

FACTORS AFFECTING NET CHILEAN WHEAT
IMPORTS WITHIN THE CONTEXT OF THE
NORTH AMERICAN FREE TRADE
AGREEMENT

BY

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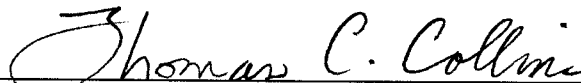
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NOMENCLATURE

Constant	constant term for entire equation
Dummex	dummy variable for entire equation
GDP	gross domestic product, per capita, in constant 1985 \$US
GDPD	gross domestic product, per capita, in constant 1985 \$US, multiplied by value of dummy variable
lag	quantity of per capita net wheat imports, in metric tons, lagged one year
lagD	quantity of per capita net wheat imports, in metric tons, lagged one year, multiplied by value of dummy variable
NAFTA	the North American Free Trade Agreement
NetWM	quantity of per capita net wheat imports, in metric tons
Pbov	price of imported bovine meat, \$US/metric ton
PbovD	price of imported bovine meat, \$US/metric ton, multiplied by value of dummy variable
Pc	price of imported corn, \$US/metric ton
PcD	price of imported corn, \$US/metric ton, multiplied by value of dummy variable
Pw	price of imported wheat, \$US/metric ton
PwD	price of imported wheat, \$US/metric ton, multiplied by value of dummy variable

Real	real appreciation index
RealD	real appreciation index, multiplied by value of dummy variable

CHAPTER ONE

INTRODUCTION

Problem Statement

NAFTA

One of the most important trade agreements involving the United States is the North American Free Trade Agreement (NAFTA). Passage of the NAFTA agreement by Congress in 1992 represented a paradigm shift in U.S. trade policy. In the past, the U.S. trade policy was focused on the multilateral General Agreement on Trade and Tariffs (GATT) accords. In the mid 1980's, when the Geneva round of GATT talks broke down, the U.S. trade negotiators shifted their focus away from the multilateral GATT, concentrating instead on bilateral agreements as a means to achieve some progress in tariff reduction. Trade negotiations with immediate neighbors, combined with past GATT and Most Favored Nation (MFN) policies necessitated the formation of free trade areas as opposed to commodity-by-commodity preferential trade agreements.

Additionally, NAFTA is a political tool. Currently, the U.S. has relatively few trade restrictions on most imports and low import tariffs on most goods. Further reductions of import tariffs (down to 0%) does not greatly benefit U.S.

consumers nor hinder U.S. producers. However, foreign signatories to the agreement receive the direct benefit of tariff-free access to the large U.S. market, as well as the indirect benefit of attracting foreign capital into their country in order to exploit tariff-free access of the U.S. market.

Wheat

Wheat is an important crop in Oklahoma. Currently, the U.S. market for wheat is at the mature stage; it is doubtful that much growth in the U.S. wheat market can be achieved by inducing the U.S. consumer to purchase more products containing wheat. In the future, the best possible source of growth for U.S. wheat will come from international trade, where income and price elasticities are more benign.

The three NAFTA countries, the U.S., Canada, and Mexico, are currently in discussions with Chile regarding its application to join the agreement. Ascension into the NAFTA requires the (eventual) removal of all barriers to trade among the Agreement's members. If Chile were to join the NAFTA, the resulting trade flows could be markedly different from those of today.

Currently the NAFTA wheat market may be characterized as bi-polar; the U.S. and Canada are wheat exporters, while Mexico is a wheat importer. Chile both exports and imports wheat. This phenomenon may be explained by self-sufficiency goals, seasonal differences, specific wheat varieties desired,

the need to fulfill specific marketing gaps, or other reasons. In the recent past, however, Chile has been a net importer of wheat every year (see appendix).

Purpose and Objectives of the Study

Instead of examining the limited history of the NAFTA agreement so far, the purpose of this thesis is to look towards the future of the Agreement. The U.S. Trade Representative, Mickey Kantor, has indicated that Chile would be the next country with which the United States negotiates a free trade arrangement. Allowing a new member into the Agreement could significantly alter trade flows among the member countries. Wheat is a major export crop of both Canada and the United States, and is of particular interest to Oklahoma. The purpose of this study is to examine the effects on the NAFTA imported wheat market after the hypothetical inclusion of Chile in the Agreement.

The North American Free Trade Agreement

The process leading to the North American Free Trade Agreement, (NAFTA) began in 1987, when President Reagan sent notice of intent to the U.S. Congress to sign a trade agreement with Canada. Congress agreed to allow "fast track" approval of the trade agreement. "Fast track" means that the President could negotiate the agreement, then submit the agreement to Congress for ratification exactly as negotiated by the executive branch, allowing no amendments by Congress. The resulting Canada-United States Free Trade Agreement, (CUSTA), implemented in 1989, was the first of the hemispheric agreements to radically reduce trade and investment barriers between the U.S. and Canada.

In 1990, Mexican President Salinas asked President Bush to consider a free trade agreement between the U.S. and Mexico. Mexico joined the General Agreement on Trade and Tariffs (GATT) in 1986, and subsequently, the U.S. and Mexico deepened their commitment to mutually expand trade and investment. Canada joined these negotiations in 1991, and together the three countries negotiated the NAFTA. The objective of the NAFTA is to eliminate all tariffs among the three countries over a transitional period, leading to a free trade area.

Under the NAFTA agreement, the bilateral arrangements between Mexico and the U.S. and Mexico and Canada removed or are phasing out

tariffs on a broad range of products, including agricultural products. Also, each country is permitted duty-free access to a portion of the market for certain highly sensitive commodities, including corn, dry beans, and poultry in Mexico, and fruits and vegetables in the U.S. (USDA). A select number of Mexican imports of U.S. agricultural commodities will enter Mexico subject to a tariff rate quota (TRQ). These commodities include corn, poultry, and pork, among others. The TRQ will enable a portion of Mexican imports from the U.S. to enter Mexico duty free. After the import quota is filled, any additional imports by Mexico will be subject to a tariff. The quota will be increased each year and the tariff reduced to zero over the phase-in period (USDA).

Since the successful completion of NAFTA, the movement toward hemispheric economic integration gained momentum and attracted more attention, both from the U.S. and the rest of Latin America and the Caribbean. The U.S. Trade Representative, Mickey Kantor, recently indicated that Chile would be the next country with which the United States negotiates a free trade arrangement. Before formal negotiations with Chile begin, the three NAFTA countries have to reach a common understanding of the terms for membership and set up a negotiating team. The trade pact does not lay out any specific requirements to join NAFTA (Davis).

Reform in Latin America

Economic integration has been a theme of Latin American economic policy since the 1960's. To understand Latin America's failures, one must revisit the 1940's.

At the end of World War II, countries thought that the Great Depression of the 1930's would return. To avoid this possible outcome, the UK, France, Germany, and Italy took the Keynesian path and enlarged their public sectors. The U.S. expanded Depression Era programs dealing with agriculture, home mortgages, and the like. Latin American countries reacted by creating parastatals and ran large debts with "easy money" monetary policies.

Another way Latin American countries attempted to deal with the impending troubles was through import substitution. The Depression lowered prices of primary products, which made up the bulk of Latin American exports. War lead the industrial nations to focus on war products instead of the manufacturing goods that the Latin American countries were reliant on as imports. As a pragmatic response to hard times (Depression) and war (WWII), most Latin American countries adopted import substitution.

After the war, industrial countries used the GATT to lower tariffs whereas Latin American countries used import substitution. Initially, import substitution worked well with labor intensive techniques for nondurables, but as they tried to manufacture more capital intensive goods, inefficiencies

crept in with increasing levels of protection. Policies of import substitution and state capitalism implied that in any regional trade arrangement, the partners would be buying from each other at far higher prices than they would pay for the same goods imported from industrial nations. Statist industrial policies and expansionary fiscal and monetary policies plus import substitution ensured failure of the attempts in the 1960's to economically integrate Latin America.

Economic and political conditions in Latin America have changed since the mid-1980's. Parastatal firms have been sold, inflationary macroeconomic policies have been widely discredited, import substitution has been abandoned, and excessive bureaucracy is being trimmed. The U.S. is no longer widely perceived as an economic and political adversary. Additionally, Latin America has ended most armed conflicts, rejection of military officers as political leaders, widespread embrace of democracy. The success of the reform process will largely depend on the ability of individual governments to win public support by ensuring that the process of change is accompanied by social fairness.

Economic Reform in Chile

The case of Chile is noteworthy for two reasons. First, like Korea, Taiwan, and Thailand, to name a few, economic liberalization preceded political liberalization by over a decade. Secondly, Chile has been a pioneer of free

trade and practitioner of unilateral liberalization.

The beginnings of reform date back to the 1960's, when under Eduardo Frei, Chile was one of the original signers of the Cartagena Declaration which created the Andean group in 1969. In 1970, president Allende initiated policies of nationalizing industries and drastic import substitution.

In 1973, Pinochet seized control in a bloody coup. He instituted an economic stabilization and liberalization program the next year, reversing both macro. and micro. policies of the Allende regime. In 1976, Chile left the Andean Group. By 1980, over 460 companies privatized and tariffs had been reduced from an average of 105% to 10%. Liberalization was stalled in 1982 - 83, when internal and external pressures forced the nationalization of the banking sector to avoid its complete collapse. Tariffs were raised to 35% (gradually cut to 15% by 1988). The year 1985 lead to refocusing on economic policy, including policies of stimulating public investment, reprivatizing the financial sector, using monetary policy to target interest rates, and devaluation of the exchange rate with a crawling peg. Chile enjoyed an average growth rate of 6.3% from 1985 to 1989.

Compared to other Latin American countries, Chile was moderately successful with external debt problem of the mid 80's. In 1985, Pinochet instituted a debt conversion program (for Chilean buyers) and a debt/equity swap program (for foreign buyers). The swap program was made attractive by an implied subsidy of 30% for its customers. From 1985 - 1990, Chile halved its external debt.

Democratic control of Chile returned when Patricio Aylwin took over as

president in 1990. To demonstrate fiscal responsibility of his elected government, Aylwin balanced macro stability against social demands, with policies stressing continued price liberalization, a stable exchange rate, and low tariff levels. The tax reform of 1990 increased corporate taxes and made individual tax rates more progressive, allowing for increased social expenditures. In 1991, tariffs were cut to a uniform 11% rate, and a labor reform act limited employers' power to discharge and lock-out its employees.

Chile is relatively open to foreign investment, and an active pursuer of trade agreements. While participating in the latest round of GATT negotiations, Chile signed many bilateral agreements. In October 1990, Chile signed an agreement with the United States under the Enterprise for the Americas Initiative. In 1991, Chile signed an agreement with Argentina and signed an agreement with Mexico to eliminate tariffs on 96% of their trade by 1996, and passed a new patent and trademark law. Chile rejected possible entry into the Mercosur trading area because the Mercosur external tariff was higher than Chile's current tariff. In 1992, Chile signed an agreement with Argentina to integrate their respective mining sectors, signed four agreements with Malaysia eliminating all tariffs on bilateral trade after 5 years, and the U.S. announced that Chile would be the next country in line for negotiating a trade agreement with the United States after completion of the NAFTA agreement. Venezuela and Columbia each signed bilateral treaties with Chile in 1993 to phase out all tariffs by 1999.

CHAPTER TWO

LITERATURE REVIEW

The purpose of this literature review is to examine previously published works covering the broad topics of the thesis. These topics include international wheat trade, demand for imports, free trade, and NAFTA. The studies selected for inclusion in this literature review were also examined regarding the functional form chosen for the model.

Studies involving wheat did not examine factors affecting wheat import demand directly, but instead focused on the effects of financial difficulties on wheat import demand (Kondreas, Bushnell and Green), and estimates of market share elasticities of wheat imports (Shalaby, Yanagida, and Hassler).

Studies of functional form examined the empirical question of which functional form performs best for single equation, import demand studies. Three studies, (Thursby and Thursby; Khan and Ross; Boylan, Cuddy and O'Muircheartaigh) examined aggregate imported demand equations with differing functional forms, while Murray and Ginman studied the relative price specification of the traditional aggregate import demand equation.

Studies of aggregate import demand were examined in order to compare empirical results of generated estimates. Warner and Kreinin modeled import demand and demand for exports simultaneously for their given countries, whereas Melo and Vogt, and Arize and Afifi examined only the import demand equations of their chosen countries.

The studies of NAFTA were restricted to predictions about possible outcomes of NAFTA formation, since most were published before final passage of the trade agreement by the United States. The most widely cited NAFTA study was the Brown, Deardorff and Stern model, which modeled the entire economies of the NAFTA participants. Grennes and Krissoff used a partial equilibrium model to examine to possible effects of NAFTA on particular areas of agriculture. Espana detailed possible results of NAFTA formation and failure of NAFTA formation. Finally, Rosson, Davis, Angel, and Segarra analyzed free trade impacts on U.S. - Mexican meat trade through elasticities.

It is hoped that this literature review will allow this researcher to better focus the scope of this study, to select a proper functional form for the desired model, and to compare the results of this study to the already existing literature.

Studies Involving Wheat

Considering the importance of wheat in world markets, and the fact that wheat is a major export crop for many countries throughout the world, the relative scarcity of studies involving wheat was quite surprising. Two studies were judged to be significant to this thesis. Kondreas, et al., examined the effects of dollar devaluations on all U.S. grain imports while Shalaby, et al, estimated elasticities of U.S. wheat import market share in eight Latin

American countries.

Kondreas, Bushnell and Green studied how dollar devaluations of the mid 70's lead to increased demand for U.S. grain. The team modelled the following import demand equation:

$$M_t^k = a_0 + a_1 (P_{us_t} / P_{w_t}) + a_2 (P'_t / P_{w_t}) + a_3 (P_{k_t} / P_{w_t}) + a_4 Y_{k_t} + u_t$$

where,

M_t^k = U.S. commercial wheat exports

K_{th} = Commercial import demand for U.S. wheat by K^{th} country

P_k = Domestic wheat price

P_{us} = U.S. export price

P_w = World price of wheat

P' = World price of substitute (rice)

Y_k = Country k's per capita income

For export demand, a high correlation of export prices of major wheat exporters and high correlation of wheat and rice prices meant (P_{us}/P_w) and (P'/P_w) were very stable over time. Monetary variables were expressed on a common currency basis. Importing countries were aggregated into 5 regions: Developed countries, Africa, Latin America, Asia, and Eastern Europe and the U.S.S.R.. Concessional wheat sales affect commercial wheat sales. Lagged import demand reflected continuity of existing patterns of wheat trade. Following is the export demand equation:

$$M_t = \beta_0 + \beta_1 Q_t + \beta_2 P E_t + \beta_3 Y E_t + \beta_4 C_t + \beta_5 M_{t-1} + u_t$$

where,

M_t = U.S. commercial wheat exports

Q_t = per capita wheat production in region Q

C_t = concessional wheat exports to that region

PE_t = "effective" U.S. wheat exports to that region in \$U.S.

YE_t = "effective" per capita real income in \$U.S.

M_{t-1} = lag variable

Annual U.S. wheat export observations for 1954 - 1972 were used. Consistent series for domestic prices and incomes for importing countries were not available, so certain changes were made. A Food Price Index, 1958 = 100, was used as a proxy for the domestic price of wheat variable, and a Real Income Index, 1958 = 100, was used as a proxy for per capita real income variable in importing countries.

Export demand functions were estimated by Ordinary Least Squares (OLS) and Conditional Least Squares (CLS). OLS estimations of income coefficients did not fit a priori expectations for developed countries, Africa, U.S.S.R. & Eastern Europe. Lagged imports coefficients were between 0 and 1 for Latin America for all estimations, negative for Developed, Africa and U.S.S.R. & Eastern Europe, indicating an adjustment coefficient greater than 1, which signals possible overreaction to events by those countries. Concessional import coefficients were negative for Developed, Latin America, and Africa, and positive for Asia and U.S.S.R. & Eastern Europe. A negative value for this coefficient means that P.L. 480 food aid acts as a substitute for commercial imports. Increased domestic production of wheat per capita negatively effects

U.S. wheat exports for Developed, Latin America, and Africa while being a positive effect on Asia and U.S.S.R. & Eastern Europe.

