firms do not perceive their actions as large enough to affect the relative attractiveness of their country to foreign buyers.

However, the model developed in Chapter One suggests that as the level of exports of a country rises, buyers will become more willing to allocate buying expenditures there, and individual firms will find that the cost to them of entering new export markets will decline with the easier, and closer access to foreign buyers.

Firms, on aggregate, face a production possibilities frontier constraint. However, since firms will not perceive the full character of break-in costs, they will not perceive

the true nature of the production possibilities frontier. From their perspective, the production constraint is:

$$(2.2) \qquad H_t = \alpha - \beta/2X_t^2 - \gamma/2[X_t - X_{t-1}]^2$$

where break-in costs are solely a function of the rate at which firms are expanding their exports. Firms will not perceive their choice of export levels today as affecting break-in costs in the future.

However, a social planner interested in maximizing social welfare would see this effect, and the true nature of the intertemporal production possibilities constraint.

3. Competitive Equilibrium

In a country producing non-traded (home) goods and manufactured traded goods, a competitive equilibrium will be achieved as consumers maximize their utility and firms maximize their profits, both subject to the relevant constraints. Demand and supply conditions, which are generated through the utility and profit maximizing behaviors described above, will determine a unique sequence of equilibrium relative prices, $\{P_t\}$, where P_t is the price of the tradable good in terms of the nontraded good.

This competitive equilibrium can be described through the solution to an optimization problem. Suppose the utility that households derive from the consumption of home and traded goods can be described by a utility function

$U(C_t, H_t)$, where C_t is home consumption of the traded good, and H_t is consumption of the nontraded good. This utility function has the usual properties, that is, $U_1(\cdot) > 0$, $U_2(\cdot) > 0$, $U_{11}(\cdot) < 0$, and $U_{22}(\cdot) < 0$, where subscripts refer to partial derivatives.

Competitive equilibrium will occur when households maximize their utility, and firms maximize profits according to their perceived constraints. These constraints include the balance-of-payments constraint and the production-possibilities constraint. It is assumed that the country can borrow and lend at the world interest rate (r^*), but that the sum of discounted net borrowings is equal to zero.[2] The optimal path for consumption and production will be described by the solution to the following problem:

$$(2.3) \quad \max \sum_{t=1}^{\inf} \{1/(1+r)^{t-1}\}\, U(C_t, H_t) \quad \text{subject to:}$$

$$1) \quad H_t = \alpha - \beta/2X_t^2 - \gamma/2[X_t - X_{t-1}]^2$$

$$2) \quad \sum_{t=1}^{\inf} \{1/(1+r^*)^{t-1}\}(X_t - C_t) = 0$$

Substituting in the first constraint, this problem can be set up as a Lagrangian of the form:

$$(2.4) \quad \max \sum_{t=1}^{\inf} \{1/(1+r)^{t-1}\}U(C_t, \alpha - \beta/2X_t^2 - \gamma/2[X_t - X_{t-1}]^2) -$$
$$\Phi \left[\sum_{t=1}^{\inf} \{1/(1+r^*)^{t-1}\}[(X_t - C_t)]\right] = 0$$

The first-order conditions for the solution of this problem are:

$$(2.5)\quad \{1/(1+r)^{t-1}\}U_{Ct} - \{1/(1+r^*)^{t-1}\}\Phi = 0,$$

for t = 1,2,...,infinity

$$(2.6)\quad \{1/(1+r)^{t-1}U_{Ht}\{-\beta X_t - \gamma(X_t - X_{t-1})\} + \{1/(1+r)^{t}\}\ U_{Ht+1}\{\gamma(X_{t+1} - X_t)\} + \{1/(1+r^*)^{t-1}\}\Phi = 0,$$

for t = 1,2,...,infinity

Rearranging these first-order conditions, an expression can be obtained that describes this economy's marginal rate of substitution in any period between home and non-traded goods.

$$(2.7)\quad \frac{U_{Ct}}{U_{Ht}} = \beta X_t + \gamma(X_t - X_{t-1}) + \frac{(1+r)\,[\beta X_t + \gamma(X_t - X_{t-1})]}{\gamma(X_{t+1} - X_t)}\ \frac{U_{Ct}}{U_{Ht+1}}$$

Note that the first term on the right hand side of the equation would correspond to the derivative of a static production possibilities frontier of the form: $H_t = \alpha - \beta X_t^2$. But because the introduction of "break-in" costs implies a dynamic production possibilities frontier that includes time as an element, the optimal marginal rate of substitution for this economy involves a more complicated expression, including production of exports and utility in future periods. This marginal rate of substitution reflects the trade-off between production and consumption of home versus traded goods, that is perceived as optimal by households and firms in this economy.

Using the first-order conditions, an expression can also be obtained for the optimal marginal rate of

substitution between tradables in any two periods. This expressions takes the form:

$$(2.8) \qquad \frac{U_{Ct}}{U_{Ct+1}} = \frac{(1+r^*)}{(1+r)}$$

The optimal consumption profile for traded goods is a function of the relationship between the world interest rate and the home discount rate. An increase in the rate at which households discount future utility relative to the world interest rate, would result in higher relative consumption of traded goods today. This consumption profile is similar to that derived by Dornbusch (1983).

The optimal intertemporal marginal rate of substitution for home goods is represented by:

$$(2.9) \qquad \frac{U_{Ht}}{U_{Ht+1}} = \frac{[1/(1+r)]\gamma(X_{t+1} - X_t)}{[\beta X_t + \gamma(X_t - X_{t-1})]} + \frac{U_{Ct}/U_{Ht+1}}{[\beta X_t + \gamma(X_t - X_{t-1})]}$$

The optimal consumption profile for home goods, like the marginal rate of substitution for home and traded goods, is a more complicated expression which is related to future as well as current production of the traded good, as well as utility derived from consumption of the traded good. Again, this expression reflects the trade-off between current and future consumption of home goods that is considered to be optimal from the point of view of households and firms, given their perceived constraints.

Any path for consumption and production of home and tradable goods that satisfies these three equations will be optimal from the point of view of firms and households. However, since firms do not perceive the full nature of the intertemporal production constraint that they face, the competitive equilibrium described above will not maximize social welfare from a social planner's point of view. A social planner would take into account the fact that break-in costs for any individual firm will be a function of the overall exporting activity of the country. The optimal equilibrium from a social planner's point of view would satisfy a slightly different optimization problem:

$$(2.10) \quad \max \sum_{t=1}^{\inf} \{1/(1+r)^{t-1}\}\, U(C_t, H_t) \quad \text{subject to:}$$

$$1) \quad H_t = \alpha - \beta/2X_t^2 - \gamma/2[X_t - X_{t-1}]^2 + \delta/2(X_{t-1})^2$$

$$2) \quad \sum_{t=1}^{\inf} \{1/(1+r^*)^{t-1}\}(X_t - C_t) = 0$$

Substituting in the first constraint, this problem can also be set up as a Lagrangian:

$$(2.11) \quad \max \sum_{t=1}^{\inf} \{1/(1+r)^{t-1}\}U(C_t,\ \alpha - \beta/2X_t^2 - \gamma/2[X_t - X_{t-1}]^2 + \delta/2X_{t-1}^2) - \Phi[\sum_{t=1}^{\inf} \{1/(1+r^*)^{t-1}\}[(X_t - C_t)] = 0$$

The first-order conditions for this problem are:

$$(2.12)\quad \{1/(1+r)^{t-1}\}U_{Ct} - \{1/(1+r^*)^{t-1}\}\Phi = 0,$$

for t = 1,2,...,infinity

$$(2.13)\quad \{1/(1+r)^{t-1}U_{Ht}\{-\beta X_t - \gamma(X_t - X_{t-1})\} +$$
$$\{1/(1+r)^{t}\}\ U_{Ht+1}\{\gamma(X_{t+1} - X_t) + \delta X_t\} +$$
$$\{1/(1+r^*)^{t-1}\}\Phi = 0,$$

for t = 1,2,...,infinity

Rearranging these first-order conditions, the three marginal rates of substitution that are optimal from the social planner's point of view can be obtained.

$$(2.14)\quad \frac{U_{Ct}}{U_{Ht}} = \beta X_t + \gamma(X_t - X_{t-1}) + \frac{(1+r)[\beta X_t + \gamma(X_t - X_{t-1})]}{\gamma(X_{t+1} - X_t) + \delta X_t}\ \frac{U_{Ct}}{U_{Ht+1}}$$

$$(2.15)\quad \frac{U_{Ct}}{U_{Ct+1}} = \frac{(1+r^*)}{(1+r)}$$

$$(2.16)\quad \frac{U_{Ht}}{U_{Ht+1}} = \frac{\gamma(X_{t+1} - X_t) + \delta X_t}{(1+r)[\beta X_t + \gamma(X_t - X_{t-1})]} + \frac{U_{Ct}}{U_{Ht+1}[\beta X_t + \gamma(X_t - X_{t-1})]}$$

It is interesting to compare the marginal rates of substitution that are perceived as optimal from the social planner's point of view to those that are perceived as optimal from firms' point of view. The social planner's

marginal rate of substitution between home and traded goods includes an additional positive term in the denominator. This implies that the social planner would perceive as optimal a lower rate of consumption of home goods relative to tradables in any time period. Since the supply of home goods will always equal the demand in equilibrium, this would imply a lower optimal rate of production of home goods relative to exportables, from the social planner's point of view.

This result is obtained because firms do not perceive their actions as affecting the attractiveness of their country to foreign buyers, who can assist them in their exporting activities. Therefore, firms do not realize the full future profitability of exporting. A social planner would take this into account in determining the optimal path of consumption and production for the economy, and the result would be a set of prices in competitive equilibrium that would lead firms and consumers to produce and consume quantities of the home and export goods so as to satisfy the equations above.

The social planner's optimal intertemporal rate of substitution for home goods has an additional positive term in the numerator. This implies that the social planner would perceive an optimal consumption profile for home goods that would involve less current consumption of home goods relative to future consumption of home goods. Again, this reflects the social planner taking into account the fact

that resources moved into the exporting sector today will result in increased profitability of exports in the future. Thus, the optimal intertemporal trade-off for the social planner for consumption of home goods involves less consumption and production of home goods in the current period relative to that of future periods.

If firms and households are choosing consumption and production levels based on the marginal rates of substitution that they perceive as optimal, the competitive equilibrium of the economy will not optimize social welfare by the social planner's criterion. Therefore, a social planner, or government, would want to consider the use policy measures designed to bring the economy closer to the optimal path of production and consumption. Since the externality occurs only on the production side of this economy, an appropriate policy response to such an externality is the use of an export subsidy. An export subsidy would increase the willingness of firms to produce for the export market, given any set of demand conditions for goods in the home market.

The remainder of this chapter will focus only on the supply side of this economy, so that the analysis that follows is a partial equilibrium analysis. An intertemporal export supply function will be computed, that describes firm behavior. Another function will be derived that will describe optimal export supply behavior from a social planner's point of view. Due to the presence of the

externality, these functions will be different. The use of export subsidies in order to influence firm's export supply will be examined.

4. Firms' Aggregate Export Supply Function

As before, it is assumed that firms do not realize the full potential profitability of exporting, since they do not realize that by exporting today, they will reduce the "break-in" costs faced by exporting firms in the future. If all firms maximize profits, their export supply function over any planning horizon will be optimal, given their constraints. Therefore, the aggregate level of exports offered by manufacturing firms will satisfy the problem:

$$(2.17) \quad V_t = \max_{X_t} \sum_{t=1}^{T} 1/(1+r)^{t-1}\{P_t X_t + H_t\}$$

subject to equation (2.2), the perceived intertemporal production possibilities constraint:

$$H_t = \alpha - \beta/2 X_t^2 - \gamma/2[X_t - X_{t-1}]^2$$

Substituting in the constraint, this is equivalent to:

$$(2.18) \quad V_t = \max_{X_t} \sum_{t=1}^{T} [1/(1+r)]^{t-1}\{P_t X_t + \alpha - \beta/2 X_t^2 - \gamma/2[X_t - X_{t-1}]^2\}, \quad \text{subject to } X(0) = X_0.$$

Differentiating with respect to X_t yields the following system of first-order conditions:

$$(2.19)\quad P_t - \beta X_t - \gamma[X_t - X_{t-1}] + \gamma/(1+r)[X_{t+1} - X_t] = 0 \quad ,$$
$$\text{for } t = 0,1,\ldots,T-1.$$
$$(2.20)\quad 1/(1+r)^T\{P_T - \beta X_T - \gamma[X_T - X_{T-1}]\} = 0.$$

This is a system of second-order linear difference equations, or Euler equations. To solve this system, two boundary conditions are needed. The first is given by the initial condition, $X(0) = X_0$. The second is the transversality condition. The transversality condition states that the limit of equation (2.20) as T goes to infinity is zero. This condition requires that $\{P_{t+i}\}$ and the solution for $\{X_{t+i}\}$ be of exponential order of less than (1+r), which ensures that the solution of difference equation (2.19) will be finite.

To solve equation (2.19), the roots of the characteristic equation must be found. The characteristic equation of (2.19) is:

$$(2.21)\quad 1 - \{\beta(1+r)/\gamma + 2 + r\}z + (1+r)z^2 = 0.$$

The roots of the difference equation are $\lambda_1=1/z_1$ and $\lambda_2=1/z_2$. In this problem, the quadratic formula yields roots that can be described by the following:

$$\lambda_1 > 1 \; ; \; 0 < \lambda_2 < 1.$$

Since there is an unstable root (λ_1), the transversality condition requires that the equation be

solved "forward." The solution of the difference equation can be written as :

$$(2.22) \quad X_t = \lambda_2 X_{t-1} + \lambda_2/\gamma \sum_{t=0}^{inf} (1/\lambda_1)^j P_{t+j}$$

Equation (2.22) describes the aggregate export supply function for firms in this economy. This equation implies that, in the short run, due to the costs involved in breaking into export markets, the supply function for firms producing manufactured goods will be a function not only of current relative export prices, but of the whole sequence of future relative export prices over the planning horizon.

Since future export prices will affect current exporting activity, an effective export promotion strategy will have to take this into account. In order to determine the appropriate set of export promotion measures, it is first necessary to compute an export supply function that is optimal from the social planner's point of view, and compare it to the function above.

5. The Social Planner's Optimal Export Supply Function

In the section above, it was assumed that resource allocation decisions with regard to determining the level of exports of a country were made by firms on the basis of profit maximization, and individuals on the basis of utility maximization. This section of the paper will look at the optimal production/consumption paths from a social planner's

point of view. The main difference in the social planner's problem is that they perceive the true nature of the production possibilities frontier. That is, the social planner is aware that as the level of exports of the country increase, break-in costs decline as foreign buyers begin to allocate increased resources in the country. The true production possibilities frontier takes the form of equation (2.1):

$$H_t = \alpha - \beta/2X_t^2 - \gamma/2[X_t - X_{t-1}]^2 + \delta/2X_{t-1}^2$$

The last term represents the idea that as the level of exports of the country increase, break-in costs decline. The problem that the social planner will solve in determining the optimal supply function for manufactured exports will be:

$$(2.23) \quad V_t = \max_{X_t} \sum_{t=1}^{T} [1/(1+r)]^{t-1}\{P_tX_t + \alpha - \beta/2X_t^2 - \gamma/2[X_t - X_{t-1}]^2 - \delta/2X_{t-1}^2\},$$

subject to $X(0)=X_0$, and the transversality condition.

The first-order conditions for this problem are:

$$(2.24) \quad P_t - \beta X_t - \gamma[X_t - X_{t-1}] + \gamma/(1+r)[X_{t+1} - X_t] + \delta/(1+r)X_{t-1} = 0 \quad , \quad \text{for } t = 0,1,\ldots,T-1.$$

$$(2.25) \quad 1/(1+r)^T\{P_T - \beta X_T - \gamma[X_T - X_{T-1}] + \delta/(1+r)X_t\} = 0.$$

The social planner will derive an optimal export supply function of the form:

$$(2.26) \qquad x_t = \lambda_2^* x_{t-1} + \lambda_2^*/\gamma \sum_{t=0}^{inf} (1/\lambda_1^*)^j \, {}_tP_{t+j}$$

It can be shown (see Appendix A) that the solution to the social planner's problem implies a higher level of exports than the solution of the representative firm's problem for any given sequence of relative export prices $\{P_{t+j}\}$, since $\lambda_1^* < \lambda_1$, and $\lambda_2^* > \lambda_2$.

6. The Problem of Time-Consistency and the Optimal Export Promotion Policy

In the section above, it was shown that the optimal export supply function from the point of view of the social planner differs actual export supply. A number of policy measures could be used to affect exporting behavior. A first-best solution would be for the government to address the distortion that leads to the externality directly, by providing firms with export marketing assistance and by helping them to contact and establish relationships with foreign buyers. In the context of the model, this would directly lower the break-in costs for firms.

However, the provision of subsidies to exporting firms would also raise exporting activity, so subsidies are another policy instrument that could be used to induce firms to export at the social planner's level. In the case where the government lacks the resources or know-how to assist

firms with export marketing, this may be the only tool available to the government to raise exporting levels.

The following is a discussion of how, in the context of the model presented in the previous section of the paper, one could solve for a sequence of unit export subsidies over some planning horizon, $\{S_t\}_{t=0}^{n}$, that would lead firms to optimal export supply. In this case, a policy-maker would want to choose $\{S_t\}_{t=0}^{n}$ to solve the following minimization problem :

$$(2.27) \qquad \min_{\{S_t\}} \sum_{t=0}^{n} b^t (X_t - X_t^*)^2$$

where b^t is a subjective discount factor (which could be one in all periods), and $(X_t - X_t^*)^2$ is a quadratic loss function relating actual exports to target export levels (X_t^*) in each period. From the model presented in the first part of this paper, we know that the supply function of firms will be of the form of equation (2.22):

$$X_t = \lambda_2 X_{t-1} + \lambda_2/\gamma \sum_{t=0}^{\inf} (1/\lambda_1)^j (P_{t+j} + {}_tS_{t+j}), \text{ with } X_{-1} \text{ given.}$$

This supply function will be the constraint for the minimization problem in equation (2.27). Given a known sequence of prices $\{P_{t+j}\}$, we can solve for the sequence $\{X_t^*\}$, where:

$$(2.28) \qquad X_t^* = \lambda_2^* X_{t-1} + \lambda_2^*/\gamma \sum_{t=0}^{\inf} (1/\lambda_1^*)^j P_{t+j},$$

with X_{-1} given.

