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THE EXCHANGE RATE AND THE COMPETITIVENESS OF U.S. AGRICULTURAL COMMODITY TRADE

The Ohio State University

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THE EXCHANGE RATE AND THE COMPETITIVENESS
OF U. S. AGRICULTURAL
COMMODITY TRADE

DISSERTATION

Presented in Partial Fulfillment of the Requirements for
the Degree Doctor of Philosophy in the Graduate
School of The Ohio State University

By

Cyprian Onyeogadirimma Ejiasa, B.S.(Hons), M.B.A., M.A.

* * * * *

The Ohio State University
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To My Father
A Living Example of
The Triumph of Will Over Odds
ACKNOWLEDGEMENT

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To my wife and children: thank you for your many sacrifices and for bearing with me for so long.
To all others too many to mention: fellow students, faculty, and staff of Economics and Agricultural Economics Departments, thanks to all of you for the individual ways each of you became a part of my total experience.

Above all, I acknowledge the help of God whose grace guides me on the path of life.
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INTRODUCTION

This dissertation examines the effect of changes in the U.S. dollar exchange rate on the U.S. agricultural commodity trade. A rise in the exchange rate or commodity price is said to reduce competitiveness only if it leads to a loss of market share.

The study is motivated by three related considerations: first, the increasing importance of foreign markets for the U.S. agriculture, next, the growing end stock of agricultural commodities, with all its implications for farm prices and income, and finally, the pivotal role of the exchange rate in international trade.

Agricultural policy attempts to deal with the problem of growing end stock mainly through production control. However, end stock, or excess supply of agricultural commodities continues to grow, inspite of fairly successful attempts at controlling production. It is argued in this study that the relative neglect of the demand side of the excess supply problem is the reason excess supply keeps rising, inspite of reductions in production. Policy has not been as vigorous in augmenting, or sustaining demand as it has been in curtailing production. In fact, sometimes, government policies have tended to reduce demand. In

---

1 USDA; ERS, "An Initial Assessment of the Payment-In-Kind Program", April 1983.
recent years, inflation-directed monetary policy and unprecedented federal deficit, acting through the exchange rate, have reduced foreign demand for U.S. agricultural commodities. In the meantime, domestic demand, as a percent of aggregate demand, has also been declining, while competition from other exporters has intensified. Therefore, unless demand-oriented policies are vigorously pursued, traditional production control programs will be even more ineffective in lowering excess supply in the near future. This study points to one direction which such policies could take.

In view of the growing importance of foreign demand for U.S. agricultural products, and the singular importance of the exchange rate in that regard, this study examines the effect of the exchange rate on U.S. share of foreign import markets. An increase in the exchange rate is found to have stronger negative impact on U.S. share of world import markets for major agricultural commodities than an equivalent rise in price. Related tests also show that rising interest rate raises the exchange rate of the U.S. dollar which, in turn, reduces U.S. share of world import markets.

These findings imply that, one, a policy of lowering the exchange rate will be more effective in dealing with the excess supply problem than a policy of lowering commodity prices. The ideal of course, is to keep both price and exchange rate down. Second, the present mix of monetary and fiscal policies, which is sustaining a relatively strong dollar, is not helping the excess supply problem. Finally, and perhaps most important for future agricultural policy, is the need for consistency between agricultural policy and the rest of macro-economic policy. Agricultural policy should be treated as a well synchronized part of overall economic policy package—not in isolation. For instance, in the recent past, while agricultural policy was aimed
at lowering agricultural production, with a view to reducing excess supply, monetary and fiscal policies were having the unintended effect of reducing demand, thus increasing excess supply. While each of the policies may have been sensible in isolation, as a package, they were inconsistent.

The rest of the dissertation is organized into five chapters. Chapter I discusses the problem and pertinent conceptual issues. Chapter II reviews the literature. Chapter III discusses the theoretical structure and methodology of the study. Chapter IV analyzes the empirical findings. Finally, Chapter V summarizes the findings and examines their policy implications.
CHAPTER I

THE PROBLEM AND CONCEPTUAL ISSUES

The first section of this chapter discusses the problem to be addressed in this dissertation. The next section will discuss conceptual issues relevant to the study. Section three presents a historical analysis of the relationship between exchange rate and key agricultural variables. And the final section examines the relationship between the exchange rate and interest rate.

1.1. The Problem

Excess supply, borne of excess capacity and weak demand, is the aspect of the U.S. agriculture which this dissertation seeks to address. Of particular interest are the policies that deal with this problem. From 1965 through 1981, the excess of total supply of agricultural commodities over aggregate demand averaged 22.4%, (table 2). This condition is basic to two other problems of direct interest to farmers. The first of these is the problem of low per capita income in agriculture relative to that of the non-agricultural population. The second is the long-term viability of farming as an economic activity.

These two problems are discernible from the data in table 1.
Table 1. Analysis of Farm Income
(Percent)

<table>
<thead>
<tr>
<th>Period</th>
<th>Farm Population</th>
<th>Non-Farm Sources</th>
<th>Government Payment a, (Net Farm Income) b</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(Per Capita)</td>
<td>All Sources</td>
<td></td>
</tr>
<tr>
<td>(1)</td>
<td>(2)</td>
<td>(3)</td>
<td></td>
</tr>
<tr>
<td>1934</td>
<td>32</td>
<td>39</td>
<td>12</td>
</tr>
<tr>
<td>1935-1939</td>
<td>41</td>
<td>31</td>
<td>11</td>
</tr>
<tr>
<td>1940-1949</td>
<td>52</td>
<td>25</td>
<td>6</td>
</tr>
<tr>
<td>1950-1959</td>
<td>51</td>
<td>32</td>
<td>4</td>
</tr>
<tr>
<td>1960-1969</td>
<td>64</td>
<td>46</td>
<td>19</td>
</tr>
<tr>
<td>1970-1979</td>
<td>85</td>
<td>50</td>
<td>11</td>
</tr>
<tr>
<td>1980</td>
<td>81</td>
<td>61</td>
<td>6</td>
</tr>
<tr>
<td>1981</td>
<td>89</td>
<td>55</td>
<td>6</td>
</tr>
<tr>
<td>1982</td>
<td>78</td>
<td>62</td>
<td>16</td>
</tr>
<tr>
<td>1983</td>
<td>n/a</td>
<td>64</td>
<td>40</td>
</tr>
</tbody>
</table>

Source: USDA Agricultural Statistics, various issues.

a Government Payments: prices and income support plus payments under the various production control and conservation programs.

b Net Farm income: farm marketing receipts, government payments, non-money income (such as value of home consumption, imputed rent, changes in inventory), less production expenses.


From column (2), which gives per capita income of farmers as a percent of per capita income of non-farmers, per capita income of farmers averaged about 50% of that of the non-agricultural population throughout the decades of the 1940s and 1950s. In earlier periods, the percentage was even lower. However, the data show an upward trend.
The viability problem is relatively less apparent from the data but is nonetheless discernible. The third column gives farm income from non-farm sources as a percentage of total farm income. It is evident from these data that non-farm activities account for a growing share of total farm income. Throughout the decade of the 1970s, there was, on the average, a fifty-fifty split in income from farm and non-farm sources. However, during the 1980s, non-farm sources dominate farm sources in total farm income. Evidently, farming is no longer the major source of income to farmers. Underlying this is a long-term out-migration of resources, especially labor, from farm to non-farm activities. This raises questions about the average farmer's perception of farming as a viable long-term economic activity. Since the 1930s, price support policies have had the effect of sustaining a non-optimal level of resources in agriculture even when market signals would indicate otherwise.

1.1.1 Origins of the Excess Supply Problem

In the 1920s, U.S. agriculture experienced a depression due to a decline in foreign demand for its products. This was exacerbated in the 1930s by a wave of protectionism which cut foreign demand even further, worsening the excess supply situation. Consequently, farm prices and income fell so low that the government initiated a program, which was meant to be temporary, the purpose of which was to raise farm prices and thus income. Under the program, the Federal Farm Board was authorized to purchase some of the excess commodities to prop up farm prices, and to sell the acquired commodities when prices increased.
The assumption underlying this policy was that demand for agricultural commodities was relatively price inelastic. A policy of raising farm prices was, therefore, rightly expected to raise farm income. The Board's efforts, however, did not raise prices and income measurably before its budget was exhausted. Consequently, the Agricultural Adjustment Act of 1933 created the Commodity Credit Corporation (CCC), and authorized it to borrow funds from the U.S. Treasury to carry on the price support program of the Federal Farm Board. The program, although initially viewed as a temporary program, retains its essential elements until today: direct commodity purchase, and non-recourse loans.

Under the direct purchase program, the CCC acquires any quantity of a supported commodity offered in the market at a guaranteed minimum price - the support price level. Under the non-recourse loan program, the CCC offers loans to farmers with their crops pledged as collateral. The loan amount equals the "loan rate" (the support price) times the quantity of the farmer's crop pledged as collateral. If market price later rises above the loan rate, the farmer sells his crop and pays off the loan. If instead, market price drops below the loan rate by the time the loan comes due, the farmer may freely default on the loan and the CCC automatically acquires the pledged commodities in full settlement for the loan.

The effect of these two programs was to establish a floor below which market price of a supported commodity could not fall when market demand was weak. Market price signals which would have ordinarily led to a reduction in production were thus distorted. Farmers quite naturally maintained, or even expanded, their production capacity as the CCC acquired the excess of their production over market demand.
The market was thus always artificially cleared at the price-support level. This was the origin of the excess supply problem. These points are illustrated in figure 1.

Suppose that for the given supply and demand conditions which characterize the demand and supply schedules in figure 1, the CCC sets the price-support level at $P_s$. The result is that farmers will supply $Q^s_o$, while aggregate market quantity demanded (domestic and foreign combined) at that price is $Q^d$. The resulting excess supply at that price is $E^s(P) = S^o_o(P_s) - D(P_s)$ or equivalently, $(Q^s_o - Q^d)$. Ordinarily, this excess supply would have put downward pressure on price which would simultaneously raise quantity demanded and reduce quantity supplied and thus guide the system back to equilibrium.

However, this price signal is distorted when, as price begins to fall below $P_s$ and farmers choose to default on their loans, the CCC steps in to acquire the excess supply quantity at the price-support level, artificially clearing the market for the supported commodity. With the assurance that the CCC will acquire their excess output at the price support level, the farmers quite naturally maintain, or even expand their production capacity such that the supply schedule may shift to $S^1(P)$ or beyond, thereby exacerbating the excess supply situation.

1.1.2 Changing Policy Parameters

The policy of supporting farm prices as a way of raising farm income was a logical policy at the time it was initiated, but not any more. As Schuh (1984) points out, the underlying assumption of price
Figure 1: Effect of Price Support Policy on Excess Supply
In elasticity of agricultural products has changed, and so should policy. In the 1930s, foreign demand was a minor component of the aggregate demand for U.S. agricultural products. Therefore, domestic demand, which was relatively price inelastic, dominated aggregate demand. As a result, the weighted average price elasticity of aggregate demand was less than one. Under such conditions, any policy that raises farm prices would also raise farm income.

However, the underlying assumption of inelasticity appears less plausible today for several reasons. First, foreign demand is now a significant and growing component of aggregate demand, while the share of domestic demand is steadily declining (table 2). Secondly, while domestic demand may still be relatively price inelastic, since agricultural commodities have few domestic substitutes, that may no longer be true of foreign demand. Many importing countries now produce some fraction of their total need for the imported commodity, and for the quantity they import, they have several alternative sources from which to import. Thus for the foreign importer, there are several substitutes for U.S. agricultural commodities. This fact tends to make foreign demand sensitive to changes in U.S. prices. Therefore, the weighted average price elasticity of aggregate demand for U.S. agricultural commodities has increased and may have become elastic. If this is the case, then price support is no longer a sensible policy. It only exacerbates the excess supply problem as farmers expand their productive capacity in the face of slackening demand. Unremitting commitment to the price-support program, after the underlying parameter has changed, is a major source of error in U.S. agricultural policy.
1.1.3 Controlling Excess Supply

As government stock of acquired agricultural commodities grew, so did its cash payments to farmers under various commodity programs. This, in turn, reinforced the farmer's incentive to expand output. During the last six years of the 1930s following the passage of the Agricultural Adjustment Act of 1933, government payment to farmers averaged about 12% of total net income of farm operators. This was a period of weak foreign demand due to widespread protectionist trade policies. Over the next twenty years, the payment averaged about 5% of net income of farmers, and rose to an average of 15% over the following twenty years ending in 1979. During the eighties, it rose again to an average of 17% per year with a peak of 40% in 1983 (table 1).

With government cash outlay on farm programs rising, it became apparent that the root cause of the problem was excess supply for which policy was partly responsible. Farmers were basing their production decisions on the price support level without regard to depressed market conditions. Controlling excess supply became a major focus of agricultural policy. Assorted production control programs, such as the acreage reduction program (ARP), and the payment-in-kind (PIK) program which paid farmers not to plant, have been used for this purpose.

However, problems of "slippage" make these supply-oriented programs ineffective in reducing excess supply. For instance, farmers under the ARP or PIK program tend to withdraw only their least fertile lands from cultivation and to intensify the cultivation of their more fertile land placed under the program. They also tend to substitute more chemical inputs, such as fertilizers, for the withdrawn acreage in
order to increase yield. The net result could leave excess supply unaffected or possibly worsened.

More fundamentally, even if these programs were effective in reducing production, the basic problem of excess supply will not necessarily be solved. This is simply because many forces are operative on the demand side, and their demand-reducing effects could more than offset any reduction in production.

This fact appears to have been overlooked in the various supply-oriented programs designed to control excess supply. All such programs implicitly hold the demand schedule constant. But, since excess supply is a problem, not only of too much production but also of inadequate demand, it cannot be solved merely by manipulating only the supply side of the equation. Policy must also aim at creating new demand, or at least, sustaining existing demand for agricultural commodities. This is the missing blade of the policy scissors. These points are illustrated graphically in figure 2.

At the given price, $P_s$, the initial excess supply $E_{s0}^s(P_s)$, is given by $[S_0(P_s)-D_0(P_s)]$, or equivalently by $(Q_0^s - Q_d)$. Now, suppose that after the implementation of some production control program, production falls such that the supply schedule falls to $S_1(P)$. If nothing else changes, excess supply will be reduced to $E_{s1}^s(P_s)$ which equals $(Q_1^s - Q_d)$. Additional production control measures might even wipe out the remaining excess supply. This is the illusory scenario implicit in the various supply-oriented programs, with the built-in temptation that more
Figure 2: Demand Side Forces, Production Control, and Excess Supply
production control measures will eliminate excess supply. The reason for the appeal of this illusion is that the demand schedule is implicitly held constant.

