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Analysis of Fiscal and Monetary Impacts

of U.S. Wheat Exports to Japan

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ABSTRACT

Wheat is one of the most essential agricultural commodities in the world, and one of the top three commodities produced by the U.S. The U.S. exports the majority of its wheat. Japan has been a major market for U.S. wheat, mainly purchasing hard red winter, hard red spring, and soft white wheats.

The objective of this study is to measure the impacts of macroeconomic variables on U.S. wheat exports to Japan. Two major hypotheses were proposed: (1) the exchange rate plays a significant role in affecting the level of U.S. wheat exports to Japan and (2) other macroeconomic variables impact the level of U.S. wheat exports to Japan. Three economic theories were integrated to incorporate the exchange rate and other macro variables in the same demand equations.

In accordance with previous research in this area, the results led to ambiguity in what actually impacts the level of agricultural exports. The results did not have any significance in showing that the exchange rate and other macro variables had an impact on the level of exports. Three reasons for perhaps the non-influence on exports is one, monetary variables do not determine the exchange rate and thus, do not influence U.S. wheat exports to Japan through the exchange rate. Two, political reasons which cannot be quantitatively measured and three, Japan has a government agency which does all of the purchasing of wheat for its country. The government intervention could, in fact, break off some kind of link between macro variables and agricultural exports.

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CHAPTER 1

INTRODUCTION

Wheat is one of the most essential commodities in the world for nutrition, and the U.S. is capable of providing wheat in every class and specific characteristics deemed necessary for a consumer. Hence, wheat is one of the U.S.'s major exports and more is shipped than used domestically. The problem being researched is to try to determine the role the exchange rate and other macroeconomic variables play in influencing U.S. wheat exports to Japan.

Japan is a very important market for U.S. wheat; they are consistent purchasers of U.S. wheat. In fact, during the eleven year period examined in this study, Japan never ranked below fourth in the world as an importer of U.S. wheat. The U.S. depends heavily on Japan's importing habits for the wheat commodity, so their spending pattern on wheat is very significant to the U.S. This has a multiplying impact on the U.S.'s economy. Since the majority of U.S. wheat is exported, U.S. farmers would like to maintain, if not increase, the positive and healthy trade with our top importers. Agricultural trade is very complex and involves many agents, from the farmer to the importer. Each member of the marketing chain between the farmers and the importer will ultimately be affected by the amount of wheat the U.S. exports, and hence, understanding the determinants of wheat exports is important.

Understanding the monetary impacts on agricultural exports is still in the evolutionary process. Export sales orders placed usually have some kind of time lag before the commodity is actually shipped to its destination. Therefore, this dynamic is important in the purchasing contract of currencies being exchanged. Another factor could be that exports of wheat are tied into other import/export deals. Uncertainty of the market and stock holdings of wheat could be another factor in trying to understand the monetary impacts on U.S. wheat exports.

We are considering only one country and one commodity broken down into classes because we are interested in the specifics of what takes place in the level of wheat exports when the exchange rate and other macroeconomic variables vary. Each country acts differently to importing decisions, depending on the circumstances at hand. Therefore, an aggregate approach to studying this international trade problem would necessarily yield generalizations, which may conceal specificity. This can be misleading when aggregate results may not hold at the disaggregate level and vice-versa. This is in fact, the major contribution this research is trying to ascertain. By using a disaggregate approach in a theoretically consistent way, we hope to shed some light on specific patterns or trends in importing a differentiated commodity.

Earlier studies focused on the impacts of the exchange rate on an aggregate of agricultural commodities and countries. The models used were quite broad and general in their analysis. Results and conclusions of some of these studies conflict, depending on the variables, the time period, the type of theoretical model used, and the use of real versus nominal values. Only a few studies used more than one monetary variable in their estimations of fiscal and monetary impacts on agricultural exports. Chambers (1981) suggested that other macroeconomic variables should be included for future research in this area. Orden (1986) investigated the macroeconomic impacts on agriculture using the exchange rate, interest rate, money supply, a trade-weighted index, GNP, and agricultural prices. Orden's results showed strong evidence of macroeconomic impacts on agriculture and a strong interaction between the interest rate and the exchange rate. However, ambiguity in the specific links between the variables remains. This research expands upon the earlier research by taking a more specific route in analyzing the macroeconomic impacts on U.S. wheat exports to Japan. The additional insights into this matter will help governmental agencies, economists, and countries better understand the monetary and fiscal impacts on agricultural products and help generate export shipments projections.

The study is also unique in that the analysis is on individual classes of wheat. Wheat demand models that incorporate wheat class information are relatively rare, stemming back to the late 1960's. Nonetheless, a few authors have attempted to utilize class information. As Henning notes in 1967, "Reekie estimated class-level export demand functions and substitution elasticities for Canadian and U.S. wheats to analyze implications of U.S. pricing policies (Henning)" (Hjort, 13). There are five basic classes of wheat: hard red winter (HRW), soft red winter (SRW), hard red spring (HRS), durum, and white. Based on topography, soils, and climate differences in the U.S., there are varying degrees of these classes called varieties which delve into the ample characteristics of each class of wheat. In this study, the top three classes of wheat exported to Japan by the U.S. are analyzed. The three classes were HRW, HRS, and soft white.

HRW wheat is high in the percentage of protein content and strong in gluten. The protein content is very important in wheat because it determines its uses for baking needs. Therefore, it is used for yeast breads and hard rolls. The states of Kansas, Nebraska, and Oklahoma represent 50 percent of the total grown in the U.S. and exported. This is the most popular and largest class which is used domestically and exported.

HRS wheat is the highest in the percentage of protein content. It is also used for yeast breads and hard rolls. The states of Minnesota, Montana, and the Dakotas represent 15-20 percent of the total grown and exported. This is the third highest ranking wheat the U.S. exports.

Soft white is the lowest in the percentage of protein content. It is mainly used for noodles, flat breads, cakes, pastries, and crackers. East Asia and the Middle East is where most of this wheat is shipped. It is grown mainly in the Pacific Northwest, such as in Washington, Oregon, and Idaho. This is the fourth highest ranking wheat the U.S. exports.

Japan does not grow much wheat, and what is produced is highly subsidized. Therefore, they rely on the U.S. and our two main competitors, Canada and Australia to supply their wheat. Export merchandising is done differently in the U.S. and in Japan. The U.S. has two types of exporters. Either very large, privately-owned, multi-national companies or cooperatively-owned firms. On the other hand, Japan uses a government agency for the entire country. This agency is called the *Japanese Food Agency*, which approves eleven Japanese trading companies as the sole suppliers for the country. The U.S. exporters and cooperatives negotiate with the eleven designated trading companies.

The objective of this study is to measure the impacts of macroeconomic variables on U.S. wheat exports to Japan. Two major hypotheses have been proposed. The first is that the exchange rate plays a significant role in affecting the level of U.S. wheat exports. The second proposed hypothesis states that other macroeconomic variables impact the level of exports. There are two hypotheses because as will become clear, economic theory will not allow the exchange rate and other monetary variables to be in the same equation.

The model chosen to test both hypotheses is a linear demand function, or more specifically, the absolute version of the Rotterdam Model (ARDM) where the level of exports is a function of the exchange rate, wheat prices by class, the transportation rate, and total expenditures on U.S. wheat exports to Japan for the first hypothesis. In the second hypothesis, the level of exports is a function of the interest rates, money supplies and GNP's in the U.S. and Japan, the transportation rate, wheat prices, and total expenditures on U.S. wheat exports to Japan. The assumptions of the demand model are an open-market economy, one domestic and one foreign country, transportation costs of the commodity, the money supplies are fixed by the governments, and a partial equilibrium approach to the trade model. Three theories will be applied to this research: demand theory, the law of one price, and the monetary approach to exchange rate determination.

To accomplish these objectives, a review of previous studies in this area will be discussed in Chapter 2. This review will provide the basis for the development of the model used in this study and will highlight relative empirical results for comparative purposes. In Chapter 3, the theoretical and empirical models will be presented using a theoretically and empirically consistent functional form. The data and estimation results will be analyzed in Chapter 4. The analysis will break down wheat by class, export sales versus export shipments, and the importance of seasonal dummy variables. In Chapter 5, the summary and conclusions will be presented.

CHAPTER 2

LITERATURE REVIEW

Research on U.S. agriculture and international trade incorporating the effects of the exchange rate and other macroeconomic variables is still a relatively new concept. As the noted literature will show, there are conflicting views on the role of the exchange rate and other macroeconomic variables in U.S. agriculture and trade. Arguments still persist regarding variables to use, real or nominal, theoretical model to use, a partial or general equilibrium model, and what effect, if any, do exchange rates have on agricultural trade. These arguments are exacerbated by the lack of a firm theoretical foundation in previous studies. It is therefore, difficult to compare studies because there is no consistent theoretical or empirical methodology. Because of the lack of a coherent methodology for analyzing exchange rate and macro variable effects on agricultural trade, the literature review presented here will be chronological.

Schuh (1974) was one of the first economists to discuss the role of exchange rates in agricultural trade. His article addressed the role of exchange rates in U.S. agricultural trade using a model of induced technical change. He stressed that the overvaluation of the dollar made U.S. products less competitive in the world market which led to the decrease in exports. There was no econometric analysis conducted and the time period used was after the W.W. II period through 1971. To determine when the dollar was overvalued, he used selected data such as gold stocks, crops harvested, balance of payments, and commodity support prices in a non-parametric way to benchmark the start of overvaluation and to verify its persistence. He concluded that the exchange rate variable should not be omitted from the trade analysis, for it could lead to further insight of trade problems and agricultural development. Schuh's paper presented a set of hypotheses that could be tested empirically and began the evolutionary process of including macroeconomic variables, such as exchange rates in agricultural trade research.

A comment to Schuh's paper was made by Grennes (1974) who agreed with the dollar being overvalued, but did not agree with Schuh's evidence. Grennes claimed that Schuh's measure of the excess demand for foreign exchange, the liquidity deficit, was unconvincing.

> "More persuasive evidence of overvaluation exists, including Floyd's study of the dollar using the elasticity approach and Houthakker's estimate of overvaluation using purchasing power parity techniques. The most direct evidence of overvaluation is that under the current float, market forces have valued the dollar at nearly 20% less than in 1971. Schuh's main point about the dollar being overvalued is probably valid but his evidence is inappropriate" (Grennes, 134).

The terms of trades effects of an overvaluation were very favorable for the U.S. in the sense that they were a major buyer and seller in the world markets. Schuh made reference to a detailed report done by Basevi of the U.S.'s tariff structure. This report stated that the U.S. could overcome a lot of the losses in exports due to production and consumption inefficiency based on their tariff structure. The author mentioned a couple of authors who supported the point that the U.S. had very favorable trade effects through an almost unity estimate for the foreign elasticity of demand for U.S. agricultural products. Grennes also cited that direct subsidies were positively correlated with the degree of overvaluation of the dollar, and therefore, the two effects on agricultural trade canceled each other out. Hence, agricultural prices were not affected by the exchange rate policy.

In Schuh's reply (1974) to Grennes, Schuh agreed with Grennes on the terms of trade effects and highlighted this in his original paper in footnote seventeen. However, Schuh disagreed with Grennes' last assertion on the direct subsidies. Schuh asserted that export subsidies represented income transfers to the foreign consumer and not to the domestic producer. Therefore, this did not suggest that there was a positive correlation between the magnitude of subsidies and the overvaluation of the dollar.

Another comment to Schuh's paper was by Vellianitis-Fidas (1975) who agreed that the exchange rate was a valuable variable which should not have been omitted from trade analysis. Vellianitis-Fidas stated that Schuh did not spend enough time supporting this hypothesis with strong evidence. In fact, Vellianitis-Fidas's argument was similar to Grennes' in that she claimed Schuh's evidence was unconvincing in supporting the hypothesis. A country's position in its balance of payments is an essential part of determining whether a country's currency is over- or undervalued. Vellianitis-Fidas argued that Schuh's choice of selected data did not give the overall or more accurate picture of a country's currency position. "The various parts of the balance of payments are interrelated. Forced improvements in one part may be at the expense of another part. An assessment of the balance of payments situation of a country is done in total and a country's monetary and exchange rate policy is concerned only with its overall balance of payments, not with any section and certainly not with any one sector, such as agriculture in that section" (Vellianitis-Fidas, 692). Vellianitis-Fidas also stated that the time span investigated was misleading because during the 1940-50 period, the U.S. was the only country at the time to supply goods to Europe. "The decrease in gold stocks after the early 1950's was more an indication of the rebuilding of Europe and Japan, not a downturn in the international economy of the United States" (Vellianitis-Fidas, 693). There was no definite connection between fluctuations in the gold stock and the position of the dollar against other currencies. Vellianitis-Fidas did not agree with Schuh's hypothesis that changes in the exchange rate impacted agricultural exports, empirically or theoretically. If there was an impact, it would be very minimal. The author followed the generally accepted notion that demand for agricultural exports are price inelastic.

Johnson, Grennes, and Thursby (Johnson, et al. 1977) were inspired by Schuh's paper to try to test the hypothesis by considering the exchange rate and other explanatory variables such as tariffs, export taxes, and transportation costs. These explanatory variables can be considered as part of the shipping policy. Johnson, et al. looked at the wheat market in the analysis, and the evidence failed to support Schuh's hypothesis that the exchange rates matter. The exchange rate did not prove to have a stronger effect on prices than any of the other variables taken separately. Data was used from the time period of 1973 - 1974, when prices had large increases and when many policy changes took place. Six countries' exports were segregated out as endogenous variables and the rest of the world's exports was an exogenous variable. The six countries were the U.S., Canada, Australia, Argentina, European Economic Community (EEC), and Japan. The endogenous variables of the model were thirteen trade flows, thirteen demand prices, and six supply prices.

The model used was a short-run forecasting one which assumes the supply-side is exogenous. The system used was deterministic and Armington-type restrictions were applied. Armington's model is derived by maximizing an underlying utility function in a two-step process. "The direct and cross-price elasticities are found from a set of restrictions on the space that allows their calculation from some basic demand elasticities and (in our case) a basic elasticity of substitution among different kinds of wheat" (Johnson, et al., 626).

This model was chosen to try to determine how the U.S. price of wheat was affected by a dollar devaluation with respect to Europe and Japan, by a lowering of the EEC variable levy, by higher export taxes from Canada and Australia, and by the U.S. transport policy, which raised shipping costs between the U.S. and Japan and Europe. Johnson, et al. stated that dollar devaluation contributed to the rise in the U.S. domestic wheat price in 1973-74. This monetary effect should not be ignored, but neither should it be exaggerated. In the same year the insulating policies that restrained wheat exports and encouraged wheat imports had a more powerful effect in raising the U.S. wheat price. The results also indicated a canceling effect between the U.S. shipping policy and the devaluation of the dollar. The shipping policy which raised transportation costs, led to a lowering of the wheat price in the U.S. The devaluation of the dollar led to an increase in the wheat price by at least the same amount as the decline due to the shipping policy. With the canceling effect, the shipping policy or the devaluation of the dollar would not have a significant impact on wheat prices. If there is not a canceling effect between the devaluation of the dollar and the shipping policy, then the U.S. shipping policy would have more of an impact on wheat prices than the devaluation of the dollar.

In conclusion, all major importers and exporters besides the U.S. adopted insulating policies to protect their consumers from the sharp rises in price due to a devaluation of the dollar. Foreign commercial policies were more important to the U.S. than the devaluation of the dollar. Johnson, et al. stated that the results of the shipping policy effects were a concern which needed further investigation for increased insight into international trade analysis.

Islam (1978) developed an import demand function for Asian rice which had foreign reserves, price, income, and domestic production as independent variables. This import demand function was designed to explain the presence of direct government regulation of imports and/or foreign exchange shortages. The hypothesis was that rice imports for a typical Asian country depended on partly a variable termed "desired imports" and partly on a variable termed "government-determined imports". The reasoning behind this was that the government varied restrictions on rice imports indirectly with the country's capacity to import. This capacity was reflected by the country's foreign exchange reserves. The underlying theory was that a significant proportion of government intervention in rice-importing was motivated by a desire to conserve foreign reserves. Therefore, a government when trying to preserve foreign exchange, would most likely try to reduce the level of rice imports in response to an increase in the international currency price. The import demand function was estimated using an ordinary least squares (OLS) with annual data for six Asian countries for the period 1953-72. The empirical results supported the theory. "Positive and high income and reserve elasticities imply that changes in a country's foreign exchange earnings can affect imports in two significant ways. First, ceteris paribus, if a country's exports increase, then its per capita income increases, thus inducing higher imports. Second, an increase in exports will lead to higher foreign exchange reserves and, hence, higher imports" (Islam, 534). In conclusion, the paper suggested that a bilateral agreement between a deficit-trading country and a surplus-trading country using rice and non-rice products would benefit all.

Chambers and Just (1979) approached the exchange rate effect in trade analysis by investigating the restrictions being applied in previous models. The misspecifications in theoretical and empirical models could have been the problem why researchers were continuously coming up with conflicting results and conclusions. The purpose of this paper was to review critically the theoretical and empirical results in past agricultural economics literature on the effects of devaluation of the exchange rate on agricultural markets.