Import demand was responsive to U.S. export price and currency realignments, however a U.S. policy of price cuts to stimulate increased commercial exports might be less effective than the estimates suggest. Generally, less developed areas have a higher magnitude import demand elasticity, with U.S.S.R. & Eastern Europe having the highest of the five areas in this study.

Shalaby, Yanagida, and Hassler examined the U.S. market share of eight Latin American countries' wheat imports in order to estimate elasticities of market share. The paper recommended using market share response parameter rankings in determining eligibility for participation in U.S. agricultural trade programs.

The team estimated the percentage share of wheat imports from the U.S. as a function of the border price of U.S. wheat imports as a percentage of the border price of all wheat imports by that country. They used market share and habit formation model specification. The equations in the model used lagged import share as a variable, and the price ratio was calculated as a two year moving average to capture lagged effects. Each of the eight chosen Latin American countries had one equation in the system, and seemingly unrelated regression (SUR) was used on the system to estimate the parameters.

$$\ln S_t = D_0 + D_1 \ln (S_{t-1}) + D_2 [\ln(R_t) + \ln(R_{t-1})] + e_t$$

where:

S = actual market share

R = relative prices (percentage of U.S. border price of wheat
to the world border price of wheat for the importing country)

D_2 = short-run share elasticity

$2D_2 / (1-D_1)$ = long-run share elasticity

e = random error term

\ln denotes natural logarithm

t represents time

All of the parameters' signs were consistent with theory and expectations. The desired market share elasticities were statistically significant at the 5% level, and the long run share elasticities were, in absolute terms, larger than the short run elasticities. Looking at Chile in particular, the short run market share elasticity of U.S. wheat was -1.6867 while the long run market share elasticity of U.S. wheat was -4.8998. Both of these parameters are significant at the 5% level.

Of these two studies involving wheat, only the Kondreas study examines factors directly affecting wheat imports. The Shalaby study examines factors affecting market share elasticity, which in economic terms could be considered a derivative of the wheat import decision. There does not seem to be a consensus regarding what factors to use in modeling substitutional or complementary relationships with wheat, forcing a de facto ad hoc variable selection process by the investigator.

Studies of Functional Form

Each study in this literature review involving the estimation of an economic model was examined with regard to the specific functional form chosen for that model in order to draw a consensus conclusion about functional form.

The studies of this particular section deal with the question of functional form as it relates to the "appropriateness" of results. Given the fact that choosing the correct functional form is vital to the validity of the results, this facet of model selection is crucial to the investigator.

Thursby and Thursby begin with a simple assertion. Most estimates of import demand follow this form: $Q = f(P, Y)$ which raises several questions. How to properly measure Q , P , or Y ? Which functional form to use? Should lagged variables be included? Should structural shifts be included?

Thursby, et al. encountered a new set of problems from the model selection process. An ad hoc selection may be chosen based on sign and significance of coefficients, which leads to using estimates to test a theory. Models including dynamic behavior through lagged values of the dependent variable are often accepted, while some use adjusted R-squared, the Box-Cox procedure, or the Durbin-Watson statistic to select a model. Overall, procedures are not standardized.

Thursby and Thursby examined nine models of aggregate import demand

for each of five industrialized countries (Canada, Germany, Japan, the U.S. and the U.K.) to determine which of the frequently used single equation models of import demand are appropriate. An appropriate model was defined as one which generates unbiased, or at least consistent and efficient elasticity estimates, with minimum variance preferred. The procedure used in this paper was to test for first order autocorrelation. Then, the Regression Specification Error Test (RESET) was performed to test for omitted variables, incorrect functional form, nonindependence of regressors, and disturbances. Finally, tests for non-first order autoregressive process (LRS) were performed. The results were reported regarding functional form, measures of variables, and structural shift.

Thursby and Thursby found that the best models (except for Canada) were a log specification (logged independent variable/logged dependent variables). Regarding measures of variables, Thursby et al. assert that the method used to quantify variables does not influence results, and that lagged quantity variables performed better than lagged price or income variables. Finally, a structural shift in the early 70's, reflecting the oil crisis, was important for certain countries. Regarding elasticity estimates, they found a greater similarity between accepted models than between rejected models.

Several conclusions were drawn by Thursby, et al. All tested models performed poorly, but application of statistical procedures could allow one to select an appropriate type of model from this class. Import demand functions differ among countries in ways more fundamental than simple parameter differences, and significant autocorrelation statistics imply

misspecification. Finally, the authors assert that this paper's procedure is important; accepted models yield different elasticities than rejected models.

Murray and Ginman stated that since trade policy effectiveness is dependant upon reliable estimates of import, export, and income elasticities, determining the correct functional form is vital. The traditional model used is the log - linear model (logged independant variable/logged dependant variables), but this form could be incorrectly specified.

The traditional model utilizes a mathematical specification of the prices of imports in domestic currency and the price of domestic substitutes which are constrained to be equal in magnitude and opposite in sign. The constraint can be eliminated by using the following specification:

$$\ln (Q) = B_0 + B_1 \ln(y) + B_2 \ln (P_m) + B_3 \ln (P_d) + u$$

where:

B_1 = income

B_2 = import price elasticity

B_3 = domestic price elasticity

Murray and Ginman estimated the above equation using unadjusted aggregate data for Canada during the years 1950 - 1964, along with the traditional model. The traditional equation had a substantially smaller income elasticity and a somewhat smaller import price elasticity of demand

than the proposed import model.

The same test was run for U.S. data with results consistent with the Canadian estimation. Finally, a log-linear form using real income instead of money income and including the domestic price index of non-traded items was estimated. The real income elasticity was approximately one and import price elasticity was approximately equal to one -- both lower than the traditional model suggests. These two results lead Murray, et al, to conclude that the relative price specification of the traditional import demand model is inappropriate for estimating aggregate import demand parameters because imports compete with both domestic goods and non-traded goods such as services and construction.

Khan and Ross used the Box-Cox procedure to analyze the aggregate import demand equation for three major industrial economies: the U.S., Canada, and Japan.

The Box-Cox procedure uses a generalized functional form employing a family of power transformations, increasing the range of functional forms available for estimation. This procedure can also be used to determine which specific form (linear or log-linear) within a particular class of functions is optimal in a certain sense. The procedure begins with the following formula:

$$\frac{M^\lambda - 1}{\lambda} = a_0 + a_1 \frac{P^\lambda - 1}{\lambda} + a_2 \frac{Y^\lambda - 1}{\lambda} + e$$

If $\lambda = 1$, the equation becomes identical to a linear equation. If $\lambda = 0$, the

equation becomes identical to a log-linear equation. Assuming that the errors, e , are normal, the values of the parameters in the equation,

$$M_t(\lambda) = a_0 + a_1 P_t(\lambda) + a_2 Y_t(\lambda) + e_t$$

can be obtained by maximum likelihood (L_{\max}) methods. L_{\max} is found for various levels of λ , in 0.10 increments. A 95% confidence level around the L_{\max} estimate is calculated to determine which functional form is preferred. Two forms of each equation were estimated: equilibrium relationships implying instantaneous adjustment of importers to changes in the relative price of imports and real income, and partial-adjustment form in which the change in imports is related to the difference between the demand for imports in period t , and the actual level of imports in the previous period.

For all 3 countries, the confidence interval does include 0 in the equilibrium form of the equation. The confidence interval for the dynamic formulation contains 0 for the U.S. and Canada while the dynamic form for Japan contains 1, not 0. These results confirmed that the log - linear formulation of the import demand equation could not be rejected in favor of the linear formulation for aggregate import demand.

Boylan, Cuddy and O'Muircheartaigh examined the two most common functional forms for import or export demand relationships, linear and log - linear, noting that economic theory gives no guidance as to which form is best. The linear functional form for an aggregated import demand function implies a decreasing price elasticity of import demand and an income

elasticity tending towards unity, while a log-linear (linear in logarithms) formulation implies constant elasticities with respect to price and income, which may be considered too restrictive. However, the Box-Cox procedure can be used to determine which of these two forms is preferable.

Boylan, et al studied the results of the estimation of a generalized import demand function for three of the smaller economies of the European Union, namely Ireland, Denmark, and Belgium. These three were chosen to reflect a more intermediate level of economic development than those of the Khan and Ross study.

For all three countries, the log - linear specification was found to be superior to the linear formulation for aggregate import demand. Using the log - linear form, import demand equations were estimated for the three countries. For all three, price and income parameter estimates had the expected signs, and had a very high r^2 .

Synthesizing the results of these four studies indicates that the log - linear functional form is the preferred functional form for import demand studies when investigating elasticities of demand, given the caveat that in certain cases, for certain countries, during certain periods of time, other functional forms may perform just as well. The mere fact that so many studies comparing the linear and the log - linear specifications of single equation import demand exist indicates that, despite the empirical evidence, the discipline is still unconvinced as to which functional form performs best.

One small step towards alleviating the anxiety over functional form may be a standardization of terms; the same preferred functional form (logged

independant variable/logged dependant variables) was described as the log specification (Thursby and Thursby), the log - linear specification (Murray and Ginman, Khan and Ross), and linear in logarithms (Boylan, Cuddy and O'Muircheartaigh). It was only by examining the form of the model itself, as presented in each respective paper, that one could determine which functional form was used in the estimation.

Studies of Aggregate Import Demand

Many studies of aggregate import demand are available in the literature of economics. However, proper procedures for selecting the correct functional form to estimate are not standardized, and methods for quantifying data variables for analysis are often dependant upon the limited scope of data available in the realm of international statistics. These studies were examined to determine the level of confidence in single equation import demand estimations as well as the individually generated variables of each distinctive equation.

Melo and Vogt estimated real income and relative price elasticities of demand for Venezuelan imports using disaggregated annual data from 1962 - 1979. The period of 1973 to 1979 was of particular interest due to Venezuela's oil exporter status; this period was examined for evidence of changes in overall import demand caused by the rapid increase in oil prices. The following import demand function was estimated:

$$\log M_{it} = a_{0i} + a_{1i} \log (P_{Mi} / P_{Di})_t + a_{2i} \log (Y_t) + a_{3i} D_{it} + u_{it}$$

where:

M_i = quantity demanded of the i th import commodity

P_{Mi} = price of commodity i

P_{Di} = price of domestic substitute

Y = real gross domestic product

u_i = random disturbance

a_{1i} = relative price elasticity of demand for commodity i ($a_{1i} \leq 0$)

a_{2i} = real income elasticity

D_{it} = dummy variable, a proxy for increased oil prices of 1974 - 1979

The equation was used to estimate elasticities for total imports as well as five disaggregated groups: tobacco & beverages, chemicals, machinery & transportation, food, and manufacturing imports.

All estimates of price and income had the expected signs, and adjusted r^2 ranged from 0.933 to 0.988. All income estimates were significant at the 5% level, while 3 out of 6 price elasticities were significant at the 5% level. These results were extensively compared to a previous study of Venezuelan imports by Khan (1975).

Warner and Kreinin modeled and estimated import demand and demand for export functions for nineteen industrialized countries and 16 less developed countries for the period from 1972 to 1980, and for nineteen

industrialized countries for the period 1957 to 1970 to compare periods of fixed and floating exchange rates. Import equations were estimated for all products, and then for all non-petroleum products. The independent variables were real income and relative import to domestic wholesale prices, respectively. The relative price variable was separated into three components -- exchange rate, domestic price, and import price in foreign currency -- rather than a composite relative price variable to yield a more accurate result. All equation variables were expressed as logarithms to yield elasticities in results.

Warner and Kreinin tested the homogeneity assumption which constrains import prices and domestic wholesale prices to be equal in magnitude but opposite in sign.

Most variables had the expected signs and had satisfactory explanatory power. Using the price ratio of imports to exports was not found to be justified in most countries, including the U.S.. Most income, and practically all price and exchange rate coefficients had the correct expected sign. Floating exchange rates were shown to have affected trade volumes of imports in many countries, but in different directions. Finally the exchange rate and the export price of competing countries are powerful determinants of a country's exports.

Arize and Afifi examine aggregate import demand functions for 30 developing countries, mostly located in Africa. Four log - linear variants of an import demand model relating the real quantity of imports demanded to a ratio of import prices to domestic prices and to domestic real income, were

estimated -- two equilibrium demand equations and two disequilibrium demand equations. Disequilibrium demand equations were represented by including a lagged dependant variable in the equation. Additionally, Arize and Afifi used the Farley and Hinich (1970) test for stability to examine whether the country's import demand relationship changed during the period of estimation.

For 23 of the 30 countries, the relative price elasticity had the expected negative sign and was significantly different from zero at the 10% level. The stability tests indicated that a statistically stable equation could be identified for every country in the sample. Finally, results indicated a large response of import volumes to changes in import or relative prices, and furthermore, consumers responded more to changes in domestic goods than to equal changes in import prices.

Generalizing results from these studies reveals some useful indications for future studies. All of the studies cited here used the log - linear functional form. Most income and price variables of these studies were statistically significant, and most variables studied possessed the expected signs.

However, procedures for selecting the correct functional form to estimate are not standardized. Furthermore, methods for quantifying data variables for analysis are often dependant upon the limited scope of data available in the realm of international statistics. The possible weakness of the data used for estimation is an ongoing and unavoidable problem in international economic studies using historical data.

Studies Involving Free Trade / NAFTA

The prospect of a free trade agreement between the U.S., Canada, and Mexico stimulated research and debate on many fronts. The relative speed of the process of ratification of the NAFTA agreement limits the number of available economic studies of the Agreement currently available. As time goes by, the quantity of studies of the impacts and projected impacts of NAFTA are sure to increase.

In a pre-passage article Espana examined the possible impacts of a NAFTA on U.S.-Mexican trade and investment flows. Espana argued that a NAFTA with Mexico would be beneficial for both Mexico and the U.S. since the agreement would "lock in" the progress already achieved in Mexico from its extensive economic reforms. He cited many studies which indicate that all participants in the proposed NAFTA would benefit from passage of the agreement, noting that Mexico would gain the most when looking at the amount gained versus GDP. Finally, the NAFTA would stimulate a reallocation of resources among sectors within the boundaries of the agreement, fostering a more efficient allocation of resources. Espana also noted the ramifications if the U.S. did not agree to passage of NAFTA, and suggested that the NAFTA agreement could be a model for future GATT negotiations, given its ground-breaking approach in areas such as rules of origin, intellectual property rights, trade in services, textiles, and agricultural products, foreign investment regulations, government procurement, and

many others areas.

The debate over the creation of the North American Free Trade Agreement stimulated many studies of the proposed agreement. One of the first to appear was a study by Brown, Deardorff, and Stern. This paper had two purposes: 1.) Identify important issues in analyzing the impact of a NAFTA, and 2.) Quantitatively estimate the effects of elimination or reduction of trilateral tariffs, non-tariff barriers, and investment barriers.

Brown, et al, noted that the addition of Mexico to the U.S. - Canadian Free Trade Agreement raised several concerns for the participants. The United States was particularly concerned about wages and employment of unskilled labor. Both agreement parties were concerned with the international allocation of capital. Mexico was concerned about the benefits of liberalization versus the costs of economic dislocation caused by the creation of a North American Free Trade Agreement. Canada was worried that its past import protection had insulated imperfectly competitive domestic industries from the competitive pressures associated with free trade. Canadian firms were forgoing economies of scale in production to provide a wide variety of products to the Canadian market. The United States was frustrated with the impasse of multilateral negotiations, and in addition was well aware of potential political benefits of trade liberalization within the hemisphere. Mexico's failed industrial policies in the 1970's lead its leaders to seek development by increasing international specialization of production and a more liberal trade policy. Mexico's relative labor abundance could mean that Mexico would produce labor intensive goods, the U.S. and Canada

would produce capital intensive goods, and unskilled labor wages would fall in the U.S. and Canada.

Brown, et al, stressed several points of economic theory regarding the creation of a free trade area. Economic welfare should increase in all three countries. The agreement should improve international allocation of production, leading to more specialization, and should eliminate tariff-induced consumption distortions between domestic goods and imports from NAFTA partners (while a new distortion between NAFTA and non-NAFTA countries is introduced). Transition costs for the U.S. are not expected to be high, but could be disruptive for Mexico. All three may experience improvement in terms of trade with non-NAFTA countries, raising economic welfare. International specialization should narrow the wage gap between the U.S. and Mexico, reducing immigration pressure on the U.S.. Finally, economies of scale may be realized because of more competition within NAFTA could raise real return to both capital and labor.