However, the demand schedule may not be constant as policy implicitly assumes. Operative forces on the demand side, such as changes in the exchange rate, induced perhaps by macroeconomic policy, could lower the aggregate demand schedule from \( D_0(p) \) to \( D_1(p) \) or beyond, such that \( E^s_2(p) \), which is given by \( (Q_1^s - Q_1^d) \), may very well exceed \( E^s_0(p) \).

1.1.4 Research Objective

In view of the issues discussed above, this dissertation will study one of the operative forces on the demand-side of the excess supply problem. Specifically, I propose to examine the effect of changes in the U.S. dollar exchange rate on the competitiveness of U.S. agricultural commodity export. This will be accomplished by examining the sensitivity of U.S. agricultural export market share to changes in the U.S. dollar exchange rate. The results of the study are expected to help answer the question of whether the U.S. is losing or could lose its export market share on account of increases in the U.S. dollar exchange rate. As will be shown later, a reduction in the absolute volume of exports will not necessarily reduce export market share, whereas a reduction in export market share necessarily reduces the absolute volume of export. Therefore, export market share, rather
than absolute volume of export, is the relevant variable in a study of competitiveness which is the focus of the present study. Other studies to be reviewed later, have examined the effect of exchange rate changes on export volume per se, but not the more basic issue of competitiveness.

The emphasis here on exchange rate is justifiable on several grounds. First, the currency exchange rate of an exporting country such as the U.S. is an important element in the price the importer must pay. Therefore, changes in the exchange rate has the potential to restructure the trade flow of the exporter, or to diminish its competitiveness in international markets. Also, a rise in the U.S. dollar exchange rate, by raising the price the importer must pay, not only diverts the importer to alternative sources of import, but stimulates increased production both in the importing country and by competing suppliers. All these will tend to weaken aggregate demand for U.S. agricultural commodities and to worsen excess supply, farm income, government payments to farmers, and the viability of U.S. agriculture.

A second justification for the emphasis on exchange rate is the emerging significance of export markets for U.S. agricultural products. Foreign demand for U.S. agricultural commodities is an important and growing component of the aggregate demand schedule for U.S. agricultural commodities. The export share of total U.S. agricultural grain supply rose from an average of 16.4% for the period 1965-69, to 28% for the period 1975-79, and to 31.3% for the first two years of the eighties. At the same time, the share of total grain supply used domestically has been declining. It fell from 59.4% during 1965-69, to 51.8% during the 1975-79, and further down to 47.3% for the first
two years of the eighties. This slackening of domestic demand is reflected in a rising grain stock, (table 2).

Table 2. Distribution of Total U.S. Grain Supply (Percent)

<table>
<thead>
<tr>
<th>Demand</th>
<th>Foreign</th>
<th>Domestic</th>
<th>End Stock</th>
</tr>
</thead>
<tbody>
<tr>
<td>1965-69</td>
<td>16.4</td>
<td>59.38</td>
<td>24.23</td>
</tr>
<tr>
<td>1970-74</td>
<td>21.94</td>
<td>61.02</td>
<td>21.22</td>
</tr>
<tr>
<td>1975-79</td>
<td>28.41</td>
<td>51.77</td>
<td>19.75</td>
</tr>
<tr>
<td>1980-81</td>
<td>31.25</td>
<td>47.31</td>
<td>24.34</td>
</tr>
</tbody>
</table>

Source: Derived from USDA, Agricultural Statistics, 1982, Table 1. Supply includes production, beginning stock, and imports.

Therefore, if foreign demand for U.S. agricultural commodities is elastic as argued earlier, then, changes in the exchange rate have serious implications for U.S. agriculture.

Furthermore, several independent policies pursued for purposes unrelated to the farm problem, impact upon it through the exchange rate. Of particular relevance here are the tight monetary policy of the Federal Reserve Bank, aimed at containing inflation, and the expanding federal budget deficit. Both policies, by keeping U.S. interest rate high relative to those of its trading partners, may partly explain the present strength of the U.S. dollar.

Finally, the fact that the U.S. dollar is now floating, and the high degree of integration in the international capital and money
markets, brought about by advances in communication technology, are both important new elements to the issue. International capital flows now behave more like "hot money" - flowing rapidly in the direction of highest real rate of return. Therefore, a relatively high U.S. real interest rate will tend to increase international demand for the U.S. dollar, which will tend to raise the exchange rate of the U.S. dollar. These new elements make the exchange rate more susceptible to forces that were relatively unimportant in the past. Changes in the exchange rate may well be the most important single factor affecting the U.S. agricultural commodity trade.

In view of the above points, it appears relevant for policy to seek an understanding of the extent to which changes in the exchange rate affects agricultural export market share.

The remainder of this chapter will analyze historical changes that have occurred in key variables that bear upon the farm problem to see how such changes reflect observed changes in the exchange rate. The goal is to gain insight into the nature of the relation between these variables and the exchange rate. Also, a brief analysis of the link between the U.S. interest rate and the exchange rate will be presented. There is a widespread belief that high U.S. interest rate is largely responsible for the relative strength of the U.S. dollar. The goal of the analysis, therefore, is to set out succinctly, the conditions under which a change in the interest rate may be expected to lead to a change in the exchange rate. Finally, to avoid ambiguities, the next section will spell out how the term "competitiveness" will be used in this dissertation.
1.2 Competitiveness

The term "competitiveness", as used in this dissertation, is distinguished from the term "competition", as in the "degree of competition in a given market". Although the two terms are not amenable to easy definition, competition may be described in terms of the price elasticity of a market demand schedule of a well defined product. In a price-quantity, \((p, q)\), plane, a typical constant price elasticity demand schedule reflects the buyers' degree of freedom to choose from substitute products. A higher degree of freedom is associated with a higher price elasticity demand schedule, and correspondingly, to a higher degree of competition among sellers for a given sale. Therefore, the price elasticity of such a demand schedule contains information about the degree of competition in the market. This point is demonstrated more formally below and also illustrated in figure 3.

From the total revenue function

\[ (1.2.1) \quad R = pq \]

it may be shown that

\[ (1.2.2) \quad \frac{r}{p} = 1 + \frac{1}{\eta_{q,p}} \]

where "r" is marginal revenue, and \(\eta_{q,p}\) is the price elasticity of demand.

From (1.2.2) it is seen that

\[ (1.2.3) \quad \lim_{\eta_{q,p} \to -} \frac{r}{p} = 1 \]


Throughout this dissertation, elasticities will be denoted as: \(\eta_{i,j}\), and will be read as the elasticity of "i" with respect to "j".
which, in the limit, defines "perfect competition". Therefore, \( \eta_{q,p} \) contains information about the "degree of competition" in the given market. The larger it is in absolute value, the greater the degree of competition in the market.

Competitiveness, on the other hand, presupposes a given degree of competition in a market. It refers to the ability of a seller to gain market share in a given market, or to the inability of the seller's competitors to counter its attempts at gaining market share.

An illustration might help clarify the concept. Suppose there are only two competitors in a market. Let \( C_r, (r = 1, 2) \), denote the competitiveness of the rth seller, and \( \Theta_r \), a vector consisting of the elements of the seller's terms-of-sale such as the exchange rate, price, or credit terms, etc. Also, let \( D_o(P) \), be the given market demand schedule, embodying the degree of competition that characterize that particular market. Therefore

\[
C_r = C_r(\Theta_r, D_o(P))
\]

is some function which expresses the relation between a seller's

---

3 Balassa (1962) defines "competitiveness" as "ability to sell", under conditions of fixed exchange rates. Islam (1983-84) conceives of it in terms of changes in price, cost, or exchange rate. For instance, a depreciation of the yen against the U.S. dollar is taken to mean a loss of competitiveness by the U.S. and a corresponding gain by Japan. However, in the text, only if Japan is able to gain market share from the U.S. by reason of the exchange rate change, will it be said to have gained competitiveness over the U.S.
competitiveness and his terms-of-sale, given the market demand schedule for the commodity of interest.

Suppose further that there is a link between the elements of \( \theta_1 \) and \( \theta_2 \) such that \( \frac{\partial \theta_2}{\partial \theta_1} > 0 \). Then the concept of competitiveness, with respect to the first seller, may be stated as follows:

\[
(1.2.5) \quad \frac{\partial C}{\partial \theta_1} \neq 0 \quad \text{for} \quad 0 < \frac{\partial \theta_2}{\partial \theta_1} < 1
\]

\[= 0 \quad \text{if} \quad \frac{\partial \theta_2}{\partial \theta_1} = 1.\]

That is, if some element of the first seller's terms-of-sale changes, the seller's ability to gain market share depends on the induced response of the corresponding element in the other seller's terms-of-sale. Furthermore, a seller may be able to gain market share through a change in a particular element of his terms-of-sale, but be incapable of doing so through a change in some other element of his terms-of-sale. The practical significance of this point for each seller in a given market is to determine which of the various elements of \( \theta \) has the most effect on the seller's ability to gain market share. For instance, if one's competitors in a market are just as capable of giving price discounts, a seller cannot gain market share by granting price discounts.

To highlight further, the point of equation (1.2.5), suppose that the particular element of the vector \( \theta_1 \) that changed is price, and that the observed change is a fall in price. Then, the equation states that an improvement in the seller's competitiveness ("ability
to gain market share), as a result of the fall in price, depends, not on the fallen price per se, but on the induced response of competing seller's prices. If the fall in price induces an equivalent fall in the competing seller's prices, no change in market shares will occur. But, if competing seller's prices do not respond to the seller's fallen price, then, the seller may gain market share. Thus, as a corollary to equation (1.2.5), a change in price per se, or some other element of $\Theta$, is not in itself, an indication of a change in competitiveness.

Figure 3 further illustrates the concepts of competition and competitiveness. Each of the constant price elasticity demand schedules, NQ, AA, BB, CC, and LP, corresponds to a different degree of buyers' freedom to choose from alternatives. As the degree of freedom rises from zero towards infinity, the zero price elasticity demand schedule, NQ, rotates around the point T towards the infinite price elasticity demand schedule, LP. The shape of each demand schedule, as described by its price elasticity, summarizes the buyers' sensitivity to price changes. The degree of sensitivity to price changes is determined by the underlying degree of buyers' freedom to choose. And the higher the degree of sensitivity to price changes, the higher the degree of competition among sellers in that market for a given sale. Hence, the price elasticity of a market demand schedule, over its entire range, contains information about the degree of competition in the given market.

---

4 The aggregate volume of sales in the market may rise as a result of the fallen prices, depending on the size of price and income elasticities.
Figure 3: Consumer Degree of Freedom, Price Elasticity, Competition, and Competitiveness
Competitiveness on the other hand, presupposes the existence of a market demand schedule. Thus, for a given demand schedule, such as BB, it refers to the ability of a seller to gain some share of the market through changes in some element of his terms-of-sale, such as price, or payment schedule, etc., over which he has control.

An efficient producer may gain market share by offering lower prices which its less efficient competitors cannot match. This element of inability on the part of competitors is vital to the concept of competitiveness. If the lower price is matched by its competitors, then there would be no change in market share on account of price changes although the quantity of the product traded in the market may rise depending on whether or not the market demand is price elastic. Therefore, in this illustrative example, the elasticity of the competitors' price with respect to that of the seller, contains information about the seller's competitiveness in the given market. This is demonstrated more formally below.

Suppose the market share of exporter "i" is a function of its relative price:

\( k_i = k_i(\lambda_1) , \lambda_1 \equiv \frac{p^*_i}{p^*_j} ; k_i < 0 \)  

(1.2.6)  

where \( k_i \) is the exporter's market share, \( p^*_i \) is the c.i.f. price of the product supplied by exporter "i", and \( p^*_j \) is the c.i.f. price of the product supplied by a competing exporter, "j". From (1.2.6), own-price elasticity of the exporter's market share is

\( \eta_{k_1,p^*_i} = \eta_{k_1,\lambda} (1 - \frac{\eta_{p^*_j,p^*_i}}{\eta_{p^*_j,p^*_i}}) \)  

(1.2.7)
where \( n_{k, \lambda} < 0 \) is the elasticity of substitution between the competing products, and \( n_{p_j^*, p_i^*} > 0 \) is the elasticity of \( p^* \) with respect to \( p_1^* \). From (1.2.7) it is seen that

\[
\left(1.2.8\right) \lim_{\eta p_j^*, p_i^* + 1 \to 0} \eta_{k_1, p_i^*} = 0
\]

so that as \( \eta_{p_j^*, p_i^*} \) approaches one, \( \eta_{k_1, p_i^*} \) approaches zero. Under what condition therefore, may one expect a change in an exporters' own price not to affect that exporter's market share? That is, under what condition will \( n_{k_1, p_i^*} = 0 \)? This will happen, if and only if,

\( n_{p_j^*, p_i^*} \) equals one. That is, if and only if, a change in \( p_1^* \) is exactly matched by an equal percentage change in \( p_j^* \), thus restoring the initial price structure. In that case, neither exporter gains nor loses market share although the quantity of the product traded may have changed depending on the price elasticity of the market demand schedule. It may then be inferred that the closer the international price adjustment elasticity is to one, the less likely an exporter's

---

5 The elasticity of one country's price with respect to that of another country will later be referred to as "the international price adjustment elasticity". 
market share is to be affected by changes in its price. Under such conditions, the exporter's competitiveness, or ability to gain market share, will be independent of changes in its price.

An important point of distinction is worth noting here. A rise in the exporter's price, \( p^* \), will usually reduce the absolute volume of exports as importers adjust to the price change by substituting away from exporter "\( i \)" to relatively cheaper sources of import. That is, \( \eta_{k,\lambda} \), the elasticity of substitution, will usually be negative. But such a change in the exporter's price need not affect its export market share. That is, \( \eta_{k,\lambda} \cdot p^*_i = 0 \) is consistent with \( \eta_{k,\lambda} < 0 \). This may be explained intuitively as follows: the initial rise in \( p^*_i \) sets off a chain of adjustments which begins with the importer's demand shift to relatively cheaper sources. This in turn generates excess demand for the product of these other suppliers, exerting upward pressure on their prices. When the adjustment process is over, the effect of the initial price change on export market share of exporter "\( i \)" will depend on the weighted average elasticity of the price of all competing suppliers with respect to \( p^*_i \). If this elasticity is zero, or less than one, then \( k_i \) will fall. If it is equal to one, then \( k_i \) will not change.