Chambers and Just noted that in some former research, the papers' results and conclusions were not consistent with their theoretical framework and assumptions. They mentioned that classical statistical theory suggests that a variable needs to come from a true, clear-cut theoretical model before it can be meaningfully tested to be statistically significant or insignificant. One cannot argue a case statistically without having a sound, theoretical structural base and remain consistent in their analysis. Chambers and Just cited Vellianitis-Fidas at-fault in this category because there was no underlying theoretical structure to support their argument.

Other researchers were at fault for problems of multicollinearity, degrees of freedom, and data requirements prohibiting the estimation process of situations such as cross-price effects. Ordinary Least Squares (OLS) could yield inconsistent estimates when the independent variable is endogenous, and Chambers and Just cited Greenshields' treatment of the impact of changes in the yen-dollar exchange rate on U.S. grain and soybean exports to Japan, as an example. This is an apparent econometric problem. Greenshields' results concluded that the devaluation had little impact on these exports. Chambers and Just stated that Japan's decision on how much grain to import from the U.S. is probably determined to some extent by the volume of other imports from the U.S. and, also, to some extent by the volume of its exports to the U.S. Both cases would be affected by an exchange rate devaluation.

Chambers and Just stated some possible solutions to these theoretical and empirical problems. "Thus, one possibility is to construct separate price indices for 'all other' traded commodities and all nontraded commodities, weight the 'all other' commodity index by the exchange rate, and include both along with the own price (in the importing country) as separate regressors. This approach allows for fluctuations that arise directly from exchange rate variation as well as from price movements in the exporting country" (Chambers and Just, 255).

Chambers and Just also suggested treating the exchange rate as a price index for all other traded goods. The authors refer to Orcutt who addressed making explicit assumptions about the separability issue of utility functions underlying the import demand equations. The assumptions would include the exchange rate directly in the excess demand and import equations to allow for the differential effects of exchange rate and price fluctuations. "Fletcher, Just, and Schmitz have applied this principle to an agricultural market by including exchange rate as a separate regressor. Their results indicate that the exchange rate had dramatic impacts on the level of exports of U.S. wheat and that U.S. wheat price is exchange rate elastic" (Chambers and Just, 255).

Models prior to this were too restrictive in their approach to evaluating the effects of the exchange rate on agricultural commodities. These models either did not have the exchange rate at all or the exchange rate was used to adjust prices in the model. Chambers and Just realized the importance of this related exchange rate specification problem by using a more general form of the exchange rate as a separate regressor. This variable also involved a weighted price index of other traded goods, if possible. Much of the problem of analyzing the exchange rate effects in agriculture lies in the lack of appropriate price indices for certain commodities.

Chambers and Just received a couple of comments from the literature mentioned above. The first was from Grennes, Johnson, and Thursby (Grennes, et al. 1980) who found Chambers and Just's research incomplete and misleading. Chambers and Just mentioned that cross-price effects were not employed in the model of Grennes, et al. However, cross-price effects were apparently incorporated into their model, but were not explicitly stated. Grennes, et al. agreed that trade models should contain a broader range of products, but where should one logically stop including products. They criticized Chambers and Just as being just as vulnerable in not including all variables. Grennes, et al. stated that the only restriction they placed on the exchange rate was that changes in the real exchange rate alter exports. Therefore, the demand for U.S. wheat exports should not be affected by a simultaneous increase in the dollar price of all foreign currencies and the same increase in all U.S. products' prices. "As long as one invokes the law of one price, the domestic price will rise by more than the devaluation only if the foreign price rises" (Grennes, et al., 250). Grennes, et al. argued that Chambers and Just did not address reasons for ignoring the law of one price in explaining the dollar devaluation inducing an increase in the foreign wheat price.

Chambers and Just (1980) brought forward by Grennes, et al. agreed with a number of issues such as including cross-price effects and nontraded goods, in estimating foreign demand for imports. Chambers and Just still argued that the exchange rate could have a more reaching effect on trade than a change in U.S. grain prices because of implications for trade in all other goods and the related impacts on balance of trade. In turn, this would impact the Japanese purchasing power for U.S. wheat.

There was also disagreement on whether or not a general equilibrium model was assumed. Chambers and Just stated that a general equilibrium model could not be assumed for several reasons. The reasons cited are that the price of corn in their model was exogenous, the other commodities traded by another country were excluded in the effects, and the balance of trade should be affected more extensively, as well as, the associated purchasing power by another country for a commodity abroad.

The main thrust of Chamber and Just's original paper (1979) is that the exchange rate should be given greater flexibility in a trade model by tying its effects to a small group of commodities. Chambers and Just continually supported this idea by agreeing with Grennes, et al. that the exchange rate affects all cross-prices, even though the impact of an individual price (excluded) may not be affected. However, the aggregate impact of the exchange rate may be significant. Therefore, it is essential to give greater flexibility to the exchange rate in a trade model.

Another concept called into question was the validity of the law of one price and not the purchasing power parity. It was noted that the law of one price (LOP) may not hold at all times due to, for example, trade barriers. This is why Chambers and Just in their original paper again refer to the model of Johnson, et al., which takes into account trade restrictions when examining exchange rates. Using a more simple empirical model which does not include non-traded good prices, will not account for the indirect effects of the exchange rate on all goods in the economy. Inclusion of non-traded goods is essential in the estimation of a foreign country's demand for imports. Chambers and Just would like to see future researchers seek to improve the specifications of a model to provide more accurate results and not settle for partial effects of a change in the exchange rate.

Orden's comment (1986a) to Chambers and Just's article (1979), focused on applying a general equilibrium approach to trade theory, instead of using the single-market constraints tied to the partial equilibrium. He argued that the movement of income between two countries is key, but the partial equilibrium does not consider this. The general equilibrium model is used to analyze relative prices, production, consumption, exports, and imports under the condition of balanced trade. However, as Orden stated (p.993), "the general equilibrium trade model, while rich in the treatment of goods markets, ignores asset markets and is simple in its treatment of money. It is static and thus cannot explain intertemporal asset decisions that would account for a trade imbalance at a particular moment in time. These are severe limitations".

Chambers and Just (1981) wrote a second paper based on the aforementioned paper in this literature review. They recognized the fact that their original paper may have had too many restrictive specifications in their model for the exchange rate. This paper sought to identify the major dynamic characteristics of the adjustment process of export and price effects on U.S. agriculture. The econometric model used consisted of fifteen equations, three of which were identities. The equations explained disappearance, inventories, exports, and production for corn, soybeans, and wheat. The authors developed the model to try to acknowledge the exchange rate adjustment as a monetary effect with adequate flexibility in the specification. This model also considered the domestic and foreign sectors of U.S. agriculture. The data used was quarterly between the period of 1969(I) and 1977(II), and the model was estimated as a single system by three-stage least squares (3SLS). They used dynamic multiplier methods in their empirical analysis. The model appeared to fit well and indicated an adequate level of statistical significance.

For the most part, the results indicated that the devaluations of the dollar in the early 1970's had very important effects on agricultural exports and prices. The empirical evidence from this paper strongly supported the earlier work done by Schuh. The domestic disappearance and inventories were also greatly affected. Chambers and Just pointed out that the short-run effects were more apparent and dramatic than the long-run effects. In general, monetary variables such as the money supply could have significant effects on agriculture through the exchange rate. Based on this empirical research, exchange rate fluctuations did in fact have a statistically significant real impact on agricultural markets by altering the level of exports. "Because the exchange rate is essentially a monetary variable, these results have other important implications for the agricultural sector. For example, an important implication of this research is that policy tools, such as open market operations, which are usually viewed as having little or no effect on agricultural markets can have significant impacts via the exchange rate. Similarly, fluctuation in other monetary variables also can have important effects on U.S. agriculture" (Chambers and Just, 45).

Based on the Chambers and Just's 1981 paper, Chambers (1981) extended this theory to consider some monetary variables for future research in agricultural commodity trade: money supply and interest rates. Chambers' theme to this paper was only to suggest and discuss some pertinent issues for future research in this area. Chambers thought bringing in the monetary approach to the balance of payments and exchange rate determination would be considered the next best step in furthering the research in this area. The fundamental idea underlying the monetary approach was the identity of the balance of payments with the difference between the demand for and the supply of a currency. There were several problems Chambers stated that future researchers will confront. One was establishing a satisfactory theoretical model which would show the appropriate interaction between the various monetary factors and commodity trade. A second problem was finding a suitable empirical model which would recognize the significant interaction amongst the variables.

Chambers carried out some quick, rough causality tests to see if any evidence would exist for a relationship between monetary instruments and commodity trade. The time period used in this test was 1973 through mid-1980, using monthly data. The hypotheses were the money supply does not cause agricultural exports/imports and the interest rate does not cause agricultural exports/imports. There was some evidence of a causal relationship between the money supply and exports/imports. There was little evidence of a causal relationship between the interest rate and exports/ imports. Another problem would arise in whether or not to establish a specific model for the problem at hand, or to develop a more general model which could tap into a wide-range of empirical estimations. Chambers suggested in closing, a first step would be to bring in the monetary variables in reduced-form equations for more specific trade models.

The Jabara and Schwartz (1987) paper analyzed the nature and timing of commodity price adjustments in response to exchange rate changes and extended the analysis by testing for price-stickiness in agricultural commodity markets. The two essential areas of focus were first to test the law of one price through the exchange rate pass-through for several agricultural commodities in the same import market, and second, to test the differential pass-through response to a depreciation of the dollar versus an appreciation. The "ratchet effect" hypothesis states that when a country devalues its currency, most or all of the price adjustment takes place in the devaluing country. The "ratchet effect" hypothesis was continuously employed because some economists have suggested that the price response to an exchange rate change is asymmetrical when dealing in an imperfectly competitive market. The result is price-stickiness to a given exchange rate change and low exchange rate pass-through.

The annual data used in the Jabara and Schwartz study were for five agricultural commodities: beef, corn, cotton, soybeans, and wheat. These commodities were in five separate linear demand functions. The time period used was between 1974 and 1984. In the case for wheat, two prices are involved in the trading. In Japan, there is a price paid by the licensed importer from the exporter and then there is the second price paid by the Food Agency for wheat from the importer. Hence, the pass-through to the import price is affected by exporter behavior, as well as, by the Japanese importers' behavior in passing the exchange rate change through to the controlling agency. The results for wheat indicated that the estimated coefficients for concurrent changes in the exchange rate were significantly different from zero at the 5% level. The law of one price was tested and held throughout the entire time period which was also tested. In analyzing the exchange rate pass-through, the results indicated that Japanese government intervention cut the link between current exchange rate changes and domestic wheat prices. After 1981, the results showed that domestic wheat prices and the exchange rate moved in the same direction. This meant that a constant Japanese resale price was no longer consistent with the law of one price. Also, no asymmetric exchange rate response was found valid for wheat. "Most analyses of agricultural trade and exchange rates treat agricultural commodities as flex-price goods. Under a flexible exchange rate system, international commodity arbitrage forces adjustments in commodity prices and exchange rates to reflect 'the law of one price' except where agricultural trade barriers and insulating price policies are involved" (Jabara and Schwartz, 589). The authors stressed that the lack of exchange rate pass-through could result in lower levels of exports, just as government intervention, insulating price policies, international events, and price-stickiness does.

Orden (1986b) investigated the macroeconomic impacts on agriculture. The model and variables for this research paper extended from Orden's (1986a) work. Orden stressed the controversial theoretical perspectives that still persist in analyzing empirically macroeconomic effects on agriculture. In one model, the economy was viewed in a stochastic equilibrium in which all prices were flexible, agents had rational expectations, and the markets cleared. A second model avoided the market-clearing approach by having some prices not perfectly flexible over some medium length of time. The third model took into consideration the effects of inflation on agriculture. This model had a combination of the previous two models; it incorporated a flexi-price/fixed-price scheme. Quarterly data was used in a six-variable vector autoregressive (VAR) model. The variables employed were the seasonally-adjusted U.S. money supply, the interest rate on 3-month Treasury bills, a trade-weighted index of the value of the dollar against the currencies of 10 industrial countries, the general price level as measured by the U.S. gross national product (GNP) deflator, the value of U.S. agricultural exports, and agricultural prices as measured by the index of prices received by farmers for all crops. Nominal values were used for the interest rate, exchange rate, exports, and crop prices.

The results showed that there is substantial evidence of macroeconomic impacts on agriculture. Lagged exchange rates were significant in the equation for exports, and there was evidence of intricate interactions amongst the macroeconomic variables. The interest rate and the exchange rate had a strong interaction. Money supply shocks had only a minimal effect on exports and a relative effect on prices. In conclusion, there was still much ambiguity in the specific links between the variables. "In particular, there is strong evidence both for the effects of financial variables on agricultural exports and prices and for the effects of autonomous changes in the price level. In contrast, there is little evidence of impacts on the macroeconomic variables arising from shocks to agricultural exports or prices" (Orden, 26). In interpreting specific shocks to the model, Orden stated that it depended on the specific variables, errors, and the ability of policymakers to manipulate the data.

Bessler and Babula (1987) studied the empirical lagged relationship between exchange rates, wheat prices, wheat export sales, and wheat export shipments. Because the previous studies suggested that agricultural exports and prices are related, the authors investigated the relationship empirically. A (VAR) model was used to fit the data. They considered forecasting wheat based on the empirical lagged relationship among exchange rates and the other exogenous variables stated above. Highlighting the time lag structure between sales and shipments pointed to a need to take this knowledge into account when generating projections of marketing year export shipments. The authors recognized the difference between using export shipments and export sales. Research has shown that there is a significant difference between reporting exports as sales or as shipments (Ayuk).

Wheat prices showed a considerable response to exchange rates, especially in the long-run under the restricted VAR specification. The article stated that under a pure purchasing power parity argument, market-determined exchange rates are not supposed to have real effects. Therefore, sales and shipments should not be expected to respond to changes in exchange rates. The results indicated that wheat shipments are explained primarily by wheat sales and that the exchange rates did have a sizeable impact on shipments at twenty-four months, under the unrestricted var specification. The results also showed that sales are a good determinant for forecasting shipments which was fully expected and supports previous studies. A striking result was that under both restrictions, using wheat sales did not show much response to exchange rates. The study concluded that real exchange rates did seem to have an impact on real wheat prices. Under an unrestricted vector autoregression, wheat price responds substantially to shocks in real exchange rates.

The empirical results were almost split down the middle in terms of half of the studies showed evidence of the exchange rate impacting the level of exports, while the other half of the studies showed no evidence supporting the hypothesis. Schuh, Chambers and Just, Orden, and Bessler and Babula (for the shipments variable only) provided results which supported the hypothesis of the exchange rate having an impact on the level of exports. Grennes, Vellianitis-Fidas, Johnson, et al., and Bessler and Babula (for the sales variable only) did not obtain results to support the hypothesis.

Even though the ARDM model for this research is an original one, other models closely resemble it. The theoretical structures and applications varied from one author to the next. There are advantages and disadvantages to all of them. Some papers used a partial equilibrium approach, while some used a general equilibrium approach. For example, Johnson, et al. used a partial equilibrium aggregate commodity export model. Orden and Chambers and Just used a general equilibrium aggregate model. An advantage to the partial equilibrium analysis is the specificity of the model. One can focus on a particular problem at hand and get more in-depth results. This approach could detect particular trends and patterns associated with wheat exports to Japan only. A disadvantage could be just the opposite of this. Economists prefer to have a general model first, then apply restrictions when necessary to cater to specific, detailed problems. A trade model for this type of problem has not been established yet.

Similarly, some studies used reduced-form models, while others used a structured model. For example, Orden and Bessler and Babula used reduced-form models which impact multipliers and Chambers and Just (1981) used a structured and a reduced-form model in their analysis. A reduced-form model provides a more accurate picture of the total effects of predetermined variables than simple elasticities computed from the structural form. It is also used to generate the dynamic multipliers associated with the exogenous variables. A structural model allows for variable exogeneity, identifies restrictions, and incorporates the usual input from economic theory.

Another varying methodology which has been mentioned is to use aggregate versus disaggregate data. Aggregate commodity export models were used by all of the authors mentioned. Global analysis was used, such as the U.S. versus the rest of the world (ROW) in looking at the impacts of the exchange rate on exports. Advantages and disadvantages are very similar to those of the partial and general equilibrium approaches stated above. A disaggregate approach can account for patterns and trend specifically related to the problem at-hand. Whereas, the aggregate approach can be misleading in their results because specificity is masked. Aggregate results may not hold at the disaggregate level and vice-versa.

Regression analysis with a theoretical foundation versus the vector autoregressive (VAR) model without a theoretical foundation was another varying application in the estimations of the trade models. Most of the studies used some form of OLS, such as a two- or three-staged process. An advantage to this application is that declaring a variable to be statistically significant can be supported by a theoretical structural base. The VAR model which was used by Orden and Bessler and Babula requires that all of the variables be stationary. An advantage to a VAR model is that all variables are considered in a model, nothing should be excluded. There are no exogenous variables; they are all considered endogenous variables and only predetermined. A disadvantage to this application is that no economic theory can be applied to the model, and there is no a priori information to the lag lengths. Other disadvantages are that the variables have to have the same lag length. Especially when dealing with monetary issues as in this case, more than one monetary variable added will be too sensitive in the model. If the interest rate is added to the equation with the money stock variable, then the disturbance in money stock will disappear in the estimation (Darnell and Evans).