The model used to quantify the effects of a NAFTA was a linear, large scale computable general equilibrium model which was used to evaluate the comparative static effects of changes in trade policy on factor prices, economic welfare, intersectoral allocation of resources, and international allocation of production. Each country in the NAFTA agreement was modelled individually. An aggregate fourth nation was created from 31 major trading partners ("other 31"), with the remaining countries consigned to residual a Rest of World. In the model, these actors produce, consume and trade 23 aggregated products, and there are 6 nontraded goods. For each traded good,

market structure is either perfectly competitive or monopolistically competitive. Equilibrium prices are determined in world markets.

The model was run for five different situations:

A.) Removal of tariffs among NAFTA countries, and expansion of U.S.

import quotas applied to Mexican exports of agriculture, food, textiles, and clothing by 25%

B.) Everything in A.) plus a 10% increase in Mexican capital stock due to the removal of foreign direct investment restrictions

C.) Removal of tariffs between the U.S. and Mexico, and expansion of U.S.

import quotas applied to Mexican exports of agriculture, food, textiles, and clothing by 25%

D.) Everything in C.) plus a 10% increase in Mexican capital stock due to the removal of foreign direct investment restrictions

E.) Removal of post-Tokyo Round tariffs between U.S. and Canada.

Analysis of the results revealed that the impact of NAFTA on trade volume is lopsided for Mexico and "other 31" in the B.) and D.) scenarios; Mexican imports increased \$2.2 billion while exports increased \$12.4 billion, caused primarily by capital inflows. NAFTA formation reduced trade volume between NAFTA and "other 31". Finally, all NAFTA countries experienced welfare gains, with Mexico gaining the most. Relaxing capital import restrictions by Mexico enhanced static benefits of trade liberalization.

The conclusions of the study may be summarized as followed:

1. Participating countries all enjoy increases in aggregate welfare.
2. Although inclusion of Mexico erodes some of Canada's benefits under

CUSTA, the effect is miniscule.

3. The U.S./Mexican wage gap will narrow, reducing incentive for illegal immigration. However, real wages in the U.S. rise because of trade liberalization.
4. NAFTA yields beneficial scale effects in all 3 countries.
5. Mexican reduction of barriers to foreign direct investment will stimulate new capital formation, helping to alleviate poverty in Mexico by raising the marginal product of labor and increasing average product of capital and labor by increasing scale of production in Mexico.
6. The inflow of capital into Mexico may come primarily from outside NAFTA, suggesting fears that U.S. firms will relocate largely unfounded.
7. The U.S. shows relatively little intersectoral factor allocation, meaning low reallocation costs.
8. While there are negative effects on the rest of world, they appear relatively small.

While the Brown study looked at NAFTA's impact on every sector of the U.S. economy, Grennes and Krissoff examined the effects of a NAFTA on agriculture alone. Disaggregation of the agricultural sector into four distinct groups allowed more precise treatment of substitute and complement relationships, as well as input and output effects. The four groups examined in the model were: Grain/Oilseeds, Livestock/Meat/Dairy, Horticultural, and Other (sugar, cotton, tobacco, coffee, dry beans).

Grennes and Krissoff used a partial equilibrium 3-region, 29 commodity

static model containing commodity supply and demand equations which were parameterised to reproduce 1988 data for three areas: the United States, Mexico, and Rest of World (ROW). Canada was included in ROW to simplify the analysis and because agricultural trade between Mexico and Canada is very small. Each of the three parties produced goods that were distinguishable from each other by origin, thus being imperfect substitutes. This model represented the BASE solution, or the pre-NAFTA trade flows.

Grennes, et al, examined two different scenarios. The first was a unilateral removal of all tariffs on agricultural goods by Mexico. The second was a bilateral removal of tariffs, creating a free trade area modeled after the (still under negotiation at the time) NAFTA. NAFTA was represented by removing all tariffs and the tariff equivalent of licenses and quotas that were in place in 1988. In both models, all domestic policies were assumed to remain in place. The results of the two models describe the impact in a typical year after full implementation of the respective scenarios (for NAFTA, full implementation comes after 0 to 15 years, depending on the commodity chosen). No attempt was made to model trade during a transition period before a fully implemented NAFTA.

Based on 1988 conditions for a U.S.-Mexico FTA (simulating NAFTA), the model indicated an increase of U.S. agricultural exports to Mexico of \$482 M, and an increase in U.S. agricultural imports from Mexico of \$166 M. If Mexico unilaterally removed import barriers, U.S. exports to Mexico increase by \$435 M, (94% of the increase with a NAFTA) while U.S. imports from Mexico increase by \$25 M (15% of the increase with a NAFTA).

Focusing on wheat, the data suggest that the effects of a NAFTA on wheat will be small in magnitude. U.S. share of Mexican wheat increases from a BASE scenario of nine percent to a NAFTA scenario of ten percent.

Rosson, Davis, Angel, and Segarra analyzed free trade impacts on US-Mexican meat trade. First, they briefly outlined how expectations for North American free trade noting that trade between Canada and Mexico in agriculture, before passage of the NAFTA agreement, was negligible. Secondly, they asserted that US-Mexican trade in livestock was complementary; the U.S. exports mainly livestock products to Mexico while Mexico exports mostly live animals to the United States. Because of this complementary pattern of trade and the relatively low duties on many livestock-related products, Rosson, et al, assert that impacts of further trade liberalization will be dependent upon future income growth and economic development in Mexico.

To analyze the potential free trade impacts on Mexican meat imports, the authors used the following formula for elasticities of import demand:

$$e_{d. imp} = e_{pr} [(e_d * x_d) - (e_s * x_s)]$$

where,

$e_{d. imp}$ = Mexican import demand elasticity

e_{pr} = price transmission elasticity, assumed equal to 1 under NAFTA

e_d = Mexican total demand elasticity

x_d = ratio of Mexican total demand to Mexican imports

e_s = Mexican domestic supply elasticity

x_s = ratio of Mexican domestic supply to Mexican imports.

The estimated elasticities predict an increase in Mexican imports of U.S.livestock products. The elasticities also predict an increase in U.S.imports of Mexican feeder cattle in the short term. Over the long term, these feeder cattle imports would decline as the domestic market bid supplies away from international trade.

All of these studies predict aggregate welfare increases for all three participants in the NAFTA agreement, while noting that certain individual sectors within each economy will experience welfare losses. One drawback of all of these studies is that by their nature, they model the effects of the NAFTA on all parties only after the adjustment period, which in some cases will not take end until the year 2008. The glowing results of such studies were used to sell passage of the Agreement to the American people, without regard to the disturbances to be encountered during the adjustment period. To some Americans, the impacts, whether direct or indirect, of the trade agreement so far appear to be negative for the US; so much so that some political leaders are calling for the U.S.to pull out of the Agreement. If the U.S.is to continue down the path of free trade agreement formation, the full nature, and limitations, of the results of such studies should be clearly communicated, and if possible, studies of the projected impacts during the adjustment period involved.

Examining the literature review chapter as a whole, valuable insight is gained regarding the structure of this study. The studies involving wheat demonstrate that an ad hoc variable selection process is justified for single

commodity estimations. Kondreas, Bushnell and Green studied how dollar devaluations of the mid 70's lead to increased demand for U.S. grain using two ad hoc, single equations. Shalaby, Yanagida, and Hassler examined the U.S. market share of eight Latin American countries' wheat imports in order to estimate elasticities of market share by using a single equation with ad hoc variable selection.

Studies of functional form began with a study by Thursby and Thursby which examined nine models of aggregate import demand for each of five industrialized countries to determine which of the frequently used single equation models of import demand are appropriate. Their results confirmed that the log - linear formulation of the import demand equation could not be rejected in favor of the linear formulation for aggregate import demand. This was confirmed by Khan and Ross, who used the Box-Cox procedure to analyze the aggregate import demand equation for three major industrial economies, and found that the log - linear formulation of the import demand equation could not be rejected in favor of the linear formulation for aggregate import demand. These results were confirmed by a study by Boylan, Cuddy and O'Muircheartaigh, which examined the two most common functional forms for import or export demand relationships, linear and log - linear, for three smaller industrial European countries. They concluded that the log - linear specification was superior to the linear formulation for aggregate import demand. Finally, in their study of Canada and the U.S., Murray and Ginman concluded that the relative price specification of the traditional import demand model is inappropriate for estimating aggregate import demand

parameters because imports compete with both domestic goods and non-traded goods such as services and construction.

The studies of aggregate import demand suggest that most, but probably not all, income and price variables should have statistically significant values, and that most, but probably not all, variables in the equation should have the expected sign as predicted by economic theory. Melo and Vogt estimated real income and relative price elasticities of demand for Venezuelan imports. All estimates of price and income had the expected signs, and adjusted r^2 ranged from 0.933 to 0.988. All income estimates were significant at the 5% level, while 3 out of 6 price elasticities were significant at the 5% level. Warner and Kreinin modeled and estimated import demand and demand for export functions for nineteen industrialized countries and sixteen less developed countries to compare periods of fixed and floating exchange rates. Most variables had the expected signs and had satisfactory explanatory power, and most income, and practically all price and exchange rate coefficients had the correct expected sign. Floating exchange rates were shown to have affected trade volumes of imports in many countries, but in different directions, and the exchange rate and the export price of competing countries were found to be powerful determinants of a country's exports. This study may be contrasted with a study by Arize and Afifi, which examined aggregate import demand functions for 30 developing countries, mostly located in Africa, and found that the relative price elasticity had the expected negative sign and was significantly different from zero at the 10% level. Additionally, these results

indicated a large response of import volumes to changes in import or relative prices, and furthermore, consumers responded more to changes in domestic goods than to equal changes in import prices.

The studies of free trade and of NAFTA in particular suggest that free trade area formation leads to welfare benefits to the participants in aggregate, while certain individual sectors of an economy may suffer welfare loss. Espana argued that a NAFTA with Mexico would be beneficial for both Mexico and the U.S. since the agreement would "lock in" the progress already achieved in Mexico from its extensive economic reforms. Brown, Deardorff, and Stern examined a large scale linear CGI model of the proposed NAFTA agreement. Two of their most significant findings were that participating countries all enjoy increases in aggregate welfare, and that NAFTA yields beneficial scale effects in all 3 countries. Grennes and Krissoff used a partial equilibrium 3-region, 29 commodity static model containing commodity supply and demand equations to model two different NAFTA scenarios and found an increase of U.S. agricultural exports to Mexico of \$482 M or \$435M, and an increase in U.S. agricultural imports from Mexico of \$166 M or \$25M. Rosson, Davis, Angel, and Segarra analyzed free trade impacts on US-Mexican meat trade by examining import elasticities. The estimated elasticities predict an increase in Mexican imports of U.S. livestock products, and an increase in U.S. imports of Mexican feeder cattle in the short term. Over the long term, these feeder cattle imports would decline as the domestic market bid supplies away from international trade.

The results of this literature review lead to the proposition of an ad hoc,

single equation, to estimate import demand for wheat in Mexico and Chile. The estimation of this equation will lead to a better understanding of the factors influencing import demand in Mexico and Chile, and will form the basis of an examination of the NAFTA wheat import market after the ascension of Chile into the NAFTA agreement.

The functional form of each model in this literature review was chosen by the authors based on the intended use of the results. Most authors wanted direct measures of elasticity from their estimations; this is the result of log - linear (logarithms of dependant variable / logarithms of independant variables) estimation. The intended use of the results of this thesis are to quantify changes in net wheat imports, in bushels, given certain decreases in variables (such as import prices) due to Chilean ascension into NAFTA. This may be accomplished through the use of the linear - log functional form (linear dependant variable / logarithms of independant variables). Further discussion of the merits of linear - log estimation are included in the Chapter Four.

CHAPTER THREE

ECONOMIC THEORY

Introduction

The theory involved in examining the possible impact of Chilean ascension into the North American Free Trade Agreement includes the theory of import tariffs, theory of a customs union/free trade area, and the theory of excess demand functions.

Ascension into the Agreement will induce Chile to (eventually) eliminate import tariffs on goods produced within the Agreement area. The theory of import tariffs describes the welfare effects of changing import tariff levels on different groups within an economy. For an equal reduction in tariff levels, the theory of import tariffs describes differing effects for given countries based on the ability of that country to use its market power to determine world prices. A country that can not influence world prices for a given commodity is called as a "small" country, while a country that can influence world prices for a given commodity is called a "large" country. Note that these terms refer only to a country's ability to exercise power in the market-place, and not to geographic size.

The formation of a free trade area (FTA), such as NAFTA, by two or more countries necessitates the loss of some sovereignty. Any given country in a

FTA must allow the goods of all other countries in the FTA to enter their territory without discrimination. The theory of a customs union / free trade area explains why a country would be interested in the formation of a FTA in terms of gains and losses.

The objective of this thesis is to model the NAFTA wheat import market after the inclusion of Chile to the agreement. The results of the literature review lead to the proposition of an ad hoc, single equation, of linear - log functional form, to estimate import demand for wheat in Mexico and Chile. A single equation estimate of import demand defines an excess demand curve.

The excess demand curve is a composite function combining the underlying supply and demand functions of trading partners. It is possible to extrapolate the excess function from the underlying supply and demand functions. However, given current data availability, the excess demand function may also be estimated directly. For the sake of simplicity, direct estimation of the excess demand function is the most practical method to examine the ascension of Chile into the North American Free Trade Agreement.

Theory of import tariffs

Barrier to trade may be broadly defined into two categories: tariff barriers and non-tariff barriers. A tariff is a tax levied on a commodity when it crosses

a national boundary. A non-tariff barrier is any barrier to free trade that is not a tariff --for example quotas, sanitary or phytosanitary requirements, safety regulations, etc. As a result of the progress in the worldwide GATT accords, most barriers to trade today take the forms of non-trade barriers. Non-trade barriers are generally more difficult to negotiate out of existence because the country imposing them may claim health or safety reasons for imposition of the non-trade barrier, a position more politically defensible than a tariff for protecting domestic producers from world competition.

The object of a free trade area is the elimination of all tariffs between member countries. Tariffs may be classified into two types; the ad valorem duty and the specific duty. The ad valorem duty is a tax based on a fixed percentage of the value of the commodity -- for example a 25% tariff on imported grapes. A specific duty is a tax which is a fixed sum of money per unit of commodity, such as \$50 per imported motorcycle. Tariffs allow the country levying them to control the pattern and volume of trade with the outside world. By imposing different tariffs on different commodities the country is able to change the relative prices of the commodities, which will result in a different trade pattern than would occur in the absence of the tariffs.