The inference drawn above concerning the effect of a change in \( p^*_i \) on \( k_i \) carries over to the exchange rate case which is of direct interest here. To demonstrate this, note that the two prices in (1.2.6) are functions of the exchange rate of exporters "\( i \)". It may
then be shown that

\[(1.2.9a) \quad n_{i}e_i = n_{i} \lambda_i (p_{i}^*e_i - n_{p_{j}^*e_i}),\]

or with further manipulation \(^6\)

\[(1.2.9b) \quad n_{i}e_i = n_{i} \lambda_i (1 + n_{i}^*)(1 - n_{p_{j}^*p_{j}^*}),\]

where \(e_i\) is the exchange rate of the exporter defined as the ratio of the importer's currency to that of the exporter, and an asterisk, (*), indicates that the variable is denominated in the currency of the importer. It follows from (1.2.9) that the exchange rate elasticity of the exporter's market share will be zero, if and only if, the percentage impact of a change in the exporter's exchange rate is the same on the exporter's price as on the price of its competitor, (cf. 1.2.9a), or alternatively, if the elasticity of the competitor's price with respect to the exporter's price equals one, or if the change in \(e_i\) is exactly offset by an equal inverse change in the domestic currency.

---

\(^6\) This involves incorporating the relation: \(p_{j}^* = f(p_{i}^*),\) such that \(f' > 0;\) and the identity \(p_{i}^* = e_i p_i.\) From these, it may be shown that \(n_{p_{i}^*e_i} = n_{p_{i}^*p_{i}^*}(1 + n_{p_{i}^*p_{i}^*}),\) and \(n_{p_{i}^*e_i} = (1 + n_{p_{i}^*p_{i}^*}).\) These relations will be discussed in greater detail later.
price of the export commodity. For instance, a 10% rise in $e_i$ is offset by a 10% decrease in $p_i$, (cf. 1.2.9b). If any of these conditions are met, the initial relative price structure will be restored and there will be no change in export market share as a result of the exchange rate change. It may, therefore, be inferred that:

(1) The closer the international price adjustment elasticity, $\eta_{p^*_j, p^*_i}$, is to one, or $\eta_{p^*_j, p^*_i}$

(11) the closer the exchange rate elasticity of the domestic currency price, $\eta_{p_i, e_i}$, is to minus one.

then the less likely the exporter's market share is to be affected by changes in the exporter's exchange rate.

The foregoing discussion provides a basis for empirically testing for the effect of exchange rate changes on the competitiveness of U.S. agricultural commodity exports.

1.3 Historical Review

Interest in the effects of changes in the U.S. dollar exchange rate on agricultural trade is not new. Several studies of the effect of the devaluation of the dollar in 1933 are summarized in Benedict (1953, p. 298-299). The general tenor of their conclusions is that the effect of the devaluation on farm prices was insignificant. The intervening years witnessed a relative lack of interest on the subject, until relatively recently. Several events of the early seventies revived research interest on the subject. In August of 1971, the
Nixon administration suspended the convertibility of the U.S. dollar into gold. Four months later, the dollar was devalued by 8% in relation to gold. This was followed by a second devaluation in February, 1973, this time, by 10%, and a formal end of the fixed U.S. dollar exchange rate era. Since then, the U.S. dollar has been floating.

Subsequent to these policy changes, several variables of particular interest to the agricultural sector changed substantially relative to the four years just preceding the devaluations. This led some observers, such as Schuh (1974), to believe that the exchange rate is, at least in part, responsible for these changes. Some of these data are shown in table 3.

### Table 3: Average Annual Rates of Change

<table>
<thead>
<tr>
<th></th>
<th>Price Received</th>
<th>Total Prices Paid</th>
<th>Net Price Received</th>
<th>Agricultural Exports (Quantity)</th>
<th>Income From Farm Sources</th>
</tr>
</thead>
<tbody>
<tr>
<td>1967-70</td>
<td>3.20</td>
<td>3.85</td>
<td>-0.65</td>
<td>4.03</td>
<td>5.57</td>
</tr>
<tr>
<td>1971-73</td>
<td>18.85</td>
<td>8.83</td>
<td>10.02</td>
<td>14.97</td>
<td>34.02</td>
</tr>
<tr>
<td>1974-76</td>
<td>1.40</td>
<td>10.11</td>
<td>-8.71</td>
<td>1.85</td>
<td>-16.56</td>
</tr>
<tr>
<td>1977-80</td>
<td>7.36</td>
<td>9.84</td>
<td>-2.48</td>
<td>9.25</td>
<td>5.08</td>
</tr>
<tr>
<td>1981-</td>
<td>2.99</td>
<td>8.60</td>
<td>-5.51</td>
<td>-4.47</td>
<td>23.27</td>
</tr>
</tbody>
</table>

Source: Calculated from USDA, *Agricultural Statistics* (1979, tables 599 and 657), and (1982, table 610)

These data are organized into sub-periods approximately coinciding with important policy shifts or unusual movements in the U.S.
dollar exchange rate. This format has a dual purpose. The first is to facilitate comparison across identifiable sub-periods, and the second is to gain insight into the behavior of each variable within each sub-period in relation to the kind of exchange rate policy that characterize the sub-period.

1.3.1 Pre-devaluation Sub-period

The period 1967-70 comprises the final years of the fixed dollar exchange rate era during which the dollar was convertible into gold at the fixed exchange rate. During this period, price-received by farmers increased at an average annual rate of 3.2% compared to 3.85% for total price-paid by farmers, for a net-price change of -0.65% in price received. Income from farm sources, and the quantity of agricultural exports, increased at average annual rates of 5.57% and 4.03% respectively. An interesting observation that emerges from the data in the table is that, except for the devaluation years, 1971-73, total prices paid by farmers were rising faster than total prices received throughout the period covered by the data. This has implications for farm income and an understanding of why it has been happening will certainly improve farm policy design.

1.3.2 The Devaluation Sub-period

During the devaluation years, 1971-73, each of the variables in the table increased substantially relative to the preceding period. Price received increased at an average annual rate of almost 19% compared to about 9% for total price paid. This rate of increase in price received is almost six times its rate of increase for the
pre-devaluation period. In contrast, price paid increased only two
times its level for the pre-devaluation period. The quantity of
exports also rose by a rate 3 1/2 times faster than its rate of
increase during the pre-devaluation years.

The large favorable net increase in price-received, and the
substantial increase in agricultural exports may account for the sub-
stantial rate of increase in income from farm sources during the deva-
luation years. Income from farm sources increased during this period
by a rate higher than that for any other sub-period. Compared to the
pre-devaluation years, it rose six times higher.

These data raise the question of whether the devaluations of
the 1971-73 period had a significant bearing on the comparatively
impressive performance of these variables during that period. Are
these exchange rate movements of such signi-ficant impact on
agricultural trade as to be a cause for concern among farmers? Several
studies which will be reviewed later have examined different aspects of
these questions, and in particular, the effects of the 1971-73
devaluations on farm commodity prices. The findings are mixed.
However, I am not aware of any attempts to examine the effect of the
devaluations on price-paid by farmers, nor on the competitiveness of
U.S. agricultural exports. Since the net price-received is the more
relevant variable to the farm income problem than changes in farm
commodity prices per se, this type of study appears to be, at least,
just as important. Future research on this issue is thus warranted.
This dissertation will, however, focus on the effect of exchange rate
changes on the competitiveness of U.S. agricultural commodity exports.
1.3.3 First Sub-period of the Floating Era

As already noted, the U.S. dollar was floated after the devaluation of 1973. The exchange rate of the dollar thus ceased to be a policy instrument, but became instead, an endogenous variable whose value is determined by the vicissitude of the underlying economic condition. These conditions are, in turn, functions of economic policy. In the final analysis, therefore, the exchange rate of the U.S. dollar will float in tune with the wave of prevailing policies.

The period 1974-76 was one of high exchange rate volatility. The index of trade-weighted value of the U.S. dollar declined by 1.6% by the second quarter of 1974; gained 3% during the third quarter, and ended the year with a decline of 4.3% from its third quarter level.

Between the fourth quarter 1974 and the first quarter 1975, it fell by 4.7%. By the second quarter, it reversed its downward course, maintained an upward trend throughout 1975, finishing the year with a gain of 9.6%.

During the first half of 1976, it gained 3.6% over its level at the end of 1975. But, during the second half of the year, it reversed course again and trended downward, losing almost 2% of its mid-year value. Figure 4 presents a graphic picture of these erratic movements of the dollar.\(^7\)

\(^7\)For the actual data, see "U.S. dollar: Multilateral Trade-weighted Average", Economic Report of the President, (February 1983, p. 275).
Index of Trade-weighted Exchange Rate

- December 1971: Smithsonian Agreement, first devaluation of dollar.

Source: Fortune, Sept. 5, 1983

Figure 4: Trade-Weighted Value of the Dollar (March, 1973 = 100)
How did the variables in table 3 perform during this period of high uncertainty about the value of the U.S. dollar? Price-received by farmers had its lowest rate of increase over the entire period covered by the data. Price-paid, on the other hand, rose at 10%, a rate higher than any it had attained during the entire period covered. Exports of agricultural products rose by less than 2% in contrast with the 15% growth rate it attained during the devaluation years. Income from farm sources dipped by almost 17%, reflecting the unfavorable change in net price-received, and the relative poor performance of exports during this sub-period.

1.3.4 The Two Sub-periods Contrasted

It is instructive to contrast the two sub-periods, 1971-73 and 1974-76. During the devaluation years, 1971-1973, the quarterly average value of the trade-weighted exchange rate was 108, compared to 102 for the 1974-76 period during which the dollar was floating. Therefore, on the average, and inspite of the two devaluations, the dollar was over-valued during 1971-73 relative to the period 1974-76.

A second observation is that the variance of the exchange rates, which simply measures the dispersion of the quarterly rates from the quarterly average rate, was 62 for 1971-73 but only about 16 for the 1974-76 floating era. This relative higher variance of the exchange rate during 1971-73 vis-a-vis the period 1974-76 is largely explained by the fact that the calculated variance is amplified by the undirectional downward movement of the exchange rate during 1971-73 in contrast to its erratic movement during the period 1974-76. So, if this variance is the only information one has, one may be tempted to
infer that the exchange rate was less variable during 1974-76 than 1971-73. However, the period 1971-73 was marked by a very predictable downward trend, whereas 1974-76, inspite of its relatively low variance, was marked by high unpredictability. There was no clear trend. From quarter to quarter, importers of U.S. agricultural commodities could not be certain about the exchange rate. Growth of agricultural exports fell by 13.12% relative to the 1971-73 period. Net price-received declined by 18.73% from its 1971-73 level. Reflecting these negative changes, income from farm sources dipped by 50.58% relative to its devaluation period level.

To the extent that changes in the exchange rate help explain the observed behavior of the variables in the table, the question now arises: which should be of greater concern; the degree of over- or under-valuation, or the degree of volatility of the exchange rate? It appears from these data that the volatility, and hence unpredictability of the exchange rate, poses greater potential problems for agricultural exports and thus for farm income than the degree of over- or under-valuation per se. As already noted, the dollar was relatively over-valued during 1971-73 vis-a-vis 1974-76. Yet, exports, net price-received, and farm income, all performed better during 1971-73 than during 1974.76.

1.3.5 Second Floating Sub-period

The trade-weighted exchange rate reached a peak of 107 in the second quarter of 1976, but trended down from that point to the end of 1980. Therefore, this period was again marked by both a depreciating dollar and a predictable downward trend in the exchange rate.
Uncertainty about the exchange rate was minimal. And quite interestingly, all the variables made very impressive recoveries. The average rate of change in net price-received rose from -8.71% for 1974-76 to -2.48% for the period 1977-80 for a gain of 6.23%. Agricultural exports gained 7.4% over the same period; income from farm sources gained 21.64% over the same period. These data reinforce the inference drawn above regarding the relative impact of exchange rate volatility on agricultural trade and farm income. It may, therefore, be hypothesized that farmers may be worse off under the new floating exchange rate regime than under the old fixed exchange rate regime. Hooper and Kohlhagen (1978) in a more rigorous analysis, found that increases in exchange rate risk depresses both import demand and market prices of U.S. exports.

1.3.6 The Dollar's New Strength

The last subperiod, 1981, was separated from the years just preceding it because it marked the beginning of a new phase in the time-paths of both the exchange rate and the interest rate. On October 6, 1979, the Federal Reserve adopted a new approach to monetary policy, the purpose of which was later described as "a battle against inflation". Subsequently, the realized growth rate of the basic money

---


stock, M1, declined from 7.2% annual rate in 1978 to 5.5% in 1979. The resulting credit squeeze pressured short-term interest rates upwards, (figure 5). But this upsurge in short-term interest rate did not last. It was soon reversed by the resurgence of M1 which grew at an annual rate of 8.2% in 1980. However, re-affirming its determination to fight inflation, the Federal Reserve Bank adopted a very narrow growth range of (3.5%, 6%) for M1 for the period beginning fourth quarter, 1980 to fourth quarter, 1981, and narrower still, (2.5%, 5.5%) for the period beginning fourth quarter, 1981, to fourth quarter, 1982. This new tightening of money supply revived the surge in short-term interest rates, setting the stage for the present relative strength of the dollar. The trade-weighted value of the dollar stood at 132.84 in November, 1983, and at 145 a year later.

Thus, 1981 marked the beginning of another sub-period, 1981-83, of a rising U.S. dollar. The loss of 1.6 million jobs and $100 billion of GNP have been attributed to the strong dollar during this


11 The theoretical link between the exchange rate and interest rate is briefly examined below.

Figure 5: Selected Interest Rates (\% Per Annum)


1.3.7 Summary

The goal of the preceding review of historical data was not to draw conclusions about the relation, such as there may be, between the exchange rate and key elements of the farm problem. Rather, the goal was to gain insight into that relation. There is a strong impression from the historical data reviewed that some relationship exists. The review raised questions about the relative impact of over- or under-valuation of the dollar per se, and the degree of uncertainty about the exchange rate, on the farm problem. Based on impressions gained from the data, it was hypothesized that uncertainty, rather than over-valuation per se, poses potentially more worrisome problems for the farm problem. It was also suggested that studies of the effect of exchange rate changes on "farm prices" should focus on net-price-received rather than on farm commodity prices per se, as the former bears more directly on income from farm sources. This will entail a study of the effect of exchange rate changes on price-paid by farmers. It was also noted that the focus of the present dissertation will be on the effects of changes in the exchange rate on the competitiveness of U.S.


agricultural commodity exports. First, a compact theoretical framework will be developed within which the sensitivity of U.S. agricultural exports to the dollar exchange rate can be analyzed. Then, an empirical regression model will be used to test for the effect of changes in the U.S. dollar exchange rate on the international competitiveness of U.S. agricultural exports. Finally the link between the exchange rate and interest rate was briefly touched upon. I will conclude this chapter with a brief theoretical analysis of that link.

1.4 The Exchange Rate and the Interest Rate

This concluding section presents a brief analysis of the link between interest rates and the exchange rate. The analysis is motivated by the policy significance of this issue, and the commonly held view that the high domestic interest rate of the past few years is largely responsible for the relative strength of the dollar. A clearer understanding of how interest rates affect the exchange rate is important to any deliberate attempt to change the exchange rate by manipulating the interest rate. The goal here is to set out the conditions under which changes in interest rates may be expected to affect the exchange rate.