CHAPTER 3

THEORETICAL FRAMEWORK

The core of this study is to measure the impacts of macroeconomic variables on U.S. wheat exports. Two major hypotheses have been proposed about the influence of macro variables on U.S. wheat exports. The first is that the exchange rate plays a significant role in affecting the level of U.S. wheat exports. The second hypothesis states that other macroeconomic variables impact the level of wheat exports. There are two hypotheses because the exchange rate and the other monetary variables cannot be nested within the same equation due to economic theory. The three theories discussed later in this chapter are integrated to get the exchange rate and monetary variables into demand for U.S. wheat exports. The model chosen to test both hypotheses is the Rotterdam Model (ARDM) where the share-weighted log differences of exports is a function of the exchange rate, wheat prices, the transportation rate, and expenditure. In the second hypothesis, the level of exports is a function of the interest rates, money supplies and GNP's in the U.S. and Japan, the transportation rate, wheat prices, and expenditure. In arriving at the second hypothesis, an attempt is made to take into consideration what Chambers (1981) and Orden (1986b) suggested for future research in this area. Specifically, theory will be used to determine the correct specification of additional macroeconomic variables to employ.

The major disadvantage to previous models has been the general aggregation of variables used. The aggregate models tend to be too general and broad in their analysis. This implies that an aggregate approach can be misleading in its results because generalizations to specific commodities may hold. A second disadvantage to previous models has been the lack of more than one monetary or macroeconomic variable employed. Other studies just focused on the exchange rate and not incorporating other macro variables, such as the money supply and the interest rate. Chambers (1981) suggested that future research should consider some monetary variables because he had results which did support the hypothesis that macro effects on agriculture did come through the exchange rate. This will also be an extension of Orden's (1986b) model. Therefore, one of the advantages anticipated in this model is that more than one monetary variable will be incorporated into the estimation at one time. This specification will be used to see if there are any interactions among the macroeconomic variables, and if those variables affect the level of exports.

A second advantage is that this model will be using the three classes of wheat that Japan imports on a consistent basis in its prices and level of exports, instead of an aggregate value. This will provide a more accurate depiction of the varying characteristics of wheat on the level of exports to Japan. Most research has only analyzed total sales data, and this level of aggregation may limit the true picture in their results and conclusions (Ayuk).

Quarterly data are used in this research to more accurately capture the short-run effects of the macro variables. The quarterly data will account for the seasonality factors of the wheat crop year. Taking a more specific, partial equilibrium disaggregate approach, may shed some light on determining the impacts of the exchange rate and macroeconomic variables on exports, as compared to the aggregate approach already numerously taken. This study covers a longer period of time than most previous studies to detect any patterns or trends. In addition, only bilateral trade between Japan and the U.S. is examined in this study. A disadvantage to this approach could be, in fact, the specificity of the problem being analyzed because researchers would like to have a general model which can be applied to all trade problems, and then be able to restrict it for specific cases. Other disadvantages could be using a partial equilibrium model over a general equilibrium model and not using all of the cross-price effects possible. However, the cross-price effects are used more in estimating projections for export shipments, and this is not the main thrust of the research.

Three economic theories will be integrated to avoid any ad hocness in specifying which macroeconomic variables should be in the demand equations. These theories are consumer demand theory, the law of one price, and the monetary exchange approach. These will be presented in a chronological fashion.

3.1. Consumer Demand Theory

As Nicholson states, consumer behavior is characterized by three axioms of rational choice. The first is *completeness* where "A is preferred to B". The second is *transitivity* where "A is preferred to B" and that "B is preferred to C". The third is *continuity* where "A is preferred to B" and "any situation close to A is still preferred to B". Given the three axioms of completeness, transitivity, and continuity, a consumer is able to rank in order from least to most desirable all of the possible outcomes of goods and services. This ranking of fixed and ordered outcomes is called a utility. A consumer's preferences is assumed to be represented by a utility function of the form

$$(1) \quad U=u(q_1,q_2,\ldots,q_n),$$

where $q_1,q_2,\ldots,q_n$ are the quantities of each of n goods that might be consumed in a period. This function is unique only up to an order-preserving transformation. A consumer will maximize their utility function subject to a budget constraint. A consumer's constrained optimization problem can be solved by using the Lagrangian multiplier method.

Due to the generality of function (1), the problem is empirically too difficult and complex to handle because the data requirements would be too great. In order to make this utility problem more manageable, we make assumptions about the utility function which restrict preferences. Therefore, the utility function is assumed to be weakly separable. This assumption is employed in order to focus on the consumption of wheat by class. If true, this assumption allows decisions about the allocation of expenditures on wheat by class to be separate from the other broad categories of goods and services in the utility function. That is the commodities in (1) can be partitioned or separated into groups, so that preferences within groups can be described independently of the quantities in other groups. With weak separability, it is assumed that this utility function can now be written as

(2) $U=u[U_1(Q_1), U_2(Q_2), ..., U_m(Q_m)]$,

where $U_i(Q_i)$ is a subutility function and Q_i is a set of closely substitutable goods, such as all wheat. However, this subutility function can also be considered weakly separable, and we have

(3) $U_i=U[U_{11}(Q_{11}), U_{12}(Q_{12}), U_{13}(Q_{13})]$,

where $U_{1i}(Q_{1i})$ is total wheat into Japan from i source; i is U.S., Canada, and Australia, and Q_{1i} are all classes of wheat from i source.

Utility functions (2) and (3) represent a two-stage budgeting process. This occurs when a consumer can allocate total expenditure in two stages. In function (2), expenditure is allocated to broad groups of goods and services. All classes of wheat can be classified into one broad group and all other goods can be classified into another broad group. In function (3), group expenditures are allocated to the individual substitutable goods, total wheat by country. The subutility function (3) can be further assumed weakly separable, such that it can be written as

(4) $US_1=U_{11}(Q_1)=f(q_1,q_2,q_3)$, subject to $E=p_1q_1+p_2q_2+p_3q_3$,

where q_1 is HRW class from U.S., q_2 is HRS class from U.S., and q_3 is White class from U.S., p_i is the price of i class of wheat, and this budget constraint represents total expenditures on wheat from the U.S. In equation (4), overall country wheat expenditures are allocated to the various classes of wheat from that country. This is done by just focusing now on the broad group of all classes of wheat which can be broken down into wheat by country. A conditional demand function exists when function (4) is maximized, subject to the budget constraint. This is *conditional* because it is based on total expenditures allocated to wheat from a specific country and not total income:

(5) $q_i = f(P_1, P_2, P_3, E)$ or

(6) $q_i = f(P_1^*, P_2^*, P_3^*, E^*)$, $i = 1,2,3$,

where * is the currency in yen for Japan's market. Equation (6) is the form we are interested in because we are looking at demand from Japan's perspective. Japan is interested in the prices in terms of their currency, not in dollars. The wheat being consumed from the U.S. is purchased in yen per dollar. As with any demand function, q_i is homogeneous of degree zero in the prices and the expenditures. That is, a proportional change in all of the prices and income leaves the quantity-demanded unaffected, as well as, the consumption level. Stated alternatively, if we multiply each element of (5) or (6) through by the same variable, the equation will not change. Note this implies then that (5) or (6) represent the same demand because all prices and expenditures can be stated in the other currency by multiplying through by the exchange rate. So theoretically, the exchange rate does not affect demand because the consumer will have no money illusion. This general theoretical property holds, regardless of the form of the utility function. The restriction is essential because one can derive an empirical demand system, which is internally consistent with the demand structure in consumer demand theory. This also curtails the number of demand parameters to be estimated.

The expected relationship for the demand function is negative for the own price variable because as the own price of wheat for the dependent variable goes up, its quantity-demanded should go down. The other two price variables are either negative or positive, depending on whether the other wheats are substitute and complementary goods. As the price of a substitute wheat rises, quantity-demanded for the dependent variable should increase. This will account for a positive sign. As the price of a complementary wheat rises, quantity-demanded for the dependent variable should fall. This will account for a negative sign. The last variable, total expenditure, will be expected to have a positive sign. As expenditure increases, quantity-demanded for the dependent variable should also rise.

In order to approximate the functional form of (6), the total derivative will be taken from function (6) to yield

(7) $Dq_i = \partial f_i/\partial P_1^* dP_1^* + \partial f_i/\partial P_2^* dP_2^* + \partial f_i/\partial P_3^* dP_3^* + \partial f_i/\partial E^* dE^*$, $i=1,2,3$.

By multiplying by 1 and then dividing by q_i, the partial derivatives are converted to elasticities and demand differentials become

(8) $Dq_i/q_i = n_{i1}dP_1^*/P_1^* + n_{i2}dP_2^*/P_2^* + n_{i3}dP_3^*/P_3^* + n_{iE}dE^*/E^*$, $i=1,2,3$.

Finally, noting $dX/X = d \ln X$ for any variable X, the log form of equation (8), yields the first-order approximation to any demand function:

$$(9) \quad d\ln q_i = n_{i1}\, d \ln P_1^* + n_{i2}\, d \ln P_2^* + n_{i3}\, d \ln P_3^* + n_{iE}\, d \ln E^*,\ i=1,2,3.$$

Deaton and Muellbauer state this as the absolute version of the Rotterdam Model (ARDM). The ARDM Model is a complete demand system which is concerned with the set of conditional demand functions that explain the allocation of total expenditures on U.S. wheat to the three classes of wheat consumed by Japan.

Referring to equation (9), $d\ln q_i$ is in continuous time; however, the data observed in this research is at discrete points (quarterly), so an approximation is needed one more time:

$$(10) \quad Dq_{it} = n_{i1}DP_{1t}^* + n_{i2}DP_{2t}^* + n_{i3}DP_{3t}^* + n_{iE}DE_t^*,\ i=1,2,3,$$

where

$$(11) \quad DP_{it}^* = \ln P_{it}^* - \ln P_{it-1}^*,$$

$$(12) \quad DE_t^* = \ln E_t^* - \ln E_{t-1}^*, \text{ and}$$

$$(13) \quad Dq_{it}^* = \ln q_{it}^* - \ln q_{it-1}^*.$$

If homogeneity of degree zero holds, then in (10) $n_{i1}+n_{i2}+n_{i3}+n_{iE}=0$. The expected signs on these estimates are negative for n_{i1} and positive or negative for n_{i2} and n_{i3}, depending on if the wheats are substitutes or complements, respectively. The n_{iE} estimate will be positive, if the i^{th}

wheat is a normal good. Note however, that the exchange rate is not in (10).

To incorporate the exchange rate into equation (10) in a theoretically consistent way, the second economic theory, the Law of One Price (LOP), is introduced. The LOP is an important theory of international trade because it is used to help detect any trading patterns in commodity arbitrage. Through the LOP, the exchange rate and the transportation rate variables can now be brought into the model.

3.2. Law of One Price

The LOP theory affirms that exchange rate changes are fully transmitted to prices because it is assumed that when international primary commodities are traded, they are perfect substitutes for one another in the long-run. The LOP states that commodity arbitrage ensures that each good has a single price defined in a common currency unit throughout the world. For example,

(14) $P_i^* = \pi P_i$,

where P_i^* is the price of the i^{th} class of wheat in Japan in yen, π is the exchange rate in yen per dollar, and P_i is the price of the i^{th} class of wheat in the U.S. in dollars. This study will use a more general form of (14) based on what Goodwin, Grennes, and Wohlgenant (Goodwin, et al. 1990) used in their study because it also includes the transportation rate and allows for a more general relationship between international prices.

Therefore, for each class of wheat, the LOP will be represented in the Japanese market as

$$(15)\quad P_i^* = \alpha_o \pi^{\beta_i} T^{\delta_i} P_i^{\lambda_i} e_i^{U_i},\ i=1,2,3,$$

where T is the transportation rate of wheat between the U.S. and Japan, $\alpha_o, \beta_i, \delta_i$, and λ_i are parameters, and e is the log normal error which captures everything else, or the residual reasons for price differences between the two countries. If the LOP holds where the expected sign is positive, then we would have $P_i^* = \pi T P_i$. This could only be true, if $\alpha_o = \beta_i = \delta_i = \lambda_i = 1$, and $u_i = 0$. If the LOP does not hold, then $\alpha_0 = \beta_i = \delta_i = \lambda_i \neq 1$, as well as, $u_i \neq 0$. Even if the LOP does not hold exactly, the expected signs on these coefficients are all still positive because as π, T, or P_i increase, P_i^* is expected to increase.

In order to incorporate the LOP into the demand function (10), the log form of the LOP equation (15) is first derived. Then the log differentials are taken from the log-form equation. Therefore, equation (15) with the log differentials is substituted into equation (10) for each DP_i^*, like terms are collected, and also E_i^* is converted to the Japanese currency because $E_i^* = \pi E_i$. This will yield

$$(16)\quad Dq_{it}^* = a_{i1}DP_{1t} + a_{i2}DP_{2t} + a_{i3}DP_{3t} + a_{i4}DT_t + a_{i5}DE_t + a_{i6}D\pi_t + \text{error},\quad i=1,2,3,$$

where $a_{i1} = n_{i1}\lambda_1$, $a_{i2} = n_{i2}\lambda_2$, $a_{i3} = n_{i3}\lambda_3$, $a_{i4} = n_{i1}\delta_1 + n_{i2}\delta_2 + n_{i3}\delta_3$, $a_{i5} = n_{iE}$, and $a_{i6} = n_{i1}\beta_1 + n_{i2}\beta_2 + n_{i3}\beta_3 + n_{iE}$. Note that the coefficients in (16) have the LOP coefficients in (15) and the demand elasticities in (10) nested within Dq_{it}^{*}. This is the first equation bringing in the LOP to be estimated.

The coefficients of the price terms will be the demand elasticities, only if the LOP holds. That is if $\alpha_o=\beta_i=\delta_i=\lambda_i=1$, then $a_{ij}=n_{ij}$ for j=1,2,3, and $a_{i4}=a_{i6}-n_{iE}$. Note also, if the LOP and homogeneity holds, then $a_{i6}=0$, $a_{i4}=-a_{i5}$, and $a_{i1}+a_{i2}+a_{i3}+a_{i5}=0$. If the LOP does not hold, then the expected corresponding signs on n_{i1},n_{i2},n_{i3}, and n_{iE} will be the same as in equation (10), only if the expected positive signs on the coefficients from the LOP is obtained. That is negative for n_{i1} and positive or negative for n_{i2}, n_{i3}, and positive for n_{iE}, if the expected sign of the LOP is positive. Note that $a_{i1}=n_{i1}\lambda_1$ from the above equation could be positive two different ways, if the LOP does not hold and the signs on the coefficients of the LOP are not restricted. The two ways are by having both of these estimates being negative or by having both of these estimates being positive:

(17) $a_{ij}= n_{ij}\lambda_j$, j=1,2,3,4,6

where n_{ij} and λ_j could both be negative in sign, or they could both be positive estimates. Therefore, the overall sign on a_{ij} is unknown a priori. The effect could be from either one or from both estimates. The expected sign on the expenditure term ($a_{i5}=n_{iE}$) is positive.

Employing the LOP has mixed reviews in terms of it holding or not in empirical estimations. Ardeni (1989) stated that the LOP does not hold in the short- and long-runs. He argued that this is due to "slow passthrough, stickiness of prices, and various slow adjustments" (Ardeni, 661). Ardeni did not have transaction costs in his model, which is different from the model in this study. "Many of the previous studies on LOP and commodity prices are in fact unreliable because either they have failed to explore the time-series properties, e.g., nonstationarity, of the variables analyzed or they have inappropriately applied various transformations on these variables, e.g. first differencing"(Ardeni, 661). Goodwin, et al. stated that the LOP did hold for agricultural commodities, and transaction costs and instrumental variables were used in their model. Their argument for discrepancies in previous studies "may have been influenced by inadequate spatial price linkages and by a neglect of the transaction costs associated with international commodity exchange" (Goodwin, et al., 692). A third study by Baffes (1991) showed that the LOP is time period- and price-specific, but not a general failure. Baffes agreed with Goodwin, et al. in their results, and he also used transaction costs. Baffes' definition of transaction costs is similar to the transportation rate that we are using in the model. Baffes cited that transaction costs seemed to have caused the failure for the cases where LOP could be rejected as a maintained hypothesis. Because of this disagreement, we have specified the stochastic form of the LOP, i.e. the error term is carried through, as stated in equation (15). Equation (16) represents the model to be run for the first hypothesis. Now it is time to place in the macroeconomic variables for the second hypothesis to be tested. To do this, the third economic theory of the monetary exchange approach is introduced. This is the last theory to be integrated into the demand equation. The interest rate, money supply, and GNP are the new variables to be brought into the model.