Domestic effects of a tariff imposed by a country may be examined by making two assumptions. First, assume the country is a small part of the world market so that it does not influence world prices by its action. Second, assume this small country can import all of the product it wants at the prevailing world market price. Finally, assume that transportation costs do

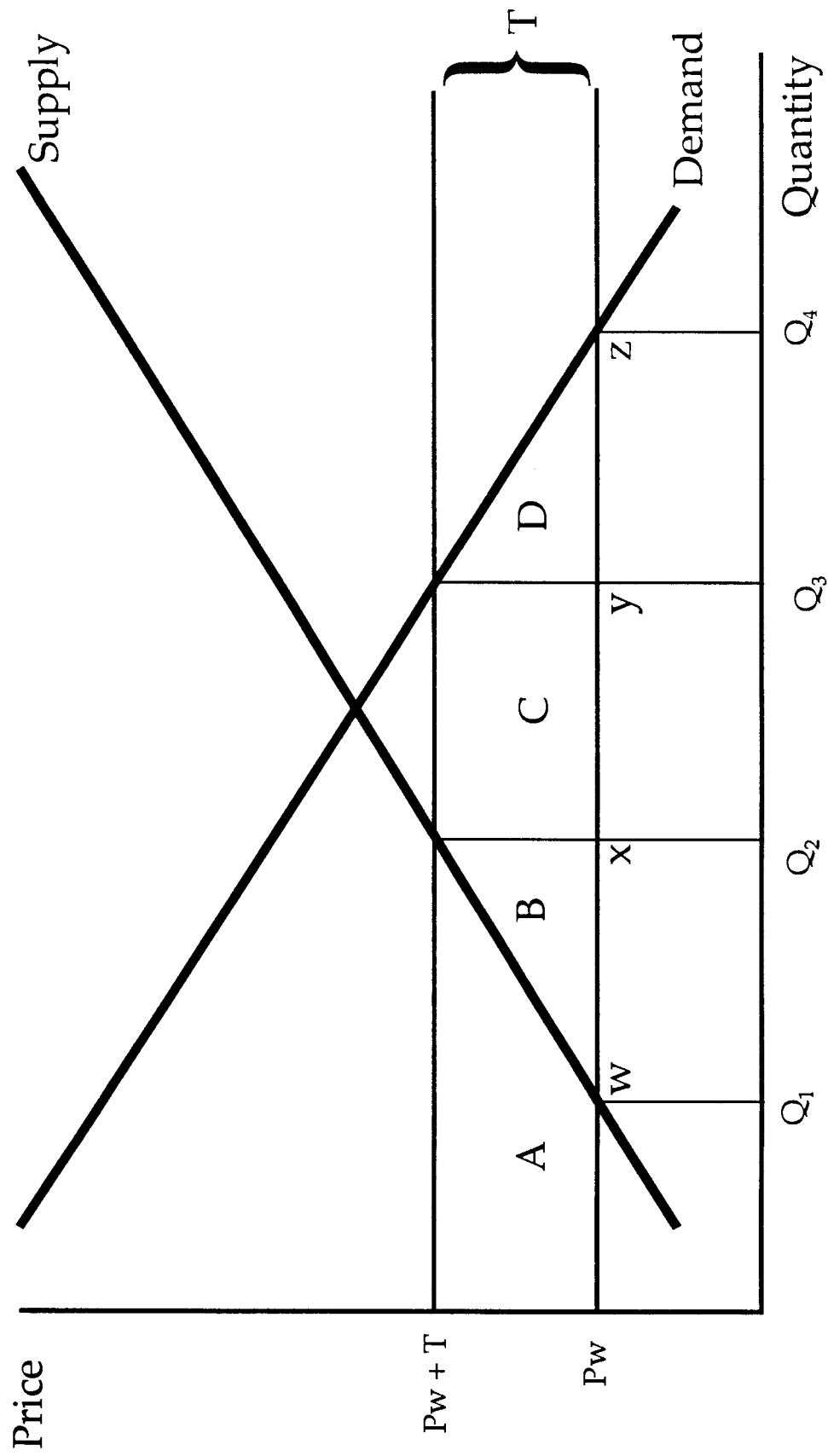
not exist, and therefore do not affect the price of imports.

The situation of a small country imposing a tariff on imports is illustrated by graph one. For purposes of illustration, we shall assume that the graph represents the wheat market. The graph illustrates the domestic supply curve, denoted as S , as well as the domestic demand curve, denoted as D . The small country faces a downward sloping demand curve in the wheat market; as price falls, the quantity of wheat demanded increases. The small country faces an upward sloping domestic supply curve; as price increases, the quantity of wheat supplied by domestic producers will increase.

The price of wheat paid by consumers and received by producers in this small country is exogenously determined by the world market, and is represented in the graph as the horizontal line, P_w . At this price, the quantity demanded by consumers is determined by the intersection of the demand curve and the P_w line, point Q_4 , while the quantity supplied by domestic producers is determined by the intersection of the supply curve and the P_w curve, point Q_1 . At this price, the quantity demanded by consumers is greater than the quantity produced by domestic suppliers; the rest ($Q_4 - Q_1$) must be purchased on the world market as imported wheat.

Assume that the government imposes a tariff on imported wheat. The tariff is represented as the vertical distance between the world price, P_w , and the new price after the tariff, $P_w + T$. At this new price, the quantity demanded by consumers is determined by the intersection of the demand curve and the $P_w + T$ line, point Q_3 , while the quantity supplied by domestic producers is determined by the intersection of the supply curve and the

Figure One: Effects of an Import Tax, Small Country Case



Source: "International Trade Policies" by Shida Henneberry and David Henneberry,
Policy Analysis Tools, pg 338

$P_w + T$ curve, point Q_2 . At this new price, the quantity demanded by consumers is greater than the quantity produced by domestic suppliers; the rest ($Q_3 - Q_2$) must be purchased on the world market as imported wheat. Additionally, the government gains revenue through collection of the tariff. The impacts of levying the tariff may be analysed geometrically.

Imposition of the tariff raised the price of wheat in the small country. Higher prices represent a welfare gain for domestic producers, geometrically represented by the area to the left of the supply curve bounded by the world market price of wheat (P_w), the new tariff imposed price of wheat ($P_w + T$), shown on the graph as areas A, B, C, and D. Higher prices represent a welfare loss for consumers, geometrically represented by the area to the left of the demand curve bounded by the world market price of wheat (P_w), the new tariff imposed price of wheat ($P_w + T$), represented by area A on the graph. The government gained revenue through collection of the tariff, geometrically represented as the area bounded by the amount of the tariff [$(P_w + T) - P_w$], and the quantity imported ($Q_3 - Q_2$), denoted on the graph as area C.

Summation of the gains and losses accrued to the different groups in the small country leads to a net social welfare analysis. The results for the imposition of a tariff by a small country, as illustrated in the graph, are summarized in the following table:

Consumer surplus loss	=	-A	-B	-C	-D
Producer surplus gain	=	+A			
Government revenue gain	=			+C	
<hr/>					
Net Social Welfare Loss			-B		-D

Imposition of a tariff by a small country implies a net social welfare loss for the country as a whole, even though some individual groups gain. By the same example, removal of tariffs by a small country implies a net social welfare gain for the country as a whole, even though some groups may lose.

Using geometric analysis, individual areas of the total effect of a tariff may be analyzed discretely. The area bounded by the price axis, the supply curve, and the amount of the tariff (area A) is known as the redistribution effect. It quantifies the higher price and higher profits gained by existing producers from the tariff, and represents a transfer of wealth lost by consumers and gained by producers.

The area wxQ_1Q_2 , bounded by the quantity axis, the line representing the non-tariff price P_w , and the change in quantity of wheat imported, $(Q_2 - Q_1)$, is called the protective effect. This area represents producer gain acquired by the increase in domestic production of wheat stimulated by the higher prices received by producers due to the imposition of the tariff.

The area yzQ_3Q_4 , bounded by the quantity axis, the line representing the non-tariff price P_w , and the change in quantity of wheat imported, $(Q_4 - Q_3)$, is

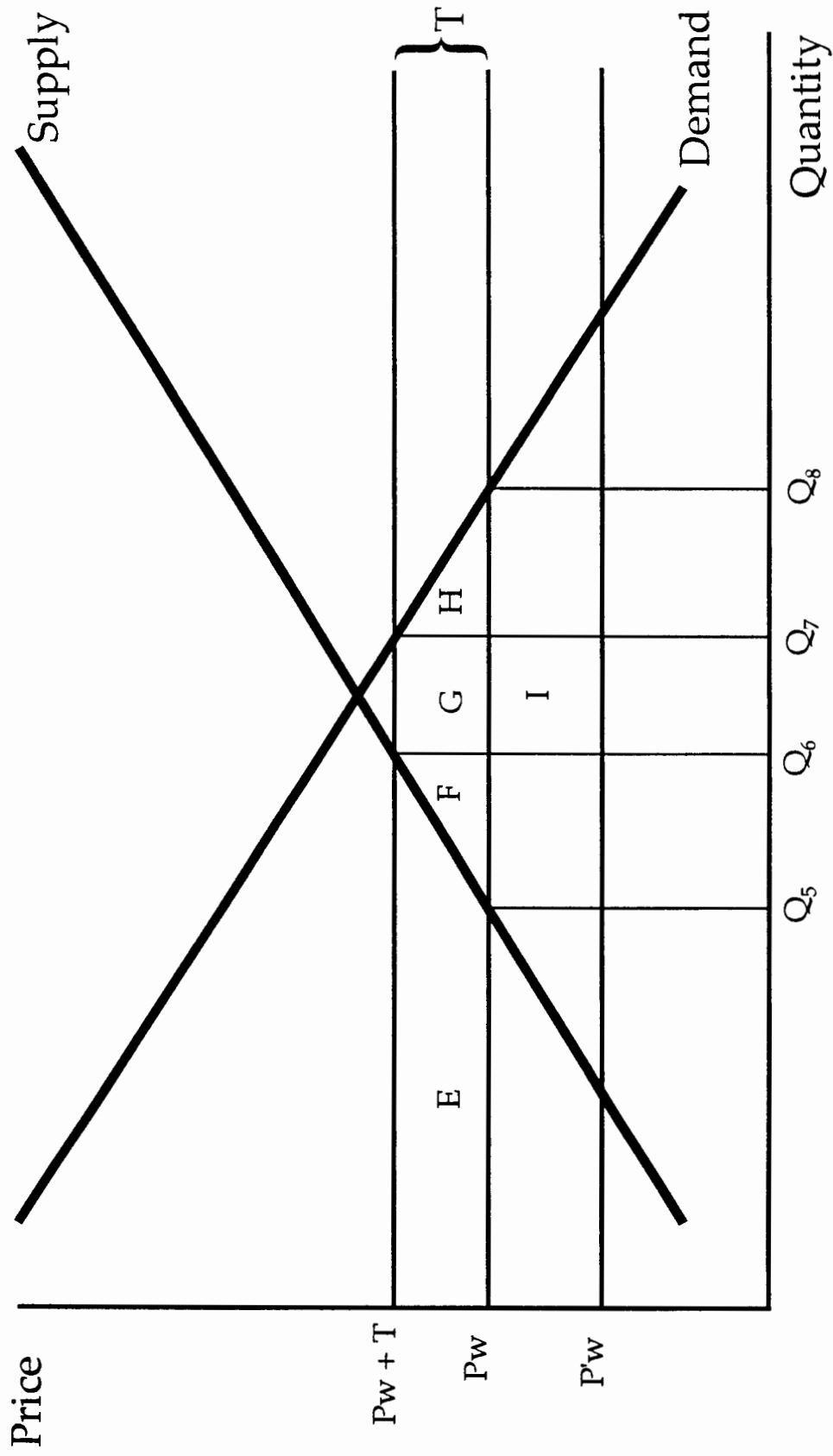
called the consumption effect. This area reflects loss to the consumer due to decreased consumption stimulated by the higher prices that must be paid for wheat due to the imposition of the tariff. Note that the two rectangles, wxQ_1Q_2 and yzQ_3Q_4 , representing a loss and a gain respectively, are always geometrically the same size, thereby cancelling each other out in the net welfare analysis.

The area bounded by the quantity of wheat imported into the country after imposition of the tariff (Q_3-Q_2), and the amount of the tariff (area C) is known as the revenue effect. It quantifies the amount of revenue gained by the government from the imposition of the tariff.

The two remaining triangles, B and D, are called dead weight loss of the tariff, or the cost of the tariff. They represent welfare loss that is not offset by a welfare gain elsewhere in the model.

The effects of an import tariff on a small country are quite different from the effects of an import tariff on a large country. The term "large country" in this case signifies that the importing country is able to influence prices in the world market through its purchasing decisions. The situation of an import tariff in a large country is diagramed in graph two. For purposes of illustration, we shall assume that the graph represents the wheat market. The graph illustrates the domestic supply curve, denoted as S, as well as the domestic demand curve, denoted as D. The large country faces a downward sloping demand curve in the wheat market; as price falls, the quantity of wheat demanded increases. The large country faces an upward sloping domestic supply curve; as price increases, the quantity of wheat supplied by

Figure Two: Effects of an Import Tax, Large Country Case



Source: "International Trade Policies" by Shida Henneberry and David Henneberry,
Policy Analysis Tools, pg 338

domestic producers will increase.

The price of wheat paid by consumers and received by producers in this large country initially is exogenously determined by the world market, and is represented in the graph as the horizontal line, P_w . At this price, the quantity demanded by consumers is determined by the intersection of the demand curve and the P_w line, point Q_4 , while the quantity supplied by domestic producers is determined by the intersection of the supply curve and the P_w curve, point Q_1 . At this price, the quantity demanded by consumers is greater than the quantity produced by domestic suppliers; the rest ($Q_4 - Q_1$) must be purchased on the world market as imported wheat.

Assume that the government of a large country imposes a tariff on imported wheat. The tariff is represented as the vertical distance between the world price, P_w , and the new price after the tariff, $P_w + T$. At this new price, the quantity demanded by consumers is determined by the intersection of the demand curve and the $P_w + T$ line, point Q_3 , while the quantity supplied by domestic producers is determined by the intersection of the supply curve and the $P_w + T$ curve, point Q_2 . At this new price, the quantity demanded by consumers is greater than the quantity produced by domestic suppliers; the rest ($Q_3 - Q_2$) must be purchased on the world market as imported wheat.

The new tariff induced price, $P_w + T$, is the price paid by consumers and received by producers for wheat in the large country. Due to the increased domestic prices, the large country reduces total wheat imports. Because this is a large country able to influence the world market, the world demand

decreases as a result of the reduction in the large country's imports. The decreased world demand for wheat leads to a decline in the world price from P_w to P'_w . The large country is able to purchase its required imports from the world market at the tariff-influenced lower world market price, P'_w . Additionally, the government gains revenue through collection of the tariff. The impacts of levying the tariff may be analysed geometrically.

Imposition of the tariff raised the price of wheat for consumers and producers in the large country. Higher prices represent a welfare loss for consumers, geometrically represented by the area to the left of the demand curve bounded by the world market price of wheat (P_w), the new tariff imposed price of wheat ($P_w + T$), represented by area E on the graph. Higher prices represent a welfare gain for domestic producers, geometrically represented by the area to the left of the supply curve bounded by the world market price of wheat (P_w), the new tariff imposed price of wheat ($P_w + T$), shown on the graph as areas E, F, G, and H. The government gained revenue through collection of the tariff, geometrically represented as the area bounded by the amount of the tariff $[(P_w + T) - P_w]$, and the quantity imported $(Q_3 - Q_2)$, denoted on the graph as area G and I.

Summation of the gains and losses accrued to the different groups in the large country leads to a net social welfare analysis. The results for the imposition of a tariff by a large country, as illustrated in the graph, are summarized in the following table:

Consumer surplus loss	=	-E	-F	-G	-H
Producer surplus gain	=	+E			
Government revenue gain	=			+G	+I
<hr/>					
Net Social Welfare Loss			-F	-H	+I

Imposition of a tariff by a large country implies an indeterminate gain or loss for the country as a whole. Net social welfare is increased if the area of gain (I) is larger than the area of loss (-F -H), but decreased if the the area of gain (I) is smaller than the area of loss (-F -H). Net social welfare gain or loss is determined by the elasticities of the supply and demand curves as well as the magnitude of the tariff. It is possible that the large country experience no net social welfare gain or loss by imposing a tariff on imports, but this can only occur if the area of gain is exactly matched by the area of loss. If this occurs, the tariff is classified as an "optimal tariff".

The theory of import tariffs predicts that decreasing import tariffs leads to increased social welfare for the country as a whole, although some sectors may experience social welfare loss as a consequence of lowering import tariffs. This theory predicts that the effect of Chile lowering import tariffs on all incoming NAFTA goods will be increased social welfare on the whole, while some previously protected sectors, such as Chilean wheat producers, may experience welfare loss due to the lowered import barriers.

Theory of a Customs Union/Free Trade Area

The NAFTA is a free trade area. A free trade area is one form of preferential trade agreements among nations. A free trade area consists of a group of countries that have abolished all tariff barriers among themselves while maintaining their respective individual tariffs towards the rest of the world.

In a free trade area, problems may arise because commodities imported from the outside world tend to enter the free trade area via the country with the lowest external tariff. Extensive documentation by so-called certificates of origin is required. Goods going from one member of a free-trade area to another are accompanied by a certificate of origin, issued to attest that the goods originated in the member country and not in a third country. The solution to the problem of certificates of origin in a free trade area is for every member of the free trade area to have identical tariff barriers towards the rest of the world.