1.4.1 The Passivity Assumption

The relation between interest rates and the exchange rate may be specified as follows:

\[
(1.4.1) \quad e = e(z, \ldots),
\]

such that \( \frac{\partial e}{\partial z} > 0 \); and \( z \equiv (r/r^*) \), is the relative interest rate of
of the U.S., \( r \) is the U.S. interest rate, and \( r^* \) is foreign interest rate.

This specification recognizes the importance of other factors in the exchange rate determination process. But since the point of interest here is the effect of the domestic interest rate, "\( r \)", on the exchange rate, all these other factors are suppressed.

So from (1.4.1), the elasticity of the U.S. dollar exchange rate with respect to the domestic interest rate is given by

\[
(1.4.2) \quad \eta_{e,r} = \eta_{e,z} (1 - \eta_{r^*,r}) > 0
\]

where \( \eta_{e,z} > 0 \), is the elasticity of the dollar exchange rate with respect to the relative interest rate. Intuitively, a rise in the U.S. interest rate relative to foreign interest rate, assuming international capital mobility, will lead to a rise in foreign demand for dollar-denominated financial assets and so to increased demand for the dollar, and thus to a rise in the dollar's exchange rate. Therefore,

\[
(1.4.2i) \quad \eta_{e,r} > 0 \text{ iff } \eta_{r^*,r} < 1
\]

\[
(1.4.2ii) \quad \eta_{e,r} = 0 \text{ iff } \eta_{r^*,r} = 1
\]

\[
(1.4.2iii) \quad \eta_{e,r} < 0 \text{ iff } \eta_{r^*,r} > 1
\]

Evidently, the sign of \( \eta_{e,r} \) depends crucially on the sign and size of \( \eta_{r^*,r} \), which is the elasticity of foreign interest rate.
with respect to domestic interest rate. Clearly, one cannot take the 

gsign of $\eta$, for granted. Therefore, a priori statements about the 
effect of changes in domestic interest rate of a relatively open 
eyeconomy, on its exchange rate, involves overly restrictive implicit 
assumptions about the policy response of other open economies to such 
changes in domestic interest rate, (the sign of $\eta_{r^*,r}$), and the 
degree of that response, (the size of $\eta_{r^*,r}$). Whether or not a rise 
in U.S. interest rates will lead to a rise in the value of the U.S. 
dollar depends both on the interest rate policy response of other open 
economies, and the degree of that response. Such policy responses, 
which themselves depend on the overall economic goal of these other 
countries during the relevant time horizon, determine the sign of 
$\eta_{r^*,r}$; the intensity of the policy responses, determine its size. 

If, for instance, an increase in the U.S. interest rate induces a more 
than proportionate increase in foreign interest rates, through 
appropriate policy reactions, or portfolio adjustments, then, $\eta_{e,r}$ 
could very well be negative, (cf. 1.4.211). That is, a rise in U.S. 
interest rate could lead to a depreciation of the dollar, contrary to 
popular beliefs. If there is only an offsetting response, then $\eta_{e,r}$ 
equal to zero as in (1.4.211). In this case the exchange rate would be 
insensitive to changes in interest rates. But, if other economic 
objectives in these countries are considered more important more than 
relative interest rate levels, then, they may not respond to changes in 
U.S. interest rate. In this case, $\eta_{r^*,r}$ will be zero and $\eta_{e,r}$ will
be positive as in (1.4.21). This strong passivity assumption, namely, that \( \eta_{r^*,r} \) equals zero, is embodied in the usual discussion of the effect of changes in domestic interest rate on the exchange rate. Relax this assumption and one ceases to be certain about the effect of an increase in domestic interest rate on the exchange rate.

The gist of all this is that policy makers cannot safely presume, except perhaps in the very short-run, that other open economies will not respond to unfavorable international interest rate differential that drains liquidity from their economies. On the contrary, there are some clear indications that other countries are not passive regarding such interest rate differentials. After a period of waiting to see if the U.S. will adopt policies that will reduce its interest rate, several European countries are being "pressured" or "forced" by high U.S. interest rates "to keep their interest rates higher than they would like", in order to limit the outflow of

\[ 15 \text{ See (1.4.21) for the varying degrees of this implicit assumption.} \]

\[ 16 \text{ See, for instance, "How to Cool the Dollar: Even the Experts Can't Agree", Special Report, Business Week, (June 27, 1983, p. 100). See also "Interview with Donald T. Regan", (ibid, p. 93).} \]

\[ 17 \text{ In the very short-run, during which time reaction policies cannot be adopted by other countries, this assumption is tenable.} \]
liquidity. It seems reasonable, therefore, to postulate that $\eta_{r^*,r} > 0$, while its size is an empirical matter. However, for completeness, it is noted that for those few countries with excess liquidity, $\eta_{r^*,r}$ could conceivably be negative since they could adopt policies that encourage the outflow of liquidity.

Therefore, the ultimate effect of a change in domestic interest rate on the exchange rate, depends on the policy response of other open economies. Thus, given the prevailing floating exchange rate regime, the parameter $\eta_{r^*,r}$ must be taken into account by monetary and fiscal authorities when considering the effect of changes in domestic interest rate on exchange rate, and how to control it.

1.5 Summary and Objective

It was argued that excess supply is an important aspect of the problem of U.S. agriculture, and that it is the result of weak demand and policy-induced excess capacity. It was then argued that this problem is basic to the relative low income of those engaged in farming, and the long-term viability of farming as an economic activity.

In dealing with this excess-supply problem, agricultural policy focuses mainly on supply-oriented programs with insufficient attention to the demand side of the problem. For this reason, it was

---

argued that, because excess supply is a problem not only of too much production, but also of inadequate demand, supply-oriented programs alone are unlikely to solve it. To deal more effectively with the problem, it was argued that agricultural policy must also aim at creating new demand, or at least, sustaining existing demand. This was called "the missing blade of the policy scissors."

In view of the one-sided nature of the policies designed to control excess-supply, it was stated that the objective of this dissertation is to examine one of the major forces operating through the demand side of the excess-supply problem. Specifically, the effect of changes in the U.S. dollar exchange rate on the competitiveness of U.S. agricultural commodity export will be studied in selected major import markets. This will be done by examining the sensitivity of U.S. export share to changes in the U.S. dollar exchange rate. The commodities to be studied are wheat, corn, and soybean. Other commodities could not be studied for lack of appropriate data. The import markets in which they will be studied are Japan and the world market.

The choice of Japan besides the world market is based on the importance of that market for U.S. agricultural commodities, the strong competition the U.S. faces in that market from several other major exporters, and the fact that the exchange rate of the U.S. dollar against the Japanese yen has experienced the most pronounced change of the U.S. dollar's exchange rate against major currencies in recent years. These factors make the Japanese import market a good testing ground for the effect of the U.S. dollar exchange rate on the competitiveness of U.S. agricultural commodity export.

As an extension of the basic study, the proposition that an appreciation of the U.S. dollar against the currency of a competing
exporter to a given import market will tend to decrease the U.S. export share relative to that of the competing exporter in the given market, will also be tested. In Japan, for instance, Canada is a major U.S. competitor in the export of wheat. I will, therefore, test the hypothesis that a rise in the U.S. dollar exchange rate against the Canadian dollar will tend to reduce U.S. export share of wheat to Japan relative to that of Canada.

A second objective of this dissertation is to test the empirical validity of the passivity assumption discussed earlier. The view is commonly held that rising U.S. interest rate is largely responsible for the recent relative strength of the dollar against other major currencies. It is particularly believed that the U.S. dollar-Japanese yen misalignment of the past three years is largely due to rising U.S. interest rate. If this is true, that implies that the interest rate is one channel through which monetary and fiscal policies transmit their impact to agriculture, and therefore, that by controlling the interest rate, the farm problem may be controlled.

However, as a general proposition, this point of view was earlier shown to be valid only under some rather restrictive and implicit assumptions. The strong version of the assumption is that the elasticity of foreign interest rate with respect to U.S. interest rate is zero. This version of the assumption states, in effect, that foreign countries will not act to counter U.S. economic policies that have the effect of widening the differential between their interest

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Islam (1984) has a good discussion of the issues.
rates and that of the U.S.

The weak version of the assumption recognizes positive elasticity but holds that the response is inelastic, (cf. (1.4.21)). In other words, this version recognizes the possibility that foreign interest rate policies may respond to U.S. interest rate policy, but only in a relatively inelastic manner.

These assumptions will be tested with West German, British, French, Japanese, and Canadian data. If it is found that the interest rate of any of these countries is insensitive to changes in U.S. interest rate, then, given the high mobility of capital across countries, a rise in U.S. interest rate will be expected to raise the value of the U.S. dollar against the currency of that country. And if such a country is a major importer (or competing exporter) of U.S. agricultural commodities, then a rise in U.S. interest rate, through its effects on the exchange rate, could worsen the farm problem. Such a finding will also establish the interest rate as one channel through which the impact of monetary and fiscal policies is transmitted to the farm sector. If instead the elasticity is found to be close to one, then the exchange rate will be insensitive to changes in the interest rate.

In summary, the major objectives of the study are:

1. To examine the effect of changes in U.S. dollar exchange rate, and commodity prices, on the competitiveness of U.S. agricultural commodity exports. A rise in the exchange rate is said to reduce competitiveness, if it leads to a fall in market share.

2. To test the empirical validity of the "passivity assumption", namely, that $0 < \eta_{r^*,r} < 1$. 

CHAPTER II

LITERATURE REVIEW

This chapter reviews the literature on the effect of exchange rate changes on domestic farm prices and exports. A major issue that emerges from this review concerns the size of the exchange-rate-elasticity of domestic farm prices. Some find it inelastic; others find it elastic. An attempt is made to resolve the issue on theoretical grounds.

2.1 The Exchange Rate and Agriculture

Schuh (1974) has stimulated renewed interest in the effect of exchange rate changes on agricultural exports and domestic agricultural prices. His paper which came after the devaluations of 1971 and 1973 was timely. Unusual movements in certain important variables relevant to the farm problem, (table 3), appeared to affirm the hypothesis that over-valuation of the dollar was, at least in part, responsible for the depressed domestic farm prices of the 1950s and 1960s, and the consequent worsening of the farm income problem. The reverse side of this hypothesis is that the devaluations of the early 1970s explain a major part of the observed increases in farm prices and income during this period. Thus, the paper, and the apparent effects of the two devaluations preceding it,
spawned several empirical studies aimed at confirming or rejecting the hypothesis. The results so far have been mixed. Some of these studies: Clark (1974), Vallianitis-Fidas (1976), Greenshields (1974), Johnson, Green, and Thursby - JGT (1977), and Kost (1976), are critically reviewed in Chambers and Just - CJ (1979). Therefore, only summary statements about their findings will be necessary here.

Clark ascribes only a small part of the increase in farm prices to the exchange rate devaluations. His study also suggests that the devaluations had relatively larger effects on agricultural commodities than on manufactured products.

Kost, Vallianitis-Fidas, and Greenshields, each examined the effect of exchange rate on agricultural commodity exports and each concluded that the devaluations had no significant impact on agricultural exports.\(^2\)

JGT (1977) sought to explain the unusual increase in wheat price in 1973. They found that the 10% devaluation of 1973 raised domestic price of wheat by 6.9%, indicating a relatively inelastic response. They attributed 40.8% of the rise in wheat price in 1973 to price-insulation policies of major U.S. trading partners, suggesting

\(^1\)For counter critiques of Chambers and Just (1979), see Grennes, Johnson and Thursby (1980), and Reed (1980). For a critique of the counter critiques, see Chambers and Just (1980).

\(^2\)See Vallianitis-Fidas (1975) for her critique of Schuh (1974), and Schuh (1975) for a counter critique of Vallianitis-Fidas (1975).
that the exchange rate devaluation of 1973 was of lesser importance to the rise that year in wheat price than foreign commercial policy. Their overall conclusion is that movements in the exchange rate is important and should not be ignored, but neither should it be exaggerated.

However, as they point out, (footnote 12, p. 623), it may be inappropriate to generalize their result. Also, I am somewhat skeptical about their assumption (p. 622 -p. 623), that the impact effect of the exchange rate on domestic price of wheat is the same as that of transport-cost, tariffs, and so on. This assumption, which is built into their estimates through their inverse matrix $X^{-1}$, may bias their result. Exchange rate changes generate uncertain expectations regarding their future course; reactions of market participants to such changes may be expected to be different from their reactions to changes in transport-cost which is less flexible and little publicised.

Collins, Meyers, Bredahl - CMB (1980) also examined the relative effect of price insulation policies and the exchange rate. They distinguished between real and nominal price insulation policies. They found that the effect of exchange rate changes on real domestic commodity prices depended on whether U.S. trading partners are following a real or nominal price insulation policy, and on whether trade was "free". Taking wheat, for instance, they found that the exchange rate had a 7.4% impact on real domestic wheat price under foreign real-price insulation policy, an impact of 8.3% under the assumption of free trade.

In their model, "free trade" is defined in terms of the degree of international price transmission. If international price transmission is perfect, "free trade" is presumed to exist.
but a 24.6% impact under foreign nominal-price insulation policies, (p. 661). This pattern holds for all the other crops covered in their study: corn, soybean, and cotton. These data indicate that the kind of insulation policy being pursued by foreign countries is important to exchange rate effects on domestic prices.

On the relative impact of exchange rate changes vis-a-vis foreign price-insulation policies, they found that inflation-adjusted exchange rate played a minor role in the large commodity price increases of the early 1970s. For instance, during the period 1971/1973 -1973/1974, their result showed that of the 108% increase in real wheat price, only a mere 7% was attributable to inflation-adjusted exchange rate. Again, the pattern, though not the magnitude, holds for the other crops, (p. 663).

CMB (1980) show that the degree of exchange rate impact on commodity prices depends on the commodity, the period, and the country involved. Thus, one cannot generalize the result of any one commodity. But, I note some reservations about the export function on which their results are based. Denoting the demand and supply of the U.S. for a commodity as $D_{us}$ and $S_{us}$ respectively, CMB specify U.S. export function as:

$$ (2.1.1) \quad S_{us} - D_{us} = \varepsilon_i (D_i - S_i) $$

---

4 For further discussions of the role of price insulation policies in determining world commodity prices, see Sampson and Snape (1980).
where \( D_i \) and \( S_i \) denote demand and supply respectively, for the \( i \)th importing country such that \( (D_i - S_i) > 0 \) is the excess demand of the \( i \)th importing country for the commodity involved, (p. 658). Then assuming that equilibrium existed, they proceeded to derive their analytical formula on which their estimates were based.