3.3. Monetary Exchange Approach

The monetary approach is known as a complement to the purchasing power parity concept (PPP), which in absolute terms is $\pi = P^*/P$. The PPP concept explains the exchange rate in terms of the ratio of the domestic and the foreign prices over a comparable basket of goods and services. Money demand and money supply domestically and abroad are used in the monetary exchange approach. To derive the monetary exchange approach, the real supply of money is equal to the real demand for money:

$$(18) \quad M^*/P^* = L^*(i^*, y^*),$$

where M^* is the nominal money supply in Japan, P^* is the general price level in Japan, L^* is the real demand function, which is dependent upon the nominal interest rate (i^*) and the level of real income (y^*) in Japan. Commodity arbitrage can now equal prices of traded goods, such that $P^* = P\pi$. This is the very restrictive form of the PPP or the LOP.

The exchange rate can be expressed in terms of the general price levels from the domestic and foreign countries:

$$(19) \quad \pi = P^*/P.$$

Hence, the general price levels can be substituted with the ratios of the money supply to the money demand:

$$(20) \quad \pi = P^*/P = M^*L(i,y)/ML^*(i^*,y^*).$$

This is the basic statement of the monetary approach to the exchange rate where P^* is the general price level in Japan, M^* is the money supply in Japan, P is the general level in the U.S., M is the money supply in the U.S., L is the real demand function, which is dependent upon the nominal interest rate (i) for each country accordingly and the GNP level (y) for each country accordingly. It explains the exchange rate in terms of the money supply and demand and the relative price levels domestically and abroad. The equation can be interpreted as the exchange rate for Japan will depreciate, if there is an increase in Japan's money supply, a decrease in Japan's money demand, or a decrease in Japan's relative price of nontraded goods. Conversely, if all the macro variables for the U.S. changed, then the exchange rate for Japan would also change. For example, if there is a decrease in the U.S.'s money supply, then Japan's exchange rate will depreciate. According to the monetary approach hypothesis, an increase in the money supply of the domestic country (Japan) will bring about depreciation before it increases the price level in the domestic country. The hypothesis also states that a decrease in the money demand of the domestic country brings about depreciation in two ways in the domestic country's exchange rate: either from an increase in the interest rate or a decrease in real income from the domestic country. It is believed that a rise in the interest rate of the domestic country is a sign of inflation. Therefore, the demand for money falls in the domestic country and the exchange rate depreciates. Equation (20) is a rather restrictive form of the monetary approach to exchange rate determination. The more general form would be

(21) $\pi_t = g(M^*, M, i^*, i, y^*, y, U_t)$,

where U_t is the error term. The approach used here will be to take a first-order, log-differential approximation to this function. This approach is the same as that used in obtaining the ARDM Model.

(22) $D\pi = n_{\pi M}{}^*DM^* + n_{\pi M}DM + n_{\pi i}{}^*Di^* + n_{\pi i}Di + n_{\pi y}{}^*Dy^* + n_{\pi y}Dy + n_{\pi u}DU$,

$k = M^*, M, i^*, i, y^*, y, u$

where $DX_t = \ln X_t - \ln X_{t-1}$ and X_t is any variable and $n_{\pi k}$ is the elasticity of π with respect to each of the k independent variables. The ARDM Model is used here for the second model, as well. Based on the monetary exchange approach theory, the expected signs for $n_{\pi K}$ are positive for $n_{\pi M}{}^*$, $n_{\pi i}{}^*$, and $n_{\pi y}$. The expected signs for $n_{\pi K}$ are negative for $n_{\pi M}$, $n_{\pi i}$, and $n_{\pi y}{}^*$.

Substituting equation (22) back into the demand equation (16) for the exchange rate yields the new regression to be run employing the macroeconomic variables:

(23) $Dq_{it}{}^* = a_{i1}DP_{1t} + a_{i2}DP_{2t} + a_{i3}DP_{3t} + a_{i4}DT_t + a_{i5}DE_t + b_{i1}DM_t{}^* + b_{i2}DM_t +$

$b_{i3}Di_t{}^* + b_{i4}Di_t + b_{i5}Dy_t{}^* + b_{i6}Dy_t + \text{error}$, $i = 1,2,3$,

where $a_{i1} = n_{i1}\lambda_1$, $a_{i2} = n_{i2}\lambda_2$, $a_{i3} = n_{i3}\lambda_3$, $a_{i4} = n_{i1}\delta_1 + n_{i2}\delta_2 + n_{i3}\delta_3$, $a_{i5} = n_{iE}$, $b_{i1} = n_{\pi M}{}^*a_{i6}$, $b_{i2} = n_{\pi M}a_{i6}$, $b_{i3} = n_{\pi i}{}^*a_{i6}$, $b_{i4} = n_{\pi i}a_{i6}$, $b_{i5} = n_{\pi y}{}^*a_{i6}$, and $b_{i6} = n_{\pi y}a_{i6}$. Note however, that the exchange rate has been substituted out of (23) for the macroeconomic variables to be tested for the second hypothesis.

Note that the a_{ij} coefficients have been discussed already in detail, and that they do not change in equation (23). As in equation (16) with the LOP, the expected signs for the macro variables in (23) are going to be very difficult to detect because b_{ig} encompasses three different estimates from each class of wheat. Again, the LOP parameters and the original demand parameters are nested within Dq_{it}^*. Equation (23) represents the macro variables with the b_{ig} coefficients.

(24) $b_{ig}=n_{\pi k}{}^*a_{ij}$, g=1,2,3,4,5,6.

The $n_{\pi k}$ estimate on the b_{ig} coefficient is the elasticity component of the exchange rate with respect to each of the macro variables. The a_{ij} estimate, as stated earlier, has the LOP coefficients and the demand elasticities. Assuming that the monetary exchange approach theory holds, we know what the expected signs are for $n_{\pi k}$. The a_{ij} estimate is unknown a priori, so the signs on the b_{ig} coefficients depend on the signs of the LOP parameters and the original demand parameters. Therefore, the overall signs for b_{ig} are unknown.

The monetary approach to the exchange rate is still a mystery in terms of what actually determines its fluctuations. According to Meese (1990), previous studies have not been able to determine the correct explanatory variables to explain major currency movements over the post-Bretton Woods era. He cites that possibly economists have not yet discovered the appropriate set of fundamentals, nor have models been able to detect currency fluctuations. "Neither models of exchange rates based on macroeconomic fundamentals nor the forecasts of market participants as embodied in the forward rate or survey data can explain exchange rate movements in the post-Bretton Woods era significantly better than a naive alternative such as a random walk model" (Meese, 132). We have attempted here to overcome this criticism by using the stochastic form of the monetary approach to exchange rate determination.

This section viewed the three theories of consumer demand, LOP, and the monetary approach to the exchange rate. The consumer demand theory is used to identify as many properties as possible in the demand system based on economic theory. The LOP is used to detect trading patterns of commodity arbitrage and to help explain the allocation of total expenditure. This is achieved by noting where a country purchased its commodity in a lower-priced market and hence, where it was sold in a higher-priced market. The ARDM Model is an approximation of the demand system. The last theory incorporates monetary and other macroeconomic variables to test the significance of the fluctuations in the exchange rate. The literature cited in this section coincides with the literature review section in terms of ambiguity still persisting in international trade analyses of this nature.

CHAPTER 4

DATA & ESTIMATION RESULTS

The objective of this chapter is to assess the applicability of the two major hypotheses being proposed. The first stating that the exchange rate plays a significant role in affecting the level of U.S. wheat exports, and the second stating that other macroeconomic variables impact the level of wheat exports. The two ARDM models used to test these hypotheses attempted to integrate three economic theories into demand equations. The estimation results will be presented in tabular form, containing Table 1 through Table 24. Note that all of the tables are in the Appendix.

In drawing conclusions on the results, there is no way to know from these models, if demand theory, the LOP, or the monetary approach to exchange rate determination holds. The individual parameters were not estimated to test these theories, only some reduced-form was tested. In reference to the theoretical framework chapter, the coefficients being discussed are a combination of several other coefficients. Therefore, expected signs cannot be determined. Based on the theoretical derivation in Chapter 3, there is no way to tell what the signs will be. If the signs do not fit, then the only rational reasoning is because at least one of the economic theories did not hold. However, we do not know which one in particular did not hold. To discuss the expected signs on the coefficients, one would have to assume that at least one of the theories is true a priori.

The analysis will be presented and compared for each class of wheat:

hard red winter (HRW), hard red spring (HRS), and soft white (WHI) through the two hypotheses. The analysis will also compare the export sales and export shipments with and without seasonal dummy variables. Tables 1-12 represent the first hypothesis being tested. The first six tables are the results for three classes of export sales, with and without seasonal dummies. The second six tables are the results for the three classes of export shipments, with and without seasonal dummies. Tables 13-24 represent the second hypothesis being tested. The first six tables are the macroeconomic results for the three classes of export sales, with and without seasonal dummies. The second six tables are the macroeconomic results for the three classes of export shipments, with and without seasonal dummies. Two econometric procedures were used on each class of wheat for export sales and shipments, with and without dummies. The two procedures were the instrumental variable approach (IV) and the ordinary least squares estimation approach (OLS). In the Theoretical Framework Chapter, the error term was carried throughout the estimated models. Since the error term was in the LOP and the monetary approach to exchange rate determination, the IV procedure is used to account for the measurement error. The IV estimation is used to break up the correlation with the error term to obtain a consistent estimator. This is why the IV procedure was used because the OLS procedure is not appropriate in this case.

Since there are so many models that are estimated, the economic discussion and interpretation of the results for the first hypothesis will be postponed until the end of the first twelve tables. A summary that includes an economic interpretation will also be included. Similarly, an economic discussion of the second hypothesis will be postponed until after the last twelve tables. Because of this, the discussion of the individual tables will be limited to an observation of the signs, significance, and magnitudes without any economic interpretation.

The results will be summarized by first noting all of the signs of the variables. Secondly and thirdly, the significance and the magnitudes of each of the estimates will be discussed for each table. At the end of this chapter, the results of this analysis will be summarized and conclusions drawn. The criteria for the significance of the t-tests and the F-tests was at a 95 percent confidence interval. All t-tests reported are two-tailed. It will be noted in the analysis where this is not true. However, most of the variables were not significant, but this will be discussed in further detail later on in this chapter. Also, the overall magnitudes of the estimates are very small. Before the results are analyzed, a discussion on the data set and econometric models needs to be addressed. Forty-three marketing quarter observations were used in the analysis, covering calendar years 1979 through 1989. The U.S. wheat prices were from the *Grain and Feed Market News* through the FAS-USDA. The prices were wheat cash prices in dollars per bushel for leading classes at major markets. The HRW (hard red winter) wheat prices were from the Kansas City market. The protein content was classified as "ordinary protein". The HRS (hard red spring) wheat prices were from the Minneapolis market. The protein content was classified at "14 percent". The WHI (soft white) wheat prices were from the Portland market. The prices were all in nominal terms and were converted into real terms using the U.S. consumer price index (CPI).

The exchange rate, the GNP for Japan and the U.S., money supply for Japan, and the production variable were taken from the IMF's *International Financial Statistics*. The nominal exchange rate was also converted into real terms and to be in yen per dollar. The GNP variables were measured in annual rates. The money supply variables are classified as M1. M1 consists of currency plus bank accounts on which one can write checks. The CPI, the money supply for the U.S., and the three-month interest rate for the U.S. were taken from the Federal Reserve Bank of St. Louis. The transportation rate was taken from the IWC's *World Wheat Statistics* and their *Market Report*. Japan's three-month interest rate was obtained from the OECD's *Financial Statistics*. The instrumental variables used in the IV estimations were the seasonally-adjusted industrial production lagged by one month, as well as, the lagged variables of all of the independent variables used for each model.

The export sales and shipments data were taken from *U.S. Export Sales* through the FAS-USDA. This source is considered the best source to use in running regressions on exports because it is counter-checked with the Federal Grain Inspection Service, which accounts for some of the adjustments in the data. The data extracted from *U.S. Export Sales* began in 1979 instead of earlier because there were drastic data method changes in 1975. This export data contains no Public Law 480 (PL 480) wheat or concessional agreements. That is, Japan did not receive any of the U.S. wheat as a gift or under any very low interest rate terms, which were essentially designed for Third-World countries. Therefore, there is no misspecification error of this type in the demand for the classes of U.S. wheat.

The two econometric procedures used for the analysis have trade-offs in their applications which should be considered. The IV estimator is consistent under both a null and an alternative hypothesis. The null hypothesis represents having no measurement error, whereas, the alternative hypothesis represents having measurement error. Therefore, it is unaffected by measurement error. The IV estimator is used in this research because the error term is carried throughout the estimated models. The IV estimator "produces a consistent estimator in a situation in which a regressor is contemporaneously correlated with the error, but not without cost" (Kennedy, 136). The cost is that the variance is greater than that of the OLS estimator. The advantage to the IV procedure is that it is asymptotically unbiased. Therefore, the confidence interval is greater in the fact that the true estimate lies within the variance. One thing to note is that it is very difficult to choose the correct instrumental variables because these variables must be first uncorrelated with the error term, and second, must be highly correlated with the regressor for which it is to serve as an instrument. Therefore, the "R^2" that is reported in the results tables will be low. The R^2 stated is actually the square of the correlation coefficient between the observed and the predicted value of the dependent variable because R^2 is invalid in two-stage least squares estimation.

The OLS estimator is consistent and efficient under the null hypothesis, but inconsistent under the alternative hypothesis. Therefore, it is affected by measurement error. The downfall to the OLS estimator is that it is asymptotically biased. That is, the regressors are contemporaneously correlated with the error term. The advantage to the

OLS procedure is that the variance is smaller than that of the IV procedure. "In general, no alternative estimators are available with superior small-sample properties, so the OLS estimator is retained on the basis of its desirable asymptotic properties" (Kennedy, 135).

The dummy variables interpretation needs to be clearly addressed. Since there is an intercept involved with the dummy variables, the dummy being dropped from the equation is represented in the intercept when the remaining dummy variables are all zero. The dropped dummy variable is D4 (fourth quarter seasonal dummy). With the intercept included, the omitted dummy variable becomes the benchmark to which the others are compared. The coefficients on the remaining dummies measure the extent to which they differ from the benchmark. The demand equations represent the differences. That is, the expected level of export sales or shipments from each quarter differing from the level of exports in the fourth quarter. Therefore, the effect of D1 for example, is given by the intercept plus the coefficient estimate on the D1 variable. This coefficient is also interpreted as the difference in the intercept between D1 and the dropped dummy variable (D4). This holds for the other two dummies, as well. Perfect multicollinearity would result, if all four dummy variables were included. An F-test was done on the set of dummy variable coefficient estimates to see whether or not the categorization is relevant.

The Durbin-Watson (DW) test was also used to test for first-order autocorrelation. If the test proves significant, then the hypothesis is accepted that no autocorrelation exists. For the most part, the DW test was inconclusive. This is considered "the most serious weakness" of the

DW test, according to Kennedy. Kennedy also noted another weakness in the DW test when a lagged value of the dependent variable is used as a regressor. This test shows a bias towards accepting the hypothesis of no autocorrelation.

4.1 Results of First Hypothesis

An analysis of the results will now be presented. Table 1 shows the results for Class 1 (U.S. hard red winter) sales to Japan with seasonal dummies. Overall, both the IV and OLS models show similar results. In both models, the signs on DP1, DP3, D1, D2, and D3 are all negative. While in both models, the signs on DE and DTR are both positive. The only signs that differ across models are on DP4 and DEX. In the IV model, DP4 has a positive sign, while being negative in the OLS model. In the IV model, the sign on DEX is positive, while it is negative in the OLS model. The only variables significant in both models are DE and D1, while D3 is significant in the OLS model. In general, the most important variables in terms of magnitudes of estimates are DP1, DTR, DE, and D3. The DW, the F-statistic, and the F-test on the dummy parameters for the OLS model are all significant. For the F-test, we reject the hypothesis that the dummy parameters all equal zero. The R^2 is relatively high for both models, showing that most of the variation in the dependent variable is attributed to the set of independent variables.

Table 2 shows the results for Class 1 (U.S. hard red winter) sales to Japan without seasonal dummies. Overall, both the IV and OLS models show the same results. In both models, the signs on DP1, DP3, DP4, and

DEX are all negative. While in both models, the signs on DE and DTR are both positive. The only variable significant in both models is DE. In general, the most important variables in terms of magnitudes of estimates are DE, DP1, and DP3. The DW and the F-statistic for the OLS model are also significant. The R^2 is slightly lower than in Table 1, but still a strong indication that the appropriate variables are accounted for in the model.

Table 3 shows the results for Class 3 (U.S. hard red spring) sales to Japan with seasonal dummies. Overall, both the IV and OLS models show similar results. In both models, the signs on DP3, DP4, and DTR are all negative. While in both models, the signs on DP1, DE, DEX, and D1 are all positive. The only signs that differ across models are on D2 and D3. In the IV model, D2 and D3 have a positive sign, while being negative in the OLS model. The only variable significant in both models is DE. In general, the most important variables in terms of magnitudes of estimates are DP1, DP4, and DE. The DW and the F-statistic are also significant in the OLS model. The R^2 is pretty low for both models.