The first-order conditions for this minimization problem are of the form:

$$(2.29)\quad d/dS_0 = 2[X(0) - X^*(0)]\lambda_2/\gamma + 2/(1+r)[X(1) - X^*(1)]\lambda_2{}^2/\gamma + 2/(1+r)^2[X(2) - X^*(2)]\lambda_2{}^3/\gamma + \ldots + 2/(1+r)^n[X(n) - X^*(n)]\lambda_2{}^{n+1}/\gamma = 0$$

$$(2.30)\quad d/dS_1 = 2[X(0) - X^*(0)]\lambda_2/(\lambda_1\gamma) + 2/(1+r)[X(1) - X^*(1)]\{\lambda_2{}^2/(\lambda_1\gamma) + \lambda_2/\gamma\} + 2/(1+r)^2[X(2) - X^*(2)]\{(\lambda_2{}^3/\lambda_1\gamma) + \lambda_2{}^2/\gamma\} + \ldots + 2/(1+r)^n[X(n) - X^*(n)]\{(\lambda_2{}^{n+1}/\lambda_1\gamma) + \lambda_2{}^n/\gamma\} = 0$$

$$\vdots$$

$$(2.31)\quad d/dS_n = 2[X(0) - X^*(0)]\lambda_2/(\lambda_1{}^n\gamma) + 2(1+r)[X(1) - X^*(1)]\{\lambda_2{}^2/(\lambda_1{}^n\gamma) + \lambda_2/(\lambda_1{}^{n-1}\gamma)\} + 2/(1+r)^2[X(2) - X^*(2)]\{\lambda_2{}^3/(\lambda_1{}^n\gamma) + \lambda_2{}^2/(\lambda_1{}^{n-1}\gamma) + \lambda_2/(\lambda_1{}^{n-2}\gamma)\} + \ldots + 2/(1+r)^n[X(n) - X^*(n)]\{\lambda_2{}^{n+1}/(\lambda_1{}^n\gamma) + \lambda_2{}^n/(\lambda_1{}^{n-1}\gamma) + \lambda_2{}^{n-1}/(\lambda_1{}^{n-2}\gamma) + \ldots + \lambda_2/\gamma\} = 0$$

Where:

$$[X(0) - X^*(0)] = \lambda_2 X_{-1} + \lambda_2/\gamma(P_0 + S_0) + \lambda_2/(\gamma\lambda_1)(P_1 + S_1) + \ldots + \lambda_2/(\gamma\lambda_1{}^n)(P_n + S_n) - \lambda_2{}^* X_{-1} - \lambda_2{}^*/\gamma P_0 - \lambda_2{}^*/(\gamma\lambda_1{}^*)P_1 - \ldots - \lambda_2{}^*/(\gamma\lambda_1{}^n)P_n.$$

$$[X(1)-X^*(1)] = \lambda_2\{\lambda_2 X_{-1} + \lambda_2/\gamma(P_0+S_0) + \lambda_2/(\gamma\lambda_1)(P_1+S_1) + \ldots + \lambda_2/(\gamma\lambda_1^n)(P_n + S_n)\} + \lambda_2/\gamma(P_1 + S_1) + \lambda_2/(\gamma\lambda_1)(P_2 + S_2) + \ldots + \lambda_2/(\gamma\lambda_1^{n-1})(P_n + S_n) + \lambda_2^*\{\lambda_2^* X_{-1} - \lambda_2^*/\gamma P_0 - \lambda_2^*/(\gamma\lambda_1^*)P_1 - \ldots - \lambda_2^*/(\gamma\lambda_1^n)P_n\} - \lambda_2^* P_1 - \lambda_2^*/(\gamma\lambda_1^*)P_2 - \ldots - \lambda_2^*/(\gamma\lambda_1^{n-1})P_n,$$ and so on.

Solving this system of n equations for n unknowns $\{S_t\}_{t=0}^{n}$, yields solutions of the following form:

$$(2.32) \quad S_t = \theta_0 X_{-1} + \theta_1 P_0 + \theta_2 P_1 + \theta_3 P_2 + \ldots + \theta_n P_n, \text{ for } t = 0,1,2,..,n$$

Therefore, one can solve for the optimal sequence of subsidies at t=0 that will minimize the loss function over a n-period planning horizon.

One issue that should be addressed when considering any policy measure to be implemented over time is whether the optimal sequence of policy measures is time-consistent. In general, problems concerning the time-consistency of optimal policy measures arise when agents' (in this case, firms') decisions concerning economic activity today are based at least in part on the policy actions they expect the government to take in the future.

In the example above, it will be shown that the optimal sequence of subsidies will not be time consistent. This occurs because, once the government announces the optimal

sequence of subsidies $(S_0, S_1, \ldots, S_n)$ in period one, and firms respond by producing a higher level of exports, the government may "cheat" in the second period and offer a lower subsidy. In fact, in period two, it will be optimal for the government to do so, because the level of exports of firms in period one will no longer be affected by the subsidy in future periods. The government can then take E_0 as a constant in its minimization problem.

For example, suppose the government announces the optimal sequence of subsidies solved for above, $\{S_t\}$ at t=0. Firms then respond by producing a higher level of exports at t=1, fully expecting to receive the subsidies announced in future periods. The-first order conditions with respect to S_1 and S_2, for the government's minimization problem at t=0 were derived above. Then, suppose at t=1 that the government re-solves its loss minimization function. The problem that the government must solve will now be:

$$(2.33) \qquad \min_{\{S'_t\}} \sum_{t=1}^{n} b^t (X_t - X_t^*)^2$$

The sequence denoted $\{S'_t\}$ will be the time-consistent set of subsidies. Taking the derivative of the loss function with respect to S'_1 yields the following first-order condition:

$$(2.34) \qquad d/dS'_1 = 2[X(1) - X^*(1)]\,\lambda_2/\gamma + 2/(1+r)[X(2) - X^*(2)]\lambda_2^2/\gamma + 2/(1+r)^2[X(3) - X^*(3)]\lambda_2^3/\gamma + \ldots + 2/(1+r)^{n-1}[X(n) - X^*(n)]\lambda_2^n/\gamma = 0$$

Where:

$$X(1) = \lambda_2\{\lambda_2(P_0 + S_0) + \lambda_2/\gamma(P_1 + S_1) + \ldots+\lambda_2/(\gamma\lambda_1^{n-1})(P_n + S_n)\} + \lambda_2/\gamma(P_1 + S'_1) + \lambda_2/(\gamma\lambda_1)(P_2 + S'_2)+\ldots+\lambda_2/(\gamma\lambda_1^{n-1})(P_n + S'_n),$$

which is different from the first-order condition found at t=0. For example, at t=1, the derivative $dX_0/dS'_2 = 0$; since firms have already made their export decisions for period zero.

This implies that, if the government can change its plans in future periods, it will find it optimal to do so. For example, it may be the case that once firms have been induced to export by current subsidies and promises of future subsidies, then the government could cut back on the subsidies and firms would still export more, since they had already undertaken the "adjustment costs" necessary to break into new export markets.

However, if firms know that it will be optimal for the government to change its plans in this way in the future, then they will lower their expectations of future subsidies, knowing that the government is likely to renege on subsidies promised for the future.

In this way, a policy-making dilemma presents itself. For, unless the government can credibly precommit to the optimal sequence of export subsidies, the announcement of future export subsidies will have little effect on exporting behavior because firms will expect that these future subsidies will not materialize. In this situation, export

subsidies will not be a very powerful tool for encouraging exporting by forward-looking firms.

7. Simulation Analysis

While it was shown in the model presented above that the optimal and time-consistent subsidies will be different, the model itself cannot predict whether the difference between the two sequences of subsidies is large or small. To know this, one must know the values of the parameters of the economy in question. Simulation analysis may shed some light on this question.

A simulation was run to calculate the optimal and time-consistent subsidies over a 15-year planning horizon, with a randomly chosen sequence of prices, assuming the following parameter values:

parameter	assumed value
γ	0.25
β	0.7
r	0.04
δ	0.08
E_{-1}	35

These parameter values implied the following:

$$\lambda_1 = 4.70 \quad ; \quad \lambda_1^* = 4.39$$

$$\lambda_2 = 0.22 \quad ; \quad \lambda_2^* = 0.24$$

While the parameter values for the variables (γ, β, and E_{-1}) were chosen at arbitrarily, the parameter δ was chosen so as

to satisfy the restriction of the model. The discount rate was set at 0.04, which is consistent with other simulation models (for example, see Kydland and Prescott, 1982).

The optimal subsidy sequence was obtained by solving a system of 15 simultaneous, linear equations, and the time-consistent subsidy sequence was obtained by solving a system of 14 equations.

The following are the optimal sequence of subsidies (as solved for at t=0), and the time-consistent sequence of subsidies (as solved for at t=1).

time	Optimal subsidy	Time-consistent subsidy
0	2.88	-
1	2.38	2.31
2	2.49	2.48
3	3.17	3.16
4	2.83	2.83
5	3.07	3.07
6	2.65	2.65
7	3.16	3.16
8	3.13	3.13
9	3.27	3.27
10	2.66	2.66
11	2.52	2.52
12	3.04	3.04
13	2.80	2.80
14	3.35	3.35

In this simulation, the time-consistent subsidy was found to differ from the optimal subsidy in only the first three years of the simulation. The time-consistent subsidy was found to be three percent lower than the optimal subsidy in the first year, and less than one percent lower than the optimal subsidy in the second and third years.

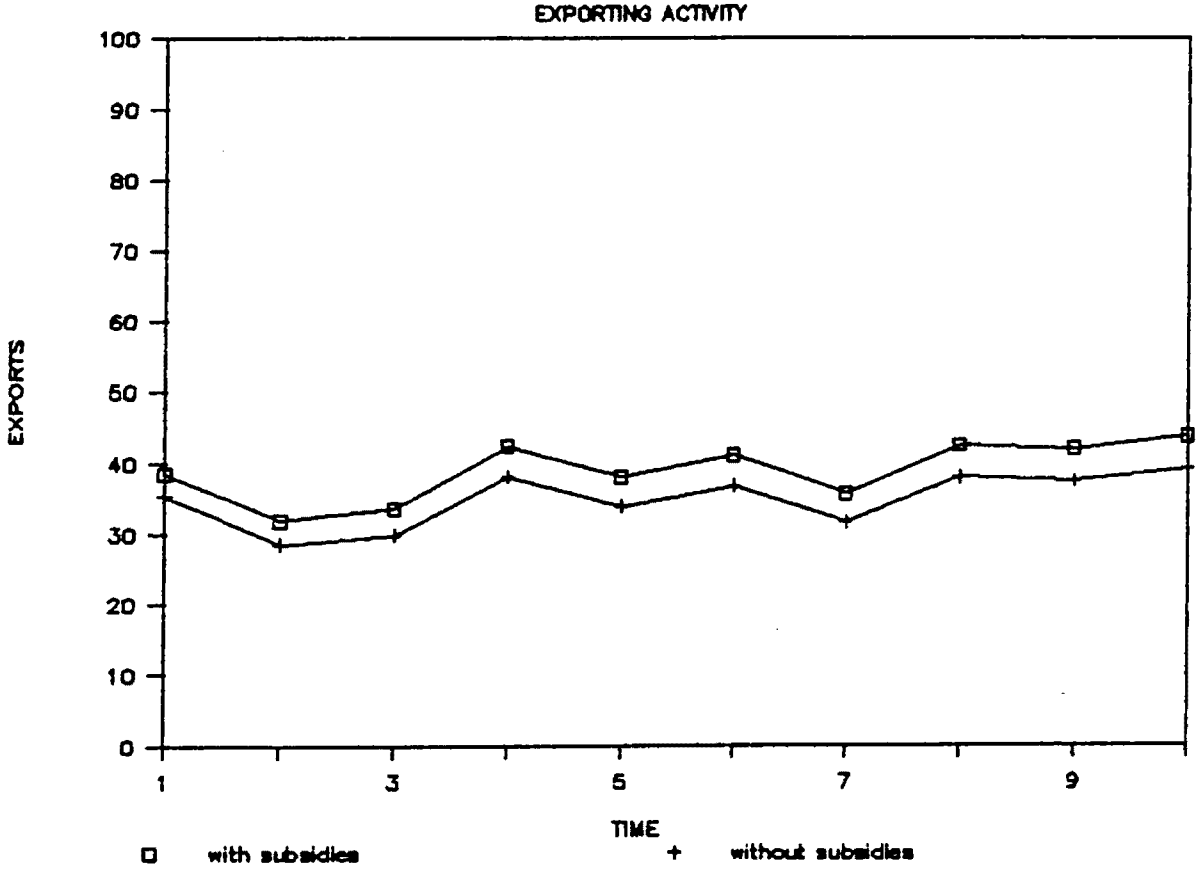
Similar results were found using different parameter values. In no case did the time-consistent subsidy differ from the optimal subsidy by more than two percent. Those results are listed in Appendix B.

Figure 2.1 shows projected exports over a ten year period, using the export supply function of firms (equation (2.22)), and the optimal export supply function from the point of view of the social planner (equation (2.28)). As the graph illustrates, exporting activity with the subsidies would be significantly higher than without the subsidies. However, since the time-consistent subsidies are so close in magnitude to the optimal subsidies, exporting activity would be the same with either sequence of subsidies. These results suggest that the time-consistency problem may not be a serious impediment in fact to export promotion.

8. Relevance of the Model: The Experience of East Asia

According to the hypothesis presented above, if a country with a low level of exports provides subsidies to

FIGURE 2.1


EXPORTING ACTIVITY
EXPORTS
100
90
80
70
60
50
40
30
20
10
0
1
3
5
7
9
TIME
with subsidies
without subsidies

manufactured exports, then the entry of firms into the export market will attract the resources of foreign buyers, making it easier for other firms to follow. Once the country is established in manufactured export markets, and break-in costs fall to low levels, then the need for subsidies and other incentives to bring the level of exports up to the level of the social planner would decline.

The model suggests that in the beginning, in countries that have few manufactured exports, an export-oriented growth strategy may have to include substantial export subsidies and other export incentives. However, this model would predict that once export levels rise, an outward oriented growth strategy can be maintained even without subsidies, as the entry of firms encouraged to export by the subsidies will lower the cost of exporting of other firms, giving them greater incentive to export. In this way, exporting success may well breed exporting success.

The case of Korea, for example, appears to fit this pattern. As was discussed in the previous chapter, the Korean government instituted a number of export incentives, (including export subsidies), in the 1960's which probably allowed Korea to make the initial push into manufactured export markets.

In addition, the Korean government established the Korean Trade Promotion Corporation (KOTRA) to assist exporting firms in their relations with foreign buyers. KOTRA played a large role in the marketing of exporters'

goods abroad in the 1960's, and also directed efforts aimed at attracting foreign buyers to Korea. In fact, providing direct export marketing assistance of this type to infant-exporters would be the first-best policy response to the distortion that leads to the social planners' optimal level of exports being higher than that of firms.

Export subsidies and incentives became quite important in Korea during the 1960's. It is interesting to note that in addition to achieving rapid growth in manufactured exports in general in the 1960's, Korea was able to break into a number of new export markets such as the market for electrical machinery, clothing, footwear, and wigs.

However, after 1973 Korea was able to abolish many of these export incentive mechanisms. Exporters in Korea no longer receive lower direct tax rates, or excessively large wastage allowances on imported inputs. They still receive duty-free access to inputs -- but this is not a subsidy, since exporters must sell their goods at world prices as well. In addition, exporters still have preferential access to loans, but the interest subsidy is smaller.

Therefore, the model presented above is consistent with Korea's recent history. Study of the recent economic history of other successful exporters such as Singapore and Taiwan also reveals that substantial export incentives were used initially to promote manufactured exports. Also, institutions similar to Korea's KOTRA were established in

those countries to aid manufacturing firms in breaking into world markets.

In addition to the internal conditions mentioned above, the East Asian countries also enjoyed relatively low levels of protectionism in the developed countries in the 1960's. Clearly, levels of protectionism in the developed countries will also be a determinant of the future success of export-oriented growth strategies.

9. GATT Restrictions on the Use of Export Subsidies by LDCs

Any country considering the use of infant-export-industry subsidies must consider the rules of GATT and the possible international repercussions that could result from the use of such subsidies.

The GATT Subsidies Code, a result of the Tokyo Round of Multilateral Trade Negotiations, authorizes the use of countervailing duties (CVDs) against export subsidies that cause "material injury" to the importing country. Material injury is loosely defined as a subsidy causing a decline in the production, profits, prices or employment of a domestic industry. But the Code does allow for the use of export subsidies by developing countries to the extent that they are justified by "competitive and development need." However, as Nam (1987) has noted, the preferential treatment toward developing countries' use of subsidies does not amount to much in practice, since developing countries are

subject to countervailing duties in the case of material injury, just as are other countries. And, in fact, the United States does not apply the injury test in cases against imports from nonsignatories to the Subsidies Code.

In recent years, the United States has increased its use of CVDs against imports from developing countries. Other industrial countries have also sought CVDs on some LDC imports.

These recent trends do raise some important concerns regarding the use of infant-export-industry subsidies as a tool to promote greater export orientation in developing countries. However, it should be noted that, at least to date, the most common LDC targets of CVDs have been the "newly industrialized" countries that have already achieved a fairly high level of exports. The infant-export-industry subsidy argument does not apply to these countries, but rather to those countries that have very low levels of exports. And to the extent that the developed countries apply the injury test before imposing CVDs, those countries exporting at very low levels are especially unlikely be targeted for CVDs, since they are unlikely to be exporting enough to cause injury to the domestic industry of an industrial economy. However, the current threat of the possible use of CVDs against LDC exporters probably discourages entry into export markets.

GATT rules on the use of export subsidies by LDCs will be re-evaluated during the current Uruguay Round of

Multilateral Trade Negotiations. The conclusions derived from the model above suggest that it would be appropriate to relax the conditions under which LDCs are able to use export subsidies without being subject to countervailing duties. Since export subsidies can help compensate firms in LDCs with low levels of exports for the particularly high costs that they face when breaking into foreign markets, the use of export subsidies by LDCs with low levels of exports can be justified by "competitive and development need."