The left side of the equality, which they interpret as "U.S. export supply", connotes that the rest of the world is merely an accommodating "vent for surplus" of U.S. farm products. This is hardly tenable in view of the growing surplus of U.S. farm products and the many programs designed to curtail it. A more realistic formulation will account for U.S. demand for inventory, or at least, interpret \( D_{US} \) broadly enough to include inventory or stock demand as this can have significant impacts on prices and thus, on the reported results.

The right side of the equality, which they interpret as "the demand for U.S. exports", implies that the U.S. is the sole supplier of the commodity to all importing countries. This, of course, is unrealistic. A more realistic formulation will recognize the fact that the U.S. supplies only some fraction, large or small, of the world's import demand for the commodity. Because of the implications of this specification, which is dominant in the literature, I shall discuss it more fully in the next chapter.

As noted earlier, CJ (1979) present a critical review of the theoretical structure and empirical specification of most of these studies. Their basic contention is that the models used in these studies have a built-in exchange rate inelasticity of domestic farm
prices because they ignore cross-price effects. But, it will be de­
monstrated in a subsequent section that the exchange rate inelasticity
of domestic farm prices is consistent with theoretical expectations,
even after account is taken of cross-price effects. Thus, it is argued
here that the real empirical question concerning the effect of the
exchange rate on domestic farm prices is: where in the interval (-1, 0)
does the elasticity of domestic farm prices with respect to the
exchange rate, lie?

Shei (1978) used a four-sector general equilibrium model
which incorporates the role of money supply because, as he noted,
previous empirical analyses had employed the partial elasticity
approach which, he argued, tended to over-estimate the exchange rate
elasticity of domestic prices, (P. 5-6). The exchange rate elastici­
ties derived from by his results are summarized in table 4.

Table 4: Exchange Rate Elasticity of
Various Domestic Prices

<table>
<thead>
<tr>
<th>Year</th>
<th>Domestic Crop Price</th>
<th>Domestic Livestock Price</th>
<th>Domestic Industrial Price</th>
<th>Domestic General Price-level</th>
<th>Crop Exports</th>
</tr>
</thead>
<tbody>
<tr>
<td>1971</td>
<td>-0.33</td>
<td>-0.10</td>
<td>-0.03</td>
<td>-0.10</td>
<td>-0.33</td>
</tr>
<tr>
<td>1972</td>
<td>-0.29</td>
<td>-0.09</td>
<td>-0.02</td>
<td>-0.03</td>
<td>-0.23</td>
</tr>
<tr>
<td>1973</td>
<td>-0.19</td>
<td>-0.08</td>
<td>-0.04</td>
<td>-0.08</td>
<td>-0.11</td>
</tr>
<tr>
<td>1974</td>
<td>-0.20</td>
<td>-0.08</td>
<td>-0.02</td>
<td>-0.03</td>
<td>-0.14</td>
</tr>
</tbody>
</table>

Source: Calculated from Shei (1978); p. 106 and p. 110.

The degree of inelasticity implied by these data is highly
suspect because the estimated coefficients of his structural equations
on which these results are based, are mostly insignificant. In his own words, "The price ... elasticities calculated from the estimated crop and industrial export demand equations were not satisfactory", (p. 86).

However, the general finding of inelasticity of domestic farm prices, with respect to the exchange rate, is in keeping with the theoretical conclusion of Dornbusch (1973) whose model, like that of Shei, is based on a composite agricultural product, (p. 874).

Shei's other interesting findings are worth noting. First, changes in the money supply in 1973 had a larger impact on crop prices than the exchange rate devaluation of that year. In particular, an increase of 10.43% in domestic base money led to a 7.17% rise in crop price. Although the response is inelastic, it is more than thrice the exchange rate effect for the same year. Secondly, the devaluations had larger impacts on crop prices than on industrial and livestock prices. Thirdly, the 10.43% increase in domestic base money had a 4.10% impact on industrial prices compared to the 7.17% impact on farm prices, Shei (1978; p. 115). These results suggest that farm prices are more sensitive to changes in monetary factors than non-farm prices.

In the same vein, Bordo (1980) found that farm prices responded to changes in money supply with about half the response lag of industrial prices, (p. 1098). Barnett, Bessler and Thompson (1983) examined the structuralist argument that money supply was passive, merely accommodating increases in farm prices which, they claim, result

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5 See also Clark (1974), op cit.
from real shocks. They found that money supply, in keeping with the monetarist position, had a causal effect on farm prices with no feed-back from farm prices to money supply, (p. 306). Chambers and Just (1982) found that the long run elasticities of wheat and soybean prices, with respect to money supply, were positive and very elastic, while corn price was inelastic but close to one, (p. 244).

These results have direct implications for the farm problem. Agricultural policy cannot continue to ignore the impact of monetary policy and monetary factors on agriculture. A tight monetary policy such as is being pursued now, has a more depressing direct effect on farm prices and income than on industrial prices and income. Indirectly, the combined effect of the tight monetary policy and the expanding deficit spending by all levels of government, through the exchange rate, bear more adversely on the agricultural sector than on the

---

6 Chambers and Just (1982) finds that increase in money supply will raise exports of wheat, corn and soybean substantially, (p. 244). But Shui (1978), with a more aggregate data, finds that increase in money supply will lower "crop exports", but in an inelastic way, (p. 11).

7 The effect on farm income will be "depressing" if demand for farm products is relatively inelastic. Therefore, a decrease in farm prices due to tight monetary policy, may be expected to depress farm income. But, if, as argued earlier, this inelasticity axiom is no longer valid, then tight monetary policies which reduces farm prices may raise farm income. However, if the fall in farm prices is proportionately less than the monetary policy induced increase in the exchange rate, then farm income will fall.
non-agricultural sector. These negative effects may more than offset whatever positive effect the traditional supply-oriented agricultural policy programs may have. There is, therefore, a need for co-ordinated policy. Agricultural policy ought to be drawn up in the context of overall economic policy - not in isolation. The degree of interdependence among the various strands of economic policy calls for consistency among the various sectoral policy packages. The alternative is to continue adding to the basket of disjointed agricultural policy legislations that cater only to obvious shortrun farm problems, but with little regard to the longrun viability of the sector.

The studies reviewed so far, most of which dealt with the effects of exchange rate on farm prices, suggest that the exchange rate elasticity of farm prices is less than one. Those dealing with farm exports concluded that the exchange rate had no significant impact on exports. The next paper reaches a different conclusion on both scores.

CJ (1981, 1982) used econometric models to examine the dynamic effects of the exchange rate and the money supply on commodity markets. Their results show significant and elastic exchange rate impacts on farm prices and exports. The relevant results are summarized in table 5.

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8 Increased government borrowing to finance the growing deficits puts upward pressure on U.S. interest rates. This increases the differential between U.S. and foreign interest rates which, in turn, induces an increase in demand for U.S. dollar as international investors realign their portfolios in favor of assets denominated in U.S. dollars. This tends to raise the exchange rate of the U.S. dollar.
Table 5: Dynamic Impact Multipliers Of a Unit Change in the SDR/U.S. Dollar Exchange Rate

<table>
<thead>
<tr>
<th>Variables (Per Capita)</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
<th>12</th>
<th>Cumulative Impact Multipliers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wheat</td>
<td>-2.04</td>
<td>-0.441</td>
<td>-0.01</td>
<td>0.104</td>
<td>0.126</td>
<td>0.124</td>
<td>0.116</td>
<td>0.106</td>
<td>0.098</td>
<td>0.089</td>
<td>0.082</td>
<td>0.075</td>
<td>-1.57</td>
</tr>
<tr>
<td>Corn</td>
<td>-5.53</td>
<td>-0.884</td>
<td>0.09</td>
<td>0.277</td>
<td>0.287</td>
<td>0.261</td>
<td>0.231</td>
<td>0.203</td>
<td>0.177</td>
<td>0.155</td>
<td>0.136</td>
<td>0.119</td>
<td>-4.47</td>
</tr>
<tr>
<td>Soybean</td>
<td>-0.47</td>
<td>-0.069</td>
<td>0.001</td>
<td>0.010</td>
<td>0.011</td>
<td>0.011</td>
<td>0.010</td>
<td>0.009</td>
<td>0.009</td>
<td>0.008</td>
<td>0.008</td>
<td>0.007</td>
<td>-0.46</td>
</tr>
<tr>
<td>Real Prices</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wheat</td>
<td>-0.03</td>
<td>-0.020</td>
<td>-0.013</td>
<td>-0.011</td>
<td>-0.010</td>
<td>-0.009</td>
<td>-0.008</td>
<td>-0.007</td>
<td>-0.006</td>
<td>-0.006</td>
<td>-0.005</td>
<td>-0.125</td>
<td></td>
</tr>
<tr>
<td>Corn</td>
<td>-0.03</td>
<td>-0.013</td>
<td>-0.008</td>
<td>-0.006</td>
<td>-0.005</td>
<td>-0.004</td>
<td>-0.004</td>
<td>-0.003</td>
<td>-0.003</td>
<td>-0.002</td>
<td>-0.002</td>
<td>-0.082</td>
<td></td>
</tr>
<tr>
<td>Soybean</td>
<td>-0.10</td>
<td>-0.021</td>
<td>-0.006</td>
<td>-0.003</td>
<td>-0.002</td>
<td>-0.002</td>
<td>-0.002</td>
<td>-0.002</td>
<td>-0.002</td>
<td>-0.002</td>
<td>-0.002</td>
<td>-0.141</td>
<td></td>
</tr>
</tbody>
</table>

Source: Chambers and Just (1981), p. 43
These impact multipliers indicate that a devaluation exerts upward pressure on domestic farm prices for more than three years following the initial devaluation, but with a steadily diminishing impact intensity over time. In contrast, exports rise sharply during the first post-devaluation quarter. During the second quarter, exports are still rising, but at a much reduced rate. By the third quarter, exports actually begin to fall. The sustained rise in commodity prices tends to dampen both domestic and foreign (export) demand for farm products. Although the pattern is the same, the magnitude of impact differs across crops and crop prices. Thus, it appears that the favorable effect of exchange rate devaluation on farm exports is short-lived. A sustained devaluation will, in the longrun, tend to dampen farm exports indirectly, by raising farm prices.

On the issue of exchange rate elasticity of exports and domestic farm prices, their relevant results are summarized in table 6.

Table 6: Exchange Rate Elasticity of Exports and Prices

<table>
<thead>
<tr>
<th></th>
<th>Shortrun</th>
<th>Longrun</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exports</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Per Capita)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wheat</td>
<td>-1.83</td>
<td>-1.48</td>
</tr>
<tr>
<td>Corn</td>
<td>-4.07</td>
<td>-3.45</td>
</tr>
<tr>
<td>Soybean</td>
<td>-0.78</td>
<td>-0.67</td>
</tr>
<tr>
<td>Prices</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wheat</td>
<td>-1.24</td>
<td>-0.79</td>
</tr>
<tr>
<td>Corn</td>
<td>-1.90</td>
<td>-1.38</td>
</tr>
<tr>
<td>Soybean</td>
<td>-2.64</td>
<td>-2.17</td>
</tr>
</tbody>
</table>

Source: Chambers and Just (1981), p. 44
It is not clear what meaning one should attach to "export per head" in this context, and thus, to their exchange-rate-elasticities of export. CJ offer no justification except that it "preserves the linearity of the system", (p. 33). Their export "elasticities" are therefore, incomparable to the other elasticities reported so far. It is also not evident in the paper which population was used; that of the importer or the exporter. This adds to the difficulty in interpreting their results.

Unlike the previously reviewed studies, CJ find the exchange rate elasticity of farm prices to be greater than one in absolute values, except for wheat in the longrun. Their longrun result for wheat is not significantly different from the finding of JGT (1977) who reported an elasticity of -0.69 for wheat. One important thing to note about CJ's result is that the shortrun elasticities are all larger than their longrun counterparts, reflecting a dwindling impact of the devaluation on both prices and exports over time.

The major issue which CJ (1979) raised and which appear to be reinforced by their present results has to do with the magnitude of the exchange-rate elasticity of domestic farm prices. All the studies previously reviewed found it to be inelastic. In CJ (1981), they view their elasticity results as vindication of their contention in CJ (1979), namely, that the omission of cross-price elasticities by previous researchers unnecessarily constrains the exchange rate elasticity of domestic farm prices to the unit interval, (-1, 0).

Although theory does not always provide clear cut answers about the magnitude of parameters; only their expected signs; it often
will suggest reasonable restrictions on specific parameters that are necessary for the consistency of the larger body of accepted theory. It will be shown below that the inelasticity of domestic farm prices with respect to the exchange rate is consistent with received theory. CJ seem to be aware of this as is evident from their footnote "4", CJ (1981), p. 39), although the restriction need not be as stringent as that footnote seems to imply.

2.2 Summary

This review reflects the essence of the present state of empirical knowledge on the exchange rate issue vis-a-vis the agricultural sector, which is, that no conclusive evidence is as yet available. Nonetheless, there is strong support for the view that agricultural exports and domestic farm prices are sensitive to changes in the exchange rate and other monetary factors. The available evidence also indicate that the favorable impact of devaluation on agricultural exports occur largely in the shortrun subsequent to which an induced upward pressure on domestic prices of the export commodities tends to dampen the initial gain.

One important implication of the available evidence for the growing inventory of farm products is that exchange rate devaluation provides strong shortrun stimulus for the reduction of farm product inventory. Immediately following a devaluation, the evidence indicates that there is usually a sharp rise in foreign demand, while at the same time, due to the seasonal nature of agricultural production, supply tends to be very inelastic. Consequently, inventory provides the only means of satisfying the expanded shortrun foreign demand. Thus, if
well timed, exchange rate devaluation could be an effective instrument for dealing with the farm excess supply problem, and thus, the farm income problem.

Another major policy issue raised concerns the consistency of agricultural policy with the rest of economic policy. It was inconsistent, for instance, to implement the PIK program in 1983 and simultaneously follow a tight monetary, and deficit spending policies, which, as independent policies, were aimed at very important economic problems of the time. But, due to the relative stronger sensitivity of the agricultural sector to the effects of these policies, what positive effects there was from the PIK program was, perhaps, more than offset, leaving the farm excess supply still a major problem inspite of the large participation in the PIK program.

I am not aware of any other attempts to examine the effects of the exchange rate on export market share, which is the focus of the present study.
CHAPTER III

THEORETICAL STRUCTURE AND METHODOLOGY

This chapter discusses the methodology and theoretical structure of the model for the present study. The model's basic equation is

\[(3.0.1) \quad x_j = \sum_{i=1}^{n} k_{ij} E_{ij}, \quad i = 1, 2, \ldots, n; j = 1, 2, \ldots, m\]

which is the export function of the U.S. for commodity \( j \), to all importing countries, \((i = 1, 2, \ldots, n)\). The variables \( k_{ij} \), U.S. share of the import market for commodity \( j \), and \( E_{ij} \), the import need of importer \( i \) for commodity \( j \), are discussed below.