Table 4 shows the results for Class 3 (U.S. hard red spring) sales to Japan without seasonal dummies. Overall, both the IV and OLS models show similar results. In both models, the signs on DP3 and DP4 are both negative. While in both models, the signs on DP1, DE, and DEX are all positive. The only sign that differ across models is on DTR. In the IV model, DTR has a positive sign, while being negative in the OLS model. The only variable significant in both models is DE. In general, the most important variables in terms of magnitudes of estimates are DP3, DP4, DE, and DTR. The DW and the F-statistic are significant in the OLS model.

The R^2 is really low for both models.

Table 5 shows the results for Class 4 (U.S. soft white) sales to Japan with seasonal dummies. Overall, both the IV and OLS models show similar results. In both models, the signs on DP1, DP3, and DP4 are all negative. While in both models, the signs on DE, D1, D2, and D3 are all positive. The only signs that differ across models are on DEX and DTR. In the IV model, DEX has a positive sign, while being negative in the OLS model. In the IV model, the sign on DTR is negative, while it is positive in the OLS model. The only variable significant in both models is DE. In general, the most important variables in terms of magnitudes of estimates are DP3, DTR, and DE. The DW is significant in the OLS model. The R^2 is really low for both models.

Table 6 shows the results for Class 4 (U.S. soft white) sales to Japan without seasonal dummies. Overall, both the IV and OLS models do not show similar results. In both models, only the sign on DP1 is negative. While in both models, the signs on DE and DEX are both positive. The signs that differ across models are on DP3, DP4, and DTR. In the IV model, DTR has a positive sign, while being negative in the OLS model. In the IV model, the signs on DP3 and DP4 are negative, while being positive in the OLS model. The only variable significant in both models is DE. In general, the most important variables in terms of magnitudes of estimates are DP3, DE, and DEX. The DW and the F-statistic are significant in the OLS model. The R^2 is really low for both models.

Table 7 shows the results for Class 1 (U.S. hard red winter) shipments to Japan with seasonal dummies. Overall, both the IV and OLS models do not show similar results. In both models, the signs on DP1 and

DP3 are both negative. While in both models, the signs on DP4, DES, and DTR are all positive. The signs that differ across models are on DEX, D1, D2, and D3. In the IV model, DEX has a positive sign, while being negative in the OLS model. In the IV model, the signs on D1, D2, and D3 are negative, while being positive in the OLS model. The only variable significant is DES in the OLS model. In general, the most important variables in terms of magnitudes of estimates are DP3, DES, and DEX. The DW and the F-statistic are also significant in the OLS model. The R^2 in the OLS model is twice as large as in the IV model.

Table 8 shows the results for Class 1 (U.S. hard red winter) shipments to Japan without seasonal dummies. Overall, both the IV and OLS models show similar results. In both models, only the sign on DP3 is negative. While in both models, the signs on DP4, DES, and DTR are all positive. The only signs that differ across models are on DP1 and DEX. In the IV model, DP1 and DEX have a positive sign, while being negative in the OLS model. The only variable significant in both models is DES, while DP1 is significant in the OLS model. In general, the most important variables in terms of magnitudes of estimates are DP3, DES, and DEX. The DW and the F-statistic are significant in the OLS model. The R^2 in the OLS model is exactly twice as large as in the IV model.

Table 9 shows the results for Class 3 (U.S. hard red spring) shipments to Japan with seasonal dummies. Overall, both the IV and OLS models show very similar results. In both models, the signs on DP1, DP3, DP4, D1, and D3 are all negative. While in both models, the signs on DES, DEX, and DTR are all positive. The only sign that differ across models is on D2. In the IV model, D2 has a negative sign, while being positive in the OLS model. The only variable significant in both models is DES. In general, the most important variables in terms of magnitudes of estimates are DP1, DP3, and DES. The DW and the F-statistic are significant in the OLS model. The F-test in the IV model is also significant, which means that the three dummy variables are not equal to zero, so we reject the hypothesis. The R^2 is at the mid-way point (0.46 for the IV and 0.53 for the OLS, respectively) for both models.

Table 10 shows the results for Class 3 (U.S. hard red spring) shipments to Japan without seasonal dummies. Overall, both the IV and OLS models do not show similar results. In both models, the signs on DP3 and DP4 are both negative. While in both models, the signs on DES and DTR are both positive. The signs that differ across models are on DP1 and DEX. In the IV model, DP1 and DEX have a negative sign, while being positive in the OLS model. The only variable significant in both models is DES. In general, the most important variables in terms of magnitudes of estimates are DP1, DP3, and DES. The DW and the F-statistic are both significant in the OLS model. The R^2 is relatively low in both models at 0.40 and 0.50, respectively.

Table 11 shows the results for Class 4 (U.S. soft white) shipments to Japan with seasonal dummies. Overall, both the IV and OLS models show similar results. In both models, the signs on DP4, DTR, and D1 are all negative. While in both models, the signs on DP1, DES, DEX, and D3 are all positive. The only signs that differ across models are on DP3 and D2. In the IV model, D2 has a positive sign, while being negative in the OLS model. In the IV model, the sign on DP3 is negative, while it is positive in the OLS model. The only variables significant in the OLS model are DP4 and DES. In general, the most important variables in terms of magnitudes of estimates are DP1, DP3, and DES. The DW and the F-statistic are also significant. The R^2 is 0.40 in the IV model and 0.64 in the OLS model.

Table 12 shows the results for Class 4 (U.S. soft white) shipments to Japan without seasonal dummies. Overall, both the IV and OLS models do not show similar results. In both models, only the sign on DP4 is negative. While in both models, the signs on DP1 and DES are both positive. The signs that differ across models are on DP3, DEX, and DTR. In the IV model, DTR has a positive sign, while being negative in the OLS model. In the IV model, the signs on DP3 and DEX are negative, while being positive in the OLS model. The only variable significant in both models is DES, while DP4 is significant in the OLS model. In general, the most important variables in terms of magnitudes of estimates are DP3, DP4, and DES. The DW and the F-statistic in the OLS model are both significant. The R^2 are 0.49 and 0.58, respectively.

4.2 Summary of Results for First Hypothesis

The results for the first hypothesis, representing Tables 1-12 will now be summarized. Tables 25-30 represent the summary of coefficient signs for each class of wheat across all models. In Tables 25 and 28 for Class 1 (HRW) wheat, the negative signs of DP1 showed overall that its own price was consistent with demand theory, if the LOP holds in sign. However, there was one case with export shipments, in which this did not hold true. The majority of the other two classes of wheat had negative signs, indicating that they were more of complements than substitutes.

The expected signs on the remaining variables (DE, DES, DEX, and DTR) were positive, only if the LOP held. This holds in the economic interpretation for the other two classes of wheat, as well. The only two variables which were positive throughout were DTR (transportation rate) and DES (expenditure in the shipments model). The seasonal dummy variables were all negative in Table 25 and split evenly in Table 28, indicating that the omitted dummy variable (D4) had more of an impact with export sales (Table 25) and a canceling effect with export shipments (Table 28). Overall in Table 25, there were seven variables which were significant in their signs. Four came from the DE variable on all of its positive signs, two came from the D1 variable on all of its negative signs, and one came from the D3 variable on its negative sign. In Table 28, there were four variables which were significant in their signs. One came from the DP1 variable on its negative sign and three came from the DES variable on its positive sign.

In Tables 26 and 29 for Class 3 (HRS) wheat, the negative signs of DP3 showed overall that its own price was consistent with demand theory, if the LOP holds in sign. The majority of the other two classes of wheat had negative signs, indicating that they were more of complements than substitutes. The only variables which were positive throughout were DE and DES (expenditure in the sales and shipments models). DEX was almost all positive, except for one case in the shipments model. The seasonal dummy variables fluctuated throughout. Overall in Table 26, there were four variables which were significant in their signs. All four came from the DE variable on its positive signs. In Table 29, there were four variables which were significant in their signs. All four came from the

DES variable on its positive sign.

In Tables 27 and 30 for Class 4 (WHI) wheat, the negative signs of DP4 showed overall that its own price was consistent with demand theory, if the LOP holds in sign. However, there was one case with export sales, in which this did not hold true. An almost even split of the other two classes of wheat had negative and positive signs, indicating that they were a combination of complements and substitutes. The only variables which were positive throughout were DE and DES (expenditure in the sales and shipments models). DEX was almost all positive, except for two cases. The seasonal dummy variables were all positive in the export sales models and fluctuated in the export shipments models. Overall in Table 27, there were four variables which were significant in their signs. All four came from the DE variable on its positive signs. In Table 30, there were five variables which were significant in their signs. Two came from the DP4 variable on its negative sign and three came from the DES variable on its positive sign.

The expenditure variables (DE and DES) were the only significant ones, except in a few cases where Tables 1, 8, 11, and 12 had other variables, which were also significant. The DW and the F-statistic were significant in all of the OLS models, except for in Table 5, where the F-statistic was not significant. The DW in the IV model were all considered inconclusive. None of the F-tests were significant, except for in Tables 1 and 9. For all of the other tables, excluding 1 and 9, we failed to reject the hypothesis that the dummy parameters all equal zero. When all of the three dummy variables (D1, D2, D3) equal zero, then the intercept in this case, represents the fourth quarter dummy. Therefore, the three dummy variables differ from the fourth quarter dummy by the coefficient value of the intercept. For the most part, the IV model had the largest magnitudes, except for in Table 12. The R^2 values ranged between a very low 0.24 and 0.77.

4.3 Results of Second Hypothesis

The second hypothesis is now going to be analyzed. The exchange rate is substituted out, using the monetary approach to obtain the macroeconomic variables in demand equations. These macro results are presented in Table 13 through Table 24.

All of the macro variables (DM1, DJMS, DTB, DJCM, DGNP, and DJNP) are coming through the exchange rate. Therefore, if the monetary approach to exchange rate determination were true, then we could tell the signs on these variables by the sign on the exchange rate in the first twelve models. Only when the theory is correct, can we carry over the sign on the exchange rate to the macro variables. Note that the signs would be reversed, if the sign for the exchange rate in any of the first twelve models was negative. This holds for all of the macro variables for all three classes of wheat. Table 1 is a good example to show what the expected signs for each of the macro variables will be, based on a positive and a negative sign of the exchange rate. Therefore, Table 13 will represent the expected signs on each of the macro variables based on the sign of the exchange rate in Table 1. This will be discussed at the end of this next paragraph.

Table 13 shows the macro results for Class 1 (U.S. hard red winter) sales to Japan with seasonal dummies. Overall, both the IV and OLS models do not show similar results. In both models, the signs on DP3, DP4, DJMS, DTB, D1, and D3 are all negative. While in both models, the signs on DE, DM1, and DTR are all positive. The signs that differ across models are on DP1, DJCM, DGNP, DJNP, and D2. In the IV model, DP1, DGNP, DJNP, and D2 have a positive sign, while being negative in the OLS model. In the IV model, the sign on DJCM is negative, while being positive in the OLS model. The only variable significant in both models is DE, while D1 is significant in the OLS model. In general, the most important variables in terms of magnitudes of estimates are DJMS, DJNP, and DGNP. The DW and the F-statistic in the OLS model. The R^2 values are 0.37 and 0.78, respectively.

The expected signs for each of the macro variables based on the sign of the exchange rate in Table 1 will now be discussed. From the theoretical chapter, we saw that the coefficients on the macrovariables are composed of two terms, i.e. $b_{ig}=a_{i6}n_{\pi k}$. Now, from the first hypothesis and Tables 1-12, a_{i6} may be signed. Note then, if a_{i6} is positive, then the sign on the b_{ig}'s should be the same as $n_{\pi k}$ is from the monetary approach to exchange rate determination, assuming that the monetary approach to exchange rate determination holds. Alternatively, if a_{i6} is negative, then the sign on the b_{ig}'s should be opposite in sign to that of $n_{\pi k}$, assuming that the monetary approach to exchange rate determination holds. If these sign relationships do not hold, it would be concluded that the monetary approach to exchange rate determination does not hold in sign.

As a demonstration of determining if the monetary approach to exchange rate determination holds in sign, consider the relationship between Tables 1 and 13. Table 13 shows the results obtained by substituting out the exchange rate via the monetary approach to exchange rate determination in Table 1. In Table 1 under the IV procedure, the sign on the exchange rate is positive ($a_{16}>0$). Hence, we expect b_{1M}^*, b_{1i}^*, and b_{1y} to be positive and b_{1M}, b_{1i}, and b_{1y}^* to be negative in Table 13 under the IV procedure, if the monetary approach to exchange rate determination holds. From Table 13, we see that b_{1M} (DM1), b_{1y} (DGNP), and b_{1y}^* (DJNP) are positive in sign. From Table 13, we also see that b_{1M}^* (DJMS), b_{1i} (DTB), and b_{1i}^* (DJCM) are negative in sign. It therefore seems that the monetary approach to exchange rate determination does not hold in sign for HRW sales, under the IV procedure for DGNP and DTB.

Alternatively, in Table 1 under the OLS procedure, the sign on the exchange rate is negative ($a_{16}<0$). Hence, we expect b_{1M}^*, b_{1i}^*, and b_{1y} to be negative and b_{1M}, b_{1i}, and b_{1y}^* to be positive in Table 13 under the OLS procedure, if the monetary approach to exchange rate determination holds. From Table 13, we see that b_{1M} (DM1) and b_{1i}^* (DJCM) are positive in sign. From Table 13, we also see that b_{1M}^* (DJMS), b_{1i} (DTB), b_{1y} (DGNP), and b_{1y}^* (DJNP) are all negative in sign. It therefore seems that the monetary approach to exchange rate determination does not hold in sign for HRW sales, under the OLS procedure for DM1, DJMS, and DGNP.

The discussion of Table 13 indicates that the sign on the macro variables will be restricted by the sign on the exchange rate, and this will apply to all of the remaining tables, as well. Since this restriction was not imposed, we will not discuss the remaining tables in this fashion. The point of this discussion was just to illustrate the relationships between the first hypothesis and the second.

Table 14 shows the macro results for Class 1 (U.S. hard red winter) sales to Japan without seasonal dummies. Overall, both the IV and OLS models show similar results. In both models, the signs on DP1, DP4, DJCM, DGNP, and DJNP are all negative. While in both models, the signs on DE and DJMS are both positive. The signs that differ across models are on DP3, DM1, DTB, and DTR. In the IV model, DP3 and DTB have a positive sign, while being negative in the OLS model. In the IV model, the signs on DM1 and DTR are negative, while being positive in the OLS model. The only variable significant is DE in the OLS model. In general, the most important variables in terms of magnitudes of estimates are DGNP, DJNP, DM1. The DW and the F-statistic are both significant. The R^2 values are 0.18 and 0.73, respectively.

Table 15 shows the macro results for Class 3 (U.S. hard red spring) sales to Japan with seasonal dummies. Overall, both the IV and OLS models show very similar results. In both models, the signs on DP4, DM1, DTB, DJCM, DTR, and D2 are all negative. While in both models, the signs on DP3, DE, DJMS, DGNP, DJNP, D1, and D3 are all positive. The only sign that differ across models is on DP1. In the IV model, DP1 has a negative sign, while being positive in the OLS model. The only variable significant in both models is DE, while DJMS and D1 are significant in the OLS model. In general, the most important variables in terms of magnitudes of estimates are DJMS, DJNP, and DGNP. The F-tests in both models are significant, meaning that we reject the hypotheses. The R^2 values are at the mid-way point with 0.41 and 0.57, respectively.

Table 16 shows the macro results for Class 3 (U.S. hard red spring) sales to Japan without seasonal dummies. Overall, both the IV and OLS models show similar results. In both models, the signs on DP3, DP4, DTB, and DTR are all negative. While in both models, the signs on DP1, DJMS, DJCM, DGNP and DJNP are all positive. The only signs that differ across models are on DE and DM1. In the IV model, DE and DM1 have a negative sign, while being positive in the OLS model. The only variable significant is DE in the OLS model. In general, the most important variables in terms of magnitudes of estimates are DP1, DJNP, and DGNP. Only the DW is significant in the OLS model. The R^2 is very low for the IV model at 0.05 and 0.42 for the OLS model.

Table 17 shows the macro results for Class 4 (U.S. soft white) sales to Japan with seasonal dummies. Overall, both the IV and OLS models do not show similar results. In both models, the signs on DP3, DJMS, DGNP, and D3 are all negative. While in both models, the signs on DE, DM1, DJCM, and D2 are all positive. The signs that differ across models are on DP1, DP4, DTB, DJNP, DTR, and D1. In the IV model, DP1, DJNP, and DTR have a positive sign, while being negative in the OLS model. In the IV model, the sign on DP4, DTB, and D1 have a negative sign, while being positive in the OLS model. The only variables significant are DE, DJMS, and D2 in the OLS model. In general, the most important variables in terms of magnitudes of estimates are DJMS, DJNP, and DM1. The DW is only significant in the OLS model. The R^2 is very low at 0.18 and 0.56, respectively.