Notes to Chapter 2

1. The break-in cost function is assumed quadratic. This increases the computational ease in solving the problem, but should not qualitatively affect the results obtained.

2. It is assumed that the country has no initial foreign debt.

CHAPTER 3

THE EFFECT OF REAL EXCHANGE RATE UNCERTAINTY ON THE MANUFACTURED EXPORTS OF LESS DEVELOPED COUNTRIES

1. Introduction

In recent years, there has been growing interest in firm behavior under uncertainty. Of particular interest has been the question of optimal output choice for a firm facing price uncertainty. This problem was initially analyzed by McCall (1967), and Sandmo (1971), in papers that established the general result that a risk averse firm will choose to produce less output in the presence of price uncertainty than it would in a certain environment. Later papers, including those by Leland (1972), Meyer (1975), Turnovsky (1973), Hu (1975), Katz, Paroush and Kahana (1982), and Katz and Hillman (1986), have extended the analysis of firm behavior under uncertainty, and have shown that under a number of different assumptions concerning the firm and the type of uncertainty in its environment, firm behavior will not be independent of the degree of price uncertainty that it faces.[1]

The relationship between price uncertainty and output

behavior is particularly relevant for exporting firms in countries with highly unstable exchange rates. The price that an exporter receives in terms of domestic currency will be the exchange rate times the foreign currency price of the exported good. Instability in the exchange rate, then, will lead to instability in the price that the firm receives for its exports.

As was discussed in the first chapter, many developing countries are seeking to expand their manufactured exports in efforts to follow more outward-oriented development strategies. The usual policy prescription for such a country offered by the leading development specialists and institutions is to reduce import barriers, and to devalue the exchange rate. However, less is said about the possible importance of maintaining stability of the exchange rate over time.

The purpose of the following two chapters is to address this issue. This chapter will make a theoretical case for the importance of exchange rate uncertainty in determining the export performance of manufacturing firms in developing countries. The next chapter will use empirical methods to analyze the relationship between LDC manufactured exports and exchange rate uncertainty.

In the section below, the sources and causes of exchange rate uncertainty in developing countries will be discussed. Available evidence regarding the nature of typical LDC export contracts and the LDC exporter/foreign

buyer relationship will be presented. And finally, a model that incorporates these specifics regarding the operation of exporting firms in developing countries will be developed and analyzed.

2. The Sources of Uncertainty for Exporting Firms in Developing Countries

Profit margins for exporting firms are determined by the relationship between export revenues and costs of production. A firm's unit export revenue will be equal to SP^*, where P^* is the world price of the good and S is the nominal exchange rate. In the case of manufactured goods, world prices are fairly stable and predictable. However, in many countries, nominal exchange rates are not adjusted to compensate for changes in the domestic price level relative to the price level of trading partner countries. Since nominal wages can be expected to rise along with the general price level, the relationship between export revenues and costs of production, or the firm's profits, will become uncertain. In other words, uncertainty in the real exchange rate, defined as the ratio of unit export revenues to a general price index, or an index of wages, will mean uncertainty in profits for exporting firms.

Real exchange rate uncertainty may stem from a number of sources in developing countries. In many countries, the growth rate of the money supply is variable and

unpredictable, leading to high and variable rates of domestic inflation. This kind of monetary policy is often coupled with erratic nominal exchange rate management. Faced with high domestic inflation, many countries allow their exchange rates to become overvalued, and only periodically correct this with jump devaluations.

To the extent that erratic exchange rate and money supply policies lead to variability in the real exchange rate, much of the real exchange rate uncertainty experienced by firms in developing countries may be policy-induced. However, in other countries, real exchange rate uncertainty has real sources. For example, many developing countries derive most of their export revenues from a single agricultural commodity. If the world price of the commodity experiences large fluctuations, this will affect the balance of payments and national income, thereby causing swings in the real exchange rate. Therefore, the extent of real exchange rate uncertainty among countries varies, not only according to differences in policy but differences in economic structure.

3. Export Contracts and the Exporter/Foreign Buyer Relationship

Exchange rate uncertainty affects exporting firm decision-making because when firms produce under contract, they typically must choose output levels before the price they will receive in terms of domestic currency is known.

Export contracts are typically denominated in foreign currency. Also, there is usually a fairly long lag between the time when the contract is signed and the time when actual payment is received (and the foreign currency can be changed into domestic currency). While the time frame involved on any particular deal will depend on factors like the type of good being produced, and the length of the association between the exporter and the importing firm, discussions with U.S. firms that import goods from developing countries did reveal a typical timetable for importer/LDC exporter contract arrangements.[2] This timetable is outlined in Table 3.1.

The first step in the process usually involves a visit to the exporting firm by the importer (or foreign buyer, from the exporter's point of view). During this visit, the foreign buyer and the exporter will agree on the quantity and specifications of the goods to be produced, as well as the foreign currency price that will be paid for the goods. This initial agreement between the exporter and the foreign buyer usually takes place six to nine months before the firm begins production of the goods. While this agreement may be an informal oral agreement, or a written contract, in most cases it will involve a written contract. The policy of the large importers interviewed is to always work on the basis of a written import contract.

About four weeks before the start of production, the importer will usually arrange with its bank for an

TABLE 3.1

Timetable for Typical Buyer/LDC firm Transactions

6 to 9 months before the start of production	Foreign buyer vists firm. Firm and buyer agree on quantity to be produced, and on (foreign currency) price.
1 month before the start of production	Foreign buyer arranges a letter of credit with its bank which specifies the quantity of goods to be imported, and the price that will be paid for those goods.
2 to 3 months	The exporting firm produces the goods.
immediately upon presentation of shipping documents	The firm may present the letter of credit to its bank and receive payment for the goods.

irrevocable letter of credit to be issued on its behalf, in favor of the exporting firm. This letter of credit is a legal document that authorizes the exporting firm to draw (with the assistance of an intermediary bank in the exporter's country) a draft against the foreign buyer's bank for the value of the shipment, upon presentation of shipping and inspections documents that prove that the goods have been produced to specifications and have been shipped to the buyer. The letter of credit is irrevocable, in that it cannot be modified or canceled without the consent of the exporting firm.[3]

Actual production of the goods will often take three to four months, depending on the size of the order and the good being produced. Once the goods have passed through inspection at the border and have been shipped, the exporting firm may then draw a draft on the buyer's bank. If the shipping and inspection documents conform with the letter of credit, then the bank will accept the draft and payment will be made to the exporting firm.

The total time that elapses, then, from the initial agreement between the buyer and the exporter, and the final payment for the finished goods, will be about eight months to one year. If the nominal exchange rate and costs of production move in very different ways during those eight to twelve months, the exporting firm could find itself either losing money on the deal, or ending up with unexpected

profits. An uncertain exchange rate then increases the riskiness of being in the export business.

While most of the buyers interviewed indicated that it was their policy to work only on the basis of contracts based on a fixed price in U.S. dollars, one importer did report having recently begun to use a contract with one supplier that made the dollar price contingent on the exchange rate of the exporting firm's currency at the time of payment. This contingent contract included a proviso specifying an upward adjustment in the U.S. dollar price, should the exporter's nominal exchange rate appreciate beyond a specified level.

This type of contingent contract would effectively share the exchange risk between the exporting firm and the foreign buyer. However, this type of contract is not in widespread use. Further, buyers from the large U.S. department stores indicated that they would not consider using such contracts, even if they were requested by suppliers, since the cost to them of changing prices in catalogues and stores would be prohibitive. It is the exporting firm, then, that typically must bear the burden of exchange rate risk.

However, while entering into contracts with foreign buyers may be risky for exporting firms, it may also yield substantial benefits for those firms. This is because, when a foreign buyer enters into a contract with an LDC exporter, the buyer will often provide that firm with substantial

technical assistance. The American buyers interviewed indicated that they almost always give their developing country suppliers exact specifications of the good to be produced. This eliminates the need for the exporting firm to do market research to determine the types of goods that will sell in foreign markets. In addition, when a firm contracts with a foreign buyer, it doesn't need to worry about marketing its goods abroad. The buyer takes on that responsibility.

These findings are consistent with the World Bank study of Korean exporting firms that was cited in the previous chapter, (Rhee, Ross-Larson and Pursell, 1984). In that study it was found that relationships with foreign buyers were a key in determining why the exporting firms were able to successfully break into manufactured export markets. They found that in Korea, buyers often provided exporters with technical information including the provision of blue-prints and specifications, information on production techniques and technical specifications of competing products, and feedback on design and quality. In addition, buyers were found to have to taken responsibility for most of the marketing of the Korean export goods, particularly in the 1960's, when Korean firms were initially breaking into export markets.

4. A Model of Exporting and Real Exchange Rate Uncertainty

The establishment of direct relationships with foreign buyers can yield substantial benefits for the producers of manufactured exports from LDCs. As indicated above, foreign buyers are often willing to invest substantial resources in LDC exporters in terms of providing them with technical and marketing assistance. However, in a country where the real exchange rate is variable, there is a disadvantage to producing under contract for foreign buyers, since the firm will have to set export levels before the price it will receive in terms of domestic currency is known.

In the two period model that will be developed below, the trade-offs that the firm faces under conditions of real exchange rate uncertainty will be analyzed. The firm in this model faces uncertain profits due to real exchange rate uncertainty. While the firm knows what its costs will be in the second period, it does not know what the future nominal exchange rate will be, and therefore, it does not know the value of the future real exchange rate.

The firm is assumed to be risk neutral, and has two options with respect to production. It can produce under contract (a quantity denoted q_C), and receive technical and marketing assistance from foreign buyers that enables it to produce at lower cost. The contract is assumed to specify the foreign currency price of the good (this price is normalized to 1). However, since the nominal exchange rate is uncertain, producing under contract is risky, since q_C must be set before the real exchange rate is known.

The other option for the firm is to produce part or all of its output for the export "spot market". The advantage of doing so for the firm is that export quantities can be set after the real exchange rate is known. However, since the firm does not enter into contracts with buyers it does not receive assistance from buyers so that its costs are higher.

The problem for the firm is to choose the level of output that it will produce under contract for the next period. Once it makes this decision, it is assumed that the firm will always meet its contractual obligations, even if the exchange rate takes on an unfavorable realization.[4]

Exchange rate uncertainty can be represented by the following: the exchange rate (denoted as S) is assumed to take on one of two values, with probability τ and $(1-\tau)$, respectively. The expected value of the exchange rate in period two can be represented as:

$$(3.1) \qquad E(S) = \bar{S} = \tau S_1 + (1-\tau) S_2$$

The firm faces two known cost functions. The function representing total cost of production under contract is:

$$(3.2) \qquad TC_C = [a/(m+1)]q_C^{m+1} \ .^5$$

It is assumed that the total cost of production in the spot market (TC_S) is higher than that of production under contract, and that it is represented by the following equation:

(3.3) $TC_s = [b/(m+1)]q^{m+1}$, where $b > a$.

The problem for the firm is to maximize expected profit, or the difference between expected total revenue and expected total cost. Expected total revenue in period two can be represented as:

(3.4) $E(TR) = \bar{S}q_c + \tau S_1(q_1 - q_c) + (1-\tau)S_2(q_2 - q_c)$

where q_1 and q_2 represent total production in states one and two, and $(q_1 - q_c)$ and $(q_2 - q_c)$ represent production for the spot market in states one and two.

The expected total cost function takes the form:

(3.5) $E(TC) = [a/(m+1)]q_c^{m+1} + \tau x_1 + (1-\tau)x_2$, where

$$x_1 = \begin{cases} [b/(m+1)]q_1^{m+1} - [b/(m+1)]q_c^{m+1} & \text{for } q_1 > q_c \\ 0 & \text{for } q_1 = q_c \end{cases}$$

$$x_2 = \begin{cases} [b/(m+1)]q_2^{m+1} - [b/(m+1)]q_c^{m+1} & \text{for } q_2 > q_c \\ 0 & \text{for } q_2 = q_c \end{cases}$$

That is, x_1 and x_2 represent the cost of production for the spot market in states one and two. If the firm chooses not to produce for the spot market, then q_1 and q_2 are equal to q_c and additional production costs are zero. However, if the firm finds it optimal to increase output after the exchange rate is known, then additional output costs can be represented by x_1 and x_2.

The optimization problem the firm will solve is:

$$(3.6)\qquad \underset{q_c, q_1, q_2}{\text{Max}} \quad \bar{S}q_c + \tau S_1(q_1 - q_c) + (1-\tau)S_2(q_2 - q_c) - [a/(m+1)]q_c^{m+1} - \tau x_1 - (1-\tau)x_2, \text{ with}$$

$$x_1 = \begin{cases} [b/(m+1)]q_1^{m+1} - [b/(m+1)]q_c^{m+1} & \text{for } q_1 > q_c \\ 0 & \text{for } q_1 = q_c \end{cases}$$

$$x_2 = \begin{cases} [b/(m+1)]q_2^{m+1} - [b/(m+1)]q_c^{m+1} & \text{for } q_2 > q_c \\ 0 & \text{for } q_2 = q_c \end{cases}$$

subject to: $q_1 \geq q_c$, $q_2 \geq q_c$, $q_c \geq 0$, $b > a$.

Since the firm is assumed to fulfill all contractual obligations, q_1 and q_2 are restricted to be greater than or equal to q_c. That is, total production in states one and two must be at least equal to q_c. In addition, production under contract can never be negative, so q_c must be greater or equal to zero.

The solution that maximizes the firm's expected profits will depend on the cost of producing for the spot market. Equation (3.7) below will maximize profits as long as spot market production costs are very high. Specifically, as long as $b/a > S_2/E(S)$, the firm will maximize expected profit by setting q_c at the level specified by equation (3.7). However, if $b/a < S_2/E(S)$, then equation (3.8) will maximize the firm's expected profit.

$$(3.7)\qquad q_c = [\bar{S}/a]^{1/m} \; ; \; q_1 = q_2 = q_c.$$

$$(3.8)\qquad q_c = [\tau S_1/(a-(1-\tau)b)]^{1/m} \; ; \; q_1 = q_c; \; q_2 = [S_2/b]^{1/m}.$$

This is reasonable, since if the cost of spot market production is too high (b is too large), we should expect that spot market production will be zero in both states. This solution is the same as the case of perfect certainty, since if the real exchange rate is known with certainty the firm will produce entirely under contract so as to minimize costs. If the exchange rate were to take on its expected value with certainty, then the firm would simply set marginal costs of production under contract equal to E(S), so that the firm would produce a quantity of contract production under certainty (q_{cc}) of;

$$(3.9) \qquad q_{cc} = [\bar{S}/a]^{1/m}.$$

That output under certainty is the same as output under uncertainty when the ratio b/a takes on high values is not surprising. If spot market production costs are prohibitively high, the problem collapses to the simple problem of choosing output levels before prices are known. Since the firm is risk neutral, it will simply choose that level of output that maximizes expected profit.

The remainder of this chapter will focus on the more interesting case where spot market production is feasible, in other words, where the ratio b/a satisfies the inequalities:

$$b/a < S_2/\bar{S}.$$

5. The Effect of Uncertainty on Exporting Behavior

Under uncertainty, when the firm has the capability of adjusting output ex post, though at a higher cost than production under contract, it will produce a smaller quantity of output under contract. This can be seen by comparing the certainty level of contract production, q_{cc}, with the level chosen when spot market production is feasible.

$$(3.10) \qquad q_{cc} = [\bar{S}/a]^{1/m} > [\tau S_1/(a-b(1-\tau))]^{1/m} = q_c$$

as long as

$$\{\tau S_1 + (1-\tau)S_2\}/a > \tau S_1/(a-b(1-\tau)),$$

which, with some algebraic manipulation, is equivalent to the inequality: $b/a < S_2/E(S)$, the condition under which solution (3.7) maximizes firm profits.

This result is intuitive, since a firm that is able to adjust production levels ex post should be expected to reduce production commitments under contract in an effort to minimize losses if the real exchange rate takes on a low value.

It is also interesting to see how an increase in exchange rate uncertainty will affect expected, or average output levels. We can represent E(q), the expected quantity of export production under uncertainty, by the following:

$$(3.11) \quad E(q) = \tau[\tau S_1/(a-b(1-\tau))]^{1/m} + (1-\tau)[S_2/b]^{1/m}.$$

That is, if S_1 occurs, the firm will produce only what it has contracted to produce. However, if S_2 occurs, then the firm will produce q_2, selling (q_2-q_c) on the spot market.

An increase in exchange rate uncertainty can be represented by an increase in mean-preserving spread, where the spread between the two values that the exchange rate can take on increases while the mean remains constant. Given that the expected exchange rate can be represented by $E(S) = \tau S_1 + (1-\tau)S_2$, an increase in mean-preserving spread, will occur with a change in S_2 and τ (holding S_1 constant) that satisfies the equation:

$$(3.12) \qquad dE(S) = 0 = S_1 d\tau - S_2 d\tau + (1-\tau)dS_2$$

Rearranging, the following equality is obtained that must hold for any such change in mean-preserving spread (MPS):

$$(3.13) \qquad \frac{d\tau}{d(S_2 - S_1)_{MPS}} = \frac{(1-\tau)}{(S_2-S_1)}$$

To see how an increase in exchange rate uncertainty would affect average, or expected output of exports, equation (3.11) is differentiated with respect to τ. The following expression is obtained:

$$(3.14) \qquad \frac{dE(q)}{d\tau} = \tau \left[\frac{\tau S_1}{m(a-b(1-\tau))} \right]^{(1-m)/m} \frac{(a-b)S_1}{(a-b(1-\tau))^2} +$$

$$\left[\frac{\tau S_1}{a-b(1-\tau)}\right]^{1/m} - \left[\frac{S_2}{b}\right]^{1/m}$$

Note that the second two terms in the expression are simply q_c and q_2, as they were derived in the optimization problem. We know that any solution to that problem must have q_c less than or equal to q_2, since it is assumed that the firm will always make good on its contract commitments. Therefore $q_c - q_2$ must be less than or equal to zero. Since we know that $a < b$, the first argument in the expression above will be a negative number.