Three important points about equation (3.0.1) are worth noting. First, it states that the volume of U.S. export of commodity \( j \) is jointly determined by \( k_{ij} \) and \( E_{ij} \). Thus, if world import-need for commodity \( j \) is given, \( k_{ij} \) becomes the sole determinant of the volume of U.S. export of that commodity. Unfortunately, the literature is replete with export functions that implicitly set \( k_{ij} \) to one. This is unrealistic at best. In general, it is inappropriate to assign values, implicitly or explicitly, to \( k_{ij} \), a priori. The effect of this practice on parameter estimates of export functions will be demonstrated later.
The second point is that $E_{ij}$, the import need function of country $i$ for commodity $j$, is determined primarily by domestic demand and supply conditions of the importing country, although it is also affected by the degree of openness of its economy, particularly, through international price linkages.

Finally, $k_{ij}$, which is the U.S. export share of commodity $j$ in the import market $i$, is independent of $E_{ij}$. In other words, an exporter's market share is independent of market size. These points are elaborated further below.

3.1 Import Need Function, Import Need, and Import Demand Function

The import need of the importing country $i$, for commodity $j$, is the solution to its import need function for a given domestic price structure. The import need function, on the other hand, expresses the relation between the excess of that country's demand for the commodity over its domestic supply, and its internal price structure. Finally, the import demand function for commodity $j$ expresses the relationship between import and import prices, for given foreign exchange reserves. These concepts are taken up separately below.

3.1.1 Import Need Function

The import need function of country $i$, for commodity $j$, may
be specified as follows:

\[ (3.1.1) \ E_{ij}^{*} = E_{ij} \ (P^*, Y^*, N_0, T_0, H_0, U_0) > 0, \]

such that

\[ \frac{\partial E_{ij}}{\partial P^*} < 0, \quad \frac{\partial E_{ij}}{\partial Y^*} > 0, \]

\[ \frac{\partial E_{ij}}{\partial N_0} > 0, \quad \frac{\partial E_{ij}}{\partial T_0} < 0, \quad \frac{\partial E_{ij}}{\partial H_0} > 0, \quad \frac{\partial E_{ij}}{\partial U_0} < 0; \]

where "r" is the index of other commodities in the consumer basket which may relate to commodity \( j \) as complement, or substitute. This equation expresses the relation between the country's import need \( E_{ij} \) for commodity \( j \), and its internal price structure, \( P^* \), with other elements of the country's demand and supply condition held constant.

### 3.1.2 Import Need

Equation (3.1.1) yields the country's import need for commodity \( j \), for a given domestic price structure, \( (P^*_o) \), levels of

---

1 The term "import need" is preferred here to the more general term, "excess-demand" to avoid ambiguities. The difference between the two terms is analogous to the difference between a "set" and its "subset". Excess-demand generally refers to the excess of demand over supply at various prices, where "supply" is defined to include imports from some, or all sources. Import need, on the other hand, is a particular "excess-demand", where "supply" in this case refers strictly to domestic production. It excludes all imports.
disposable income, \((Y^*)\), population, \((N^*_0)\), resources committed to the production of commodity \(j\), \((H^*_0)\), the state of production technology, \((T^*_0)\), and the country's preference pattern, \((U^*_0)\). The variable \(P^*_0\) is a vector with elements consisting of the price of commodity \(j\), \((P^*_j)\), in the domestic market, and prices of other commodities in the consumer market basket, \((P^*_r)\), \(r = 1, 2 \ldots n-1\). Some, or all of these other commodities are related to commodity \(j\), either as substitutes, or as complements. Therefore, the quantity of import need for commodity \(j\) may be stated as follows:

\[
(3.1.2) \quad E_{ij} = E_{ij}^*(P^*, Y^*, N^*_0, T^*_0, H^*_0, U^*_0) > 0.
\]

It is the excess of quantity demanded of commodity \(j\), over its domestic supply, at the prevailing domestic prices. This is the quantity of the commodity the country has to import, barring foreign exchange constraints, in order to meet domestic demand for the commodity.

The central point of equations (3.1.1) and (3.1.2) is that a country's import need is determined, primarily, by its domestic demand and supply conditions. For instance, an increase in disposable income is assumed to increase the demand for the commodity, and thus the import need for the commodity. An improvement in production technology, or an increase in the level of resources committed to the production of the commodity, will increase domestic supply of the commodity, and therefore, will reduce the import need for the commodity, and so on.
However, this import need is also affected by the economy's degree of openness, particularly, through international price linkages. For instance, if the economy is sensitive to price shocks from foreign economies, then a rise in foreign prices of the imported commodity could reduce the country's import need by inducing increased domestic production and lowering the quantity demanded of the commodity. Similarly, an external shock that lowers domestic income will reduce import need, by lowering the demand schedule for the commodity.

If, instead, the country's internal price structure is insulated against external price influences, then its import need will be independent of external price changes.

3.1.3 Import Demand Function

The quantity of import need and the actual quantity of import of commodity \( j \) need not be equal. A country may have a large import need but short on the requisite purchasing power - foreign exchange reserves. Therefore, it is important to distinguish between "import demand" and "import need". The import demand function expresses the relation between import and import prices, given the importing country's foreign exchange reserve. The import demand function may be specified as follows:

\[
(3.1.3) \quad M_j = M_j(\gamma^*, R^*), \quad \text{such that } \frac{\partial M_j}{\partial R^*} > 0, \quad \frac{\partial M_j}{\partial \gamma^*} < 0,
\]

where "\( \gamma^* \)" is some index of c.i.f. import prices of the commodity, and \( R^* \) is the country's foreign exchange reserve. In general, a country's import will be less than, or equal to its import need. That is,
(3.1.4) \[ M_j = M \sum E_{ij} (P^*_0, Y^*_0, \ldots) \]

The equality will hold if the country faces no foreign exchange constraint, in which case, \( R^* \) and \( Y^* \) are good proxies for each other. In all that follows, the equality is assumed to hold, in which case one may speak interchangeably of import demand and import need.

3.2 Market Share, \( k_{ij} \)

Given its import need, determined as described above, an importing country faces the independent problem of choosing from alternative sources of import, the country, or countries, from which to import. If it faces no foreign exchange constraints, it will usually be able to import all it needs. But, if it faces a foreign exchange constraint, its actual imports will be less than its import need, unless it is able to obtain some financing. In either case, in choosing the countries from which to import, the importing country will consider relative c.i.f. prices, and thus implicitly, the exchange rate. It will also consider product quality, and the reliability of the source as a supplier. Other factors, such as political alliances, may also be important, but will not be emphasized here. Therefore, the share of the country's import need supplied by any one of the competing suppliers, such as the U.S., may be specified as follows:

\[ (3.2.1) \quad k_{ij} = k_{ij} (\lambda^*; Z); \quad \alpha_{kj} / \alpha_{kj} < 0, \quad \alpha_{kj} / \alpha_{kj} > 0, \]

where \( \lambda^* \equiv (p^*_j / p^*_j) \), is the relative c.i.f. price of commodity \( j \).
supplied by the U.S. to the importing country \( i \), and \( Z \) is a vector with element consisting of some index of the quality of the commodity originating from the U.S., and some index of U.S. reliability as a supplier. The direct impact of the exchange rate on \( k_{ij} \) may also be introduced through \( Z \). A long standing trade relation through which trading partners come to know each other, is crucial to the issue of reliability. Such trade relations may introduce "perverse" responses to price signals. It is conceivable, for instance, that an importer may increase its import volume from a given source in the face of a rising relative price, in order to sustain their good historical trade relations.

An important point noted earlier about equation (3.2.1) is that it is independent of the importing country's import need. In other words, it is independent of market size. Furthermore, since

\[
(i) \quad 0 < k_{sj} < 1
\]

and

\[
(ii) \quad \sum_{s} k_{sj} = 1
\]

where \( "s" \) is the index of sources from which an importer imports commodity \( j \), it may fruitfully be thought of as the probability that the importing country will import some of its import need from an exporting country "s". Consider the following mental experiment. Imagine that the importing country's import need has been determined, and that the country is now faced with the independent problem of choosing from alternative foreign sources of supply. What is the
probability that it will choose a particular exporter, such as the U.S.? This probability is given by equation (3.2.1).

Given the importer's import need, \( k_{ij} \) is the sole determinant of U.S. export of the commodity to that country, (cf. equation (3.0.1)). Several variants of this specification of the export function abound in the literature. Some set \( k_{ij} \) implicitly to one, implying in the probability sense, that each importer is certain to import all its needs for the commodity from the U.S. Or, in the market share sense, that the U.S. is a monopoly supplier of the commodity to all importers. Other variants implicitly assign a residual value to \( k_{ij} \) by postulating a "residual" export function for the U.S.

In general, it is inappropriate to assign values, implicitly or explicitly, to \( k_{ij} \), a priori. As will be demonstrated shortly, it reduces the usefulness of parameter estimates of the export function. The basic contention here is that the U.S. will supply some fraction of the importing country's import need. This fraction, which is the U.S. market share, is independent of the size of the importer's import need. If it equals one, then the U.S. is a monopoly supplier of commodity \( j \) to country \( i \). If it equals zero, then the U.S. does not supply the commodity to that country. But the actual market share, determined by equation (3.2.1), will most likely lie within these two end points.

3.3 The Hypothesis

The goal of this dissertation is to test the hypothesis that the export share of the U.S., \( k_{ij} \), is sensitive to changes in the
exchange rate. That is, changes in the exchange rate affects the competitiveness of U.S. agricultural exports. Or, put differently, that changes in the exchange rate affects the probability that the importing country will import some fraction of its import need for commodity \(j\), from the U.S.

3.4 International Price Linkages

As previously noted, although import need is determined primarily by domestic demand and supply conditions, it is also affected by changes in foreign prices, through international price linkages. This section specifies, and briefly discusses those linkages.

\[
(3.3.1) \quad p^*_{jc} = f(p^*_{ju}); \quad \frac{df}{dp^*_{ju}} = f' > 0
\]

where \(p^*_{jc}\) is the average c.i.f. price of all U.S. competitors in the given market, and \(p^*_{ju}\) is the c.i.f. price of the commodity, originating from the U.S. Both prices are denominated in the currency of the importing country. A rise in the U.S. price, \(p^*_{ju}\), is expected to lead to a rise in the average price of U.S. competitors in the market, \(p^*_{jc}\), because the commodity \(j\) originating from the U.S., is assumed to be a close, but not necessarily a perfect substitute of the same commodity.
originating from other competing exporters. Therefore, if U.S. price rises, importing countries adjust, at least in part, by shifting some of their demand to U.S. competitors, which will tend to pressure their prices upwards.

\[(3.3.2) \quad p^* = g(p^*_j), \quad ag/\partial p^*_j = g' > 0 \]

where \(p^*_j\) is the domestic market price of commodity \(j\) in the importing country, (cf equation (3.1.1)). The expectation that \(g'\) will be positive or zero may be justified by noting that \(p^*_j\) is the import procurement price of commodity \(j\), while \(p^*_j\) is its domestic resale price, which necessarily incorporates the importer's margin. But, if the government insulates \(p^*_j\) from \(p^*_j\), perhaps by subsidizing imports, then \(g'\) will be zero.

\[(3.3.3) \quad p^*_j = e_{p_ju} \]

This is purely a definitional relationship between the U.S. dollar denominated price of commodity \(j\) originating from the U.S., and its c.i.f. price denominated in the currency of the importing country. It is cast as an identity so that it will not be mistaken for the extreme
version of the PPP theory, or the "law of one price". Instead, it is
construed here as a statement of the practical fact that the importing
country has to pay for its imports in the currency of the exporter, or
its equivalent. The exchange rate, "e", is defined as the ratio of the
importing country's currency to the U.S. dollar.

3.5 Other Relations In the Model

\[(3.4.1) \quad D_{ij} = D_{ij}(P^*, \gamma^*, N^*, U^*)\]

is the aggregate demand function of commodity j in the importing country
i. The variables are as defined in equation (3.1.1), and the standard
expected signs apply.

---

2The extreme version of the PPP theory implies that the exchange rate
between any two currencies is equal to the price ratio of the two
countries. Officer (1976) is a good review of the PPP theory, Krugman
(1978) and Frenkel (1978) empirically reject the basic tenet of the PPP
theory. The "law of one price" theory holds that products of the same
class, regardless of country of origin, are homogeneous, or perfect
substitutes. Therefore, assuming zero transport cost and free trade,
the dollar-price (or any other currency) of any product originating
from country A will be equal to the dollar-price of the same product
originating from any other country, B. Any divergence between the two
prices, even momentarily, will be wiped out by the arbitrage which the
price differential is presumed to set in motion. The powerful impli-
cation of this theory is that changes in the exchange rate cannot
affect relative prices of goods originating from different countries.
Isard (1977) and Richardson (1978) empirically reject the theory.
is the domestic supply (production) function of commodity j, in the importing country i. The variables are also as defined in equation (3.1.1), with the standard expected signs applying.

\[(3.4.3) \quad E_{ij} = (D_{ij} - S_{ij}) > 0\]

is, by definition, the import need function, equation (3.1.1).

3.6 The Role of Income and Credit

It was stated earlier that once a country's import need for commodity j is determined, \( D_{ij} \) becomes the sole determinant of U.S. export volume of that commodity to that country. This statement may appear to overlook the role of other important variables such as the income of the importing country, or more appropriately, its foreign exchange reserve. However, the logic of the statement is straightforward. It simply states that a seller's sales volume is determined by the share of the market the seller controls. If its share of the market is zero, its sales volume in that market will necessarily be zero, regardless of the size of the market. Therefore, of primary interest to the individual seller are not those factors that determine market size, but those that determine the seller's share of the market.

What then is the role of income, or some appropriate proxy?
It is well received in consumer theory that income is a major determinant of consumer demand. In the same way, income is considered a major determinant of a country's import demand in the sense that a rise in the country's income is expected to result in a rise in that country's demand for the imported commodity, assuming, of course, that the commodity in question is "normal". That is, income is a major determinant of market size. This is the role of income.