Table 18 shows the macro results for Class 4 (U.S. soft white) sales to Japan without seasonal dummies. Overall, both the IV and OLS models do not show similar results. In both models, the signs on DP1, DP3, DJMS, and DJNP are all negative. While in both models, the signs on DE and DJCM are both positive. The signs that differ across models are on DP4, DM1, DTB, DGNP, and DTR. In the IV model, DP4, DM1, DGNP, and DTR have a positive sign, while being negative in the OLS model. In the IV model, the sign on DTB is negative, while being positive in the OLS model. The only variable significant is DE in the OLS model. In general, the most important variables in terms of magnitudes of estimates are DM1, DJNP, and DGNP. Only the DW is significant in the OLS model. The R^2 is extremely low for both at 0.10 and 0.49, respectively.

Table 19 shows the macro results for Class 1 (U.S. hard red winter) shipments to Japan with seasonal dummies. Overall, both the IV and OLS models do not show similar results. In both models, the signs on DP1, DP3, DJMS, and DTB are all negative. While in both models, the signs on DP4, DES, DTR and D2 are all positive. The signs that differ across models are on DM1, DJCM, DGNP, DJNP, D1, and D3. In the IV model, DM1, DJCM, DGNP, DJNP, and D2 have a positive sign, while being negative in the OLS model. In the IV model, the sign on D3 is negative, while being positive in the OLS model. The only variable significant is DES in the OLS model. In general, the most important variables in terms of magnitudes of estimates are DM1, DJNP, and DGNP. Only the DW is significant in the OLS model. The R^2 values are 0.14 and 0.58, respectively.

Table 20 shows the macro results for Class 1 (U.S. hard red winter) shipments to Japan without seasonal dummies. Overall, both the IV and OLS models show similar results. In both models, the signs on DP1, DTB, DJCM, and DJNP are all negative. While in both models, the signs on DP4, DES, DGNP, and DTR are all positive. The only signs that differ across models are on DP3, DM1, and DJMS. In the IV model, DP3, DM1, and DJMS all have a positive sign, while being negative in the OLS model. The only variable significant is DES in the OLS model. In general, the most important variables in terms of magnitudes of estimates are DP1, DJNP, and DGNP. The DW and the F-statistic are both significant in the OLS model. The R^2 values are respectively, 0.22 and 0.54.

Table 21 shows the macro results for Class 3 (U.S. hard red spring) shipments to Japan with seasonal dummies. Overall, both the IV and OLS models show very similar results. In both models, the signs on DP1, DP3, DJNP, D1, D2, and D3 are all negative. While in both models, the signs on DES, DTB, DJCM, DGNP, and DTR are all positive. The only signs that differ across models are on DP4, DM1, and DJMS. In the IV model, DP4 and DM1 have a positive sign, while being negative in the OLS model. In the IV model, the sign on DJMS is negative, while being positive in the OLS model. The only variable significant in both models is DES. In general, the most important variables in terms of magnitudes of estimates are DJMS, DJNP, DP1, and DM1. Only the DW is significant in the OLS model. The R^2 values are 0.40 and 0.59, respectively.

Table 22 shows the macro results for Class 3 (U.S. hard red spring) shipments to Japan without seasonal dummies. Overall, both the IV and OLS models show similar results. In both models, the signs on DP1 and DJNP are both negative. While in both models, the signs on DES, DJMS, DTB, DGNP, and DTR are all positive. The only signs that differ across models are on DP3, DP4, DM1, and DJCM. In the IV model, DP3, DP4, and DM1 have a positive sign, while being negative in the OLS model. In the IV model, the sign on DJCM is negative, while being positive in the OLS model. The only variable significant is DES significant in the OLS model. In general, the most important variables in terms of magnitudes of estimates are DP1, DJMS, DJNP, and DGNP. The DW and the F-statistic are both significant in the OLS model. The R^2 in the OLS model is exactly twice as large as in the IV model.

Table 23 shows the macro results for Class 4 (U.S. soft white) shipments to Japan with seasonal dummies. Overall, both the IV and OLS models show some similar results. In both models, the signs on DTB, D1, and D2 are all negative. While in both models, the signs on DES, DM1, DJMS, DJCM, DGNP, and DJNP are all positive. The signs that differ across models are on DP1, DP3, DP4, DTR, and D3. In the IV model, DP4 and DTR have a positive sign, while being negative in the OLS model. In the IV model, the sign on DP1 and DP3 are negative, while being positive in the OLS model. The only variables significant are DES, DP4, and DJNP in the OLS model. In general, the most important variables in terms of magnitudes of estimates are DM1, DJNP, and DGNP. The DW and the F-statistic are significant in the OLS model, as well as, the F-tests being significant in both models. The R^2 values are respectively, 0.35 and 0.76.

Table 24 shows the macro results for Class 4 (U.S. soft white) shipments to Japan without seasonal dummies. Overall, both the IV and OLS models do not show similar results. In both models, only the sign on DTB is negative. While in both models, the signs on DP3, DES, DM1, and DJCM are all positive. The signs that differ across models are on DP1, DP4, DJMS, DGNP, DJNP, and DTR. In the IV model, DP4, DJMS, DGNP, and DTR have a positive sign, while being negative in the OLS model. In the IV model, the signs on DP1 and DJNP are negative, while being positive in the OLS model. The only variables significant are DES, DP4, and DJNP in the OLS model. In general, the most important variables in terms of magnitudes of estimates are DP1, DJNP, and DGNP. The DW and the F-statistic are also significant in the OLS model. The R^2 values are an extremely low 0.01 and a relatively high 0.73, respectively.

4.4 Summary of Results for Second Hypothesis

The results for the second hypothesis, representing Tables 13-24 will now be summarized. Tables 31-36 represent the summary of macro coefficient signs for each class of wheat across all models. In Tables 31 and 34 for Class 1 (HRW) wheat, the negative signs of DP1 showed overall that its own price was consistent with demand theory, if the LOP holds in sign. However, there was one case with export sales, in which this did not hold true. The majority of the other two classes of wheat had negative signs, indicating that they were more of complements than substitutes, if the LOP holds in sign. The expected signs on the variables (DE, DES, and DTR) were positive, only if the LOP held. This holds in the economic interpretation for the other two classes of wheat, as well. The only two variables which were positive throughout were DE and DES. DTR was all positive only in the shipments models. The seasonal dummy variables fluctuated throughout all of the models. Overall in Table 31, there were four variables which were significant in their signs. Three came from the DE variable on its positive signs and one came from the D1 variable on its negative sign. In Table 34, there were only two variables which were significant in their signs. Both came from the DES variable on its positive sign.

In Tables 32 and 35 for Class 3 (HRS) wheat, there was almost an even split between the signs of DP3. This indicated that its own price was not consistent with demand theory, if the LOP held in sign. Again, there was almost an even split in the signs with the other two classes of wheat, indicating that they were a combination of complements and substitutes. The only two variables which were all positive in the shipments models were DES and DTR. DTR was all negative in the sales models. The seasonal dummy variables were all negative in the shipments models and fluctuated in the sales models. Overall in Table 32, there were five variables which were significant in their signs. Three came from the DE variable on its positive signs, one came from the DJMS variable on its positive sign, and one came from the D1 variable on its positive sign. In Table 35, there were three variables which were significant in their signs. All came from the DES variable on its positive sign.

In Tables 33 and 36 for Class 4 (WHI) wheat, there was an even split between the signs of DP4. This indicated overall, that its own price was not consistent with demand theory. There was a slight majority with the other two classes of wheat having negative signs, indicating that they were more of complements than substitutes. DE and DES were positive throughout both models. The only two variables which were all positive in the shipments models were DM1 and DJCM. DJMS was all negative in the sales models. DJCM was all positive in the sales model. The seasonal dummy variables were all negative in the shipments models, except for in one case, and fluctuated in the sales models. Overall in Table 33, there were four variables which were significant in their signs. Two came from the DE variable on its positive signs, one came from the DJMS variable on its negative sign, and one came from the D2 variable on its positive sign. In Table 36, there were six variables which were significant in their signs. Two came from the DP4 variable on its negative signs, two came from the DES variable on its positive signs, and two came from the DJNP variable on its positive signs.

Tables 37-39 represent the summary of coefficient signs across all classes. Table 37 shows the coefficient signs for all Class 1 (HRW). Overall, the signs for DP1 were negative, indicating that its own price was consistent with demand theory, if the LOP held in sign. The majority of the signs for the other two classes were negative, indicating that they were mostly complements to HRW wheat. All of the DES coefficient signs were positive, indicating that the LOP did hold. All but one of the DTR coefficient signs were positive, also indicating that the LOP held. For the rest of the variables, the signs were varied. Overall in Table 37, there were seventeen variables which were significant in their signs. One came from the DP1 variable on its negative sign, seven came from the DE variable on its positive signs, five came from the DES variable on its positive signs, one came from the D1 variable on its positive sign and two on its negative signs, and one came from the D3 variable on its negative sign.

Table 38 shows the coefficient signs for all Class 3 (HRS). Overall, the signs for DP3 were negative, indicating that its own price was consistent with demand theory, if the LOP holds in sign. The majority of the signs for the other two classes were negative, indicating that they were mostly complements to HRS wheat. All of the DES coefficient signs were positive, indicating that the LOP did hold. All of the DGNP coefficient signs were positive, indicating that at least one of the economic theories did not hold. For the rest of the variables, the signs were varied. Overall in Table 38, there were sixteen variables which were significant in their signs. Seven came from the DE variable on its positive signs, seven came from the DES variable on its positive signs, one came from the DJMS variable on its positive sign, and one came from the D1 variable on its positive sign.

Table 39 shows the coefficient signs for all Class 4 (WHI). For the most part, the signs for DP4 were negative, indicating that its own price was mostly consistent with demand theory, if the LOP holds in sign. However, the Class 4 wheat was not as strong as the other two classes of wheat in demand theory. There was almost an even split between the signs for the other two classes were, indicating that they were a combination of substitutes and complements to WHI wheat. All of the DE and DES coefficient signs were positive, indicating that the LOP did hold. Also, all of the DJCM coefficient signs were positive, indicating that at least one of the economic theories did not hold. For the rest of the variables, the signs were varied. Overall in Table 39, there were seventeen variables which were significant in their signs. Two came from the DP4 variable on its negative signs, six came from the DE variable on its positive signs, five came from the DES variable on its positive signs, one came from the DJMS, two came from the DJNP variable on its positive signs, and one came from the D2 variable on its positive sign.

The expenditure variables (DE and DES) were not mostly significant for both models, such as the case was for the first hypothesis. Only Tables 13, 15, and 21 were significant for both models. All of the other tables were only significant in the OLS model. The DW and the F-statistic were significant in all of the OLS models, except for in Tables 15, 16, 17, 18, 19, and 21, where the F-statistic was not significant. The DW in the IV models were all considered inconclusive. None of the F-tests were significant, except for in Tables 15 and 23. For all of the rest of the tables, we failed to reject the hypothesis that the dummy parameters equal zero. The magnitudes overall were much larger for the macro results than with the exchange rate results (Tables 1-13). The DGNP variable appeared to have dominated consistently with having the largest magnitude. The R^2 values ranged between an insignificant 0.01 and 0.78. There was a drastic gap between the very low R^2 values for the IV models and the much higher values for the OLS models.

By comparing the results on a class basis, it appears that the HRW wheat for export sales or class 1 has R^2 values which are the largest for both hypotheses, and their estimates have the largest magnitudes. However, HRW wheat for export shipments is the least effective out of the three classes in terms of the same criteria. This holds true with and without the dummies. For export shipments, it appears that the WHI wheat is more effective based on the R^2 values and magnitude of the estimates. The WHI wheat also had significant DP4 (price of WHI wheat) variables in all of the OLS models with and without dummies. The HRS wheat is very close behind in its significance of the DP3 variable for both hypotheses, using export shipments as the dependent variable. However, the HRW wheat had larger magnitudes on its estimates without the dummies than the other two classes for both hypotheses.

This discussion suggests that the exchange rate and other macro variables do not significantly impact the level of U.S. wheat exports by class to Japan. There may be other factors that have not been considered which may play a significant role in affecting the level of U.S. wheat exports. However, these results do support what the literature review chapter cited. Especially what was cited in the theoretical chapter pertaining to what Meese had mentioned. Meese stated that the exchange rate does not influence the level of exports, nor do macro variables coming through the exchange rate. The results supported this notion because overall, neither the exchange rate nor any of the macro variables were significant in explaining U.S. wheat exports by class to Japan.

CHAPTER 5

SUMMARY & CONCLUSIONS

In this final chapter, the research undertaken will be summarized and conclusions drawn from the analyses presented in the previous chapters. The analyses presented will be compared and contrasted with previous research in determining, if macroeconomic variables impact the level of U.S. wheat exports. This will be followed by suggestions for future research in this area.

Most research done on U.S. agriculture and international trade incorporating the effects of the exchange rate have produced conflicting results and conclusions. There are different perspectives on the role the exchange rate and other macro variables play in determining the level of exports. Earlier studies have focused on the impacts of the exchange rate on an aggregate of agricultural commodities and countries. The models used were quite broad and the results yielded were generalizations, masking specificity. Thus, the central issue in this research is to take a disaggregate approach to perhaps detect any patterns or trends in the U.S. wheat by class exports to Japan. One country (Japan) and one commodity (wheat) were studied, and the wheat was separated into three distinct classes.

Out of the literature cited in chapter 2, four authors had results which did not agree with ours. Schuh (1974) agreed that the exchange rate did impact the level of exports, but he did not run any econometric analysis. Chambers and Just (1979) had results from a (3SLS) procedure, which did support the hypothesis that the exchange rate did impact dramatically on the level of exports. Orden (1986) had results from a VAR procedure, which stated that there was substantial evidence of macroeconomic impacts on agriculture. Bessler and Babula (1987) had results from a VAR procedure, which showed that the exchange rate did have an impact on export shipments only.

Similarly, four authors cited in Chapter 2 had results which did agree with ours. Grennes (1974) disagreed with Schuh and stated that agricultural prices were not affected by the exchange rate. The results and conclusions of Vellianitis-Fidas (1975) are in agreement with what we found. Empirically and theoretically, the exchange rate did not impact agricultural exports. If there was an impact, then it would be very minimal. Johnson, et al. (1977) ran OLS models and had results which did not support Schuh's hypothesis. The results of Bessler and Babula (1987) from a VAR procedure, coincided with our results. The wheat sales did not show much response to exchange rates. The results indicated that sales were a good determinant for forecasting shipments, and that they were primarily explained by wheat sales. They also stated that under a pure purchasing power parity argument, market-determined exchange rates were not supposed to have real effects.

Chambers (1981) suggested for future research that one needs to establish a satisfactory theoretical model which would show the appropriate interaction between the various monetary factors and commodity trade. In this study, the modeling of the impact of the exchange rate and other macro variables on the level of exports has been taken a step beyond Chambers' initial suggestion. This study also follows as an extension of Orden's (1986) use of macro variables in a general equilibrium approach to trade theory. This research developed and compared the results of three economic theories, which introduced the exchange rate and the other macro variables into demand equations in differing fashions. The three theories were consumer demand, the law of one price, and the monetary approach to exchange rate determination. The absolute version of the Rotterdam Model was used to explain the allocation of total expenditures on U.S. wheat to the three classes of wheat consumed by Japan.

The results show that there was not much variance in the level of exports for the three classes of wheat. The wheat equation results definitely indicated that the three wheat classes were complements to one another, assuming that the LOP held. For example, when having the hard red winter wheat (HRW) as the dependent variable in the demand equations, the other two classes of wheat, HRS and WHI, were indicating in their price signs complements to HRW wheat. The same followed for the hard red spring wheat (HRS) when it was the dependent variable. However, when the soft white wheat (WHI) was the dependent variable in the demand equations, the other two classes of wheat, HRW and HRS, were indicating in their price signs a combination of substitutes and complements to WHI wheat. This is where the soft white wheat made a distinction from the other two classes of wheat. There were definitely more significant variables in the export shipments models than in the export sales models, indicating the lagged relationship between the two. They were probably more significant in the shipments models because export shipments are more accurate than export sales in indicating the true level of exports. The seasonal dummy variables, for the most part, were not significant according to the F-tests. In general, it appeared that the fourth quarter was the strongest in yielding the higher level of exports to Japan.

The results did not indicate overall that the exchange rate and other macro variables had an impact on the level of exports. According to Meese (1990), previous studies have not been able to determine the correct explanatory variables to explain major currency movements over the post-Bretton Woods era. In fact, Meese would not have agreed with the results of Chambers-Just (1981) and Orden (1986). Their results showed that other monetary variables and the exchange rate did have important effects on U.S. agriculture. Our results coincide with Meese's. Meese states that the exchange rate does not determine the level of exports, nor do any macro variables going through the exchange rate impact the level of exports significantly. Our results showed no significance for the exchange rate variable represented in the first hypothesis, nor for any of the macro variables going through the exchange rate represented in the second hypothesis.