The effect of an increase in mean preserving spread on expected export levels can be represented by:

$$(3.15) \qquad \frac{dE(q)}{d(S_2-S_1)}_{MPS} = \frac{dE(q)}{d\tau}\,\frac{d\tau}{d(S_2-S_1)}_{MPS}$$

$$= \frac{dE(q)}{d\tau}\,\frac{(1-\tau)}{(S_2-S_1)} < 0.$$

In other words, an increase in uncertainty, represented by an increase in mean preserving spread of the values that the exchange rate takes on, will reduce expected production (that is, the sum of production both for contract and for the spot market) for exporting firms. Not only are firms less willing to produce under contract under uncertainty,

but they are less willing to participate in foreign trade at all under conditions of exchange rate uncertainty.

6. Changes in the Relative Cost of Spot Market Production

The relative cost of producing for the spot market will change under two circumstances. First, it may be the case that foreign buyers increase their assistance to exporting firms. This would lower the cost of producing under contract (lower a), and would thus increase the cost of producing for the spot market relative to that of production for the contract export market. A second possibility is that the cost of producing for the spot market may fall, which would be the case, for example, if the government established an export marketing agency to assist exporters with market research and marketing efforts abroad.

It can be shown that in the former case, both exports produced under contract, and total (expected) exports will rise in the presence of uncertainty. Exports produced under contract are:

$$(3.16) \qquad q_c = \left[\frac{\tau S_1}{a-(1-\tau)b} \right]^{1/m}$$

Taking the derivative of this with respect to a yields:

$$(3.17)\qquad \frac{dq_c}{da} = \left[\frac{\tau S_1}{a-(1-\tau)b}\right]^{(1-m)/m} \frac{-\tau S_1}{[a-(1-\tau)b]^2} < 0.$$

Since expected total exports, or E(q), are equal to:

$E(q) = \tau[\tau S_1/(a-b(1-\tau))]^{1/m} + (1-\tau)[S_2/b]^{1/m}$, then

$$\frac{dE(q)}{da} = \frac{\tau dq_c}{da} < 0.$$

Increased assistance by foreign buyers will increase exporting firms production under contract, but will not affect their choice of total production level when the exchange rate takes on a high value. Therefore, the total expected, or average, export production level will rise.

The impact of a reduction in spot market production costs (a decrease in b) is harder to evaluate.

$$(3.18)\qquad \frac{dE(q)}{db} = \frac{\tau}{m}\left[\frac{\tau S_1}{a-(1-\tau)b}\right]^{(1-m)/m} \frac{\tau S_1(1-\tau)}{[a-(1-\tau)b]^2} +$$

$$\frac{(1-\tau)}{m}\left[\frac{S_2}{b}\right]^{(1-m)/m} \frac{-S_2}{b^2}$$

The first term of equation (3.18) is positive, indicating that as b falls, q_c will fall. However, the second term is negative, indicating that there would be an increase in spot market production in the event of a high

realization of the exchange rate. The impact on total expected production is ambiguous.

7. Contingent Contracts

As was discussed above, most U.S. importers deal with their developing country suppliers on the basis of contracts specifying fixed U.S. dollar prices. However, one importer did report having used a contract with a proviso that would adjust the price paid for the goods if the exporter's currency were to appreciate beyond some level.

In the context of the model presented above, such a contingent contract would have the impact of reducing the degree of uncertainty faced by the firm and would thus result in an increase in the firm's exporting activity. In the model above, where

$$E(S) = \tau S_1 + (1-\tau) S_2,$$

the exporter receives (given the foreign price, $P^* = 1$), S_1 per unit of exports if state one occurs, and S_2 if state two occurs. A contingent contract would specify an adjustment to P^* in the event that the exchange rate took on the the value S_1. For example, the importer would promise to pay $P^*=1$, for the goods in the event that $S = S_2$, and $P^* = (1+k)$ for the goods in the event that $S = S_1$, (with $a > 0$).

The firm's expected profit maximization problem then becomes:

$$(3.19)\quad \underset{q_c, q_1, q_2}{\text{Max}} \; \tau S_1(1+k)q_c + (1-\tau)S_2 q_c + \tau S_1(q_1 - q_c) + (1-\tau)S_2(q_2 - q_c) - TC(q_c, q_1, q_2), \text{ subject to } q_1 > q_c \,,\; q_2 > q_c \,,\; q_c > 0,\; b > a,$$

where $TC(q_c, q_1, q_2)$ refers to the same cost function as above. The solution to this problem is:

$$(3.20)\quad q_c = [\tau S_1(1+k)/(a-(1-\tau)b)]^{1/m} \;;\; q_1 = q_c;$$
$$q_2 = [S_2/b]^{1/m}$$

Optimal contract production here is clearly larger than that obtained without the contingent contract in the presence of uncertainty. However, while the contingent contract does reduce the exposure of the exporting firm to exchange rate risk, is does so by increasing the risk to the importer. And, as was noted in Section 2, many importers are unwilling to assume this type of risk. The widespread use of this type of contract is not expected, at least in the near future.

8. Forward Exchange Contracts

In most developing countries, firms do not have access to financial instruments through which they can hedge against foreign exchange risk. However, the government could provide such an instrument at a low cost. The discussion that follows describes how a forward exchange contract could be developed, and how it would affect the

behavior of exporting firms, as well as the government budget.

A forward exchange contract is simply a contract between two parties to purchase/sell an amount of foreign currency at a fixed exchange rate at a specified date in the future. In the model above, the government could provide exporting firms with a contract to exchange foreign currency export receipts for domestic currency at a fixed rate in period 2, so that firms could lock in a domestic currency price for the goods that they are producing under contract for foreign buyers.

Assuming that the government also knows the two possible outcomes of the period two exchange rate, and their respective probabilities of occurring, the government could offer a forward contract to exporting firms at an exchange rate of $(1-\phi)E(S)$ per unit of foreign currency. The variable ϕ represents a mark-up charged by the government to cover the transactions costs of the contract. The government, by entering into this contract, would incur an expected net cost of exactly zero. That is, the expected loss incurred by the government under the contract is:

$$E(\text{Loss}) = \tau[(1-\phi)E(S) - S_1] - (1-\tau)[S_2 - (1-\phi)E(S)] + \phi E(S)$$
$$= 0.$$

The first term of the expected loss is the probability of the exchange rate taking on its low value times the loss incurred by the government under the contract. The second term is the probability of the exchange rate taking on its

high value times the profit the government would earn in that case. And the third term is the transactions costs incurred by the government in carrying out the contracts. The expected loss, then, for the government in offering such forward contracts is zero.

However, while the expected cost to the government of offering such a contract is zero, the effect of the exporting behavior of firms would be large, as long as the transactions costs of such a program are small. The firm's profit maximizing decision now becomes a two stage optimization under certainty problem. In the first period, when it is necessary to enter into contracts with foreign buyers, the firm will solve the following problem to set the optimal level of production under contract (q_c):

$$(3.21) \qquad \max_{q_c} \; (1-\phi)\bar{S}(q_c) - a/(m+1)q_c^{m+1}$$

The solution to that certainty problem is:

$$(3.22) \qquad q_c^{*} = \left[\frac{(1-\phi)\bar{S}}{a}\right]^{1/m}$$

which is similar to the level of exports in the certainty case, as long as the transactions costs term, ϕ, is small.

In addition, the firm will still produce for the spot market, in the event that the exchange rate takes on its high value. This decision will be made in the second period, after the spot exchange rate is known. The firm will then solve for the optimal level of spot market

production, q_s, given the optimal level of contract production chosen above, q_c^*.

$$(3.23) \qquad \max_{q_s} \; S_2 q_s - b/(m+1)[q_s + q^{c*}]^{m+1}$$

The level of spot market production that solves that problem is:

$$(3.24) \qquad q_s = \{S_2/b\}^{1/m} - q_c^*$$

This implies that total output in the event that the exchange rate takes on a high value will be equal to: $\{S_2/b\}^{1/m}$, as in the original problem. However, spot market production will be decreased as long as q_c^* is greater than the level of contract production in the original model, which will be the case with a sufficiently small level of ϕ, the transactions costs variable. Therefore, as long as transactions costs are small, the provision of forward exchange contracts will increase the expected exports of firms faced with exchange rate uncertainty.

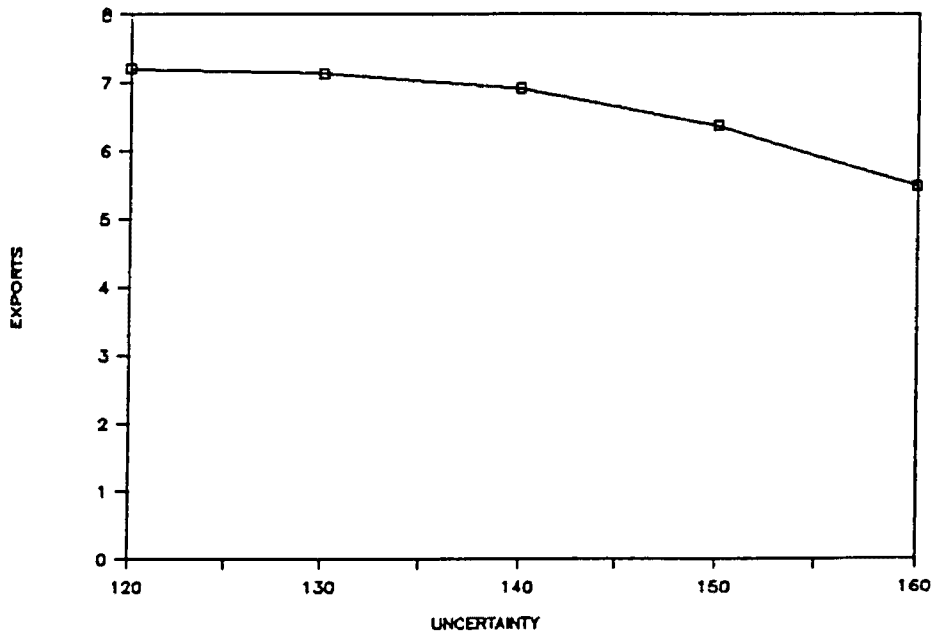
9. Simulation Analysis

In this section, a simulation will be presented that illustrates the effect of exchange rate uncertainty on exporting performance. This simulation is generated from the equations of the model above. In the simulation, the following parameter values are assumed:

parameter values	
a	40.0
b	43.0
m	0.5

In addition, the exchange rate is assumed to have an expected value of 108, where $S_1 = 60$, $S_2 = 120$, and τ has the initial value 0.2. Increased uncertainty in this model is represented by an increase in mean-preserving spread. Initial values of the variables above were changed to accomplish this according to equation (3.12). Figure 3.1 below illustrates the impact of increased exchange rate uncertainty on exporting performance. Additional simulations calculated with alternative values for the parameters and variables in the model are presented in Appendix C.

FIGURE 3.1



10. Conclusion

Previous research has established that a risk averse firm faced with price uncertainty will choose to produce less under uncertainty than it would in a certain environment. Further, these papers have established that firm output will decrease as the degree of uncertainty facing the firm increases. This has been found to be the case with a competitive firm (Sandmo (1971)), as well as with a discriminating monopolist (Katz, Paroush and Kahana (1982)) facing price uncertainty in the foreign market.

These results may well pertain to exporting firms in developing countries who are faced with exchange rate uncertainty. However, these results are dependent on the assumption of risk averse decision-makers. In order to analyze the case where decision-makers are risk averse, it is necessary to introduce an additional assumption, that the problem facing decision-makers is to maximize the utility that they obtain from the firm's profits. The objective function in the profit maximization problem is then the expected utility of firm profits.

Such a function can only be solved if it is assumed that decision-makers' preferences and attitudes toward risk can be represented by a single utility function. This assumption may be justified where decision-making responsibilities rest mainly with one individual, but it is less clearly applicable to firms managed by more than one

person. The model presented in this chapter does not assume risk-averse decision-makers. But similar results to the ones described above are obtained. That is, the firm's optimal output choice is shown to decrease with an increase in exchange rate risk.

This model is specific to firms producing manufactured exports in developing countries, since it is based on stylized facts concerning the way in which firms in developing countries do business with buyers, who are usually from the more developed countries. It is because the firm faces a trade-off between assistance from foreign buyers, and the disadvantages of working with contracts in the presence of uncertainty, that the results are obtained even with risk neutral decision-makers.

If manufactured export levels are a decreasing function of the degree of exchange rate risk facing firms, this should be of some interest to policy-makers. Countries wishing to reap the possible benefits of a more export-oriented development strategy will find export promotion to be enhanced by stabilization of real exchange rates. This may be an easily realized goal if the source of real exchange rate uncertainty is monetary or nominal exchange rate policy.

However, countries that are dependent on the export of a single commodity may not be able to prevent volatility of the real exchange rate, for reasons that were explained above. It may be the case for those countries that

achieving rapid growth in manufactured exports will be difficult without some the availability of some instrument, such as a forward exchange contract, through which firms can hedge exchange rate risk.

Notes: Chapter 3

1. Most of the models derive the same result and Sandmo and McCall, but in a few cases ambiguous results or the opposite result has been obtained. For example, Sandmo's work can be extended to show that a risk-attracted firm will increase output as it faces increased price uncertainty. Also, in Katz and Hillman's model (a model of a firm with monopoly power in the domestic market that also has the option of dumping output on foreign markets) increased price-uncertainty in the domestic market will lead the firm to increase total output.

2. Importers from the Footjoy (footwear importer), Sears, J.C. Penny, and Hudson International (sunglasses importer) were interviewed.

3. This discussion of the letter of credit and its use in the import/export business is derived from Wood and Wood (1985), pp.199-204.

4. This will be the case if the long-run costs of losing the firm's reputation are prohibitively high. For example, see Shapiro (1983).

5. This type of cost function could correspond to a Cobb-Douglas production function of the type $Y = Ax_1^{\alpha}x_2^{\beta}$. If one factor, (x_2), is fixed in the the short run, then the term m will depend on the size of α. As long as $\alpha < 1$, then it will be the case that $m > 0$. If both factors are variable, then the case of decreasing returns to scale would also imply $m > 0$.

CHAPTER 4

EMPIRICAL EVIDENCE OF THE RELATIONSHIP BETWEEN REAL EXCHANGE RATE UNCERTAINTY AND TRADE

1. Introduction

It was shown in the previous chapter that, given certain assumptions regarding the nature of the relationship between LDC exporters of manufactured goods and buyers from more developed countries, an exporting firm will choose to export less in the presence of exchange rate uncertainty than it will in a certain environment. Since data on exchange rate volatility and LDC manufactured export activity are widely available, this hypothesis can be examined in the light of actual data. This chapter will analyze data on exchange rate uncertainty and LDC manufactured exports to see whether the data are consistent with the predictions of the previous chapter.

First, methodological issues important in any investigation of the relationship between exchange rate uncertainty and trade will be discussed, namely, the choice of an index for the real exchange rate, and a definition of an index of exchange rate uncertainty. Previous, related

research efforts in this area will be described. Two alternative forms for the model to be estimated will be presented and explained, along with the results of the estimation.

2. Method

A. The Real Exchange Rate

Firms in the model in Chapter 3 were found, in the case where spot market production was infeasible, to set export production at a level such that the expected value of unit export revenue (the foreign currency price the firm obtains times the expected nominal exchange rate) was equal to marginal costs of production. In the case where spot market production was possible, the relationship between unit export revenue and marginal cost no longer held with equality.[1] However, firms still based their production decisions on the relationship between costs and revenue.

Given that the world prices of manufactured goods are fairly stable over time, uncertainty would affect such a firm in so far as it affects the relationship between the nominal exchange rate and costs of production. If the relationship between the nominal exchange rate and costs of production were to become uncertain, then firm exporting behavior would be affected. Therefore, uncertainty in the real exchange rate, defined as the ratio of the nominal

exchange rate to the firm's costs of production, should be statistically associated with lower manufactured exporting activity. One index of the real exchange rate that is closely associated with the model presented in Chapter 3 is the ratio of the nominal exchange rate to an index of wage, or labor, costs.

Unfortunately, data on wage costs are not available for most developing countries. In fact, wage indices were only found for 23 countries in the sample. For this reason, a second definition of the real exchange rate was also used in this research - the nominal exchange rate deflated by a consumer price index, where the consumer price index was used as a proxy for wage costs.[2] The use of the consumer price index as a proxy for wage costs allowed for the expansion of the sample size to a total of 46 countries.

B. Deriving a Trade-Weighted Index of Real Exchange Rate Uncertainty

A second methodological problem occurs in determining the most appropriate variable for the nominal exchange rate. Since developing countries trade with a wide range of partners, defining an exchange rate uncertainty index based solely on the nominal U.S. dollar exchange rate is inappropriate. However, given the nature of the argument presented in Chapter 3, that the relationship between foreign buyers from more developed countries and LDC

exporters can yield benefits to LDC exporters that lower their costs, only exchange rates with major developed (or more developed) trading partners were considered.

There are two basic approaches that can be taken in incorporating multiple trading partner exchange rates in the index of real exchange rate uncertainty. The first, an approach taken by Kenen and Rodrik (1984) and others, is to calculate a single "effective" real exchange rate, that consists of a trade-weighted average of bilateral exchange rates. An uncertainty index can then be calculated from this "effective" real exchange rate series.

This approach implicitly assumes that individual firms are diversified in their exporting behavior. In this case, the exchange rate relevant to any individual firm will be some weighted average of the exchange rates of the countries with which the firm trades. An uncertainty index calculated on the basis of an "effective" real exchange rate series will be relevant for the diversified exporting firm. However, while the assumption that the typical exporting firm exports to many countries may be valid for studies of the trade of industrial countries, where exporting firms are fairly large and sophisticated, it is less appropriate for LDC firms, that are smaller in size than their developed-country counterparts, and are more likely to concentrate their exporting activity with a single importing country.

For this reason an alternative approach was taken in defining an index of real exchange rate uncertainty.

Instead of calculating an index of uncertainty based on a trade-weighted real exchange rate, indices of uncertainty were calculated for the deflated bilateral exchange rates for each of a country's major trading partners.[3] These uncertainty indices were then weighted to form a trade-weighted index of real exchange rate uncertainty (the weights assigned to each trading partner are found in Appendix D). Implicit, then, in these indices, is the assumption that exporting firms in LDCs are for the most part not diversified in the destination of their exports.