However, an individual exporter cannot infer from an importer's positive marginal propensity to import, that a rise in the income of the importing country will necessarily lead to an increase in its export volume, or share of that market. A positive marginal propensity to import commodity j only says that the importing country will tend to spend x-percent of any increase in its income on the import of that commodity—assuming, of course, that there is an "import need" for the commodity to be met. It does not go on to say that this x-percent, or some fraction of it, will be spent on the commodity of any particular exporter. This is an important point, because it is at the heart of the issue. A rise in the importing country's income, by raising its domestic demand schedule for the commodity, may increase the country's "import need" for that commodity. But, there is no necessary connection between the rise in income and the importing country's choice of source of import. In other words, a rise in the importing country's income will not necessarily lead to an increase in the volume, or market share of any one exporter even if the rise in income did, in fact, increase the importer's aggregate volume of import of the commodity. Thus, for any one exporter, the importer's marginal propensity to import out of income has no necessary predictive
meaning.

One exception to the above point is that an exporter could engineer a link between an increase in an importer's income (purchasing power) and that importer's choice of import source by granting the importer a soft loan, and requiring that the loan be spent on the exporter's commodity, or by providing a "tied aid", or selling to the importer on long term credit basis. Any of these, or similar arrangements, establishes a link between a rise in the importer's purchasing power and its choice of import source. In that case, the importer's marginal propensity to import, becomes a relevant predictive parameter to the particular exporter.

By means of any such arrangements, an exporter could increase its share of a market to the extent that competing exporter's cannot match its effort. Many developing countries have large import

Akhtar and Hilton (1984) estimated the following aggregate export functions for the U.S. and West Germany, (t-values in paranthesis):

\[
Q_{US} = 1.00YF - 1.37 RELPX + 0.5CUF - 0.04S - 0.30e; \quad R^2 = .96; DW = 1.87
\]

\[
(8.75) \quad (7.78) \quad (2.78) \quad (1.82) \quad (1.71)
\]

\[
Q_G = 2.21YF - 2.38 RELPX + 0.73 CUUF - 0.22S + 0.24e; \quad R^2 = .93; DW = 2.02
\]

\[
(9.63) \quad (4.34) \quad (3.15) \quad (3.24) \quad (1.33)
\]

The question raised in the text is: do the coefficients of "foreign income (YF)" in these equations predict the importer's reaction to an increase in income, with respect to the U.S. and West Germany, as individual exporters? The position taken there is: not necessarily.
needs, but short on purchasing power. An exporter, such as the U.S., with the capacity to grant trade credits, could expand its market for exports by granting such credits. In the case of agricultural commodities, the "PL480 program" is a good example of how such an arrangement can be used to expand export markets.

Under Title I of PL480, the U.S. grants long term dollar credit sales to poor countries that meet a specified criterion. The criterion is usually set in terms of maximum levels of per capita gross national product. For instance, for the period 1980-1981, the maximum qualifying per capita gross national product averaged $678. Many qualifying countries take advantage of the program, and for the U.S. farmer, this helps ease the excess supply problem.

Under Title II of PL480, the U.S. donates food to poor countries either directly to national governments, through voluntary relief agencies, or through the World Food Program. This also is good for the excess supply problem of the U.S. agricultural sector.

Title III of PL480, the "Food for Development Program", permits a multi-year agreement with countries that use local currency proceeds from sale of commodities provided under Title I for approved development programs.

During the period 1955-1960, export of agricultural commodities under these programs accounted for an average of 33% of all U.S. agricultural commodity exports. However, by the period 1976-1980, the program had declined in importance, accounting for only 5% of total U.S. agricultural exports, (table 7).
Table 7: Agricultural Exports Under Government-Financed Programs
(as a % of total agricultural exports)

<table>
<thead>
<tr>
<th>Period</th>
<th>% Share</th>
</tr>
</thead>
<tbody>
<tr>
<td>1955-1960</td>
<td>33</td>
</tr>
<tr>
<td>1961-1965</td>
<td>28</td>
</tr>
<tr>
<td>1966-1970</td>
<td>19</td>
</tr>
<tr>
<td>1971-1975</td>
<td>9</td>
</tr>
<tr>
<td>1976-1980</td>
<td>5</td>
</tr>
</tbody>
</table>


These data illustrate the usefulness of such credit arrangements in boosting agricultural exports. But, as is evident from the data, as the U.S. government budget constraint becomes more binding, and as more of the poor countries "graduate" out of the qualifying class, the importance of the program to the excess supply problem declines. Therefore, as a demand-augmenting program, its effectiveness is limited by government budget constraint. It does not, therefore, appear to be a viable long term program for dealing with the problem with which this dissertation is concerned. Besides, the program is directed to very poor countries in a way that makes consideration of the exchange rate unimportant. The present study focuses on the effect of the exchange rate on the decision of those countries that accounted for 95% of total U.S. agricultural exports during the period 1976-1980. Do changes in the U.S. dollar exchange rate turn them to alternative sources of import, and thus reduce the U.S. share of such markets? This is the central question this dissertation seeks to address.
3.7 **Methodology**

In chapter one, a testable definition of "competitiveness" was given as "the ability to gain market share", or the "inability of competitors to counter attempts at gaining market share". So, empirically, the term "competitiveness" refers to market share in relation to a specific element of a seller's terms-of-sale.

The element of interest here is the U.S. dollar exchange rate, and the objective is to test for its impact on U.S. agricultural export market share. A finding of significant impact implies that the U.S. competitiveness in the particular agricultural export market is sensitive to changes in the exchange rate, and by further implication, that all policies affecting the exchange rate, also affect U.S. competitiveness in such markets.

The test parameter developed in chapter one is the exchange rate elasticity of export market share in specified markets. This parameter contains information on the basis of which inferences may properly be drawn concerning the "competitiveness" of agricultural exports vis-a-vis the exchange rate. In contrast, the exchange rate elasticity of export volume does not provide such information. It bears emphasizing that a change in the exchange rate, or any other element of a seller's terms-of-sale, which reduces the volume of exports need not affect export market share, whereas any change in market share will necessarily affect export volume. Therefore, market share is the more basic of the two aspects of the export issue. This point may be demonstrated more formally from equation (3.0.1), the export function for commodity j. From this equation, the exchange rate elasticity of export is given by:
\[(3.6.1) \quad n_{x_j,e} = (1 + \eta p_{ju,e}) \eta x_j, p^* < 0 \]

where

\[(1) \quad n_{x_j, p^*} = \Sigma k_{ij} \{w_{ij} + \lambda_{ij} \eta_{p^*_j, p^*_{ju}} \} < 0 ; 0 < \eta_{p^*_j, p^*_{ju}} < 1 \]

\[(ii) \quad \omega_{ij} = \eta_{k, p^*} (\alpha - \alpha_s) < 0 ; \alpha_s = S_{ij}/X_j ; \alpha_d = D_{ij}/X_j ; \alpha_s - \alpha_d > 0 \]

\[(iii) \quad n_{k, p^*} = \eta_{k, \lambda_j} (1 - \eta_{p^*_j, p^*_{ju} \lambda_j}; 0 < \eta_{p^*_j, p^*_{ju} \lambda_j} < 1 \]

Equation (3.6.1i) is the price elasticity of U.S. aggregate export of commodity \(j\). It may be derived directly by differentiating equation (3.6.1) with respect to the c.i.f. price of U.S. export of commodity \(j\), \(p_{ju}^*\). This parameter will be discussed further below in connection with other matters. Equation (3.6.1ii) is the own-price elasticity of U.S. export share of commodity \(j\) in the world market.

Suppose instead, that we are looking at U.S. export to a single market. In that case, equation (3.6.1) simplifies to:

---

\(^4\) See appendix for derivation.
\[(3.6.2) \quad n_{x_j, e} = n_{k_j, e} + k_{ij} (1 - n_{p^*_i, p^*_j, e}) (1 + n_{p^*_j, e}) \]

where the first term on the right

\[(i) \quad n_{k_j, e} = n_{k_j, \lambda} (1 - n_{p^*_j, p^*_j}) (1 + n_{p^*_j, e}) \]

is the exchange rate elasticity of export market share, and the second term is a composite of the following terms:

\[(ii) \quad \pi_i = (\alpha_d - \alpha_s) \frac{n_{p^*_i}}{s_i} < 0 \]

which is the price-elasticity of import need in the importing country \(i\), and

\[(iii) \quad n_{p^*_i, p^*_j} > 0, \quad p^*_i, p^*_j \]

is the elasticity of the domestic price of commodity \(j\) in the importing country \(i\) with respect to the c.i.f. price of the commodity originating from the U.S., and finally

\[(iv) \quad n_{p^*_j, e} < 0, \quad p^*_j \]

is the elasticity of the domestic price of commodity \(j\) in the U.S., with respect to U.S. dollar exchange.

The purpose of all this is to show that a change in the exchange rate which changes the volume of export, \(X_j\), need not affect
export market share, $k_j$. That is, $\eta_{x_j, e} < 0$, is consistent with $\eta_{k_j, e} = 0$. But, if market share is affected by the change in the exchange rate, export volume will necessarily be affected. That is, $\eta_{k_j, e} < 0$ necessarily implies that $\eta_{x_j, e} \neq 0$, (cf. equation (3.6.2)). The same may be said of a change in c.i.f. price, (cf. equation (3.6.11) and (3.6.1111)), or any other instrument in which one may be interested. Therefore, $\eta_{k_j, e}$ is the appropriate test parameter. It contains information on the basis of which inferences about the competitiveness of U.S. agricultural exports vis-à-vis the exchange rate, may appropriately be drawn. If price were the instrument of interest, the appropriate test parameter would be $\eta_{k_j, p_j^*}$, (cf. equation (3.6.1111), not $\eta_{k_j, \lambda}$, the elasticity of substitution, as in Telser (1962), and Sirhan and Johnson (1971).

3.8 How Large is $\eta_{p_j u^* e}$?

Another very important implication of the result in equation (3.6.1) concerns the controversy about the size of the exchange rate-elasticity of domestic U.S. price of the export commodity $j$, ($\eta_{p_j u^* e}$). Theory suggests that the sign of this parameter is negative. A devaluation of the U.S. dollar is expected to increase foreign demand for U.S. agricultural export by lowering the foreign
currency-equivalent price of the commodity. This, in turn, would raise the aggregate demand (foreign plus domestic) for the export commodity in the U.S., thereby pressuring its dollar-denominated price upwards. The result of all empirical studies reviewed earlier confirm the theoretical sign of this parameter. Furthermore, standard consumer theory suggests that the price elasticity of demand for export, \((n_{x_j,p^*})\), is negative, with, or without cross-price effects.\(^5\)

Finally, both theory and evidence indicate that the exchange rate elasticity of demand for export, \((n_{x_j,e})\), is also negative. In view of this discussion, the only unsettled issue about the parameter, \((n_{p_{ju},e})\), is its size.

From equation (3.6.1), it is evident that, if all three component elasticities are negative as discussed above, \((1 + n_{p_{ju},e})\) must be positive. It follows directly from this condition that \(n_{p_{ju},e}\) must be less than or equal to one in absolute value for equation (3.6.1) to be consistent with received theory.

This conclusion further implies that \(n_{x_j,e}\) lies in the

---

\(^5\) For this to be positive, the induced income effect must be negative and larger than the substitution effect of the price change. This is an empirical rarity.
interval \((\eta_{j,e} p_j^e, 0)\). Therefore, equation (3.6.1) provides a theoretical basis for judging the plausibility and consistency of the various estimates of the exchange rate elasticity of exports. So far, statements about the plausibility of such estimates have been based on arbitrary judgements. For instance, note the inconsistency of the result by CJ (1981), table 6, which shows \(\eta_{x_j,e}\) to be negative (as it should be), but \(\eta_{p_j,e}^\text{pju}\) to be greater than one in absolute value. Only their longrun result for wheat is consistent with the above conclusion. In CJ (1979), they noted that the conflicting finding on this parameter "may be due to the alternative specification of export or excess demand and supply equations", (p. 240). Beyond that, however, they are silent on the issue and focused attention on the omission of cross-price effects. The "standard theoretical model", (p. 249), which they adopted is of the type used by Tweeten (1967, 1977), Johnson (1977), and CMB (1980), which will shortly be shown to bias elasticities upwards.

3.9 Price Elasticity of Export Demand

The preceding discussions featured the price elasticity of export demand prominently. Derivations and estimates of the parameter in the literature have built-in upward bias. This section will briefly highlight the bias, and point to its source: the dominant specification of the export function in the literature.

The dominant specification of the export function is best exemplified by Tweeten (1967, 1977), and Johnson (1977):
where $E_{ij} = (D_{ij} - S_{ij})$. Tweeten, for instance, defines U.S. export of commodity $j$, as the "sum of the excess of demand quantity, $D_{ij}$, over supply quantity, $S_{ij}$, in the region or country $i". Tweeten (1977, p. 737). Conceptually, this specification is the excess demand notion of the export function. Tweeten places no restriction on $D_{ij}$ and $S_{ij}$, thus leaving the interpretation of equation (3.8.1) quite open. One may, for instance, view it as a "residual export" function, in which case $S_{ij}$ includes domestic production and import of the commodity from all sources except the U.S. Or, one may view it as the "import need" concept discussed earlier. To facilitate comparison, this later interpretation will be adopted here.

An important difference, however, is that equation (3.8.1) implicitly sets $k_{ij}$ to one, or to some "residual value". Another is the convenient assumption that the elasticity of the importer's domestic price with respect to U.S. price is equal to one. In other words, international price adjustment is assumed to be perfect.

---

6 For further discussions of this assumption see, Bredahl, Meyers and Collins (1979), Johnson, Grennes and Thursby (1977), Sampson and Snape (1980).
These two assumptions have important implications for the price elasticity parameter.

### 3.9.1 Implications of the Assumptions

From equation (3.8.1), the price elasticity of export demand is

\[ (3.8.2) \eta_{x_j, p^*_u} = \Sigma_1 \eta_{ij} \eta_{p^*_i p^*_u} < 0 \]

where

\[ \eta_{ij} = (\alpha_{d_{ij}} \eta_{d_{ij}} - \alpha_{s_{ij}} \eta_{s_{ij}}) \]

is the price elasticity of import need in the importing country, (cf. equation (3.6.2ii & 3.6.2ii)). All parameters here are as previously defined, (cf. equation (3.6.1)).

The result in (3.8.2) reflects the assumption that \( k_{ij} \) equals one. If we now incorporate the second assumption of perfect international price adjustment elasticity, (i.e. \( \eta_{p^*_i p^*_u} = 1 \)), the result in (3.8.2) becomes

\[ (3.8.3) \eta_{x_j, p^*_u} = \Sigma_1 \eta_{ij} < 0 \]

To highlight the implications of these two assumptions, compare the result in equation (3.8.3) with that in equation (3.6.1i). First, note that the effect of either assumption is to make \( \omega_{ij} \) zero. Second, if both assumptions are in effect, equation (3.6.1i) collapses
to (3.8.3). However, it is instructive to take the assumptions one by one to see their individual effects on the elasticity formula.