A customs union and a free trade area are very similar, however, the two economic organizations differ in one important aspect. A free trade area consists of a group of countries that have abolished all tariff barriers among themselves while maintaining their individual tariffs towards the rest of the world. A customs union differs from a free trade area in that all members of the customs union have the same common external tariff that applies to the

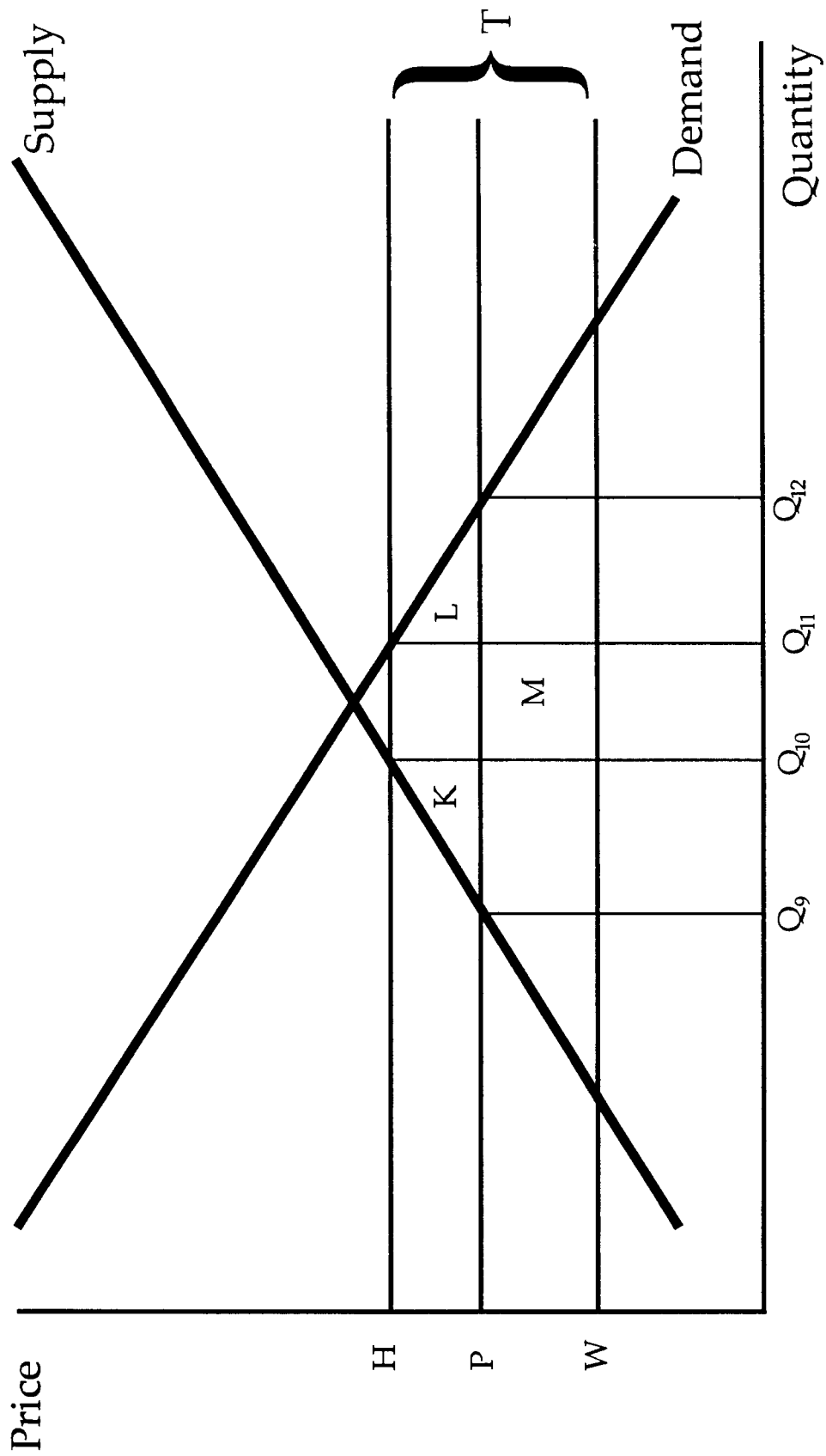
imports from any non-member country. The formation of a customs union involves the changing of tariff patterns between the countries forming the union as well as changing tariffs between the union members and the outside world.

One important aspect of customs union/free trade area concern is trade creation versus trade diversion. These concepts are illustrated geometrically on graph three. Graph three could be used to describe the situation of a customs union or a free trade area, but for the purposes of illustration and ease of explanation, the graph shall represent the formation of a customs union. The supply (S) and demand (D) curves are those of the home country. The horizontal lines represent the exogenously determined prices in the home country (H), a customs union/free trade area partner country (P), and the world price (W). The import tariff faced by non-member imports is the vertical distance between the world price and the home price, denoted on the graph as T.

At the home country's price demand exceeds supply. The home country will import the quantity $Q_3 - Q_2$ from the rest of the world at price W. Before joining the union, imports from the partner country into the home country would not occur; the price of those imports would be $P + T$, which would exceed the home country price. After joining the union, the goods of the partner country would enter the home country tariff free. In this case, the home country would import all of the good it wanted ($Q_3 - Q_2$) from the partner country.

Trade creation is generated when the output of any given product shifts

Figure Three: Effects of Customs Union Formation



Source: "International Trade Theory and Empirical Evidence: by H. Robert Heller, Figure 18 - 5

from a country, in which the cost to procure that item is high, to a participating country with lower production costs. In this example customs union formation between the home country and the partner country results in a net trade creation gain equal to the triangles K and L, reflecting increases in trade due to the customs union creation.

Trade diversion may also occur within a customs union if a country changes its trade patterns to purchase a particular good from a high-cost intraunion source rather than from a low-cost external source as before. Trade diversion, and its resulting inefficient allocation of resources, is a troubling side-effect of customs union/free trade area creation. In this example, the trade diversion deadweight loss is measured by M, representing a shift in imports from low cost world sources to the higher cost partner. To determine whether an economic union makes a country better off in the long run, one must determine whether trade creation effect ($K + L$) offsets trade diversion (M). However, the possible trade diversion outcome can be offset by the certain outcome of lowered tariff barriers among the trade agreement's members, as allowed by GATT accords.

The formation of a free trade area or customs union necessitates the removal of import tariffs, as discussed in the first part of this chapter. The welfare gains accrued to a country (from the import barrier removal necessary for free trade area formation) must be weighed against the possible welfare loss (to the non-FTA member countries) caused by trade diversion. These gains and losses may be quantified by geometric analysis and the theory of

customs union/free trade area formation. Unlike the theory of import tariffs and their removal, the theory of customs union/free trade area formation gives no general guidance as to whether welfare gains will outweigh welfare losses in any given case. Each case of CU/FTA formation must be analyzed individually.

Theory of Excess Demand Curves

The objective of this thesis is to model the NAFTA wheat import market after the inclusion of Chile to the agreement. The method used was to estimate the single ad-hoc equation representing excess demand for wheat in NAFTA plus Chile.

Excess demand is a basic tool used to analyze foreign trade theoretically. Excess demand is a composite line in the trade interface between two countries representing the underlying supply and demand functions of importers.

The elasticity of an individual excess demand function is dependant upon the elasticities of both of its respective underlying supply and demand functions. The derivation of an elasticity for an excess demand function requires detailed and intimate knowledge of these underlying supply and demand functions -- knowledge which may be impossible to acquire given currently available information. Therefore, this thesis is restricted to estimating the excess demand equation directly rather than extrapolation via

construction of the underlying supply and demand functions. Nevertheless, the excess demand function can best be understood through examination of its constructing from the underlying supply and demand functions, and how interactions in two different trading countries are translated into a third arena -- the excess function/trade interface.

Previously we have examined the effects of tariffs on a single country and the effects of the formation of a customs union/free trade area on a single country. The discussion of excess demand curves requires the introduction of a second country as well as an interaction area between these two countries. It is within the interaction area that the excess demand curve takes shape. An excess demand curve, as shown in graph four, shows the demand for imports of a given good on the world market.

It is important to note that both excess demand and excess supply functions are composite functions. The elasticity of an individual excess function is dependant upon the elasticities of both of its underlying supply and demand functions. The derivation of an elasticity for an excess function requires detailed and intimate knowledge of its underlying supply and demand functions -- knowledge that may be impossible to acquire given currently available information.

Graph four is composed of three areas: country Y, country Z, and the trade interface between these two countries. For the sake of discussion, we shall assume the following: there are only two countries in existence, transportation costs are non-existent, the two countries use the same currency, and the traded good is wheat. The areas for country Y and country Z

contain their respective, exogenously determined, supply (S) and demand (D) functions for wheat. Country Y and country Z are interconnected through the trade interface area.

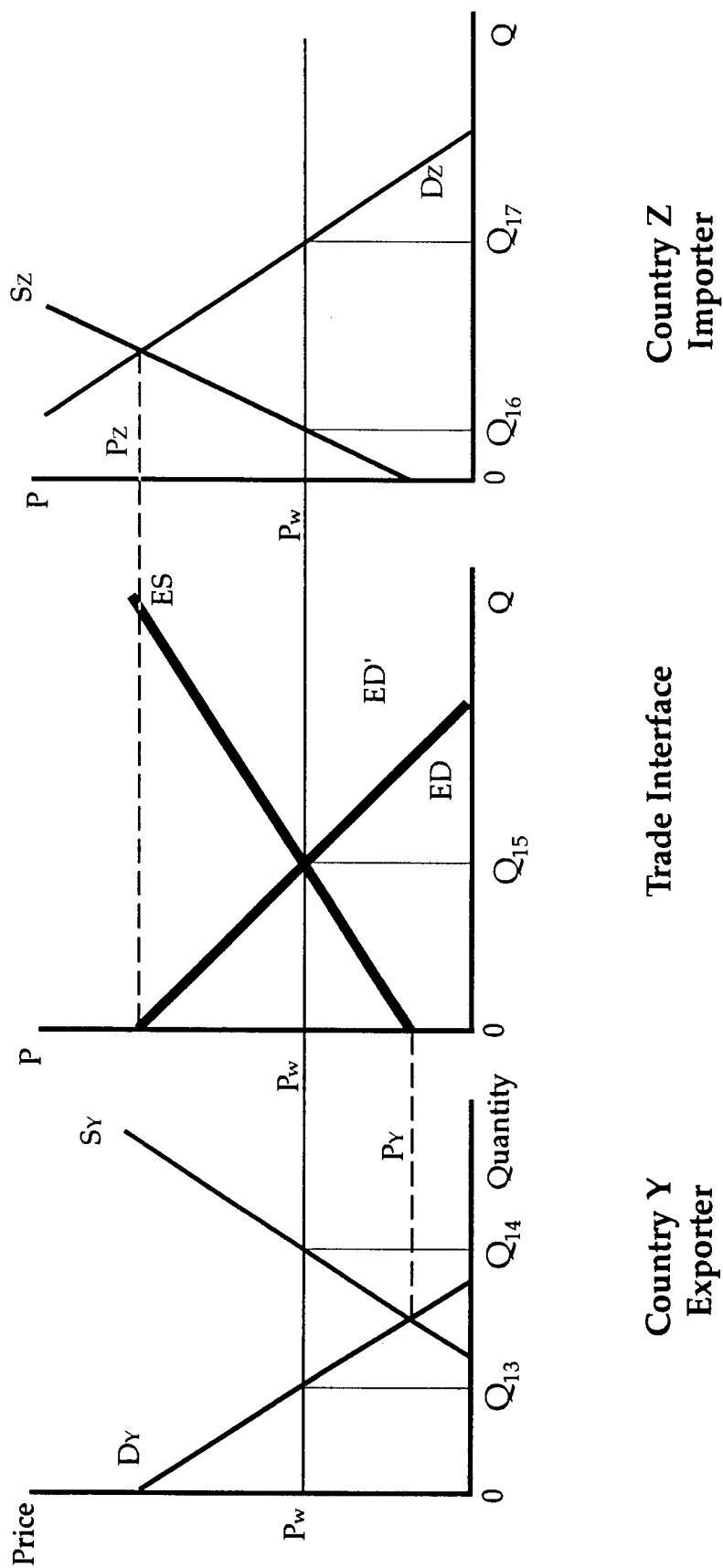
In the pre-trade (no trade) state, country Y has a relatively low equilibrium price for wheat while country Z has a relatively high equilibrium price for wheat. In the absence of trade, the domestic equilibrium price in country Y would be P_Y . For prices above P_Y , producers in country Y would produce more than domestic consumers would be willing to buy. Thus, we can trace an excess supply function for country Y in the trade interface area, ES. This supply function would represent exports from country Y onto the world market.

In the absence of trade, in country Z the domestic equilibrium price of wheat would be P_Z , which by construction and assumption is above P_Y . For prices below P_Z , consumers in country Z would demand more than the producers of country Z would be willing to produce. As prices fall, the difference would grow. This difference may be traced out in the trade interface area as an excess demand function, ED. This is the demand function for imports from the world market.

The excess demand and excess supply functions interact in the trade interface area. The point of equilibrium between these two functions determines the world price of the product, P_w . The world price discovered in the trade interface determines if trade shall occur, and the quantity of wheat traded.

In country Y, the world price (P_w) is higher than the domestic price (P_Y).

Figure Four: Excess Demand Curve



Source: "Agricultural Policies and World Markets" by Alex F. McCalla and Timothy E. Josling, Fig. 2 - 3

Consumers in country Y will demand the quantity determined by the intersection of the world price, P_w , and the demand curve, D_Y . This quantity is denoted on the graph as Q_{13} . Producers in country Y will produce the quantity determined by the intersection of the world price, P_w , and their supply curve, S_Y . This quantity is denoted on the graph as Q_{14} . The difference between the quantity supplied and the quantity demanded in country Y ($Q_{14}-Q_{13}$) is the amount that must be disposed of in the world market.

In country Z, the world price is lower than the domestic price. Consumers in country Z will demand the quantity determined by the intersection of the world price, P_w , and the demand curve, D_Z . This quantity is denoted on the graph as Q_{17} . Producers in country Z will produce the quantity determined by the intersection of the world price, P_w , and their supply curve, S_Z . This quantity is denoted on the graph as Q_{16} . The difference between the quantity demanded and the quantity supplied in country Z ($Q_{17}-Q_{16}$) is the amount that must be obtained from the world market.

By construction, at the equilibrium price between excess demand and excess supply the quantity exported by the exporting country ($Q_{14} - Q_{13}$) will match the quantity imported by the importing country ($Q_{17} - Q_{16}$) exactly; these traded quantities will also equal the quantity of traded goods indicated by the ES/ED equilibrium in the trade interface graph, Q_{15} .

These three graphs taken together form the basis of excess demand analysis. Alteration of the supply and/or demand functions in either of the

two countries involved in the analysis will alter the resulting excess functions.

Fortunately, it is possible to estimate the excess demand function directly, without knowledge of the underlying supply and demand functions. It is also possible to predict how changes in supply and/or demand functions will affect excess demand functions without knowing the ex post facto locations of the underlying functions. This is the most valuable aspect of excess demand functions, since current data availability restricts complete knowledge of the supply and demand functions of any commodity, in every country.

The theory involved in examining the possible impact of Chilean ascension into the North American Free Trade Agreement includes the theory of import tariffs, theory of a customs union/free trade area, and the theory of excess demand functions.

The theory of import tariffs predicts that decreasing import tariffs leads to increased social welfare for the country as a whole, although some sectors may experience social welfare loss as a consequence of lowering import tariffs. This theory predicts that the effect of Chile lowering import tariffs on all incoming NAFTA goods will be increased social welfare on the whole, while some previously protected sectors, such as Chilean wheat producers, may experience welfare loss due to the lowered import barriers.