C. The Bilateral Exchange Rate Uncertainty Index

One of the most difficult methodological issues is the definition of an index of real exchange rate uncertainty. In deriving an index of real exchange rate uncertainty over a sample period, one is attempting to determine the amount of unexpected variation in the real exchange rate that occurred during that period. Therefore, the concept of exchange rate uncertainty is related to, but not identical to exchange rate volatility. If firms face a real exchange rate that is very volatile, but moves very predictably, then they do not face a high degree of exchange rate uncertainty.[4] However, it is generally the case that more variable real exchange rates will be more unpredictable than relatively stable real exchange rates.

Since the real exchange rate of many countries followed some kind of trend during the sample period, it is likely that some of the variation in the real exchange rate was expected by rational, forward-looking decision makers. However, since expectations are not observable, the task at hand becomes one of proposing a model for real exchange rate expectations formation. Given such a model, the amount of real exchange rate variation left unexplained by the model corresponds to the degree of unexpected variation, or uncertainty, in the real exchange rate.

Three simple expectations-formation models were employed in deriving the three uncertainty indices for the 1960-81 period. The first was a simple quadratic trend model. The others were simple time-series models, a first-order autoregressive process, and a first-order moving average process.

Table 4.1 explains how the real exchange rate uncertainty indices were calculated from the data. An identical method was employed in calculating the three indices for a wage-index deflated real exchange rate, and the three uncertainty indices were also calculated for two subperiods, the period 1960-70, and the period 1970-81.[5]

The 46 countries in the sample are listed in Table 4.2, ranked according to their degree of real exchange rate uncertainty according to the three indices calculated in the manner described above. The first index listed is the trend-based index. The second index, (AR(1)), is the index

TABLE 4.1 : DERIVATION OF TRADE-WEIGHTED UNCERTAINTY INDICES

A. DATA

X_{ij} = nominal exchange rate for country i in terms of trading partner country j, (units of currency i required to purchase one unit of currency j).

CPI_i = consumer price index for country i.

$X_{ij}/CPI_i = r_{ij}$ = index of real exchange rate for country i in terms of trading partner country j.

$\ln r_{ij} = R_{ij}$, the natural log of the real exchange rate.

s_{ij} = weight of trading partner j for country i, determined by the relative importance of country j in absorbing country i's exports (see Note 1).

B. INDICES

U_{1ij} = the standard error obtained by estimating the following trend equation:

$$R_{ijt} = a_0 + a_1 t + a_2 t^2 + e_t, \text{ where t represents time.}$$

U_{2ij} = the standard error obtained by estimating the following equation using the first difference of the log of the exchange rate ($w_{ijt} = R_{ijt} - R_{ijt-1}$).

$$w_{ijt} = \Theta\, w_{ijt-1} + e_t$$

U_{3ij} = the standard error obtained by estimating the following equation using the first difference of the log of the real exchange rate.

$$w_{ijt} = c + \Psi e_t + \Psi e_{t-1}$$

C. TRADE-WEIGHTED UNCERTAINTY INDICES

For all indices K = 1,2,3

$$U_{Ki} = \sum_{j=1}^{J} s_{ij} U_{Kij}$$, where J is the total number of major trading partners of country i.

Table 4.2

Countries in the sample ranked according to trade-weighted uncertainty indices

	U1(trend)		U2(AR(1))		U3(MA(1))
Ghana	0.353	Paraguay	0.279	Paraguay	0.352
Paraguay	0.243	Ghana	0.244	Ghana	0.340
Chile	0.218	Argentina	0.213	Argentina	0.226
Yugoslavia	0.203	Chile	0.205	Uruguay	0.209
Argentina	0.168	Uruguay	0.201	Chile	0.202
Turkey	0.162	Pakistan	0.185	Egypt	0.190
Egypt	0.160	Philippines	0.185	Turkey	0.187
Uruguay	0.159	Egypt	0.184	Pakistan	0.181
Pakistan	0.157	Yugoslavia	0.181	Philippines	0.177
Philippines	0.142	Nigeria	0.152	Yugoslavia	0.170
Sri Lanka	0.137	Guyana	0.146	Guyana	0.153
Nigeria	0.131	Israel	0.141	Nigeria	0.145
Israel	0.126	Sri Lanka	0.130	Bolivia	0.143
Guyana	0.119	Turkey	0.126	Fiji	0.141
Singapore	0.114	Bolivia	0.126	Israel	0.139
Bolivia	0.110	Fiji	0.124	Sudan	0.130
Peru	0.108	Sudan	0.115	Sri Lanka	0.123
Fiji	0.103	Peru	0.110	Peru	0.111
Sudan	0.102	India	0.100	Korea	0.103
Hong Kong	0.100	Korea	0.095	Brazil	0.100
Taiwan	0.100	Spain	0.094	India	0.095
India	0.090	Singapore	0.089	Venezuela	0.094
Cameroon	0.090	Venezuela	0.089	Spain	0.093
Brazil	0.077	Colombia	0.086	Colombia	0.093
Ecuador	0.077	Brazil	0.081	Cote D'Ivoire	0.092
Spain	0.077	Thailand	0.080	Singapore	0.089
Colombia	0.075	Mexico	0.080	Cameroon	0.083
Mexico	0.075	Taiwan	0.075	Suriname	0.082
Korea	0.075	Ecuador	0.073	Mexico	0.080
Thailand	0.072	Cameroon	0.072	South Africa	0.079
Portugal	0.065	Malaysia	0.070	Ecuador	0.079
Malaysia	0.065	Cote D'Ivoire	0.068	Kenya	0.076
Cote D'Ivoire	0.063	Hong Kong	0.068	Thailand	0.076
S. Africa	0.058	S. Africa	0.068	Hong Kong	0.073
El Salvador	0.056	Costa Rica	0.064	El Salvador	0.070
Greece	0.055	Greece	0.063	Portugal	0.070
Venezuela	0.054	Suriname	0.062	Taiwan	0.068
Morocco	0.054	Portugal	0.059	Malaysia	0.067
Kenya	0.048	Tunisia	0.059	Tunisia	0.066
Tunisia	0.047	El Salvador	0.058	Morocco	0.065
Dominican Rep	0.046	Kenya	0.051	Dominican Repub	0.065
Costa Rica	0.046	Dominican Repub	0.050	Greece	0.063
Guatemala	0.043	Morocco	0.047	Guatemala	0.059
Suriname	0.041	Guatemala	0.045	Costa Rica	0.054
Honduras	0.036	Panama	0.041	Panama	0.050
Panama	0.034	Honduras	0.038	Honduras	0.050

based on a first-order autoregressive equation, and the third (MA(1)) is based on a first-order moving average equation. As the table illustrates, with the exception of a just a few countries, the basic rankings do not change much with the different uncertainty indices.

Table 4.3 shows the degree of correlation between the various indicators. The indices calculated with CPI-deflated exchange rate data are highly correlated with each other, as are the indices calculated with wage-deflated exchange rate data. The correlation coefficients for the wage and CPI based exchange rate indices, however, are not as large. This reflects the fact that the CPI is not a perfect proxy for labor costs.

The high degree of correlation between indices calculated with the the same data and different exchange rate expectation formation models is not surprising, since movements in exchange rates often resemble a random walk with drift. The strength of time-series models is that they take into account the nature of the stochastic process that generated the series. The nature of the stochastic process is revealed by studying the autocorrelation function of a series, which describes the amount of correlation that exists between neighboring data points in a series. Time series models can use that information in making forecasts of the series.

However, if a differenced series is a random walk, then there is no significant correlation between neighboring data

Table 4.3
Correlation Between Uncertainty Indices

Indices for 1960-81 period. Correlation coefficients:

U1 = index from trend equation using CPI data.

U2 = index from AR(1) equation using CPI data.

U3 = index from MA(1) equation using CPI data.

U4 = index from trend equation using wage data.

U5 = index from AR(1) equation using wage data.

U6 = index from MA(1) equation using wage data.

1. Correlation of 1960-81 indices.

	U1	U2	U3	U4	U5	U6
U1	-	0.92	0.94	0.59	0.65	0.62
U2		-	0.96	0.62	0.73	0.68
U3			-	0.68	0.73	0.71
U4				-	0.85	0.90
U5					-	0.86

2. Correlation coefficients for 1960-70 indices.

	U1	U2	U3
U1	-	0.94	0.95
U2		-	0.93
U3			-

3. Correlation coefficients for 1970-81 indices.

	U1	U2	U3
U1	-	0.91	0.83
U2		-	0.91
U3			-

points that can serve as information that will help in the forecasting of that series. For this reason, the high correlation between the uncertainty indices derived from the trend and the time-series models is not unexpected.

3. Previous Related Empirical Work

Most of the empirical studies that have examined the relationship between exchange rate uncertainty and trade have focused on industrial countries. Hooper and Kohlhagen (1978) looked at the relationship between nominal exchange rate uncertainty and bilateral trade flows and export prices for bilateral trade flows between the United States, Germany and other industrial countries for the period 1965-75. In their model, export contracts were assumed to be written partially in the importer's currency and partially in the exporter's currency. Both importers and exporters were assumed to partially hedge their future purchases/receipts against exchange rate uncertainty by buying/selling currency on the forward exchange market.

The trade volume equation estimated by Hooper and Kohlhagen was a reduced form of a supply and demand model of the form:

$$Q_{Xt} = b_0 + b_1 UC^*_t + b_2 UC_t + b_3 PD_t + b_4 Y_t + b_5 CU_t + b_6 EH^*_t + b_7 EH_t + b_8 U_t + e_t$$

where Q_X is export volume

UC, and UC^* are cost variables in the importing and and exporting countries, respectively

YF is the income level of the importing country

PD is the price level in the importing country

CU is the capacity utilization level in the importing country

EH and EH^* represent the expected cost of foreign exchange for the importer and exporter (they take into account partial hedging of future expenditures and receipts).

U is an uncertainty variable

The authors used three different proxies for exchange rate uncertainty (calculated over 13 weeks within each quarter): the standard deviation of the spot exchange rate and the current forward exchange rate, and the average absolute difference between the previous forward rate and the spot rate. The regressions were estimated using quarterly data.

In no trade volume regression was the coefficient on uncertainty found to be significant at the 95 percent level. The authors concluded that, while nominal exchange rate uncertainty did affect export and import price, it had no significant impact on the volume of trade for the bilateral trade flows examined.

Cushman (1983) substituted an index of real exchange rate uncertainty into the Hooper and Kolhagen model. His index of real exchange rate uncertainty was the standard deviation of quarterly changes (over a year's time) in real exchange rates. His model was identical to the one described above except that income and cost indices were

calculated in real terms, the price level variable (PD) was dropped, and the EH terms were replaced by the real exchange rate. Cushman also added a dock-strike dummy variable. He estimated this model using quarterly data for fourteen bilateral trade flows for the U.S. and Germany, over the period 1956-1977. The model was also estimated for each trade flow using lagged values of the uncertainty variables.

Cushman found a negative, significant coefficient on exchange rate uncertainty for many of the trade flows examined. In addition, he estimated the model for two subperiods, 1965 II-1966 I, and 1974 I-1975 IV. He found much larger (negative) coefficients on the uncertainty variables in the later period, when the countries had moved to floating rates.

Akhtar and Hilton (1984) looked at the impact of nominal exchange rate uncertainty on multilateral U.S. and German trade flows from 1974-81. Their index of exchange rate uncertainty was the standard deviation of the daily nominal trade-weighted exchange rate over a three-month period. They estimated the following time-series equations for the United States and Germany over the sample period:

$$Q_{Xt} = b_0 + b_1 YF_t + b_2 RELPX_t + b_3 CUF_t + b_4 U + e_t$$

$$Q_{Mt} = b_0 + b_1 YD_t + b_2 RELPM_t + b_3 CUFCU_t + b_4 U + e_t$$

where Q_X/Q_M are export/import volumes

YF is foreign income

YD is domestic income

RELPX/RELPM is the relative price of exported/imported goods to foreign substitutes (in foreign currency)

CUF is foreign capacity utilization

CUFCU is the ratio of foreign to domestic capacity utilization rates

U is the uncertainty index for trade-weighted nominal exchange rates

They found exchange rate uncertainty to have a significant negative impact on the volume of U.S. manufactured exports, and on the volume of German manufactured exports and imports. They concluded that exchange rate uncertainty does tend to depress international trade in manufactured goods.

Kenen and Rodrik (1986) examined the relationship between real exchange rate uncertainty and global trade flows of 11 developed countries during the period 1975-1984. They specifically focused on the impact of real exchange rate uncertainty on the volume of total manufactured imports of the industrial countries in their sample. They estimated the following equation for each country in the sample:

$$\ln Q_{Mt} = b_0 + b_1 R_{t-1} + b_2 \log Y_t + b_3 t + b_4 U + e_t$$

where:

Q_{Mt} is the volume of manufactured imports.

R_{t-1} is the natural log of the import-weighted real exchange rate of the importing country.

Y_t is an index of industrial activity for the importing country.

t is a trend term.

U is an index of real exchange rate uncertainty.

They estimated this equation for each country in the sample, using three alternative measures of real exchange

rate uncertainty. The first index used was the standard deviation of the monthly percentage change in the real exchange rate. The second was the standard error of the real exchange rate obtained from a log-linear trend equation, and the third was the standard error from a first-order autoregressive equation. Each index was calculated on the basis of data for 12-month and 24-month periods.

They found real exchange rate uncertainty to depress import volume for four countries in the sample (Canada, Germany, U.K. and the U.S.). These findings were found to be fairly robust across alternative specifications of real exchange rate uncertainty. In addition, real exchange rate uncertainty was not found to be positively associated with trade volume for any country in the sample.

Thursby and Thursby (1985) conducted two tests to determine the influence of exchange rate uncertainty on the exports of twenty industrial countries over the period 1973-1977. First, they looked at the impact of uncertainty on aggregate trade flows using cross-sectional data. They calculated three indices of uncertainty: the mean percent change of the exchange rate, the mean of the absolute value of percentage changes in the exchange rate, and the standard deviation of percent changes in the exchange rate over the sample period. They calculated these indices for three different exchange rates (all trade-weighted): the nominal exchange rate, the CPI-deflated real exchange rate and the WPI-deflated real exchange rate. They regressed the growth

in exports for the twenty countries over the sample period against each of the variability measures. The relationship was not found to be significant for any of the measures.

The authors then took a different approach, looking at bilateral trade flows and the uncertainty indices calculated for bilateral exchange rates. Uncertainty indices were calculated on the basis of monthly exchange rate data. Embodied in their regression equation is the Linder hypothesis, that predicts that countries with similar levels of income tend to trade with each other. They estimated a regression using pooled cross-section, time-series data, of the form:

$$X_t = b_0 + b_1 ADG_t + b_2 U_t + b_3 ME_t + e_t$$

where X_t is the value of exports from country i to country j for year t.

ADG_t is the absolute value of the difference between country i GNP and country j GNP

U_t is the uncertainty index

ME_t is an index of trend in the exchange rate

They found coefficients on the uncertainty variables in many cases to be negative and statistically significant. This was particularly the case for indices based on the nominal exchange rate and the CPI-deflated real exchange rate. They concluded that while the effect of uncertainty on aggregate trade flows appears to be minimal, it does appear to be negatively and significantly related to bilateral trading activity.

Thursby and Thursby (1987) tested for the effects of nominal and real exchange rate uncertainty on bilateral trade flows for 17 industrial countries during the period 1974-82. Their measure of exchange rate uncertainty was defined as the variance of the spot market exchange rate around its trend, where the trend equation allowed for both linear and quadratic trend. The nominal exchange rate variable used was the spot rate, and the real exchange rate variable was defined as the ratio of the spot rate to the consumer price index.

They estimated the reduced form of a supply and demand model. The estimated equation related the value of exports from country i to country j to twelve independent variables: the expected cost of foreign currency (an index similar to that of Hooper and Kohlhagen), the importing country's tastes, an index of import prices of the exports of other countries, an index of net export prices of a country's exports relative to other countries, levels of income and the CPI at home and abroad, tariffs, transport costs, and uncertainty.

They estimated an equation for each of the 17 countries, using annual data on that country's exports to 16 other countries during the nine year sample period. They found negative, statistically significant coefficients for exchange rate uncertainty for 10 countries in the sample. They found no significant difference between the effect of real and nominal exchange rate variability on trade.

In one of the few studies concerning the relationship between trade and real exchange rate uncertainty in a developing country, Coes (1981) studied the impact of reduced real exchange rate uncertainty in Brazil (following the 1968 adoption of the crawling peg) on export activity. He tested for the effects of real exchange rate uncertainty on the exports of 13 industrial sectors in Brazil during the period 1957-1974. He used the nominal cruzeiro/dollar rate times the ratio of the U.S. and Brazilian WPIs as his real exchange rate variable, and defined his uncertainty index as the integral difference in the cumulative distribution of the monthly real exchange rate and the "certain" or mean exchange rate for that year. He estimated the following equation for each of the 13 sectors:

$$(X/Q)_{it} = b_0 + b_1(1/U)_t + b_2P_{it} + b_3CU_t + e_{it}$$

where X/Q is the export coefficient for each sector

U is the real exchange uncertainty index

P_i is the relative price of sector i's output

CU is an index of Brazilian capacity utilization

Coes hypothesized a nonlinear relationship between uncertainty and export performance. He found that reduced real exchange rate uncertainty was associated with significantly higher exporting activity in 10 of the 13 manufacturing sectors examined, while he found a positive, but weaker association between reduced real exchange rate uncertainty and primary goods exports in 7 out of 9 primary goods sectors examined.

4. Empirical Evidence

The research efforts described above have yielded some evidence that exchange rate uncertainty affects trade. However, as noted before, most of this research has focused on industrial countries. The intent of this research is to test the hypothesis regarding developing countries that was developed in Chapter 3.