Also, Jabara and Schwartz (1987) discussed the Food Agency in their study, which negotiates and purchases all of the wheat for the people of Japan. The Food Agency is a government agency, so the two authors suggested that perhaps with government intervention taken place, the link is broken between the macroeconomic variables and the level of exports. Therefore, there is no impact on the level of U.S. wheat Japan imports. There is a price being passed through twice because first the eleven designated agencies purchase the wheat from the U.S., and second, the Food Agency purchases the wheat from the eleven designated agencies for the government to then distribute to the local retailers.

There are still a lot of unanswered questions concerning the role the exchange rate plays in agricultural exports. Questions of what theory, models, variables, and estimation procedures to use are still being considered. This is still a relatively new concept to be explored. The obvious variables such as the money supply, interest rates, and national income are not significant as macro variables to influence the level of exports through the exchange rate. Factors which are intangibles and cannot be measured, may have a lot to do with influencing the level of exports. The problem is much more complex than this, which leads to further research in this area.

In many respects, this research raises more questions than answers. Future research could go in ample avenues; for example, by focusing on an aggregate of commodities for one country only or for a region. Research on other not so known macro variables could be employed to see, if they influence the level of exports through the exchange rate. Studies on determining the correct instrumental variables could be key in improving the results of the demand equation. Overall, this research represents an evolutionary process in learning and understanding international trade, and hopefully will shed some light into future monetary and fiscal impacts on agricultural products.

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APPENDIX TABLES

Table 1. Results for Class 1 (HRW) Sales with Seasonal Dummies

	Models	
	IV	OLS
Intercept	0.06 (1.74)	0.03 (1.70)
DP1	-0.88 (-1.20)	-0.33 (-1.26)
DP3	-0.38 (-1.11)	-0.19 (-1.45)
DP4	0.04 (0.11)	-0.04 (-0.19)
DE	0.56 (5.29)*	0.51 (9.99)*
DEX	0.09 (0.28)	-0.12 (-0.79)
DTR	0.59 (1.16)	0.08 (0.69)
D1	-0.10 (-2.64)*	-0.07 (-2.85)*
D2	-0.08 (-1.38)	-0.02 (-0.85)
D3	-0.09 (-1.64)	-0.06 (-2.12)*
R^2	0.64	0.77
SSE	0.20	0.10
D.W.	2.31	2.81*
n	43	43
F-calculated		11.17*
F-tests 1. H_0: Dummy parameters equal zero	0.00	3.30*

Note: T-ratios in parenthesis using a two-tailed test; * Indicates significantly different from zero at 5% level.

Table 2. Results for Class 1 (HRW) Sales Without Dummies

	Models	
	IV	OLS
Intercept	-0.01 (-0.33)	0.00 (-0.46)
DP1	-0.50 (-0.55)	-0.09 (-0.36)
DP3	-0.39 (-1.29)	-0.23 (-1.74)
DP4	-0.12 (-0.29)	-0.13 (-0.59)
DE	0.61 (5.01)*	0.48 (8.94)*
DEX	-0.06 (-0.15)	-0.13 (-0.83)
DTR	0.09 (0.17)	0.12 (0.99)
R^2	0.63	0.70
SSE	0.20	0.13
D.W.	2.93	3.07*
n	43	43
F-calculated		12.13*

Note: T-ratios in parenthesis using a two-tailed t-test; * Indicates significantly different from zero at 5% level.

Table 3. Results for Class 3 (HRS) Sales with Seasonal Dummies

	Models	
	IV	OLS
Intercept	-0.01 (-0.26)	0.00 (0.12)
DP1	0.65 (0.87)	0.07 (0.21)
DP3	-0.14 (-0.39)	-0.03 (-0.20)
DP4	-0.76 (-1.76)	-0.24 (-0.95)
DE	0.43 (3.74)*	0.28 (4.31)*
DEX	0.21 (0.59)	0.19 (0.96)
DTR	-0.09 (-0.17)	-0.02 (-0.12)
D1	0.06 (1.56)	0.05 (1.52)
D2	0.01 (0.19)	-0.02 (-0.57)
D3	0.00 (-0.05)	-0.01 (-0.31)
R^2	0.43	0.46
SSE	0.21	0.16
D.W.	2.69	2.68*
n	43	43
F-calculated		2.85*
F-tests 1. H_0: Dummy parameters equal zero	2.62	1.38

Note: T-ratios in parenthesis using a two-tailed t-test; * Indicates significantly different from zero at 5% level.

Table 4. Results for Class 3 (HRS) Sales Without Dummies

	Models	
	IV	OLS
Intercept	0.00 (-0.03)	0.00 (0.36)
DP1	0.23 (0.22)	0.14 (0.50)
DP3	-0.31 (-0.87)	-0.11 (-0.72)
DP4	-0.61 (-1.35)	-0.21 (-0.84)
DE	0.41 (3.74)*	0.29 (4.47)*
DEX	0.21 (0.46)	0.11 (0.58)
DTR	0.34 (0.49)	-0.02 (-0.13)
R^2	0.30	0.37
SSE	0.26	0.18
D.W.	2.57	2.70*
n	43	43
F-calculated		3.07*

Note: T-ratios in parenthesis using a two-tailed t-test; * Indicates significantly different from zero at 5% level.

Table 5. Results for Class 4 (WHI) Sales with Seasonal Dummies

	Models	
	IV	OLS
Intercept	-0.03 (-0.80)	-0.04 (-1.63)
DP1	-0.12 (-0.14)	-0.11 (-0.37)
DP3	-0.61 (-1.50)	-0.11 (0.76)
DP4	-0.01 (-0.02)	-0.03 (0.13)
DE	0.40 (2.36)*	0.21 (3.66)*
DEX	0.26 (0.69)	-0.06 (-0.32)
DTR	-0.37 (-0.13)	0.97 (0.96)
D1	0.01 (0.18)	0.02 (0.85)
D2	0.03 (0.41)	0.04 (1.36)
D3	0.07 (1.11)	0.07 (-1.63)
R^2	0.31	0.45
SSE	0.27	0.13
D.W.	2.75	2.92*
n	43	43
F-calculated		2.70
F-tests 1. H_0: Dummy parameters equal zero	2.04	1.69

Note: T-ratios in parenthesis using a two-tailed t-test; * Indicates significantly different from zero at 5% level.

Table 6. Results for Class 4 (WHI) Sales Without Dummies

	Models	
	IV	OLS
Intercept	0.00 (0.09)	0.00 (0.01)
DP1	-0.10 (-0.09)	-0.42 (-1.64)
DP3	-0.49 (-1.16)	0.01 (0.06)
DP4	-0.18 -0.34)	0.03 (0.15)
DE	0.51 (2.48)*	0.24 (4.18)*
DEX	0.37 (0.70)	0.03 (0.17)
DTR	0.28 (0.40)	-0.08 (-0.64)
R^2	0.26	0.37
SSE	0.32	0.15
D.W.	2.90	2.85*
n	43	43
F-calculated		2.96*

Note: T-ratios in parenthesis using a two-tailed t-test; * Indicates significantly different from zero at 5% level.

Table 7. Results for Class 1 (HRW) Shipments with Seasonal Dummies

	Models	
	IV	OLS
Intercept	0.07 (0.86)	-0.02 (-0.64)
DP1	-0.03 (-0.02)	-0.45 (-1.37)
DP3	-1.10 (-1.31)	-0.08 (-0.46)
DP4	0.31 (0.46)	0.32 (1.28)
DES	0.86 (1.85)	0.30 (3.66)*
DEX	0.89 (1.24)	-0.05 (-0.26)
DTR	0.66 (0.73)	0.00 (-0.01)
D1	-0.02 (-0.25)	0.05 (1.41)
D2	-0.05 (-0.55)	0.02 (0.52)
D3	-0.13 (-0.87)	0.01 (0.27)
R^2	0.26	0.52
SSE	0.56	0.15
D.W.	2.41	3.27*
n	43	43
F-calculated		3.56*
F-tests 1. H_0: Dummy parameters equal zero	2.36	0.73

Note: T-ratios in parenthesis using a two-tailed t-test; * Indicates significantly different from zero at 5% level.

Table 8. Results for Class 1 (HRW) Shipments Without Dummies

	Models	
	IV	OLS
Intercept	0.02 (0.45)	0.00 (0.03)
DP1	0.30 (0.18)	-0.53 (-2.03)*
DP3	-1.43 (-1.49)	-0.11 (-0.65)
DP4	0.28 (0.38)	0.39 (1.66)
DES	0.78 (2.29)*	0.31 (5.16)*
DEX	1.01 (1.16)	-0.05 (-0.27)
DTR	0.76 (0.78)	0.03 (0.24)
R^2	0.24	0.48
SSE	0.68	0.16
D.W.	2.23	3.23*
n	43	43
F-calculated		4.77*

Note: T-ratios in parenthesis using a two-tailed t-test; * Indicates significantly different from zero at 5% level.

Table 9. Results for Class 3 (HRS) Shipments with Seasonal Dummies

	Models	
	IV	OLS
Intercept	0.09 (1.37)	0.01 (0.30)
DP1	-0.69 (-0.69)	-0.04 (-0.10)
DP3	-0.65 (-1.15)	-0.32 (-1.73)
DP4	-0.06 (-0.10)	-0.11 (-0.41)
DES	0.97 (3.05)*	0.43 (4.85)*
DEX	0.05 (0.10)	0.02 (0.09)
DTR	0.48 (0.58)	0.05 (0.32)
D1	-0.11 (-1.50)	-0.02 (-0.51)
D2	-0.08 (-0.89)	0.01 (0.29)
D3	-0.22 (1.68)	-0.04 (-0.73)
R^2	0.46	0.53
SSE	0.42	0.18
D.W.	2.69	2.73*
n	43	43
F-calculated		3.69*
F-tests 1. H_0: Dummy parameters equal zero	3.14*	0.61

Note: T-ratios in parenthesis using a two-tailed t-test; * Indicates significantly different from zero at 5% level.

Table 10. Results for Class 3 (HRS) Shipments Without Dummies

	Models	
	IV	OLS
Intercept	-0.02 (-0.71)	0.00 (-0.15)
DP1	-0.87 (-0.60)	0.02 (0.07)
DP3	-0.73 (-1.08)	-0.29 (-1.61)
DP4	-0.04 (-0.06)	-0.13 (-0.50)
DES	0.74 (3.00)*	0.38 (5.82)*
DEX	-0.33 (-0.48)	0.02 (0.11)
DTR	0.65 (0.69)	0.09 (0.66)
R^2	0.40	0.50
SSE	0.54	0.19
D.W.	2.83	2.75*
n	43	43
F-calculated		5.21*

Note: T-ratios in parenthesis using a two-tailed t-test; * Indicates significantly different from zero at 5% level.

Table 11. Results for Class 4 (WHI) Shipments with Seasonal Dummies

	Models	
	IV	OLS
Intercept	0.01 (0.13)	0.01 (0.36)
DP1	0.91 (1.07)	0.11 (0.38)
DP3	-0.56 (-1.13)	0.08 (0.50)
DP4	-0.24 (-0.49)	-0.51 (-2.22)*
DES	0.50 (1.70)	0.27 (3.58)*
DEX	0.16 (0.42)	0.04 (0.23)
DTR	-0.09 (-0.14)	-0.03 (-0.21)
D1	-0.03 (-0.47)	-0.03 (-0.91)
D2	0.01 (0.13)	-0.34 (-1.02)
D3	0.03 (0.24)	0.03 (0.60)
R^2	0.40	0.64
SSE	0.29	0.12
D.W.	2.56	2.84*
n	43	43
F-calculated		5.84*
F-tests 1. H_0: Dummy parameters equal zero	-3.79	1.83

Note: T-ratios in parenthesis using a two-tailed t-test; * Indicates significantly different from zero at 5% level.

Table 12. Results for Class 4 (WHI) Shipments Without Dummies

	Models	
	IV	OLS
Intercept	0.00 (-0.09)	0.00 (0.12)
DP1	0.14 (0.15)	0.15 (0.60)
DP3	-0.24 (-0.57)	0.07 (0.45)
DP4	-0.23 (-0.58)	-0.57 (-2.55)*
DES	0.46 (3.09)*	0.31 (5.46)*
DEX	-0.07 (-0.18)	0.03 (0.17)
DTR	0.05 (0.09)	-0.11 (-0.87)
R^2	0.49	0.58
SSE	0.19	0.14
D.W.	2.86	2.69*
n	43	43
F-calculated		7.21*

Note: T-ratios in parenthesis using a two-tailed t-test; * Indicates significantly different from zero at 5% level.

Table 13. Macroeconomic Results for Class 1 (HRW) Sales with Seasonal Dummies

	Models	
	IV	OLS
Intercept	0.00 (-0.01)	0.06 (1.29)
DP1	0.53 (0.29)	-0.28 (-0.93)
DP3	-1.61 (-0.86)	-0.24 (-1.53)
DP4	-0.10 (-0.10)	-0.01 (-0.05)
DE	0.76 (2.36)*	0.53 (8.60)*
DM1	1.20 (0.29)	0.22 (0.27)
DJMS	-5.09 (-0.78)	-0.54 (-0.86)
DTB	-0.43 (-0.52)	-0.04 (-0.42)
DJCM	-0.08 (-0.51)	0.00 (-0.05)
DGNP	2.73 (0.33)	-0.15 (-0.14)
DJNP	4.16 (0.35)	-1.07 (-0.66)
DTR	1.43 (0.76)	0.10 (0.78)
D1	-0.21 (-1.08)	-0.08 (-2.44)*
D2	0.07 (0.38)	-0.02 (-0.46)
D3	-0.27 (-0.94)	-0.09 (-1.95)

Table 13. (cont.)

	Models	
	IV	OLS
R^2	0.37	0.78
SSE	0.97	0.10
D.W.	2.08	2.77*
n	43	43
F-calculated		6.51*
F-tests 1. H_0: Dummy parameters equal zero	-1.35	1.87

Note: T-ratios in parenthesis using a two-tailed t-test; * Indicates significantly different from zero at 5% level.

Table 14. Macroeconomic Results for Class 1 (HRW) Sales Without Dummies

	Models	
	IV	OLS
Intercept	0.26 (0.96)	0.02 (0.57)
DP1	-1.00 (-0.27)	-0.05 (-0.20)
DP3	0.28 (0.18)	-0.22 (-1.50)
DP4	-0.60 (-0.29)	-0.13 (-0.58)
DE	0.42 (1.17)	0.49 (8.22)*
DM1	-2.48 (-0.67)	0.05 (0.06)
DJMS	0.90 (0.42)	0.18 (0.49)
DTB	0.70 (0.87)	-0.05 (-0.46)
DJCM	-0.25 (-0.97)	-0.01 (-0.15)
DGNP	-9.43 (-0.77)	-0.69 (-0.67)
DJNP	-2.70 (-0.17)	-0.98 (-0.60)
DTR	-0.21 (-0.16)	0.12 (0.90)
R^2	0.18	0.73
SSE	0.83	0.12
D.W.	2.53	2.76*
n	43	43
F-calculated		6.82*

Note: T-ratios in parenthesis using a two-tailed t-test; * Indicates significantly different from zero at 5% level.

Table 15. Macroeconomic Results for Class 3 (HRS) Sales with Seasonal Dummies

	Models	
	IV	OLS
Intercept	-0.07 (-0.73)	-0.08 (-1.38)
DP1	-0.02 (-0.05)	0.18 (0.51)
DP3	0.36 (0.80)	0.09 (0.47)
DP4	-0.61 (-1.32)	-0.39 (-1.51)
DE	0.38 (2.84)*	0.21 (2.89)*
DM1	-0.02 (-0.02)	-0.55 (-0.58)
DJMS	0.66 (0.35)	1.87 (2.56)*
DTB	-0.14 (-0.53)	-0.10 (-0.86)
DJCM	-0.07 (-0.90)	-0.01 (-0.29)
DGNP	1.75 (0.51)	0.44 (0.36)
DJNP	2.57 (0.80)	1.93 (1.03)
DTR	-0.08 (-0.15)	-0.01 (-0.04)
D1	0.03 (0.54)	0.08 (2.25)*
D2	-0.05 (-0.77)	-0.05 (-1.39)
D3	0.00 (-0.02)	0.10 (1.92)

Table 15. (cont.)

	Models	
	IV	OLS
R^2	0.41	0.57
SSE	0.21	0.13
D.W.	2.40	2.43*
n	43	43
F-calculated		2.45
F-tests 1. H_0: Dummy parameters equal zero	61.76*	2.87*

Note: T-ratios in parenthesis using a two-tailed t-test; * Indicates significantly different from zero at 5% level.

Table 16. Macroeconomic Results for Class 3 (HRS) Sales Without Dummies

	Models	
	IV	OLS
Intercept	-0.17 (-0.44)	-0.06 (-1.22)
DP1	3.78 (0.62)	0.20 (0.59)
DP3	-0.61 (-0.37)	-0.10 (-0.59)
DP4	-1.42 (-0.60)	-0.27 (-0.98)
DE	-0.02 (-0.02)	0.28 (3.99)*
DM1	-0.72 (-0.14)	0.24 (0.24)
DJMS	0.13 (0.07)	0.49 (1.09)
DTB	-0.37 (-0.30)	-0.12 (-0.98)
DJCM	0.27 (0.27)	0.01 (0.18)
DGNP	1.49 (0.09)	1.44 (1.15)
DJNP	11.35 (0.66)	1.76 (0.89)
DTR	-0.90 (-0.37)	-0.08 (-0.49)
R^2	0.05	0.42
SSE	1.60	0.17
D.W.	2.15	2.77*
n	43	43
F-calculated		1.85

Note: T-ratios in parenthesis using a two-tailed t-test; * Indicates significantly different from zero at 5% level.