The theory of customs union/free trade area describes the consequences of the formation of such areas. The NAFTA examined in this thesis is a free trade area. A free trade area consists of a group of countries that have

abolished all tariff barriers among themselves while maintaining their respective individual tariffs towards the rest of the world. The formation of a free trade area or customs union necessitates the removal of import tariffs, as discussed in the first part of this chapter. The welfare gains accrued to a country (from the import barrier removal necessary for free trade area formation) must be weighed against the possible welfare loss (to the non-FTA member countries) caused by trade diversion. These gains and losses may be quantified by geometric analysis and the theory of customs union/free trade area formation. Unlike the theory of import tariffs and their removal, the theory of customs union/free trade area formation gives no general guidance as to whether welfare gains will outweigh welfare losses in any given case. Each case of CU/FTA formation must be analyzed individually. An examination of the particular case of Chile joining NAFTA is well beyond the scope of this thesis. However, it may be noted that the GATT accords allow free trade area formation as a "second best" solution to bringing down trade barriers throughout the world.

The theory of excess demand functions describes the interactions of two countries trading goods, and allows a researcher to quantify the effects of changes in supply or demand in either country on the trading interface between them. The modelling of the effects of Chile joining the NAFTA agreement on net Chilean wheat import demand is an example of modelling an excess demand curve for Chilean wheat imports. Excess demand functions are an especially valuable tool for economists because they allow a researcher to analyze the effects of a disturbance in supply or demand in one country on

the trade interface between the two countries, without the explicit knowledge of every elasticity (both supply and demand) in each country (both importer and exporter).

This examination of the theory involved in this study leads to an examination of the model, data, and method of the study, as is described in chapter four.

CHAPTER FOUR

THE MODEL, DATA, AND METHOD OF THE STUDY

The purpose of this study is to examine the effects on the NAFTA imported wheat market after the inclusion of Chile in the Agreement. The objectives of this study are to model the net imported wheat market of the NAFTA with addition of Chile to the agreement, and to compare the factors influencing the level of wheat imports into Mexico and Chile. Price, quantity, income, exchange rate, and population data will be used to estimate a single equation ad hoc model of net per capita wheat import demand for the composite market. The estimated equation will result in an excess demand function.

The proposed model has fourteen parameters, including own price, price of a substitute (corn), price of a complement (bovine meat), and financial parameters dealing with per capita gross domestic product and inflation & exchange rates. Dummy variables shall be used to distinguish the differing reactions of Chile and Mexico. The calculated response coefficients of each country shall be used to quantify their respective reactions to a given change in variable levels.

The Model

The functional form chosen for this model is the linear - log form. Many previous import demand estimations have used the logarithmic functional form which imposes a constant elasticity over the import demand function, and generates parameter elasticity estimates. Preliminary estimations of the data set used in this study examined the logarithmic functional form as well as the linear - log functional form. The logarithmic form performed poorly, especially with regards to goodness of fit of the equation, and reliability of the individual parameter estimates. Use of the linear - log form considerably improved the estimates in these areas. Additionally, the constraint of logarithmic functions of constant elasticity over the entire import demand schedule was deemed unnecessarily restrictive for this study. These reasons lead to the choice of using the linear - log functional form for this thesis.

The linear - log form allows the dependent variable to be measured in natural units, such as bushels, whereas the independent variables are measured in logarithms. Convention dictates using base e , the natural log, for the independent variables.

For example a linear - log function is:

$$Y = B_0 + B_1 \ln X \quad (1)$$

where,

Y = dependant variable

B_0 = constant term

B_1 = parameter for independent variable, X

X = independent variable

\ln denotes natural logarithm

Let X in the above equation vary by some given percent, denoted by λ (a 10 percent change would be written as 0.10). The resulting equation is:

$$Y' = B_0 + B_1 \ln (X + \lambda X) \quad (2)$$

where,

Y' = the change in Y

λ = a given percent change in X

Subtracting (1) from (2) yields the following:

$$\begin{aligned} Y' - Y &= B_1 * (\ln [X (1 + \lambda)] - \ln X) \\ &= B_1 * \ln \frac{X(1+\lambda)}{X} \\ &= B_1 \ln (1 + \lambda) \end{aligned} \quad (3)$$

Equation (3) shows that the change in Y for a given percentage change in X is constant, regardless of the actual level of X .

The elasticity of the linear - log function, $E_{Y/X}$ is:

$$E_{Y/X} = \frac{B_1}{X} * \frac{X}{Y} = \frac{B_1}{Y}$$

The elasticity of a linear - log function is not constant; it changes inversely with the dependant variable, in this example Y. The value of the elasticity changes as the point of evaluation moves along the demand curve. A given percent increase in the independent variable, in this case X, will result in the same absolute change in Y, regardless of where on the function the increase in X occurs. But the percent increase in Y will decrease as X increases. The linear - log function is a functional form that allows the independent variable to increase at a decreasing rate without the limitation of an asymptote.

The ad hoc single equation model of net per capita wheat import demand for Mexico and Chile tested was of the following form:

Net per capita

wheat import demand = f (price of wheat,
price of corn,
price of bovine meat,
income,
lagged import quantity of wheat)

The independent economic variables in the model include prices of wheat, corn, and fresh, chilled, or frozen bovine meat, an income variable in the form of a per capita GDP index, and a lagged net per capita quantity of wheat imported variable. Modelling the addition of Chile into the NAFTA

agreement dictated the use of dummy variables in the equation. The dummy variables were composed of each of the above named variables multiplied by the qualitative dummy variable for Mexico (1 = Mexico, 0 = Chile). By making Mexico equal to one, Mexico became the base country in the model. The parameters for the non-dummy variables reflect the parameters for Mexico directly, while the dummy versions of the variables reflect the difference between Mexico and Chile in their reactions to that variable. The model estimated a regression line for net wheat demand using these six economic variables as well as dummy versions of those six economic variables, a dummy placeholder, and a constant term, totaling fourteen variables in the model.

The model is composed of regular versions and dummy versions of the same variables for two reasons. First, the use of dummy variables allows the modelling of net wheat import demand for both Chile and Mexico as a single, composite, NAFTA wheat import demand area, as will be the case if and when Chile gains entry into the agreement. Secondly, the use of dummy variables allows the quantification of the effects of each variable on the two countries as separable units. This is a valuable aspect of this model because it is not entirely reasonable to presume that the two countries will have identical or even similar reactions to the same stimuli. Dummy variables were used to isolate the effects of each variable on the Mexican data set from the effects of the same variable on Chilean data set. Because Mexico was taken as the base for the composite NAFTA model, the coefficients of the non-dummy form of each variable reflect the impact of that variable on

Mexico alone, while the coefficients of the dummy form of each variable reflect the impact of that variable on the difference between Chile and Mexico. One cannot interpret the impact of the model variables on Chile alone without manipulating the results from the single line regression equation.

The robustness of the model was evaluated by calculating "F - statistics". "F - statistics" are used to test joint hypotheses about parameters and help the researcher to choose the final version of the model. A joint hypothesis is a hypothesis about several parameters simultaneously. The hypothesis being tested is called the null hypothesis and is denoted as " H_0 ", while the alternative hypothesis is denoted " H_a ".

The first joint hypothesis to be tested examined all of the dummy variable parameters simultaneously. This would test would examine if Mexico and Chile had significantly different responses with regards to their parameters. The test took the following form:

$$H_0: \quad PwD = 0, \text{ and } PcD = 0, \text{ and } PbovD = 0, \text{ and } GDPD = 0, \text{ and } \\ \text{lagD} = 0, \text{ and } RealD = 0$$

$$H_a: \quad \text{one or more of these parameters is not zero.}$$

The resulting F statistic was calculated to be 4.2373786 with 6 and 24 degrees of freedom, possessing a p-value of 0.00478. This result indicates a very low probability that in repeated samplings of this data, all of the named parameters could be equal to zero. In other words, at least one of the named parameters is of some statistically important value. The null hypothesis of

this test would be rejected at the 10% level of significance.

The second joint hypothesis tested all of the dummy variable parameters simultaneously except for the lagged quantity variable parameter. This test would examine the level of influence that the lagged quantity variable. A model in which a lagged quantity term exercises a large influence over the entire equation would indicate that the model chosen was not robust; the model would perform just as well with or without the non-lagged variables. A major drop in the F statistic of this test in comparison to the first test would indicate that the lagged quantity variable exercised an overly large influence on the equation.

The second test took the following form:

H_0 : $PwD = 0$, and $PcD = 0$, and $PbovD = 0$, and $GDPD = 0$,
and $RealD = 0$

H_a : one or more of these parameters is not zero

The resulting test statistic was calculated to be 3.7181601 with 5 and 24 degrees of freedom, possessing a p-value of 0.01239. This result indicates a very low probability that in repeated samplings of this data, all of the named parameters could be equal to zero. In other words, at least one of the above named parameters is of some statistically important value; the lagged variable is one of at least two variables important in understanding the model. Statistically important variables are a key ingredient to robust models. The null hypothesis of this test would be rejected at the 10% level of significance.

The next test examined the non-wheat prices. The third test took the following form:

H_0 : $P_cD=0$, and $P_{bov}D=0$

H_a : at least one of these parameters is not zero

The resulting test statistic was calculated to be 5.7149989 with 2 and 24 degrees of freedom, possessing a p-value of 0.00933. This result indicates a very low probability that in repeated samplings of this data, both of the named parameters could be equal to zero. In other words, Mexico and Chile react differently to changes in the prices of compliments and/or substitutes (as defined in this model) with regards to the quantity of wheat imported. Both of these variables must be included in the model to correctly interpret how Mexico and Chile would react to changes in these variables. The null hypothesis for the third test would be rejected at the 10% level.

The final test examined the non-price financial parameters of the model. The fourth test took the following form:

H_0 : $GDPD = 0$, and $RealD = 0$

H_a : at least one of these parameters is not zero

The resulting test statistic was calculated to be 1.4155383 with 2 and 24 degrees of freedom, possessing a p-value of 0.26235. This result indicates a relatively

high probability that in repeated samplings of the data set, both of the non-price, financial parameters could be equal to zero. This should be expected from the relatively high p-values of the parameters individually. In other words, Mexico and Chile do not have widely differing responses in the quantity of wheat imported with regard to changes in their respective gross domestic products or real appreciation indexes. In this case, the null hypothesis of the fourth test could not be rejected at the 10% significance level.

The Data Used in the Model

The dependent variable in this model is net per capita wheat import demand, measured in metric tons. Net wheat import demand was defined as the quantity of wheat imported minus the quantity of wheat exported by a country in each given year. This number was then divided by the population, in units of one million people, for that given year to arrive at the net per capita wheat import demand. Population series were taken from the IMF 1993 Yearbook line 99z. Data on population (line 99z), which represent midyear estimates, are provided by the United Nations.

Quantity and value measurements of the commodities imported and exported for each country were taken directly from the Food and Agriculture Organization's Trade Yearbooks, published annually. Each yearbook provides data on the publication year and the two previous years. Data for an

individual year was selected from the yearbook published two years later (e.g. 1983 data was taken from the 1985 yearbook) to allow for corrections (e.g. the time-lag between the dispatch of goods from the exporting country and their arrival in the importing country; the use of a different classification of the same product by different countries; or the fact that some countries supply trade data on general trade while others give data on specific trade). For all commodities, export values are f.o.b. and import values are c.i.f.

Price variables for wheat, corn, and bovine meat were calculated on a per unit basis from the quantity and value data for imports using the following formula:

$$\text{Price per unit in year } t = \frac{(\text{Value of imports \$U.S. for year } t)}{(\text{Quantity of imports for year } t)}$$

All tables in the FAO Trade Yearbook use \$U.S. to value imports and exports.

For each year in the sample, a series of price per unit values for wheat was calculated from price and quantity data for wheat imports taken from the Wheat and Wheat Flour in Wheat Equivalent table in the FAO Trade Yearbook. The conversion factor of wheat flour to wheat is based on an extraction rate of 72 percent for all countries. Flour of cereals other than wheat is not included in this summary. The quantity conversion factor for wheat is 36.744 bushels of wheat per metric ton; or 1 bushel of wheat (60 pounds) = 0.027216 metric tons.

For each year in the sample, a series of price per unit values for a substitute good (corn) was calculated from price and quantity data for corn

imports taken from the Maize table in the FAO Trade Yearbook. One anomalous data point for the price of corn in Chile in 1985 was eliminated and replaced by the average of the price of corn per metric ton in Chile in 1984 and 1986.

For each year in the sample, a series of price per unit values for a complimentary good (bovine meat) was calculated from price and quantity data for bovine meat imports taken from the Fresh, Chilled, or Frozen Bovine Meat table in the FAO Trade Yearbook.

The unit values calculated for wheat, corn, and bovine meat were taken from data reported in nominal terms. Since these unit values are reported in terms of \$U.S., the nominal price series were transformed into real price series by dividing each year's price per unit value by that year's U.S. consumer price index (CPI).

The series of income variables was based on a constructed per capita gross domestic product (GDP) index. GDP figures were taken from the 1993 International Monetary Fund (IMF) Yearbook, line 99b.p, GDP [at constant] 1985 Prices. Line 99b.p refers to constant price GDP. The base year prices at which constant price data are expressed are updated by the national compilers. Constant price data for the first overlapping year are used to link different base year series. The linked series are expressed in index form and shifted to a common base period, 1985 = 100. This index is then applied to current price GDP data for 1985 to yield an estimated series at 1985 constant prices.

Each year's GDP at 1985 prices figure was divided by that year's

population, in millions, to arrive at the per capita GDP in 1985 prices price series. The per capita GDP at 1985 prices series was transformed into an index, with 1973 as a base year (1973 = 100), using the following formula:

$$\text{Per capita GDP index=} \frac{(\text{GDP year } t / \text{Population year } t)}{(\text{GDP 1973} / \text{Population 1973})}$$

for year t

Because all FAO Trade Yearbook price information is reported in terms of U.S. currency, fluctuations in exchange rates and purchasing power between the U.S. dollar and the Mexican peso or between the U.S. dollar and Chilean peso must be taken into consideration. These fluctuations were accounted for by creating a Real Appreciation index. The real appreciation rate is calculated by multiplying the ratio of the changes in the consumer price index (CPI) of the United States over the changes in the CPI in the given foreign currency by the ratio of the change in the rf exchange rates (\$U.S. per unit of foreign currency) of that given currency, using the following formula (using the U.S. and Mexico in this example):

$$\frac{rf \text{ exchange rate year } t}{rf \text{ exchange rate year } t-1} \times \frac{\frac{U.S. \text{ CPI year } t}{U.S. \text{ CPI year } t-1}}{\frac{Mexican \text{ CPI year } t}{Mexican \text{ CPI year } t-1}}$$

This series was transformed into an index with a base [1973 = 100]. When the real appreciation index increases, the U.S. dollar is appreciating against that foreign currency. When the real appreciation index decreases, the U.S. dollar

is depreciating against that foreign currency.

A variable to reflect institutional linkages through time was created by adding a one year lagged net per capita wheat imports variable.

The Methods Used to Estimate the Parameters of the Model

OLS estimation determines the line for which the sum of squared errors is a minimum. For any given data set, it is possible to find many lines for which the sum of the errors is equal to 0, but it can be shown that there is one (and only one) line for which the sum of squared errors is a minimum, called the least squares line. The statistical package Shazam was used to determine the least squares line which best fit the data set. The econometric form of the estimated model was linear - log (i.e. the dependant variable was unaltered while the natural logarithm was taken of all independent variables). The single equation thus generated is the base model of this thesis.

Observed significance levels, or p-values, were used to evaluate individual parameters in the model. The p-value for a specific statistical test is the probability, assuming H_0 is true, of observing a value of the test statistic that is at least as contradictory to the null hypothesis (and as supportive of the alternative hypothesis) as the one computed from the sample data. There are at least two advantages of using p-values instead of t-values for evaluating regression results. First, readers are able to draw their own conclusions about the reported hypothesis test by choosing a level of rejection themselves and comparing it to the reported p-value. Secondly, an exact measure of the

degree of significance of the test result (i.e., the p-value) is provided.