As described above, the methods used in defining the real exchange rate and uncertainty indices in this study are similar in many ways to those of the studies surveyed above. However, the methodology of this study differs from previous approaches in several important ways. First, for reasons explained above, the uncertainty indices used were trade-weighted averages of uncertainty indices calculated on the basis of bilateral exchange rates, rather than indices calculated on the basis of trade-weighted exchange rates. This approach was argued to be more appropriate for a study using data from developing countries. Second, unlike many of the studies described above, exporters in the model below are not able to hedge against exchange risk, due to the lack of forward exchange markets in developing countries. Third, this study focuses on the long-run effects of uncertainty on trade, using indices calculated with annual data over ten and twenty year periods. Fourth, this study estimates export supply equations only, an approach that is

appropriate for developing countries that face elastic world demand for their exports. And finally, the model in this study was estimated with cross-sectional data. The model in Chapter 3 was used as a basis for determining the form of the model to be estimated in this investigation of the relationship between exchange rate uncertainty and trade.

The model of the previous chapter suggests that, for any firm producing manufactured goods, there is a simple negative relationship between manufactured export levels and real exchange rate uncertainty. Thus, for any firm, with data from 1960-81, the following specification is suggested (exports refers to manufactured exports):

$$exports_{1981} = f(exports_{1960}, uncertainty_{1960-1981})$$

That is, for any firm, the level of manufactured exports achieved by that firm by 1981 will be a function of the firm's manufactured exports at the beginning of the period (1960), and the degree of exchange rate uncertainty experienced by the firm during the period 1960-81. The model would predict that firms experiencing lower level of exchange rate uncertainty during the period would choose higher levels of exports throughout the period, and so would have a higher level of 1981 exports (relative to their 1960 exports) than firms experiencing a high degree of exchange rate uncertainty. Since all firms within a country will experience the same degree of real exchange rate uncertainty, then by adding up their output one could obtain an equation like that above, relating a country's total

exports to the uncertainty in that country's real exchange rate.

Since the degree of exchange rate uncertainty during the period 1960-81 was found to differ between countries, one way of testing the hypothesis derived in the previous chapter would be to use cross-sectional data relating various country's exporting activity to their degree of real exchange rate uncertainty. To do this it was necessary to add variables to the estimating equation to account for differences between countries (such as country size and trade policies) that could also explain differences in exporting activity.

To account for differences in country size, the manufactured export variable was redefined as a ratio of manufactured exports to gross domestic product. In addition, the rate of growth of real per capita GNP was included as an independent variable to represent rate of economic development. This is because it has been observed (Kuznets, 1973), that economic development tends to be associated with an increase in the production of manufactures (both for the domestic and foreign market) relative to the production of agricultural goods. This kind of structural shift would be expected to occur in rapidly developing countries, which would imply a larger change in the ratio of manufactures, and manufactured exports to GDP over the sample time period than countries experiencing slow rates of growth and development.

And finally, it has long been recognized that trade policy affects export behavior by biasing incentives away from or towards export markets. Countries that have followed "inward-oriented" trade policies have typically afforded domestic markets a high degree of effective protection, while making exports uncompetitive through high tariffs on imported inputs. "Outward-oriented" countries, on the other hand, have tended to neutralize the incentive structure by removing the disincentives to export through export subsidies and other measures, and reducing effective protection levels on the domestic market. While it is difficult to quantify the degree of outward- or inward-orientation that characterizes the trade policy of each country in the sample, most economists would agree (Bhagwati, 1978), (Krueger, 1978, 1985), Balassa (1971,1978), World Bank (1987), that four East Asian countries have distinguished themselves from other developing countries by pursuing particularly outward-oriented policies. These are the East Asian countries of Korea, Singapore, Taiwan and Hong Kong. For this reason, a dummy variable was added to the regression equation in order to account for the outward-oriented policies that were implemented during the sample period by the governments of the four E. Asian countries.[5]

The regression equation then takes the form:

$$(4.1) \quad exp/GDP_{81} = b_0 + b_1(uncer_{60-81}) + b_2(\text{inc. growth}) + b_3(exp/GDP_{60}) + b_4(\text{E. Asian dummy}) + u$$

However, it would not be appropriate to estimate this equation with ordinary least squares, since there is much evidence that economic growth, one of the dependent variables, is not exogenous with respect to exporting behavior. There is a large body of literature that argues that exports may be an important determinant of economic growth rates. As was discussed in some detail in Chapter 1, this argument is supported by a considerable amount of empirical evidence. If the causation between economic growth and manufactured exports is, in fact, bi-directional, then the equation estimated above is misspecified, because economic growth is not exogenous with respect to exports. This misspecification would lead to inconsistent and biased parameter estimates. For this reason, an alternative specification of the equation to be estimated relating real exchange rate uncertainty to export performance is described below.

In order to allow for bi-directional causality between economic growth and exports, a second equation was added to the model. The basis for that equation is a simple growth model relating real per capita GDP growth to the average annual growth rates of gross domestic investment, and of the population. The model can then be represented as a two-equation system of the form :

$$(4.2) \quad exp/GDP_{81} = b_0 + b_1(uncer_{60-81}) + b_2(\text{inc. growth}) + b_3(exp/GDP_{60}) + b_4(\text{E. Asian dummy}) + u$$

(4.3) $\text{inc. growth}_{60-81} = c_0 + c_1(\text{invest}_{60-81}) + c_2(\text{pop. growth}_{60-81}) + c_3(\text{exp/GDP}_{60}) + c_4(\text{exp/GDP}_{81}) + v$

The variable invest_{60-81} in equation (4.3) is the average annual real growth rate over the period 1960-81 of gross domestic investment, and the variable (pop. growth_{60-81}) is average annual rate of growth of the population over the same period.

The export equation was estimated using indices U1-U3, for 46 countries, and indices U4-U6, for 23 countries, with the uncertainty indices calculated over the period 1960-81.[6] The aggregate manufactured exports variable used was the sum of SITC 5, 6, 7 and 8 exports.[7] Regressions were also run using individual SITC sector exports as the dependent variable. The SITC categories are as follows:

SITC 5: chemicals

SITC 6: basic manufactured goods

SITC 7: machinery and transport equipment

SITC 8: other manufactured goods

The econometric methodology employed to estimate the export equation was weighted two-stage least squares. The equations were weighted to adjust for heteroscedasticity in the residuals. The weight employed was the log of the inverse of the 1960 ratio of manufactured exports to GDP.[8] The method of two-stage least squares was used to avoid simultaneity bias. While some countries with few or nonexistent manufactured exports in 1960 were able to expand

their exporting activity greatly over the sample period, others made very little progress. In contrast, most countries with a solid manufactured export base in 1960 were able to increase steadily their export levels over the sample period. Therefore, the variance of the error term for countries with few or no manufactured exports in 1960 was higher than that of countries with a higher initial level of manufactured exports.

Since these equations are simultaneous, a weighted two-staged least squares technique was used to estimate the equation relating real exchange rate uncertainty to exports. This involved creating an instrument for the per capita income growth variable by regressing per capita real income on all predetermined variables in the equation system. The export equation was then estimated, substituting for the per capita income growth variable the instrument, and thus eliminating the problems created by the possible correlation between the income growth variable and the error term.

The full set of results from the two-stage weighted least squares estimation are found in Tables 1E and 2E in Appendix E. This includes results for disaggregated SITC sectors, and regressions using the wage-index real exchange rate uncertainty variables. Table 4.4 displays the results for aggregate manufactured exports, for uncertainty indices U1-U3.

Instead of the R^2 statistic, a goodness-of-fit (GOF) index is presented in the tables.[9] The standard R^2

TABLE 4.4 : REGRESSION RESULTS, TWO-STAGE WEIGHTED LEAST SQUARES

Sample period = 1960-1981

1. Regression with U1 uncertainty index (n=46)

Dependent variable	constant	U1	income growth	1960 ratio	E. Asia	GOF
1981 SITC (5-8)	.212* (2.0)	-.835* (2.5)	-.030 (1.1)	.434* (4.3)	.612* (4.9)	.79

2. Regression with U2 uncertainty index (n=46)

Dependent variable	constant	U2	income growth	1960 ratio	E. Asia	GOF
1981 SITC (5-8)	.230* (2.0)	-.874* (2.5)	.032 (1.2)	.390* (3.9)	.610* (4.7)	.78

3. Regression with U3 uncertainty index (n=46)

Dependent variable	constant	U3	income growth	1960 ratio	E. Asia	GOF
1981 SITC (5-8)	.270** (1.9)	-.917* (2.2)	-.041 (1.2)	.357* (3.3)	.655* (4.4)	.75

t-statistics in parentheses.
* indicates significance at the 5 percent level.
** indicates significance at the 10 percent level.

statistic would not indicate goodness of fit for the original (unweighted) model, since it is calculated from the weighted regression. The GOF index was calculated by applying the efficient parameter estimates from the weighted regression to the unweighted data to obtain fitted values for the dependent variable. The GOF index is the square of the correlation coefficient for fitted values for the dependent variable and the dependent variable. The GOF indices are fairly high for cross-sectional data (except in the regressions using the disaggregated export data).

As shown in the tables in Appendix E, The impact of uncertainty appears to weaken when looking at exports from individual SITC sectors. In most cases, the uncertainty variables are found to have coefficients that are statistically insignificant from zero. In addition, the low significance of other variables and the low GOF indices in many cases suggest that there are other influences at the disaggregated level that are affecting exports in individual SITC sectors. However, the model performs well when applied to the aggregate data, and there the impact of uncertainty appears to be significant and negative.

In Table 2E in Appendix E, the results from the regressions using wage-index based uncertainty indices are presented. Unfortunately, a time series index of wage costs was only available for 23 countries in the sample. Therefore, the results of these regressions cannot be compared directly with the results displayed in Table 4.3.

The uncertainty indices were found to have negative coefficients in the aggregate export equations, but the coefficients were only found to be significant at the 15, or 20 percent level.

In order to examine how the impact of uncertainty differed between the two decades examined, the sample was broken down into two parts, the period 1960-1970, and the period 1970-1981. The trade-weighted trend and autoregressive, and moving average equation indices were calculated for the two periods (U1A,U2A,and U3A) and (U1B, U2B,and U3B), respectively. Major trading partners for the two subperiods were calculated using the methodology described above. In many cases the major trading partners of the sample countries differed between the two periods.

The indices of real exchange rate uncertainty for the two periods are listed in Tables 4.5 and 4.6 (countries are listed according to the magnitude of their trade-weighted index). Again, the method used to calculate the indices appears to have made little difference in the relative ranking of each country according to degree of real exchange rate uncertainty. However, it is clear that the degree of real exchange rate uncertainty experienced by all countries in the sample was higher during the period 1970-81 than the period 1960-70. For example, the average value of the uncertainty index (U1) rose from 0.06 in the period 1960-70, to 0.10 in the period 1970-1981.

TABLE 4.5
Trade-Weighted Uncertainty Indices
1960-1970

	U1A		U2A		U3A
Yugoslavia	0.254	Yugoslavia	0.245	Turkey	0.229
Turkey	0.187	Philippines	0.235	Uruguay	0.218
Philippines	0.186	Uruguay	0.227	Philippines	0.214
Uruguay	0.178	Chile	0.162	Yugoslavia	0.210
Chile	0.126	Fiji	0.149	Chile	0.172
Israel	0.114	Israel	0.139	S. Korea	0.141
Fiji	0.105	Ghana	0.125	Israel	0.139
Egypt	0.090	Paraguay	0.115	Fiji	0.136
Ghana	0.081	Egypt	0.111	Paraguay	0.128
Argentina	0.081	Argentina	0.111	Ghana	0.122
Brazil	0.079	Turkey	0.106	Argentina	0.112
India	0.076	Venezuela	0.103	Brazil	0.110
Paraguay	0.075	India	0.102	Egypt	0.105
Venezuela	0.070	Brazil	0.101	Venezuela	0.095
Peru	0.068	S. Korea	0.100	Colombia	0.077
S. Korea	0.068	Colombia	0.084	India	0.075
Colombia	0.060	Peru	0.066	Bolivia	0.073
Ecuador	0.055	Ecuador	0.064	Sudan	0.072
Spain	0.044	Tunisia	0.054	Spain	0.067
Sudan	0.043	Bolivia	0.054	Nigeria	0.062
Tunisia	0.042	Spain	0.052	Peru	0.062
Nigeria	0.042	Nigeria	0.052	Ecuador	0.061
Bolivia	0.039	Sudan	0.049	Suriname	0.053
Pakistan	0.038	Kenya	0.047	Tunisia	0.053
Dominican Rep	0.034	Pakistan	0.047	Ivory Coast	0.052
Morocco	0.033	Portugal	0.043	Portugal	0.051
Taiwan	0.031	Hong Kong	0.041	S. Africa	0.049
Sri Lanka	0.029	S. Africa	0.041	Cameroon	0.047
Ivory Coast	0.029	Suriname	0.039	Pakistan	0.045
Kenya	0.027	Costa Rica	0.039	Dominican Rep	0.042
Costa Rica	0.026	Guyana	0.038	Guyana	0.036
S. Africa	0.025	Sri Lanka	0.037	Taiwan	0.036
Thailand	0.025	Dominican Rep	0.037	Sri Lanka	0.036
Greece	0.025	Taiwan	0.034	Costa Rica	0.035
Portugal	0.024	Morocco	0.032	Morocco	0.034
Cameroon	0.024	Cameroon	0.032	Kenya	0.032
Guyana	0.024	Ivory Coast	0.030	Malaysia	0.030
Hong Kong	0.022	Malaysia	0.026	Thailand	0.030
Suriname	0.020	Singapore	0.024	Hong Kong	0.029
El Salvador	0.020	Greece	0.023	El Salvador	0.024
Singapore	0.018	Thailand	0.019	Greece	0.024
Malaysia	0.017	Honduras	0.019	Singapore	0.024
Honduras	0.015	El Salvador	0.018	Honduras	0.023
Mexico	0.014	Mexico	0.015	Mexico	0.019
Guatemala	0.011	Guatemala	0.014	Guatemala	0.016
Panama	0.010	Panama	0.013	Panama	0.013

TABLE 4.6
Trade-Weighted Uncertainty Indices
1970-1981

U1B		U2B		U3B	
Paraguay	0.315	Paraguay	0.361	Paraguay	0.436
Egypt	0.217	Ghana	0.311	Ghana	0.429
Pakistan	0.206	Egypt	0.281	Argentina	0.296
Ghana	0.204	Argentina	0.211	Egypt	0.249
Sri Lanka	0.176	Bolivia	0.197	Pakistan	0.241
Chile	0.168	Chile	0.194	Guyana	0.212
Peru	0.163	Sri Lanka	0.193	Uruguay	0.194
Bolivia	0.162	Nigeria	0.190	Nigeria	0.193
Singapore	0.156	Uruguay	0.180	Bolivia	0.193
Nigeria	0.147	Peru	0.159	Sri Lanka	0.167
Mexico	0.128	Pakistan	0.154	Chile	0.159
Argentina	0.127	Turkey	0.144	Sudan	0.154
Guyana	0.120	Singapore	0.141	Turkey	0.144
Taiwan	0.114	Israel	0.140	Peru	0.135
Israel	0.106	Philippines	0.137	Israel	0.133
India	0.103	India	0.131	Philippines	0.128
Sudan	0.096	Guyana	0.131	Singapore	0.125
Thailand	0.094	Mexico	0.130	Yugoslavia	0.122
Philippines	0.093	S. Korea	0.123	S. Korea	0.119
Turkey	0.086	Thailand	0.120	India	0.114
Portugal	0.084	Taiwan	0.109	Ecuador	0.113
Yugoslavia	0.080	Brazil	0.108	Ivory Coast	0.111
Uruguay	0.077	Yugoslavia	0.098	Thailand	0.109
Kenya	0.076	Colombia	0.098	Spain	0.107
Cameroon	0.073	Greece	0.097	S. Africa	0.107
S. Africa	0.069	Hong Kong	0.095	Cameroon	0.104
S. Korea	0.068	Cameroon	0.095	Suriname	0.103
Brazil	0.063	S. Africa	0.091	Colombia	0.100
Malaysia	0.068	El Salvador	0.086	El Salvador	0.097
Greece	0.063	Portugal	0.085	Mexico	0.093
El Salvador	0.062	Malaysia	0.084	Brazil	0.091
Hong Kong	0.061	Suriname	0.083	Portugal	0.089
Ivory Coast	0.058	Spain	0.078	Tunisia	0.088
Suriname	0.057	Tunisia	0.078	Hong Kong	0.085
Spain	0.053	Sudan	0.078	Greece	0.085
Ecuador	0.052	Ivory Coast	0.077	Morocco	0.084
Fiji	0.051	Kenya	0.075	Taiwan	0.084
Colombia	0.050	Costa Rica	0.072	Fiji	0.083
Guatemala	0.048	Domin. Repub.	0.070	Malaysia	0.082
Tunisia	0.048	Fiji	0.066	Guatemala	0.082
Costa Rica	0.047	Guatemala	0.067	Domin. Repub.	0.079
Venezuela	0.046	Ecuador	0.066	Costa Rica	0.074
Panama	0.046	Panama	0.064	Kenya	0.072
Morocco	0.035	Honduras	0.055	Panama	0.070
Honduras	0.033	Venezuela	0.052	Honduras	0.066
Domin. Repub.	0.031	Morocco	0.049	Venezuela	0.065

This increase in real exchange rate uncertainty in the period 1970-81 is explained partly by the general movement by industrial countries toward floating exchange rates that occurred during the early 1970's, and served to increase exchange rate volatility on a world-wide scale. Also, the 1970s were a period of high and variable inflation rates for most countries. Therefore, both nominal exchange rate movements and domestic price movements contributed to the increased real exchange rate uncertainty experienced by most countries in the later period.