Table 17. Macroeconomic Results for Class 4 (WHI) Sales with Seasonal Dummies

	Models	
	IV	OLS
Intercept	0.12 (-0.46)	0.01 (0.24)
DP1	1.32 (0.70)	-0.26 (-0.81)
DP3	-1.76 (-0.85)	-0.18 (-1.08)
DP4	-0.10 (-0.12)	0.09 (0.38)
DE	0.40 (1.00)	0.26 (4.11)*
DM1	2.84 (0.69)	0.38 (0.44)
DJMS	-4.48 (-0.63)	-1.32 (-2.00)*
DTB	-0.21 (-0.26)	0.14 (1.37)
DJCM	0.03 (0.22)	0.02 (0.39)
DGNP	-0.51 (-0.07)	-0.30 (-0.27)
DJNP	5.88 (0.52)	-0.82 (-0.48)
DTR	0.97 (0.49)	-0.07 (-0.57)
D1	-0.05 (-0.23)	0.00 (-0.09)
D2	0.20 (1.00)	0.07 (1.99)*
D3	-0.08 (-0.27)	-0.01 (-0.23)

Table 17. (cont.)

	Models	
	IV	OLS
R^2	0.18	0.56
SSE	0.78	0.10
D.W.	2.24	2.56*
n	43	43
F-calculated		2.34
F-tests 1. H_0: Dummy parameters equal zero	2.03	1.87

Note: T-ratios in parenthesis using a two-tailed t-test; * Indicates significnatly different from zero at 5% level.

Table 18. Macroeconomic Results for Class 4 (WHI) Sales Without Dummies

	Models	
	IV	OLS
Intercept	-0.13	0.04
	(-0.48)	(0.84)
DP1	-2.10	-0.50
	(-0.55)	(-1.82)
DP3	-0.25	-0.01
	(-0.16)	(-0.08)
DP4	1.47	-0.01
	(0.66)	(0.42)
DE	0.47	0.23
	(0.94)	(3.93)*
DM1	3.11	-0.23
	(0.79)	(-0.28)
DJMS	-1.02	-0.67
	(-0.46)	(-1.79)
DTB	-0.40	0.17
	(-0.52)	(1.64)
DJCM	0.11	0.00
	(0.37)	(-0.04)
DGNP	7.85	-0.73
	(0.62)	(-0.70)
DJNP	-5.59	-0.72
	(-0.33)	(-0.44)
DTR	0.85	-0.02
	(0.55)	(-0.17)
R^2	0.10	0.49
SSE	0.95	0.12
D.W.	2.37	2.59*
n	43	43
F-calculated		2.44

Note: T-ratios in parenthesis using a two-tailed t-test; * Indicates significantly different from zero at 5% level.

Table 19. Macroeconomic Results for Class 1 (HRW) Shipments with Seasonal Dummies

	Models	
	IV	OLS
Intercept	-0.23 (-0.53)	0.04 (0.61)
DP1	-0.14 (-0.06)	-0.27 (-0.73)
DP3	-2.01 (-0.55)	-0.07 (-0.39)
DP4	1.14 (0.49)	0.20 (0.75)
DES	1.12 (0.86)	0.28 (3.20)*
DM1	2.67 (0.40)	-0.26 (-0.28)
DJMS	-2.38 (-0.35)	-0.56 (-0.83)
DTB	-0.86 (-0.62)	-0.07 (-0.61)
DJCM	0.13 (0.38)	-0.07 (-1.53)
DGNP	11.60 (0.64)	-0.63 (-0.50)
DJNP	6.01 (0.36)	-2.04 (-1.12)
DTR	1.76 (0.52)	0.07 (0.49)
D1	-0.21 (-0.49)	0.06 (1.50)
D2	0.01 (0.07)	0.02 (0.49)
D3	-0.31 (-0.52)	0.01 (0.21)

Table 19. (cont.)

	Models	
	IV	OLS
R^2	0.14	0.58
SSE	2.02	0.13
D.W.	2.44	3.05*
n	43	43
F-calculated		2.62
F-tests 1. H_0: Dummy parameters equal zero	-5.77	0.72

Note: T-ratios in parenthesis using a two-tailed test; * Indicates significantly different from zero at 5% level.

Table 20. Macroeconomic Results for Class 1 (HRW) Shipments Without Dummies

	Models	
	IV	OLS
Intercept	-0.13 (-0.49)	0.03 (0.65)
DP1	-2.34 (-1.03)	-0.38 (-1.27)
DP3	0.15 (0.13)	-0.12 (-0.70)
DP4	1.18 (0.76)	0.29 (1.16)
DES	0.48 (1.30)	0.30 (4.20)*
DM1	1.33 (0.38)	-0.32 (-0.36)
DJMS	0.73 (0.33)	-0.43 (-0.96)
DTB	-0.35 (-0.41)	-0.08 (-0.72)
DJCM	-0.05 (-0.15)	-0.07 (-1.57)
DGNP	6.94 (0.58)	0.22 (0.19)
DJNP	-3.17 (-0.29)	-1.47 (-0.84)
DTR	0.82 (0.64)	0.09 (0.65)
R^2	0.22	0.54
SSE	0.77	0.14
D.W.	2.21	3.09*
n	43	43
F-calculated		3.00*

Note: T-ratios in parenthesis using a two-tailed t-test; * Indicates significantly different from zero at 5% level.

Table 21. Macroeconomic Results for Class 3 (HRS) Shipments with Seasonal Dummies

	Models	
	IV	OLS
Intercept	0.13 (0.81)	0.05 (0.77)
DP1	-1.17 (-0.88)	-0.33 (-0.80)
DP3	-0.96 (-1.19)	-0.26 (-1.24)
DP4	0.49 (0.57)	-0.02 (-0.07)
DES	1.08 (2.67)*	0.49 (5.18)*
DM1	1.12 (0.50)	-0.25 (-0.24)
DJMS	-1.94 (-0.68)	0.31 (0.42)
DTB	0.11 (0.10)	0.14 (1.17)
DJCM	0.01 (0.10)	0.01 (0.17)
DGNP	0.66 (0.16)	0.46 (0.33)
DJNP	-0.12 (-0.02)	-2.60 (-1.30)
DTR	0.72 (0.85)	0.05 (0.32)
D1	-0.18 (-1.72)	-0.03 (-0.65)
D2	-0.06 (-0.52)	-0.01 (-0.16)
D3	-0.37 (-1.93)	-0.04 (-0.68)

Table 21. (cont.)

	Models	
	IV	OLS
R^2	0.40	0.59
SSE	0.58	0.15
D.W.	2.62	2.81*
n	43	43
F-calculated		2.71
F-tests 1. H_0:Dummy parameters equal zero	0.97	0.62

Note: T-ratios in parenthesis using a two-tailed t-test; * Indicates significantly different from zero at 5% level.

Table 22. Macroeconomic Results for Class 3 (HRS) Shipments Without Dummies

	Models	
	IV	OLS
Intercept	0.05 (0.11)	0.03 (0.61)
DP1	-2.13 (-0.17)	-0.21 (-0.67)
DP3	0.18 (0.05)	-0.23 (-1.27)
DP4	0.71 (0.17)	-0.09 (-0.33)
DES	0.64 (0.57)	0.46 (6.12)*
DM1	0.66 (0.25)	-0.31 (-0.33)
DJMS	1.15 (0.15)	0.57 (1.19)
DTB	0.18 (0.13)	0.13 (1.17)
DJCM	-0.14 (-0.17)	0.00 (0.01)
DGNP	1.42 (0.22)	0.28 (0.23)
DJNP	-7.49 (-0.19)	-2.48 (-1.34)
DTR	0.54 (0.30)	0.06 (0.38)
R^2	0.29	0.58
SSE	0.64	0.16
D.W.	2.30	2.77*
n	43	43
F-calculated		3.63*

Note: T-ratios in parenthesis using a two-tailed t-test; * Indicates significantly different from zero at 5% level.

Table 23. Macroeconomic Results for Class 4 (WHI) Shipments with Seasonal Dummies

	Models	
	IV	OLS
Intercept	-0.08 (-0.45)	-0.08 (-1.80)
DP1	-0.25 (-0.22)	0.23 (0.77)
DP3	-0.68 (-0.48)	0.02 (0.10)
DP4	0.41 (0.39)	-0.49 (-2.31)*
DES	0.72 (1.23)	0.23 (3.34)*
DM1	0.81 (0.30)	0.52 (0.69)
DJMS	0.63 (0.24)	0.24 (0.44)
DTB	-0.30 (-0.55)	-0.07 (-0.77)
DJCM	0.15 (1.04)	0.06 (1.63)
DGNP	5.52 (0.76)	0.12 (0.12)
DJNP	0.74 (0.11)	4.60 (3.19)*
DTR	0.47 (0.34)	-0.10 (-0.86)
D1	-0.13 (-0.74)	-0.03 (-0.97)
D2	-0.06 (-0.59)	-0.02 (-0.49)
D3	-0.07 (-0.32)	0.03 (0.70)

Table 23. (cont.)

	Models	
	IV	OLS
R^2	0.35	0.76
SSE	0.42	0.08
D.W.	2.83	2.57*
n	43	43
F-calculated		6.02*
F-tests 1. H_0: Dummy parameters equal zero	15.55*	11.66*

Note: T-ratios in parenthesis using a two-tailed t-test; * Indicates significantly different from zero at 5% level.

Table 24. Macroeconomic Results for Class 4 (WHI) Shipments Without Dummies

	Models	
	IV	OLS
Intercept	0.04 (0.13)	-0.06 (-1.59)
DP1	-2.36 (-0.68)	0.23 (0.96)
DP3	0.54 (0.39)	0.02 (0.17)
DP4	1.02 (0.46)	-0.51 (-2.54)*
DES	0.55 (1.14)	0.25 (4.36)*
DM1	1.02 (0.24)	0.66 (0.93)
DJMS	1.85 (0.65)	-0.18 (-0.51)
DTB	-0.03 (-0.03)	-0.05 (-0.57)
DJCM	0.08 (0.23)	0.07 (1.90)
DGNP	4.62 (0.32)	-0.53 (-0.58)
DJNP	-11.32 (-0.69)	3.91 (2.79)*
DTR	0.09 (0.06)	-0.13 (-1.14)
R^2	0.01	0.73
SSE	1.12	0.09
D.W.	2.31	2.40*
n	43	43
F-calculated		7.08*

Note: T-ratios in parenthesis using a two-tailed t-test; * Indicates significantly different from zero at 5% level.

Table 25. Summary of Class 1 (HRW) Sales Coefficient Signs Across All Models

	Positive	Significant	Negative	Significant
DP1			4	
DP3			4	
DP4	1		3	
DE	4	4		
DEX	1		3	
DTR	4			
D1			2	2
D2			2	
D3			2	1

Table 26. Summary of Class 3 (HRS) Sales Coefficient Signs Across All Models

	Positive	Significant	Negative	Significant
DP1	4			
DP3			4	
DP4			4	
DE	4	4		
DEX	4			
DTR	1		3	
D1	2			
D2	1		1	
D3	1		1	

Table 27. Summary of Class 4 (WHI) Sales Coefficient Signs Across All Models

	Positive	Significant	Negative	Significant
DP1			4	
DP3	1		3	
DP4	1		3	
DE	4	4		
DEX	3		1	
DTR	2		2	
D1	2			
D2	2			
D3	2			

Table 28. Summary of Class 1 (HRW) Shipments Coefficient Signs Across All Models

	Positive	Significant	Negative	Significant
DP1	1		3	1
DP3			4	
DP4	4			
DES	4	3		
DEX	2		2	
DTR	4			
D1	1		1	
D2	1		1	
D3	1		1	

Table 29. Summary of Class 3 (HRS) Shipments Coefficient Signs Across All Models

	Positive	Significant	Negative	Significant
DP1	1		3	
DP3			4	
DP4			4	
DES	4	4		
DEX	3		1	
DTR	4			
D1			2	
D2	1		1	
D3			2	

Table 30. Summary of Class 4 (WHI) Shipments Coefficient Signs Across All Models

	Positive	Significant	Negative	Significant
DP1	4			
DP3	2		2	
DP4			4	2
DES	4	3		
DEX	3		1	
DTR	1		3	
D1			2	
D2	1		1	
D3	2			

Table 31. Summary of Class 1 (HRW) Macro Sales Coefficient Signs Across All Models

	Positive	Significant	Negative	Significant
DP1	1		3	
DP3	1		3	
DP4			4	
DE	4	3		
DM1	3		1	
DJMS	2		2	
DTB	1		3	
DJCM	1		3	
DGNP	1		3	
DJNP	1		3	
DTR	3		1	
D1			2	1
D2	1		1	
D3			2	

Table 32. Summary of Class 3 (HRS) Macro Sales Coefficient Signs Across All Models

	Positive	Significant	Negative	Significant
DP1	3		1	
DP3	2		2	
DP4			4	
DE	3	3	1	
DM1	1		3	
DJMS	4	1		
DTB			4	
DJCM	2		2	
DGNP	4			
DJNP	4			
DTR			4	
D1	2	1		
D2			2	
D3	2			

Table 33. Summary of Class 4 (WHI) Macro Sales Coefficient Signs Across All Models

	Positive	Significant	Negative	Significant
DP1	1		3	
DP3			4	
DP4	2		2	
DE	4	2		
DM1	3		1	
DJMS			4	1
DTB	2		2	
DJCM	4			
DGNP	1		3	
DJNP	1		3	
DTR	2		2	
D1	1		1	
D2	2	1		
D3			2	

Table 34. Summary of Class 1 (HRW) Macro Shipments Coefficient Signs Across All Models

	Positive	Significant	Negative	Significant
DP1			4	
DP3	1		3	
DP4	4			
DES	4	2		
DM1	2		2	
DJMS	1		3	
DTB			4	
DJCM	1		3	
DGNP	3		1	
DJNP	1		3	
DTR	4			
D1	1		1	
D2	2			
D3	1		1	

Table 35. Summary of Class 3 (HRS) Macro Shipments Coefficient Signs Across All Models

	Positive	Significant	Negative	Significant
DP1			4	
DP3	1		3	
DP4	2		2	
DES	4	3		
DM1	2		2	
DJMS	3		1	
DTB	4			
DJCM	3		1	
DGNP	4			
DJNP			4	
DTR	4			
D1			2	
D2			2	
D3			2	

Table 36. Summary of Class 4 (WHI) Macro Shipments Coefficient Signs Across All Models

	Positive	Significant	Negative	Significant
DP1	2		2	
DP3	3		1	
DP4	2		2	2
DES	4	2		
DM1	4			
DJMS	3		1	
DTB			4	
DJCM	4			
DGNP	3		1	
DJNP	3	2	1	
DTR	2		2	
D1			2	
D2			2	
D3	1		1	

Table 37. Summary of All Class 1 (HRW) Coefficient Signs

	Positive	Significant	Negative	Significant
DP1	2		14	1
DP3	3		13	
DP4	5		11	
DE	4	7	4	
DES	8	5		
DEX	3		5	
DTR	15		1	
DM1	5		3	
DJMS	3		5	
DTB	1		7	
DJCM	2		6	
DGNP	4		4	
DJNP	2		6	
D1	2	1	6	2
D2	4		4	
D3	2		6	1

Table 38. Summary of All Class 3 (HRS) Coefficient Signs

	Positive	Significant	Negative	Significant
DP1	8		8	
DP3	3		13	
DP4	2		14	
DE	7	7	1	
DES	8	7		
DEX	7		1	
DTR	9		7	
DM1	3		5	
DJMS	7	1	1	
DTB	4		4	
DJCM	5		3	
DGNP	8			
DJNP	4		4	
D1	4	1	4	
D2	2		6	
D3	3		5	

Table 39. Summary of All Class 4 (WHI) Coefficient Signs

	Positive	Significant	Negative	Significant
DP1	7		9	
DP3	6		10	
DP4	5		11	2
DE	8	6		
DES	8	5		
DEX	6		2	
DTR	7		9	
DM1	7		1	
DJMS	3		5	1
DTB	2		6	
DJCM	8			
DGNP	4		4	
DJNP	4	2	4	
D1	3		5	
D2	5	1	3	
D3	5		3	

VITA

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Upon graduating from Spelman, she worked at Rich's Department Store in Atlanta as an executive trainee for sales management and buying. Deciding to further her education, she began graduate work for her master's degree in agricultural economics in 1992 at The University of Tennessee, Knoxville. In the summer of 1993, she was able to do preliminary research for her thesis during her internship at the U.S. Department of Agriculture in the Economic Research Service Agency. This internship also provided the opportunity for her to have her first published article in the *Wheat Situation & Outlook Report*.