The method followed was to estimate the full model which included all fourteen betas (twelve preliminary parameters, a dummy variable, and a constant term). The resulting coefficients for the single equation regression are reported on table one. In table one the results are reported for each variable (Pw, Pc, etc) as well as for the dummy version of each variable, denoted by a capital D added to the end of the regular variable symbol (PwD, PcD, etc). The selected structure of the model allows direct examination of the "regular" form of each parameter (Pw, Pc, etc) to be analyzed as the Mexican coefficient value of the given variable. To arrive at the coefficients of the variables for Chile, the dummy version of each variable was subtracted from the non-dummy version of that same variable (e.g. coefficient Pw - coefficient PwD = coefficient for Chile). The results of these calculations are reported on table two.

CHAPTER FIVE

RESULTS

The results of this study are reported on tables one through seven. Table one shows the results of the OLS regression for each variable (Pw, Pc, etc.) as well as for the dummy version of each variable, denoted by a capital D added to the end of the regular variable symbol (PwD, PcD, etc). The final two columns of table one show the r-squared and adjusted r-squared figures for each equation. Below each parameter, listed in parenthesis, is the p-value for that parameter.

Table one represents the raw output from the SAS program. These data must be manipulated into an interpretable form before drawing any conclusions about the model.

TABLE ONE

LINEAR LOG REGRESSION RESULTS: MEXICO AND CHILE WITHIN A COMPOSITE
NAFTA WHEAT IMPORT MARKET

Pw	Pc	Pbov	GDP	lag	Real	PwD	PcD	PbovD	GDPD	lagD	RealD	Dummex	Constant	r ²	adj. r ²
24777 (.246)	82822 (.001)	-61637 (.029)	-45439 (.477)	7481 (.105)	-82332 (.010)	-30211 (.296)	-100860 (.048)	74198 (.009)	116950 (.297)	-9026 (.139)	62406 (.184)	-398190 (.401)	95982 (.780)	0.8118	0.7099

The data in table one show the parameters used to separate the effects of the economic variables on each country individually. These data must be manipulated into an interpretable form before drawing any conclusions about the model.

Listed at the top of the table are the names of the estimated parameters. Below each named parameter is the sign expected from economic theory for that parameter. This reveals one of the most surprising results of this investigation: the sign of the own price variable (P_w) and the income variable (GDP) for both Mexico and Chile are not as expected.

The expected sign for the own price variable is negative; as the price of a good decreases, the quantity of that good purchased should increase. Here, the sign of the own price variable (P_w) for both Mexico and Chile is positive, meaning that as the price of wheat decreases, the quantity of wheat purchased is predicted to decrease in both of these countries. One possible reason for this outcome may be that the price of corn (P_c) plays a significant part in the purchasing decision of wheat. Note that the parameter for the price of corn is of a much larger magnitude than the parameter for the price of wheat. This indicates that the price of corn exercises more influence over the decision to buy wheat than the price of the wheat itself.

The expected sign for the income variable is positive; as income increases, the quantity of goods purchased should increase. Here, the sign of the income variable (GDP) for both Mexico and Chile is negative, meaning that as income increases, the quantity of wheat purchased is predicted to decrease for both of

these countries. This indicates that for Mexico and Chile, wheat is an inferior good.

The information on table two is divided horizontally so as to compare the response parameters of the two countries to the same variable. The results for Mexico are listed on the upper half while the results for Chile are listed below. To arrive at the coefficients of the variables for Chile alone, the dummy version of each variable was subtracted from the non-dummy version of that same variable (e.g. coefficient P_w - coefficient P_wD = coefficient for Chile). Note that the results of table two are merely parameters, not elasticities.

TABLE TWO

LINEAR LOG REGRESSION RESULTS: SEPARATED RESULTS FOR
MEXICO AND CHILE

	Pw (-)	Pc (+)	Pbov (-)	GDP (+)	lag (+ / -)	Real (-)	Constant (+ / -)
Mexico	24777	82822	-61637	-45439	7481	-82332	-398190
Chile	54988	183682	-135835	-162389	16507	-144738	-494172

Using the past five year period average populations (pop) of Mexico (84.504 million) and Chile (12.962 million), and the fact that a metric ton of wheat contains 36.744 bushels, examples of the specific effects of a change in given variables can be calculated. Table three shows the results of the calculations for the changes in net wheat imports, in bushels, given selected increases in variable levels of Mexico and Chile. The selected levels of increase are a 1%, 2%, 5% and 10% increase in each variable.

TABLE THREE

CALCULATION RESULTS: CHANGES IN NET WHEAT IMPORTS, IN BUSHELS,
GIVEN SELECTED DECREASES IN VARIABLE LEVELS
OF MEXICO AND CHILE

Level of Decrease	Pw	Pc	Pbov	GDP	lag	Real
Mexico						
1%	(-765,508.37)	(-2,558,862.41)	1,904,332.21	1,403,880.00	(-231,132.42)	2,543,723.41
2%	(-1,523,474.66)	(-5,092,513.94)	3,789,902.22	2,793,928.44	(-459,987.65)	5,062,385.09
5%	(-3,753,571.56)	(-12,547,051.84)	9,337,647.42	6,883,744.52	(-1,133,328.04)	12,472,819.69
10%	(-7,332,493.87)	(-24,510,304.22)	18,240,825.16	13,447,196.56	(-2,213,923.67)	24,365,293.85
Chile						
1%	(-260,593.69)	(870,487.56)	643,735.79	769,577.88	(-78,228.34)	685,928.01
2%	(-518,619.91)	(1,732,398.75)	1,281,129.26	1,531,573.60	(-155,685.95)	1,365,098.00
5%	(-1,277,787.55)	(4,268,323.51)	3,156,475.45	3,773,525.91	(-383,582.58)	3,363,359.55
10%	(-2,496,121.16)	(8,338,046.98)	6,166,083.84	7,371,474.13	(-749,317.52)	6,570,225.96

The calculated change estimates of table three, measured in bushels, are used to compute the percent change in net wheat imports caused by a 10% reduction in tariffs. The calculated change estimates are compared to the entire data series average of net wheat imports as well as the average of the last five years of the data series of net wheat imports.

Calculations of the percent change in net wheat imports compared to the entire data series average are given in table four. This table reflects the fact that the parameters themselves are estimated using the entire data set.

Calculations of the percent change in net wheat imports compared to the the average of only the last five years are given in table five. Results shown on table five reflect the fact that only the population average of the last five years of data were used to calculate changes in the quantity of wheat imported (in bushels).

The difference between the series average wheat imports (20,926,243.69) and the last five years' average wheat imports (22,238,203.68) for Mexico is not large (this is somewhat surprising given the wide variation in Mexican net wheat imports from year to year). Therefore, the difference in the percent change in net wheat imports for Mexico between the series average and the last five years average is not large in magnitude.

In Chile, the difference between the series average (23,417,525.63) and the last five years' average (3,549,470.00) is quite considerable. Naturally, the magnitudes of the percent changes calculated with the series average will be markedly different from the percent changes calculated with the last five

years' average. Given the recent history of Chilean net wheat imports, the estimates based on the five year averages should more accurately reflect the magnitude of the changes involved in tariff reduction of Chilean wheat imports.

TABLE FOUR

CALCULATED PERCENT CHANGE IN NET WHEAT IMPORTS IN MEXICO AND CHILE
AT GIVEN LEVELS OF DECREASE OF EQUATION VARIABLES
USING SERIES AVERAGE

Level of Decrease	Pw	Pc	Pbov	GDP	lag	Real
Mexico						
1%	-3.66%	-12.23%	9.10%	6.71%	-1.10%	12.16%
2%	-7.28%	-24.34%	18.11%	13.35%	-2.20%	24.19%
5%	-17.94%	-59.96%	44.62%	32.90%	-5.42%	59.60%
10%	-35.04%	-117.13%	87.17%	64.26%	-10.58%	116.43%
Chile						
1%	-1.11%	-3.72%	2.75%	3.29%	-0.33%	2.93%
2%	-2.21%	-7.40%	5.47%	6.54%	-0.66%	5.83%
5%	-5.46%	-18.23%	13.48%	16.11%	-1.64%	14.36%
10%	-10.66%	-35.61%	26.33%	31.48%	-3.20%	28.06%

TABLE FIVE

CALCULATED PERCENT CHANGE IN NET WHEAT IMPORTS IN MEXICO AND CHILE
AT GIVEN LEVELS OF DECREASE OF GIVEN VARIABLES
USING LAST FIVE YEAR AVERAGE

Level of Decrease	Pw	Pc	Pbov	GDP	lag	Real
Mexico						
1%	-3.44%	-11.51%	8.56%	6.31%	-1.04%	11.44%
2%	-6.85%	-22.90%	17.04%	12.56%	-2.07%	22.76%
5%	-16.88%	-56.42%	41.99%	30.95%	-5.10%	56.09%
10%	-32.97%	-110.22%	82.02%	60.47%	-9.96%	109.57%
Chile						
1%	-7.34%	-24.52%	18.14%	21.68%	-2.20%	19.32%
2%	-14.61%	-48.81%	36.09%	43.15%	-4.39%	38.46%
5%	-36.00%	-120.25%	88.93%	106.31%	-10.81%	94.76%
10%	-70.32%	-234.91%	173.72%	207.68%	-21.11%	185.10%

Mexico

The Mexican parameter for the impact of the price of wheat on the quantity of net wheat imports per million people, measured in metric tons is 24,777. The effect of a ten percent increase in the price of wheat on net wheat imports would be (change in Net Wheat Imports, in bushels):

$$\begin{aligned} &= \frac{[24,777 * \ln(1 + 0.10)] \text{ MT}}{\text{million population}} * 84.504 \text{ million population} * \frac{36.744 \text{ bu. wheat}}{\text{metric ton}} \\ &= (24,777 * 0.09531018) * 3,105.014976 \\ &= 2,361.500320501 * 3,105.01497600 \\ &= 7,332,493.87499038 \text{ bushels} \end{aligned}$$

This represents: 35.04% of the series average, or
32.97% of the five year average.

The Mexican parameter for the impact of the price of corn on the quantity of net wheat imports per million people, measured in metric tons is 82,822. The effect of a ten percent increase in the price of corn on net wheat imports would be (change in Net Wheat Imports, in bushels):

$$\begin{aligned}
 &= \frac{[82,822 * \ln(1 + 0.10)] \text{ MT}}{\text{million population}} * 84.504 \text{ million population} * \frac{36.744 \text{ bu. wheat}}{\text{metric ton}} \\
 &= (82,822 * 0.09531018) * 3,105.01497600 \\
 &= 7,893.77971175 * 3,105.01497600 \\
 &= 24,510,304.22224050
 \end{aligned}$$

This represents: 117.13% of the series average, or
110.22 % of the five year average.

The Mexican parameter for the impact of the price of bovine meat imports on the quantity of net wheat imports per million people, measured in metric tons is -61,637. The effect of a ten percent increase in the price of bovine meat on net wheat imports would be (change in Net Wheat Imports, in bushels):

$$\begin{aligned}
 &= \frac{[-61,637 * \ln(1 + 0.10)] \text{ MT}}{\text{million population}} * 84.504 \text{ million population} * \frac{36.744 \text{ bu wheat}}{\text{metric ton}} \\
 &= (-61,637 * 0.09531018) * 3,105.01497600 \\
 &= (-5,874.63355260) * 3,105.01497600 \\
 &= (-18,240,825.15933250)
 \end{aligned}$$

This represents: -87.17% of the series average, or

-82.02% of the five year average.

The Mexican parameter for the impact of the gross domestic product (GDP) on the quantity of net wheat imports per million people, measured in metric tons is -45,439. The effect of a ten percent increase in the gross domestic product on net wheat imports would be (change in Net Wheat Imports, in bushels):

$$\begin{aligned}
 &= \frac{[-45,439 * \ln(1 + 0.10)] \text{ MT}}{\text{million population}} * 84.504 \text{ million population} * \frac{36.744 \text{ bu. wheat}}{\text{metric ton}} \\
 &= (-45,439 * 0.09531018) * 3,105.01497600 \\
 &= (-4,330.79926013) * 3,105.01497600 \\
 &= (-13,447,196.560749740)
 \end{aligned}$$

This represents: -64.26% of the series average, or
-60.47 % of the five year average.

The Mexican parameter for the impact of the lagged quantity of imports (lag) on the quantity of net wheat imports per million people, measured in metric tons is 7,481. The effect of a ten percent increase in lagged one period price of wheat on net wheat imports would be (change in Net Wheat Imports, in bushels):

change in Net Wheat Imports, in bushels:

$$= \frac{[7,481 * \ln(1 + 0.10)] \text{ MT}}{\text{million population}} * 84.504 \text{ million population} * \frac{36.744 \text{ bu. wheat}}{\text{metric ton}}$$

$$= (7,481 * 0.09531018) * 3,105.01497600$$

$$= 713.01545512 * 3,105.01497600$$

$$= 2,213,923.66625512$$

This represents: 10.58% of the series average, or
9.96% of the five year average.

The Mexican parameter for the impact of the real appreciation index (real) on the quantity of net wheat imports per million people, measured in metric tons is -82,332. The effect of a ten percent increase in the real appreciation index on net wheat imports would be (change in Net Wheat Imports, in bushels):

$$\begin{aligned}
 &= \frac{[-82,332 * \ln(1 + 0.10)] \text{ MT}}{\text{million population}} * 84.504 \text{ million population} * \frac{36.744 \text{ bu. wheat}}{\text{metric ton}} \\
 &= (-82,332 * 0.09531018) * 3,105.01497600 \\
 &= (-7,847.07772365) * 3,105.01497600 \\
 &= (-24,365,293.84976820)
 \end{aligned}$$

This represents: -116.43 % of the series average, or
 -185.10% of the five year average.

Chile

The Chilean parameter for the impact of the price of wheat on the quantity of net wheat imports per million people, measured in metric tons is 54,988. The effect of a ten percent increase in the price of wheat on net wheat imports would be (change in Net Wheat Imports, in bushels):

$$\begin{aligned} &= \frac{[54,988 * \ln(1 + 0.10)] \text{ MT}}{\text{million population}} * 12.962 \text{ million population} * \frac{36.744 \text{ bu. wheat}}{\text{metric ton}} \\ &= (54,988 * 0.09531018) * 476.27572800 \\ &= 5,240.91616708 * 476.27572800 \\ &= 2,496,121.16286310 \end{aligned}$$

This represents: 10.66% of the series average, or
70.32% of the five year average.

The Chilean parameter for the impact of the price of corn on the quantity of net wheat imports per million people, measured in metric tons is 183,682. The effect of a ten percent increase in the price of corn on net wheat imports would be (change in Net Wheat Imports, in bushels):

$$\begin{aligned}
 &= \frac{[183,682 * \ln(1 + 0.10)] \text{ MT}}{\text{million population}} * 12.962 \text{ million population} * \frac{36.744 \text{ bu. wheat}}{\text{metric ton}} \\
 &= (183,682 * 0.09531018) * 476.27572800 \\
 &= 17,506.76444682 * 476.27572800 \\
 &= 8,338,046.98183277
 \end{aligned}$$

This represents: 35.61 % of the series average, or
234.91% of the five year average.

The Chilean parameter for the impact of the price of bovine meat imports on the quantity of net wheat imports per million people, measured in metric tons is -135,835. The effect of a ten percent increase in the price of bovine meat on net wheat imports would be (change in Net Wheat Imports, in bushels):

$$\begin{aligned}
 &= \frac{[-135,835 * \ln(1 + 0.10)] \text{ MT}}{\text{million population}} * \frac{12.962 \text{ million population}}{1} * \frac{36.744 \text{ bu. wheat}}{\text{metric ton}} \\
 &= (-135,835 * 0.09531018) * 476.27572800 \\
 &= (-12,946.45827372) * 476.27572800 \\
 &= (-6,166,083.83933784)
 \end{aligned}$$

This represents: -26.33 % of the series average, or
 -173.82% of the five year average.

The Chilean parameter for the impact of the gross domestic product (GDP) on the quantity of net wheat imports per million people, measured in metric tons is -162,389. The effect of a ten percent increase in the gross domestic product on net wheat imports would be (change in Net Wheat Imports, in bushels):

$$\begin{aligned}
 &= \frac{[-162,389 * \ln(1 + 0.10)] \text{ MT}}{\text{million population}} * \frac{36.744 \text{ bu. wheat}}{\text{metric ton}} \\
 &= (-162,389 * 0.09531018) * 476.27572800 \\
 &= (-15,477.32478824) * 476.27572800 \\
 &= (-7,371,474.13101361)
 \end{aligned}$$

This represents: -31.48% of the series average, or
-207.68% of the five year average.