But while the degree of exchange rate uncertainty increased during the 1970s, the regression results displayed in Table 4.7 indicate the real exchange rate uncertainty had a smaller impact on LDC trade in the 1970s than it did in the previous decade. This is curious, and in direct contrast to the results of Cushman (1983), who found an increased impact of real exchange rate uncertainty on the trade flows of industrial countries in the 1970s. In the regressions for the period 1960-70, the coefficients on all of the real exchange rate variables were found to be negative, statistically significant at the five percent level, and in the range of -0.66 to -0.83. The coefficients on the uncertainty variables for the 1970-81 regressions were found to be much smaller (around -0.19), and were at best significant at the twenty percent level. Therefore, while the extent of real exchange rate uncertainty rose during the 1970s, the ability of differences in degree of

TABLE 4.7: REGRESSION RESULTS, TWO-STAGE WEIGHTED LEAST SQUARES

Sample Subperiods

A. Sample period = 1960-1970
1. Regression with U1A uncertainty index (n=46)

Dependent variable	constant	U1A	income growth	1960 ratio	E. Asia	GOF
1970 SITC (5-8)	.040 (.5)	-.646* (2.5)	.000 (.0)	.725* (7.3)	.160** (1.7)	.77

2. Regression with U2A uncertainty index (n=46)

Dependent variable	constant	U2A	income growth	1960 ratio	E. Asia	GOF
1970 SITC (5-8)	.043 (.6)	-.646** (2.5)	.001 (.03)	.743* (7.2)	.152** (1.8)	.77

3. Regression with U3A uncertainty index (n=46)

Dependent variable	constant	U3A	income growth	1960 ratio	E. Asia	GOF
1970 SITC (5-8)	.056 (.8)	-.744* (2.9)	.000 (.0)	.740* (7.6)	.146 (1.6)	.75

t-statistics in parentheses.
* indicates significance at the 5 percent level.
** indicates significance at the 10 percent level.

TABLE 4.7 (con't.): REGRESSION RESULTS, TWO-STAGE WEIGHTED LEAST SQUARES
Sample Subperiods

B. Sample period = 1970-1981

1. Regression with U1B uncertainty index (n=46)

Dependent variable	constant	U1B	income growth	1970 ratio	E. Asia	GOF
1981 SITC (5-8)	.086**	-.110	-.016	.636*	.440*	.86
	(1.9)	(.5)	(1.2)	(7.1)	(6.5)	

2. Regression with U2B uncertainty index (n=46)

Dependent variable	constant	U2B	income growth	1970 ratio	E. Asia	GOF
1981 SITC (5-8)	.098*	-.213	-.014	.624*	.430*	.87
	(2.4)	(1.3)	(1.2)	(7.7)	(7.3)	

3. Regression with U3B uncertainty index (n=46)

Dependent variable	constant	U3B	income growth	1970 ratio	E. Asia	GOF
1981 SITC (5-8)	.105*	-.193	-.017	.642*	.440*	.86
	(2.5)	(1.3)	(1.3)	(7.3)	(6.8)	

t-statistics in parentheses.
* indicates significance at the 5 percent level.
** indicates significance at the 10 percent level.

exchange rate uncertainty to explain cross-country variations in export performance appears to have weakened.

The table below lists the coefficients on the uncertainty variables for three uncertainty indices for all sample periods.

TABLE 4.8: SUMMARY TABLE
Coefficients on uncertainty variables in the regressions

	U1	U2	U3
1960-81 regressions:	-.84* (2.5)	-.87* (2.5)	-.92* (2.2)
1960-70 regressions:	-.65* (2.5)	-.65* (2.5)	-.74* (2.9)
1970-81 regressions:	-.11 (0.5)	-.21 (1.3)	-.19 (1.3)

t-statistics in parentheses.

* indicates significance at the 5 percent level.

In all three time periods, the hypothesized negative relation between exporting and real exchange rate uncertainty appears. For the 1960-81, and 1960-70 periods, the uncertainty variable coefficients are large, and are significant at the five percent level.

These indicate that real exchange rate uncertainty has had a very sizable long run impact on exporting behavior, and that (all other factors constant) countries with particularly high levels of real exchange rate uncertainty could generate a large increase in exporting activity if they could reduce their exchange rate

uncertainty levels. For example, these results indicate that if Argentina, with a U2 index for 1960-81 of 0.213, could have reduced its real exchange rate uncertainty over the twenty-one year period to that of about the level experienced by Peru (0.11), Argentina's total manufactured exports in 1981 would have been about $7.8 billion US dollars, instead of $1.9 billion.

5. Conclusion

It was argued in the previous chapter that firms operating in countries that have a high degree of real exchange rate uncertainty will choose to export fewer manufactured goods than firms in countries with relatively stable real exchange rates. This hypothesis has been shown to be consistent with actual trade data.

The coefficients on the uncertainty variables, in most of the regressions were sufficiently large that they suggest a significant impact of uncertainty on trade behavior. For this reason, countries attempting to achieve a more outward-oriented stance with regard to trade policy would be well advised to pay more attention to real exchange rate stability. For some countries, where the source of uncertainty is external, governments might want to consider making forward exchange contracts available to firms that export, so that they can hedge against exchange rate risk. In those countries where real exchange rate uncertainty is

the result of erratic monetary or exchange rate policies, this study suggests that macroeconomic policy may well be running at cross-purposes with trade policy objectives.

Notes to Chapter 4

1. In terms of the model, when spot market production was feasible, the derivative of expected profit with respect to q_c, (contract production), yielded the following first order condition:

$$E(S) = aq_c^m + \{(1-\tau)bq_c^m + (1-\tau)S_2\}, \text{ or}$$

$$E(S) = MC(q_c) + K, \quad \text{with } K > 0.$$

2. The wholesale price index could also serve as a proxy for production costs, but data on the WPI were not available for many countries in the sample. For most countries, CPI data and nominal exchange rate data were taken from the International Monetary Fund's International Financial Statistics. Data for Taiwan was taken from the publication Taiwan: Statistical Data Book. Nominal exchange rate data for Hong Kong was taken from Balassa and Williamson (1987). Data for Korea's nominal effective exchange rate (which included the value of export subsidies) were taken from Kim (1985). Wage index data were taken from International Labour Office: Yearbook of Labour Statistics.

3. For each country in the sample, a total of two to four "major trading partners" were identified. Table 1A-3A in Appendix A lists the major trading partners for the each country in the sample for the period 1960-81, 1960-70, and 1970-81, respectively. The weights assigned to each trading partner are also listed.

A major trading partner was defined as the United States and any country importing 10% or more of the country's total exports at both the beginning and end of the time period. For some countries, where only the United States satisfied that criterion, a second major trading partner was defined as the next-to-largest trading partner of that country. The weights reflect the proportion of total exports with major trading partners in the beginning and ending year of the sample period, that were accounted for by that particular trading partner. The weights were calculated with data from the IMF's Direction of Trade Yearbook.

4. However, where capital markets are weak, even expected variability could reduce exporting activity if firms cannot obtain loans in years when the exchange rate moves unfavorably. Since it is impossible to perfectly distinguish ex post between variability that was expected and that which was unexpected, the results presented in the next section may also reflect to some degree the effect of expected exchange rate variability on exporting activity.

5. In fact, while the E. Asia dummy did turn out to be highly significant, the addition of the variable did not affect the sign or significance of the uncertainty variables.

6. For some countries, data were not available for the full sample period, so uncertainty indices were calculated with data from only part of the sample period. Data for Cameroon were only available from 1962-81, and data for Korea were available from 1960-1979. Also, the index for Costa Rica was found to be highly sensitive to the inclusion of 1981, when there was a dramatic shift in exchange rate policy. For this reason, 1981 was omitted in calculating Costa Rica's uncertainty indices.

7. Manufactured export data were taken from the United Nations, Yearbook of International Trade Statistics. Data on population growth, investment growth, and GDP growth were taken from the World Bank, World Development Report, various years, and from IMF International Financial Statistics.

8. A few countries in the sample had no manufactured exports in 1960. In those cases, in creating an appropriate weight, the ratio of manufactured exports to GDP for 1960 was set to .00001.

9. See Pindyck and Rubinfeld, page 146.

APPENDICES

APPENDIX A

SOLVING DIFFERENCE EQUATIONS

i) Solving for the roots of the characteristic equation.

The roots of the characteristic equation are:

$$\lambda_1 = 1/2\{(\beta(1+r)/\gamma + 2 + r\} + 1/2\{(\beta(1+r)/\gamma + 2 + r\}^2 - 4(1+r)\}^{1/2}$$

$$\lambda_2 = 1/2\{(\beta(1+r)/\gamma + 2 + r\} - 1/2\{(\beta(1+r)/\gamma + 2 + r)^2 - 4(1+r)\}^{1/2}$$

ii. The roots of the characteristic equation in the social planners problem.

The roots of the characteristic equation are:

$$\lambda_1^* = 1/2\{(\beta(1+r)/\gamma + 2 + r - \delta/\gamma\} + 1/2\{(\beta(1+r)/\gamma + 2 + r - \delta/\gamma\}^2 - 4(1+r)\}^{1/2}$$

$$\lambda_2^* = 1/2\{(\beta(1+r)/\gamma + 2 + r - \delta/\gamma\} - 1/2\{[\beta(1+r)/\gamma + 2 + r - \delta/\gamma]^2 - 4(1+r)\}^{1/2}$$

As was explained in the text above, to ensure that the production possibilities frontier always has a negative slope, we must restrict δ to be less than β. If we assume $\delta < \beta$ it is clear by inspection that the dominant root (λ_1^*) is positive, real, greater than one, and smaller than the root found in the firms' problem. Since it must be the case that $\lambda_2 = (1+r)/\lambda_1$, (see Sargent on the solution of a

system of Euler equations, p. 197), then the second root from the social planner's problem must be larger than that of the firm's problem. Therefore, the social planner's solution to the difference equation,

$$X_t = \lambda_2^* E_{t-1} + \lambda_2^*/\gamma \sum_{t=0}^{inf} (1/\lambda_1^*)^j P_{t+j},$$

will be a supply curve for exports that involves more exporting than the firms supply schedule, for any sequence of prices $\{P_t\}$.

APPENDIX B

CHAPTER 2 SIMULATIONS: SENSITIVITY ANALYSIS

1. A change in the slope of the production possibilities frontier (β).

parameter	assumed value
γ	0.3
β	0.17
r	0.04
δ	0.07
E_{-1}	35

These parameter values implied the following:

$\lambda_1 = 2.144$; $\lambda_1^* = 2.053$

$\lambda_2 = 0.485$; $\lambda_2^* = 0.507$

Results:

time	Optimal subsidy	Time-consistent subsidy
0	.436	-
1	.288	.288
2	.222	.222
3	0.201	0.201
4	0.180	0.180
5	0.175	0.175
6	0.165	0.165
7	0.173	0.173
8	0.172	0.172
9	0.172	0.170
10	0.157	0.160

time	Optimal subsidy	Time-consistent subsidy
11	0.150	0.150
12	0.156	0.156
13	0.145	0.145
14	0.175	0.175

2. A change in the interest rate, to 0.05.

parameter	assumed value
γ	0.3
β	0.2
r	0.05
δ	0.07
E_{-1}	35

These parameter values implied the following:

$\lambda_1 = 2.292$; $\lambda_1^* = 1.990$

$\lambda_2 = 0.458$; $\lambda_2^* = 0.529$

Results:

time	Optimal subsidy	Time-consistent subsidy
0	1.508	-
1	1.036	1.036
2	0.817	0.817
3	0.745	0.744
4	0.671	0.671
5	0.652	0.652
6	0.616	0.616
7	0.641	0.641

time	Optimal subsidy	Time-consistent subsidy
8	0.638	0.638
9	0.635	0.635
10	0.582	0.582
11	0.559	0.559
12	0.574	0.574
13	0.533	0.533
14	0.633	0.633

3. A change in the "break-in costs" parameter, to 0.25.

parameter	assumed value
γ	0.25
β	0.2
r	0.04
δ	0.07
E_{-1}	35

These parameter values implied the following:

$\lambda_1 = 2.447$; $\lambda_1^* = 2.096$

$\lambda_2 = 0.425$; $\lambda_2^* = 0.496$

Results:

time	Optimal subsidy	Time-consistent subsidy
0	1.455	-
1	0.978	0.983
2	0.773	0.778
3	0.720	0.726
4	0.649	0.659
5	0.628	0.659

time	Optimal subsidy	Time-consistent subsidy
6	0.629	0.650
7	0.603	0.614
8	0.642	0.648
9	0.643	0.647
10	0.582	0.588
11	0.554	0.565
12	0.564	0.587
13	0.535	0.546
14	0.625	0.632

APPENDIX C

SIMULATION ANALYSIS FOR UNCERTAINTY MODEL: SENSITIVITY ANALYSIS

1. A reduction in contract production costs (a reduction in the parameter a).

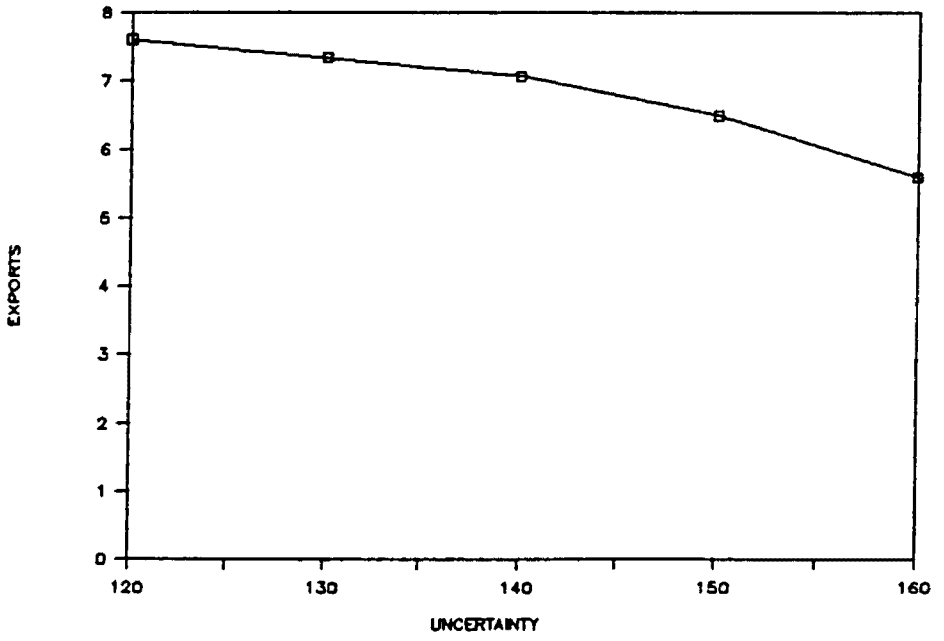


FIGURE C.1

2. An increase in spot market production costs (an increase in the parameter b).

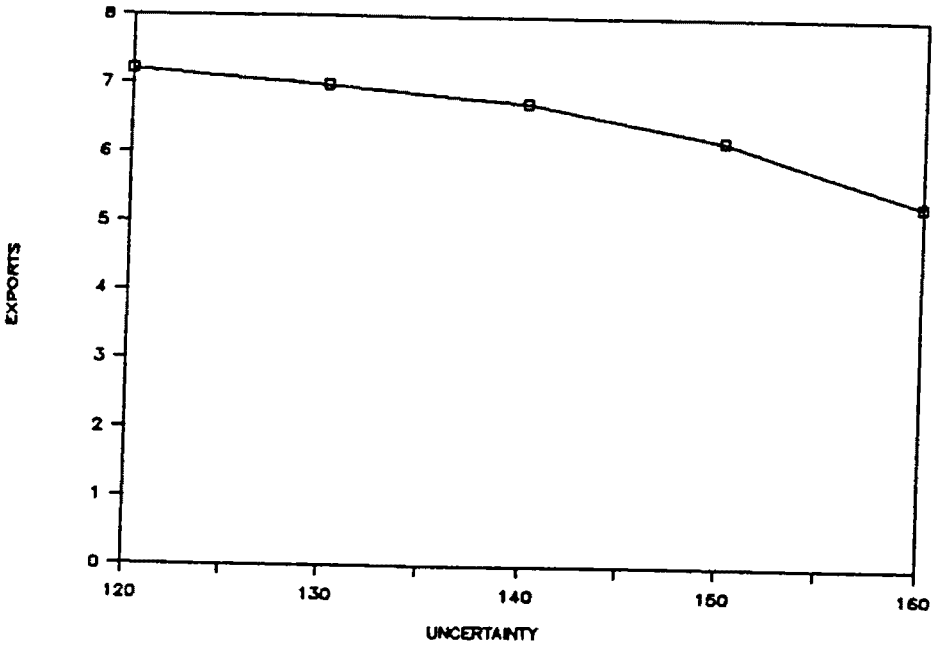


FIGURE C.2

3. A change production cost parameter m.

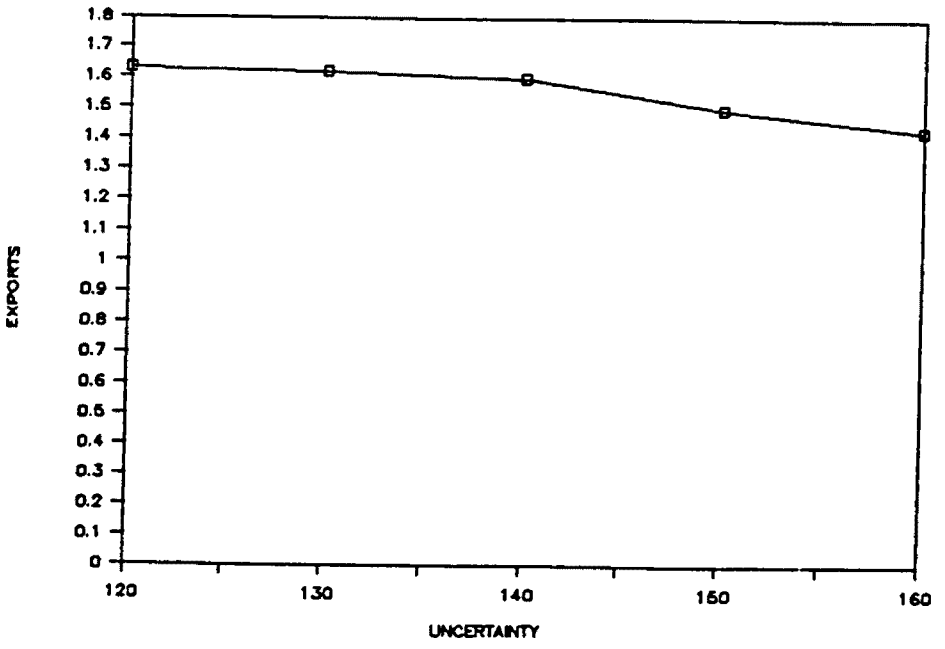


FIGURE C.3

APPENDIX D

Countries in the Sample and their Major Trading Partners for 1960-81

Country	Trading Partners	Weight
Argentina	U.S.	.725
	Germany	.275
Bolivia	U.S.	.79
	U.K.	.21
Brazil	U.S.	.75
	Germany	.25
Cameroon	U.S.	.46
	France	.33
	Netherlands	.21
Chile	U.S.	.59
	Germany	.41
Colombia	U.S.	.725
	Germany	.275
Costa Rica	U.S.	.71
	Germany	.29
Cote d'Ivoire	France	.69
	U.S.	.31
Dominican Republic	U.S.	.96
	Netherlands	.04
Ecuador	U.S.	.77
	Germany	.23
El Salvador	U.S.	.55
	Germany	.45
Egypt	Italy	.85
	U.S.	.15
Fiji	U.K.	.83
	U.S.	.17
Ghana	U.S.	.57
	U.K.	.43