The Chilean parameter for the impact of the lagged quantity of imports (lag) on the quantity of net wheat imports per million people, measured in metric tons is 16,507. The effect of a ten percent increase in lagged quantity of imported wheat on net wheat imports would be (change in Net Wheat Imports, in bushels):

$$\begin{aligned}
 &= \frac{[16,507 * \ln(1 + 0.10)] \text{ MT}}{\text{million population}} * 12.962 \text{ million population} * \frac{36.744 \text{ bu. wheat}}{\text{metric ton}} \\
 &= (16,507 * 0.09531018) * 476.27572800 \\
 &= 1,573.28513803 * 476.27572800 \\
 &= 749,317.52446682
 \end{aligned}$$

This represents: 3.20% of the series average, or
21.11 % of the five year average.

The Chilean parameter for the impact of the real appreciation index (real) on the quantity of net wheat imports per million people, measured in metric tons is -144,738. The effect of a ten percent increase in the real appreciation index on net wheat imports would be (change in Net Wheat Imports, in bushels):

$$\begin{aligned}
 &= \frac{[-144,738 * \ln(1 + 0.10)] \text{ MT}}{\text{million population}} * 12.962 \text{ million population} * \frac{36.744 \text{ bu. wheat}}{\text{metric ton}} \\
 &= (-144,738 * 0.09531018) * 476.27572800 \\
 &= (-13,795.00480452) * 476.27572800 \\
 &= (-6,570,225.95603549)
 \end{aligned}$$

This represents: -28.06% of the series average, or
-185.10% of the five year average.

Elasticities

Elasticities in linear - log models are not constant. The value of the elasticity changes as the point of evaluation moves along the demand curve. Equation (3) in the data/method chapter shows that the change in Y for a given percentage change (represented by λ) in X is constant, regardless of the actual level of X:

$$Y' - Y = B_1 * \ln (1 + \lambda) \quad (3)$$

where,

$Y' - Y$ = the difference in net per capita wheat imports

B_1 = the parameter estimate

\ln denotes the natural log

λ = the percent change in the parameter

Elasticities for each variable at selected levels of increase (λ , or level of increase) are listed on tables six and seven. Table six lists elasticities calculated using the average quantity of wheat imports for the entire data series, while table seven lists elasticities calculated using the average wheat imports of only the last five years of data. These two tables demonstrate the difference in elasticities resulting from two different ways of estimating the difference in net per capita wheat imports, ($Y' - Y$). As stated before, given the recent history of Chilean net wheat imports, the estimates based on the five year averages should more accurately reflect the magnitude of the changes involved in tariff reduction of Chilean wheat imports.

TABLE SIX
CALCULATED POINT ELASTICITIES OF VARIABLES USING
SERIES AVERAGES FOR MEXICO AND CHILE

Level of Decrease	Pw	Pc	Pbov	GDP	lag	Real
Mexico						
1%	-3.6581	-12.2280	9.1002	6.7087	-1.1045	12.1557
2%	-3.6401	-12.1678	9.0554	6.6757	-1.0991	12.0958
5%	-3.5874	-11.9917	8.9243	6.5791	-1.0832	11.9207
10%	-3.5040	-11.7127	8.7167	6.4260	-1.0580	11.6434
Chile						
1%	-1.1128	-3.7172	2.7489	3.2863	-0.3341	2.9291
2%	-1.1073	-3.6989	2.7354	3.2701	-0.3324	2.9147
5%	-1.0913	-3.6454	2.6958	3.2228	-0.3276	2.8725
10%	-1.0659	-3.5606	2.6331	3.1478	-0.3200	2.8057

TABLE SEVEN
CALCULATED POINT ELASTICITIES OF VARIABLES USING
LAST FIVE YEAR'S AVERAGES FOR MEXICO AND CHILE

Level of Decrease	Pw	Pc	Pbov	GDP	lag	Real
Mexico						
1%	-3.4423	-11.5066	8.5633	6.3129	-1.0393	11.4385
2%	-3.4254	-11.4499	8.5212	6.2818	-1.0342	11.3822
5%	-3.3758	-11.2842	8.3978	6.1909	-1.0193	11.2175
10%	-3.2973	-11.0217	8.2025	6.0469	-0.9955	10.9565
Chile						
1%	-7.3418	-24.5244	18.1361	21.6815	-2.2039	19.3248
2%	-7.3056	-24.4036	18.0468	21.5747	-2.1931	19.2296
5%	-7.1999	-24.0505	17.7856	21.2625	-2.1614	18.9513
10%	-7.0324	-23.4910	17.3718	20.7678	-2.1111	18.5104

CHAPTER SIX

CONCLUSION

This thesis examined the factors affecting Chilean wheat imports within the context of a future NAFTA agreement which would include Chile. A general review of the recent history of U.S. trade, reforms in Latin America and Chile laid the foundation for a deeper look at recent empirical studies of aggregate import demand, wheat demand, and the impact of free trade area formation and economic integration in the Western Hemisphere. The relevant theory regarding tariffs, customs unions and free trade areas, and excess demand functions was discussed.

The object of this thesis was to model net per capita wheat import demand in an expanded NAFTA wheat import market. The expanded NAFTA wheat import market includes both Mexico and Chile. Price, quantity, income, exchange rate, and population data were used to estimate a single equation ad hoc model (following Kondreas, et al, and Shalaby, et al) of net per capita wheat import demand for the composite market. The estimated equation results in an excess demand function.

The model examined had fourteen parameters, including own price, price of a substitute (corn), price of a complement (bovine meat), and financial parameters dealing with per capita gross domestic product and inflation & exchange rates. Whereas the object of the thesis was to generate an equation to estimate the effects of a percent change in a given independent variable on

the quantity of net wheat imports measured in bushels, the linear - log formulation was chosen for this model. Several tests of the model were performed to examine its robustness.

Dummy variables were used to distinguish the differing parameter estimates for Chile and Mexico. The calculated response coefficients of each country were used to quantify their respective reactions, in bushels, to a given change in variable levels. These predicted reactions were used to compare the magnitude of changes in net wheat imports compared to the series average and last five year average of net wheat imports. Finally, point elasticities were calculated for each variable at each given level of tariff reduction.

The most important finding of this paper is the fact that the price of wheat does not appear to have a major impact on the decision to buy wheat. The magnitude of the own price parameter is dwarfed by the substitute good (P_c), the complimentary good (P_{bov}), the income (GDP), and the exchange rate & inflation (Real) parameters in both Mexico and Chile. This is in stark contrast to the studies by Melo and Vogt, Warner and Kreinin, and Arize and Afifi.

Additionally, the sign of the own price parameter for both countries is not as economic theory predicts. This could partially be a result of variables other than the own price variable exercising influence on the system. Table one reveals that the p-values of the own price variables for Mexico (P_w), and Chile (P_{wD}) are 0.246 and 0.296 respectively. These levels are generally unacceptable for determining significance in econometric regressions. The

wrong sign and the low p-values of the own price variables for both countries indicate that some factor(s) other than the price of wheat could be a major influence on the decision to import wheat in these two countries.

Looking at Chile in particular, the two most significant variables for predicting wheat imports are the price of corn (P_c) and the price of bovine meat (P_{bov}), with p-values of 0.048 and 0.009 respectively. Additionally, the sign of the income variable is negative, indicating that as income increases, the quantity of wheat imported decreases. These two findings could jointly suggest that wheat is imported primarily as a feed substitute for corn and not as a food ingredient for human consumption.

Tables four and five show the percent change in net wheat imports at given levels of change in equation variables. The salient feature of these results is the difference between the results generated from the series average of wheat imports and the last five years' average of wheat imports for Chile. Chilean wheat imports went through a period of steep decline during the 80's, and only began a slight rebound during the early 90's. If Chile were to be included in the NAFTA agreement, changes in wheat imports of the magnitude of table five (last five years' average) would probably not be achieved unless wheat import tariffs were immediately reduced to zero percent. The outcomes of the situation modeled here reflect no transition period after accession into the Agreement for Chile. Immediate implementation of the full Agreement would be highly irregular, as a transition period between the pre-NAFTA state and full NAFTA enforcement is usually scheduled into such agreements.

Finally, point elasticities based on the series average and five years average imports are reported in tables six and seven. Here again, wide differences exist between the two elasticity tables for Chile based on which average is chosen. The salient characteristic of these tables is the relative magnitudes of the variables' elasticities. The largest magnitude elasticity belongs to the price of corn (P_c), a substitute good, followed by income (GDP), exchange rates & inflation (Real), and the price of bovine meat (P_{bov}), a complimentary good. The magnitude of the elasticity for the own price variable (P_w) exceeds only the magnitude of the lagged quantity of wheat imported (lag) variable. This indicates that in Chile, the price of wheat itself does not carry much weight in the wheat purchase and import decision.

This study examined possible affects of the formation of a free trade area on one country and one commodity. Surprisingly few examples of this type of study are available in contemporary economic literature. The results of this study are consistent with research on the results of NAFTA formation. Results of the Grennes study indicate very little change in U.S. share of Mexican wheat imports after Mexican ascension into the agreement -- an increase from a BASE scenario of nine percent to a NAFTA scenario of ten percent. Kondreas, Bushnell and Green examined import demand in five different regions, including Latin America, and found wheat imports into those areas to be responsive to U.S. export price and currency realignments; two factors sure to be affected by Chile's ascension into the Agreement.

One suggestion for future research in this area is to examine the impacts of stocks of wheat on wheat imports. Information regarding Chilean wheat

stocks was unavailable to this researcher, and consequently not a factor included in this thesis. The existence of grain stocks can have a large and significant impact on the import decision making process and importer behavior. However, examination of the importing behavior of Chile during the period of this study, 1973 - 1991, indicates that Chile was a net importer during each year of the study. It is highly doubtful that a country with some existing wheat grain stocks would be a net importer of wheat every year. The period of this study coincided with a period of extensive financial adjustments within the Chilean economy, especially with regards to hard currency exchange rates. Had wheat grain stocks been available, importation of a basic commodity such as wheat would be very unlikely given the difficulty of obtaining hard currency during the restructuring of the Chilean economy. Consistent importing throughout the studied period suggests that stocks of wheat were either non-existent or played a highly insignificant part in the import decision making process of Chilean wheat importers.

Additionally, an attempt to model and predict trade flows during the adjustment period of a given trade agreement could be a significant asset to the study of international trade and the agricultural economics community.

For wheat producers in Oklahoma, Chilean accession into the NAFTA agreement will probably not be a source of greatly increased wheat exports. In the recent past, Chile has not been a large importer of wheat. Additionally, Chile no longer has large, imposing tariffs on wheat imports as it did in the past. Reduction of the small existing tariffs down to zero after accession into NAFTA will not be a source of greatly increased demand for wheat imports.

According to this research, the greatest source of future demand for wheat imports in Chile will be the result of increasing imported corn prices.

CHAPTER SEVEN

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APPENDICES

The data set used for estimation of the model is presented in appendices one and two. Note that for purposes of estimation, these two data sets were merged into a single data set upon which the estimation of the model is based. The data set is presented here as two separate and distinct data sets only for clarity -- to enable the reader to immediately discern the data set for Mexico from the data set for Chile. Following are definitions of the abbreviated names:

yr	Year
Qw	Quantity of wheat imported
Pc	Price of Imported Corn
Pbov	Price of Imported Bovine Meat
Pw	Price of Imported Wheat
rf	rf exchange rate
pop	Population
GDP	Gross Domestic Product
Qexported	Quantity of wheat exported
dum	Dummy variable
CPIus	Consumer Price Index of United States
CPIMex	Consumer Price Index of Mexico
CPIch	Consumer Price Index of Chile
lagQw	Lagged One Year Quantity of Wheat Imported

Additional information regarding the variables used in the model may be found in Chapter Four of this thesis.

APPENDIX ONE
DATA SET USED IN ESTIMATION: MEXICO

yr	Qw	Pc	Pbov	Pw	rf	pop	GDP	Qexported	dum	CPlus	CPIImex	lagQw
73	718570	109	385	109	12.5	56.16	100	11069	1	47.8	2.5	640652
74	975903	156	1000	194	12.5	58.12	102.5370	18971	1	53.5	3.1	718570
75	87325	153	1040	199	12.5	60.15	104.6364	36521	1	58.2	3.6	975903
76	1505	114	583	159	15.4	61.98	105.8403	12591	1	60.7	4.1	87325
77	476614	113	405	99	22.6	63.81	106.3471	22879	1	64.2	5.3	1505
78	505788	128	1152	139	22.8	65.66	111.8834	16564	1	68.8	6.3	476614
79	1147948	149	674	176	22.8	67.52	118.7639	14380	1	76.6	7.4	505788
80	822669	156	2001	198	23.0	69.66	124.6970	23147	1	86.0	9.3	1147948
81	112793	148	2164	190	24.5	71.35	131.4183	470	1	93.2	11.9	822669
82	398460	162	1999	218	56.4	73.02	127.7075	0	1	97.0	19	112793
83	422600	135	1948	141	120.1	74.67	119.6419	0	1	99.8	38.3	398460
84	345000	150	1947	120	167.8	76.31	121.3009	300	1	103.2	63.4	422600
85	565000	148	2210	73	256.9	77.94	121.7946	0	1	105.4	100	345000
86	224100	110	2446	104	611.8	79.57	114.8655	200	1	104.4	186.2	565000
87	434600	88	984	97	1378.2	81.2	114.6598	23700	1	107.7	431.7	224100
88	1196500	129	2311	128	2273.1	82.84	113.7855	170300	1	111.5	924.6	434600
89	432400	131	2253	177	2461.5	84.49	115.2868	229900	1	116.7	1109.6	1196500
90	357800	135	2438	143	2812.6	86.15	118.0943	29	1	122.8	1405.4	432400
91	604800	126	2677	127	3018.4	87.84	120.0307	0	1	126.6	1723.8	357800

Source: Catherwood, Kara, unpublished Master of Science thesis

APPENDIX TWO
DATA SET USED IN ESTIMATION: CHILE

yr	Qw	Pc	Pbov	Pw	rf	pop	GDP	Qexported	dum	CPlus	CPIch	lagQw
73	585113	97	1208	145	0.11	9.86	100	0	0	47.8	0	373789
74	1243914	129	1048	206	0.83	10.03	99.2646	0	0	53.5	1	585113
75	606151	176	1147	192	4.91	10.20	85.0092	833	0	58.2	3	1243914
76	1134695	149	1254	226	13.05	10.37	86.5554	0	0	60.7	8	606151
77	474308	120	1360	117	21.53	10.55	93.4687	0	0	64.2	15	1134695
78	925539	115	1318	141	31.66	10.82	98.6247	0	0	68.8	21	474308
79	739055	136	1688	190	37.25	10.98	105.2362	0	0	76.6	28	925539
80	918393	161	2369	203	39.00	11.14	111.7939	0	0	86.0	38	739055
81	103585	156	2284	205	39.00	11.33	116.0034	0	0	93.2	46	918393
82	100563	128	2057	177	50.91	11.52	98.0109	0	0	97.0	50	103585
83	117700	156	1488	170	78.84	11.72	95.6345	0	0	99.8	64	100563
84	961300	235	1632	162	98.66	11.92	100.0119	0	0	103.2	77	117700
85	745800	166	1029	91	161.08	12.12	100.7907	0	0	105.4	100	961300
86	156400	97	1225	125	193.02	12.33	104.6611	1	0	104.4	119	745800
87	29000	97	1699	162	219.54	12.54	108.8102	241	0	107.7	143	156400
88	69700	128	1553	202	245.05	12.75	114.9049	11	0	111.5	164	29000
89	41700	150	1692	180	267.16	12.96	124.3213	1	0	116.7	192	69700
90	119400	158	1809	163	305.06	13.17	124.9669	0	0	122.8	242	41700
91	224700	135	2116	139	349.37	13.39	130.3103	68	0	126.6	295	119400

Source: Catherwood, Kara, unpublished Master of Science thesis

VITA

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