Country	Trading Partners	Weight
Greece	Germany	.63
	U.S.	.37
Guatemala	U.S.	.76
	Germany	.24
Guyana	U.S.	.5
	U.K.	.5
Honduras	U.S.	.87
	Germany	.13
Hong Kong	U.S.	.79
	U.K.	.21
India	U.S.	.42
	Japan	.31
	U.K.	.27
Kenya	U.K.	.55
	U.S.	.45
Korea	U.S.	.62
	Japan	.38
Malaysia	Japan	.62
	U.S.	.38
Mexico	U.S.	.9
	Japan	.1
Morocco	France	.73
	Italy	.23
	U.S.	.04
Nigeria	Netherlands	.48
	U.K.	.47
	U.S.	.05
Pakistan	U.K.	.38
	U.S.	.32
	Japan	.3
Panama	U.S.	.88
	Japan	.12
Paraguay	Argentina	.67
	U.S.	.33
Peru	U.S.	.66
	Japan	.27
	Germany	.07

Country	Trading Partners	Weight
Philippines	U.S.	.63
	Japan	.37
Portugal	U.S.	.62
	U.K.	.21
	W. Germany	.19
Singapore	U.S.	.56
	Japan	.44
South Africa	U.S.	.51
	U.K.	.49
Spain	France	.38
	Germany	.24
	U.K.	.2
	U.S.	.18
Sri Lanka	U.S.	.51
	U.K.	.49
Sudan	Italy	.56
	U.S.	.44
Suriname	U.S.	.73
	Netherlands	.27
Taiwan	U.S.	.76
	Japan	.24
Thailand	Japan	.54
	U.S.	.46
Tunisia	France	.58
	Italy	.275
	U.S.	.145
Turkey	W. Germany	.58
	U.S.	.42
Uruguay	U.S.	.585
	W. Germany	.415
Venezuela	U.S.	.8
	Canada	.12
	Italy	.08
Yugoslavia	Italy	.44
	Germany	.38
	U.S.	.18

APPENDIX E

TABLE 1E

REGRESSION RESULTS: TWO-STAGE WEIGHTED LEAST SQUARES

Dependent variable = the ratio of 1981 exports/gdp in various manufacturing sectors.

pcinc growth = average annual growth rate of real per capita GDP.

1960 ratio is the 1960 value of the dependent variable.

E. Asia is the dummy variable for the four E. Asian countries.

GOF is an index of goodness of fit (for the unweighted equation.)

1. Regressions with U1 uncertainty index (n=46)

Dependent variable	constant	U1	pcinc growth	1960 ratio	E. Asia	GOF
sitc 5	.032 (1.3)	-.116 (1.3)	-.005 (.7)	.171** (1.6)	.040** (1.7)	.12
sitc 6	.089* (2.1)	-.120 (1.0)	-.015 (1.3)	.016 (.2)	.172* (3.1)	.38
sitc 7	.004 (.2)	.014 (.3)	.001 (.3)	2.420* (22.9)	.100* (6.0)	.96
sitc 8	-.023 (1.2)	.057 (1.0)	.009** (1.8)	1.160* (34.6)	.025* (1.2)	.95
sitc(5-8)	.212** (2.0)	-.835* (2.5)	-.030 (1.1)	.434* (4.3)	.612* (4.9)	.79

TABLE 1E (con't.)

2. Regressions with U2 uncertainty index. (n=46)

Dependent variable	constant	U2	pcinc growth	1960 ratio	E. Asia	GOF
sitc5	.029 (1.3)	-.101 (1.2)	-.004 (.7)	.143** (1.6)	.034** (1.8)	.12
sitc 6	.091* (2.1)	-.131 (1.1)	-.015 (1.3)	.013 (.2)	.168* (3.2)	.37
sitc 7	.006 (.3)	-.001 (.0)	.001 (.2)	2.420* (22.9)	.105* (6.4)	.96
sitc 8	-.022 (1.1)	.055 (.9)	.008** (1.8)	1.160* (34.5)	.027 (1.3)	.95
sitc(5-8)	.230* (2.0)	-.874* (2.5)	-.032 (1.2)	.390* (3.9)	.610* (4.7)	.78

3. Regressions with U3 uncertainty index. (n=46)

Dependent variable	constant	U3	pcinc growth	1960 ratio	E. Asia	GOF
sitc 5	.033 (1.4)	-.113 (1.4)	-.004 (.8)	.144** (1.6)	.036** (1.8)	.12
sitc 6	.100* (2.1)	-.176 (1.4)	-.015 (1.3)	.013 (.2)	.168* (3.1)	.38
sitc 7	.009 (.5)	-.020 (.3)	.001 (.2)	2.430* (22.8)	.105* (6.1)	.96
sitc 8	-.022 (1.0)	.048 (.7)	.008** (1.7)	1.160* (34.0)	.027 (1.2)	.95
sitc(5-8)	.27** (1.9)	-.917* (2.2)	-.041 (1.2)	.357* (3.3)	.655* (4.4)	.75

TABLE 2E

REGRESSIONS RESULTS: WEIGHTED LEAST SQUARES
UNCERTAINTY INDICES CALCULATED WITH WAGE-INDEX DATA

1. Regressions with U4 uncertainty index (n=23)

Dependent variable	constant	U4	pcinc growth	1960 ratio	E. Asia	GOF
sitc 5	.043**	-.080	-.009	.180*	.061*	.72
	(1.7)	(1.2)	(1.3)	(2.1)	(2.2)	
sitc 6	.046	-.018	-.003	.034	.116*	.82
	(1.5)	(.2)	(.4)	(.2)	(3.1)	
sitc 7	.005	.018	.001	2.480*	.094*	.97
	(.3)	(.3)	(.3)	(17.9)	(4.5)	
sitc 8	-.008	.026	.006*	-.138	.072*	.99
	(.7)	(.6)	(2.1)	(.6)	(5.4)	
sitc(5-8)	.128**	-.264	-.018	.745*	.428*	.95
	(2.0)	(1.3)	(1.1)	(5.3)	(6.8)	

2. Regressions with U5 uncertainty index (n=23)

Dependent variable	constant	U5	pcinc growth	1960 ratio	E. Asia	GOF
sitc 5	.026**	-.082	-.004	.150*	.045*	.89
	(1.7)	(1.6)	(1.1)	(2.9)	(3.1)	
sitc 6	.037	.043	-.003	.050	.116*	.82
	(1.0)	(.3)	(.4)	(.3)	(3.1)	
sitc 7	.001	.038	.001	2.500*	.092*	.97
	(.0)	(.5)	(.3)	(17.9)	(4.4)	
sitc 8	-.014	.031	.007*	-.204	.070*	.99
	(1.2)	(.7)	(2.8)	(.9)	(5.4)	
sitc(5-8)	.062	-.232	-.001	.653*	.391*	.97
	(1.4)	(1.5)	(.1)	(7.1)	(10.0)	

Table 2E (con't)

3. Regressions with U6 uncertainty index (n=23)

Dependent variable	constant	U6	pcinc growth	1960 ratio	E. Asia	GOF
sitc 5	.054**	-.122	-.011	.197*	.068*	.69
	(1.8)	(1.4)	(1.4)	(2.1)	(2.3)	
sitc 6	.046**	-.018	-.003	.034	.116*	.79
	(1.5)	(.2)	(.4)	(.2)	(3.1)	
sitc 7	.005	.019	.001	2.480*	.094*	.99
	(.3)	(.3)	(.3)	(17.9)	(4.5)	
sitc 8	-.008	.022	.006*	-.130	.071*	.99
	(.6)	(.5)	(2.1)	(.6)	(5.2)	
sitc(5-8)	.128**	-.264	-.018	.745*	.428*	.95
	(2.0)	(1.3)	(1.1)	(5.3)	(6.8)	

t-statistics in parentheses.
* indicates significance at the 5 percent level.
** indicated significance at the 10 percent level.

BIBLIOGRAPHY

Adams, G.F. et al. (1979). "Measuring the Impact of Primary Commodity Fluctuations on Economic Development: Coffee and Brazil," American Economic Review, 69 (2), May, pp.164-168.

Ahktar, M.A. and R. S. Hilton (1984). "Effects of Exchange Rate Uncertainty on German and U.S. Trade," Federal Reserve Bank of New York, Quarterly Review, (Spring), pp.7-16.

Baghwati, J. (1978). Foreign Trade Regimes and Economic Development: Anatomy and Consequences of Exchange Control Regimes, Cambridge, MA: Ballinger.

Balassa, B. (1971). The Structure of Protection in Developing Countries, Baltimore, MD: Johns Hopkins University Press.

Balassa, B. (1978). "Exports and Economic Growth: Further Evidence," Journal of Development Economics 5, no.2, June: 181-189.

Balassa, B. (1985). "Exports, Policy Choices and Economic Growth in Developing Countries After the 1973 Oil Shock," Journal of Development Economics, 18, pp.23-35.

Balassa, B., and J. Williamson (1987). Adjusting To Success: Balance of Payments Policy in the East Asian NICs, Washington, D.C.: Institute for International Economics, Policy Analyses in International Economics.

Chen, Peter S. J. Singapore: Development Policies and Trends, Oxford: Oxford University Press, 1983.

Coes, D. V. (1981). "The Crawling Peg and Exchange Rate Uncertainty," presented at ANPEC/Ford Foundation Conference on Crawling Pegs, Rio de Janeiro, October, 1979, in John Williamson, ed., Exchange Rate Rules. London: MacMillan Press.

Council for Economic Planning and Development, Republic of China, (1984), Taiwan: Statistical Data Book, Taiwan: Council for Economic Planning and Development.

Diaz-Alejandro, C. (1976). Foreign Trade Regimes and Economic Development: Colombia, New York: Colombia University Press.

Dornbusch, R. (1983). "Real Interest Rates, Home Goods, and Optimal External Borrowing," Journal of Political Economy, 91, (1), pp.141-153.

Edwards, S. (1984). "Coffee, Money and Inflation in Colombia," World Development, pp. 1107-1117.

Edwards, S. (1985). "Commodity Export Prices and the Real Exchange Rate in Developing Countries: Coffee in Colombia," NBER Working Paper No. 1570, Cambridge, MA: National Bureau of Economic Research.

Feder, G. (1983). "On Exports and Economic Growth," Journal of Development Economics, 12, (1/2), pp.59-74.

Frank, C., et al. (1975). Foreign Trade Regimes and Economic Development: South Korea, New York: Columbia University Press.

Galenson, W., ed. (1979). Economic Growth and Structural Change in Taiwan, Ithaca, NY: Cornell University Press.

Grossman, G. and H. Horn (1986). "Infant-Industry Protection Reconsidered: The Case of Informational Barriers to Entry," unpublished draft.

Hong, W. (1979). Trade, Distortions and Employment Growth in Korea, Seoul, Korea: Korea Development Institute.

Hong, W. and L. Krause, eds. (1981). Trade and Growth of the Advanced Developing Countries of the Pacific Basin, Seoul, Korea: Korea Development Institute.

Hu, S. C. (1975). "Uncertainty, domestic demand, and exports," Canadian Journal of Economics, 8, no.2, pp.

International Labour Office, Yearbook of Labour Statistics, Geneva, ILO, various issues.

International Monetary Fund, Direction of Trade Yearbook, Washington, D.C., various issues.

International Monetary Fund, International Financial Statistics, Washington D.C., various issues.

Kaminsky, G. L. (1986). "Uncertainty, Expectations of Devaluation and Real Exchange Rate," Journal of Development Economics, pp.29-57.

Katz, E., and A. Hillman (1986). "Domestic Uncertainty and Foreign Dumping," Canadian Journal of Economics, 19, pp.403-416.

Katz, E., J. Paroush, and N. Kahana (1982). "Price Uncertainty and the Price Discriminating Firm in International Trade," International Economic Review, 23, no.2, pp.389-400.

Kenen, P. B. and D. Rodrik (1986). "Measuring and Analyzing the Effects of Short-Term Volatility in Real Exchange Rates," Review of Economics and Statistics, vol. 68,(May), pp.311-314.

Kim, K. S. (1985). "Lessons from South Korea's Experience with Industrialization," in V. Corbo and A. Krueger, eds., Export-Oriented Development Strategies, Boulder, CO: Westview Press.

Knapman, B. (1983). "Growth and Fluctuations of Fiji's Exports," Economic Development and Cultural Change, 32 (1), p.97.

Krueger, A. O. (1978). Foreign Trade Regimes and Economic Development: Liberalization Attempts and Consequences, Cambridge MA: Ballinger.

Krueger, A. O. (1981). "Export-Led Industrial Growth Reconsidered," in Wontack Hong and Lawrence Krause, eds., Trade and Growth of the Advanced Developing Countries in the Pacific Basin, Seoul, Korea: Korea Development Institute.

Krueger, A. O. (1985). "The Experience and Lessons of Asia's Super Exporters," in Vittorio Corbo and Anne O. Krueger,eds., Export-Oriented Development Strategies, London: Westview Press.

Kuo, S. (1983). The Taiwan Economy in Transition, Boulder, Colorado: Westview Press.

Kuznets, S. (1973). "Modern Economic Growth: findings and reflections," American Economic Review, 63, no.3, pp.247-58.

Kydland, Finn E. and Edward C. Prescott (1982). "Time To Build and Aggregate Fluctuations," Econometrica, 50, (6), pp. 1345-1370.

Lal, D., and S. Rajapatirana (1987). "Foreign Trade Regimes and Economic Growth in Developing Countries," The World Bank Research Observer, Vol. 2, no.2, 189-218.

Lau, L. J., and L. R. Klein (1986). Models of Development: A Comparative Study of Economic Growth in South Korea and Taiwan, San Francisco, CA: Institute for Contemporary Studies.

Leland, H. (1972). "Theory of the Firm Facing Uncertain Demand," American Economic Review, 62, pp.278-91.

Mayer, W. (1984). "The Infant-Export Industry Argument," Canadian Journal of Economics, 17, (2), pp.249-269.

McCall, J.J. (1967). "Competitive Production for Constant Risk Utility Functions," Review of Economic Studies, 34, pp.417-420.

Meese, R. A. and K. Rogoff (1983). "Empirical Exchange Rate Models of the Seventies: Do They Fit Out of Sample ?," Journal of International Economics, 14, pp.3-24.

Meyer, Robert A. (1975). "Monopoly Pricing and Capacity Choice Under Uncertainty," American Economic Review, 65, PP.326-337.

Michalopolous, C., and K. Jay (1973). "Growth of Exports and Income in the Developing World: A Neoclassical View," Discussion Paper 28, Washington D.C.: U.S. Agency for International Development.

Morawetz, D. (1981). Why the Emperor's New Clothes Are Not Made in Colombia, New York; Oxford University Press.

Morawetz, D. (1982). "Manufactured Exports, Lavor Productivity and Employment in Latin America: A Hypothesis Based on the Clothing Industry in Colombia," in Syrquin, M. et al (eds.), Trade, Stability, Technology and Equity in Latin America, New York: Academic Press.

Nam, C. (1987). Export-Promoting Subsidies, Countervailing Threats, and the General Agreement on Tariffs and Trade," The World Bank Economic Review, 1, (4), pp.727-744.

Pindyck, R. S. and D. L. Rubinfeld (1981). Econometric Models and Economic Forecasts, New York: McGraw-Hill Book Company.

Rhee, Y.W., Ross-Larson, B. and G. Pursell (1984). Korea's Competitive Edge: Managing Entry into World Markets, Washington D.C.: The World Bank.

Sandmo, Agnar (1971). "On the Theory of the Competitive Firm Under Price Uncertainty," American Economic Review, v.61, 00.65-73.

Sargent, T. J. (1979), Macroeconomic Theory , New York: Academic Press.

Schydlowshky, D., and M. Rodriguez (1982). "The Vulnerability of SMall Semi-industrialized Economies to Export Shocks: A Simulation Analysis Based on Peruvian Data," in Syrquin, M. et al (eds.), Trade, Stability, Technology and Equity in Latin America, New York: Academic Press.

Scitovsky, T. (1986). "Economic Development in Taiwan and South Korea, 1965-81," in Lau, L. (ed.) Models of Development, A Comparative Study of Economic Growth in South Korea and Taiwan, San Francisco, Ca: ICS Press.

Shapiro, C. (1983). "Premiums for High Quality Products as Returns to Reputations," Quarterly Journal of Economics, 98, pp.659-679.

Thursby, M. C. and J. G. Thursby (1985). "The Uncertainty Effects of Floating Exchange Rates," in Arndt, et. al., Exchange Rates, Trade and the U.S. Economy, Cambridge: Ballinger Publishing Co., pp.153-166.

Thursby, M. C. and J. G. Thursby (1987). "Bilateral Trade Flows, the Linder Hypothesis, and Exchange Risk," Review of Economics and Statistics, 69, (3), pp.488-495.

Turnovsky S. J. (1973). "Production Flexibility, Price Uncertainty, and the Behavior of the Competitive Firm," International Economic Review, 14, pp.395-413.

Tyler, W. (1981). "Growth and Export Expansion in Developing Countries: Some Empirical Evidence," Journal of Development Economics, 9, (1), pp.121-130.

Wood, J. H., and N. L. Wood (1985). Financial Markets, San Diego: Harcourt Brace Jovanovich Publishers.

World Bank (1979). World Trade and Output in Manufactures: Structural Trends in Developing Countries' Exports, World Bank Staff Working Paper No. 316, Wash. D.C.

World Bank (1987), World Development Report 1987, New York: Oxford University Press.