A. The k Bias

First, suppose that the assumption of perfect international price adjustment holds. Then, in equation (3.6.11), \( \eta_{ij}^* \frac{p_{jc}}{p_{ju}} \)

\( \eta_{ij}^* = 1 \), for all \( i \), in which case that equation becomes:

\[
(3.8.4) \quad \eta_{ij}^* \frac{p_{jc}}{p_{ju}} = \sum_{i} k_{ij} \eta_{ij} < 0
\]

which gives the elasticity of demand for U.S. export as a weighted average of price elasticities of import need for all importing countries, \( (1 = 1, 2, \ldots n) \), with \( k_{ij} \) as weights. Subtracting (3.8.4) from (3.8.3) yields a measure of the built-in upward bias

\[
(3.8.5) \quad B_k = \sum_{i} \eta_{ij} (1 - k_{ij}) < 0
\]

where \( (1 - k_{ij}) > 0 \) is a measure of how unrealistic it is to assume that \( k_{ij} \) equals one. The smaller \( k_{ij} \) turns out to be, the more unrealistic the assumption, and the larger the absolute value of the upward bias, \( B_k \). If \( k_{ij} \) turns out to be one, the upward bias evaporates. I shall refer to this bias as the "k-bias" to reflect the fact that it results from the implicit assumption in the dominant specification of the export function that \( k_{ij} \) equals one.
B. The P Bias

Now suppose that the k-assumption holds, (i.e. \( k_{ij} = 1 \)), in which case \( \eta_{k,\lambda} \) becomes zero, and equation (3.6.11) becomes

\[
(3.8.6) \quad \eta_{x_{ij},p_{ju}} = \sum_{i} \pi_{ij} \eta_{p_{ij}^*, p_{ju}^*} < 0
\]

which, again, is a weighted average of price elasticities of import need of the importing countries, with the weights now equal to the elasticity of the domestic market price of the commodity in each importing country, with respect to the import price of the commodity, from the U.S. Thus, the assumption of a perfect international price adjustment in a world market laden with distortions, leads to a built-in upward bias in the price elasticity of U.S. export. Subtracting (3.8.6) from (3.8.3) yields a measure of this upward bias

\[
(3.8.7) \quad B = \sum_{p} \pi_{ij} (1 - \eta_{p_{ij}^*, p_{ju}^*}) < 0
\]

where, again, \( (1 - \eta_{p_{ij}^*, p_{ju}^*}) > 0 \), is a measure of how unrealistic it is to assume a perfect international price adjustment in a distorted world market environment. The smaller \( \eta_{p_{ij}^*, p_{ju}^*} \) turns out to be, \( (i.e., \text{the more distorted the world market actually is}), \) the more unrealistic the assumption, and the larger the absolute value of the upward bias. I shall refer to this as the "p-bias" to reflect the fact that it results from the assumption of a perfect international price adjustment.
It bears emphasizing that \( B_k \) and \( B_p \) are "partial" or ceteris paribus biases. Their limited purpose is to show the effect of each of the two assumptions on the elasticity measure, while pretending that the other assumption is valid. Although important, the key point of the foregoing analysis is not merely that these assumptions bias the elasticity measure upward. A more important point is that the dominant specification of the export function, which incorporate these two assumptions, is fundamentally flawed.

C. **Shortrun Elasticity**

Another fruitful way of examining the elasticity formula of equation (3.8.3) is in terms of the adjustment time available to market participants. One may justifiably argue that international price adjustment elasticity is less than one, or possibly zero, in the shortrun. For instance, uncertainty about whether an observed price change is temporary, or permanent, could delay the adjustment of prices in the importing country to changes in import prices. Or, institutional forces, such as price insulation policies, may delay international price adjustments. In such cases, shortrun adjustments may be in the form of quantity adjustments, such as rationing. Therefore, it does not appear unreasonable to suppose that, in the very shortrun, a change in the c.i.f. price of U.S. exports does not affect the domestic market price of the commodity in the importing country, or the c.i.f. price of U.S. competitors. Consequently, all price adjustment elasticities in the elasticity formula of equation (3.6.11) will be zero. In that case, the shortrun price elasticity of export demand will be
The major point to note about this result is that it is independent of the price elasticity of the importing country's import need. In other words, the shortrun price elasticity of demand for U.S. export is independent of the price elasticity of import need in the importing countries. Rather, for given trade shares, the size of this parameter depends on the degree of source-switching by the importers, induced by their sensitivity to relative price changes as measured by $\eta k_{ij,\lambda}$. The higher the elasticity of substitution, the more elastic the shortrun demand for U.S. exports. However, the elasticity formula of equation (3.8.3) will yield a misleading result of zero elasticity in the shortrun.

3.9.2 Conclusion

Given the practical importance of the export price-elasticity parameter, researchers will enhance the usefulness of their estimates by cutting down on mere pedagogic assumptions, and lean towards more realism in modeling. The preceding analysis illustrates how biasing, or misleading, such assumptions can be, whether they are implicit or explicit.

The next section will discuss the trade share approach, and review the few studies using this approach.
3.10 The Trade Share Approach

The market share approach lends itself to a study of relative competitiveness of U.S. agricultural exports vis-a-vis its competitors in a given market. Telser (1962) used the market share approach in his study of domestic demand schedule for branded goods. He derived his basic market share equation from an applied theory of stochastic process, as a product of the conditional probability, $a_{ji}$, of switching from brand $j$ to brand $i$ in period $t$, and the unconditional probability, $z_{jt-1}$, that brand $j$ was purchased during period $t-1$. This product, which is the unconditional probability of purchasing brand $i$ during period $t$, is then summed over brand $j$, ($j = 1, 2, \ldots n$), to yield the market share for brand $i$ for period $t$, (p. 304, equation 5).

To make this operational, he substituted past market shares, $m_{jt-1}$, for brand $j$, as a proxy for $z_{jt-1}$, (p. 305), subject to the condition that shifts in the purchase of brands do not alter market shares, (p. 305, equation 13). Then he argued that the $a_{ji}$'s are functions of own price, and the average price of all other brands, (cf. equation 6, p. 310); substituted into (equation 4, p. 310) to derive his market share estimation equation, (cf. equation 10, p. 310), of the form:

\[ (3.9.1) \quad m_{it} = a_0 + a_1 m_{it-1} + a_2 p_{it} \]
where \( p_{it} \) is the difference between, (or ratio of), own price and average price of all other brands in the product class.\(^7\)

A stochastic version of (3.9.1) was then used to estimate longrun market share "price elasticities" for several product brands, (cf. table 9, p. 321), on the basis of which he concluded that "there seems to be a considerable competition among brands", (p. 323-24). However, his longrun "price elasticity" formula, (cf. equation 29, p. 313), which may be derived from (3.9.1) as:

\[
(3.9.2) \quad \eta_{m,p} = \frac{p_{a_2}}{(1 - a_1)m}
\]

clearly indicates that his "price elasticities" are more appropriately interpreted as "elasticities of substitution" between competing brands, and therefore do not provide a basis for inferences about market share behavior. The elasticity of substitution will be equivalent to the own-price elasticity of market share from which inferences may properly be drawn about market share behavior, only under the restrictive assumption that prices of all other competing brands are constant. In that case, the elasticity of the price of the competing brand with

\(\)\(^7\) This is necessarily a highly condensed sketch of Telser's theory. It does not do justice to the finer details of his theory, and therefore, is no substitute for the actual work should the reader be interested. However, the sketch captures the essence of the model.
respect to own-price will be zero, (cf. equation (1.2.7)). Therefore, the most one can infer from Telser's result is that there seems to be a considerable degree of brand switching in the market he studied.

Sirhan and Johnson - SJ (1971) used a market share model of the form in (3.9.1) in an international trade context to measure the shortrun and longrun "price elasticities" of U.S. export share of selected cotton import markets. Their goal was to test the hypothesis "that higher American cotton prices relative to competitor's prices led to the decline in the U.S. share of European import markets", (p. 593). They used a log transformation (3.9.1) to obtain estimates of longrun

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8 In his footnote 23, p. 324, Tesler reported the following interesting data on the own-price elasticity of market share: "Anheuser-Busch reduced their price per case in St. Louis in two steps while during this period their competitors did not change their prices, (emphasis mine). The Anheuser-Busch price was $2.93 in October, 1953, $2.68 in January, 1954, and $2.35 in June, 1954. Their market share rose from 12.5% in December, 1953, to 16.55% at the end of June, 1954 in response to the first price reduction. Thus, for this 5 month period, the market share elasticity is 3.8. From the end of June, 1954 to beginning of March, 1955, their market share rose from 16.55% to 39.3%. During this 9 month period, the price elasticity (of market share) is 11.2. For the entire 14 month period, the elasticity is 10.8. (FTV vs. Anheuser-Busch, Inc., 80 S. Ct 1267 (1960)".

Point: Note that the reported elasticities are own-price elasticities of market share, and that they are equivalent to the elasticity of substitution in this case only because, "during this period, their competitors did not change their prices". They probably deliberately chose not to change their prices as a basis for dragging Anheuser-Busch to court for unfair price-cutting aimed at gaining market share.
elasticities of substitution of -11.1 and -10.82 for the British and German markets respectively, (p. 597, table 3, equation 4; p. 598, table 5, equation 3), on the basis of which they concluded that "the relatively large estimates of the shortrun and longrun elasticities of market share are indicative of a high degree of sensitivity of American cotton share in the two import markets to price changes... The loss in U.S. cotton market share ... would have been greater had it not been for the reduction in price of American cotton relative to competitors", (p. 598).

Again, this conclusion is not warranted, being based on erroneous datum: the elasticity of substitution, rather than on own-price elasticity of market share. The most one can infer from an observed high elasticity of substitution is that there is a high degree of brand-switching induced by consumer sensitivity to relative price changes. This limited information provides no basis for inferences about the response of market share to an observed price change. What happens to the market share of a competitor whose price has changed depends crucially on how the prices of other competing sellers in the market respond to the price change. This additional piece of information is embodied in the elasticity of the competing sellers' prices with respect to own-price, (cf. equation (1.2.7)). To assume, implicitly, that these elasticities are zero, is to assume away the hypothesis which is being tested, except perhaps, in the very shortrun.

---

9 The elasticities associated with their other equations are said to be of "dubious value", being based on "statistically non-significant" coefficients, (p. 597-598).
The analytical insight afforded by the observed high price elasticity of substitution is that, a strong dynamic price adjustment will be set in motion in these markets as a result of a change in U.S. cotton price. Underlying this is the substantive fact that importers in these markets are very sensitive to relative price changes. As a result, a rise in U.S. cotton price induces the importers to shift their demand to relatively cheaper cotton from other sources of import. This shift in demand creates excess demand for cotton from these other sources which will tend to pressure their prices upward. One cannot measure the effect of the initial rise in U.S. price on U.S. market share while the induced adjustment is still in progress. The point at which to measure the effect of the price change on market share is the point where the induced adjustments stop - at a new equilibrium point, where a new set of relative prices and market shares will have been established. At this point, the "price elasticity of market share" will account for the induced changes in competitor's prices. If, on the average, the induced percent rise in competitors' prices is less than the initial percent rise in U.S. price, then the U.S. relative price at the new equilibrium will be higher than at the original equilibrium, and the U.S. will be expected to lose market share. Thus, the determining parameter is the elasticity of competitors prices with respect to U.S. price, \( e_{PC,US} \).

To illustrate the difference between the two parameters, and to test the hypothesis that U.S. share of the two cotton markets are sensitive to changes in U.S. price, the price elasticities of market share are estimated, using their data set. The estimated equations are given in table 8 and the resulting price elasticity parameters, and their own results, are summarized in table 9. The price elasticities

<table>
<thead>
<tr>
<th></th>
<th>U. K.</th>
<th></th>
<th>W. Germany</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>k(^a)</td>
<td>p(^a)</td>
<td>k(^b)</td>
<td>p(^b)</td>
</tr>
<tr>
<td>$\beta_0$</td>
<td>-0.79</td>
<td>-0.2</td>
<td>6.4</td>
<td>0.06</td>
</tr>
<tr>
<td>$t$</td>
<td>-1.49**</td>
<td>-2.3*</td>
<td>9.01*</td>
<td>2.74*</td>
</tr>
<tr>
<td>$\beta_1$</td>
<td>0.2</td>
<td>0.41</td>
<td>0.05</td>
<td>0.07</td>
</tr>
<tr>
<td>$t$</td>
<td>0.88</td>
<td>-0.26</td>
<td>2.8*</td>
<td>-1.8</td>
</tr>
<tr>
<td>$\beta_2$</td>
<td>-9.5</td>
<td>0.91</td>
<td>-3.5</td>
<td>0.88</td>
</tr>
<tr>
<td>$t$</td>
<td>-4.44*</td>
<td>2.58*</td>
<td>-6.7*</td>
<td>2.75*</td>
</tr>
<tr>
<td>TC</td>
<td>n/a</td>
<td>n/a</td>
<td>-0.04</td>
<td>n/a</td>
</tr>
<tr>
<td>$t$</td>
<td>n/a</td>
<td>n/a</td>
<td>-8.44*</td>
<td>n/a</td>
</tr>
<tr>
<td>$R^2$</td>
<td>0.64</td>
<td>0.96</td>
<td>0.82</td>
<td>0.86</td>
</tr>
<tr>
<td>h</td>
<td>-0.57</td>
<td>dd</td>
<td>0.01</td>
<td>dd</td>
</tr>
<tr>
<td>d</td>
<td>2.09</td>
<td>2.24</td>
<td>1.9</td>
<td>2.26</td>
</tr>
<tr>
<td>SEE</td>
<td>0.28</td>
<td>0.034</td>
<td>0.053</td>
<td>0.011</td>
</tr>
<tr>
<td>p</td>
<td>0.87</td>
<td>-0.37</td>
<td>0.03</td>
<td>-0.31</td>
</tr>
<tr>
<td>t</td>
<td>6.38*</td>
<td>1.43**</td>
<td>0.09</td>
<td>1.18</td>
</tr>
</tbody>
</table>

\(^a\)These equations are in log-form as follows: (1) Log $k_t = \beta_0 + \beta_1 \log k_{t-1} + \beta_2 \log \lambda_t + \epsilon_t$
(2) Log $P_c(t) = \beta_0 + \beta_1 \log P_c(t-1) + \beta_2 \log P_us(t) + \epsilon_t$

\(^b\)These are linear versions of those in footnote "a".

\(^c\)A trend term. $dd_h$-statistic undefined. (Cross Ref. table 9).
Table 9: Price Elasticity of U.S. Cotton Market Share in U.K. and W. Germany
Sirhan and Johnson (1971) Revisited

<table>
<thead>
<tr>
<th></th>
<th>U.K.</th>
<th>W. Germany</th>
<th></th>
<th>U.K.</th>
<th>W. Germany</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$\eta_{k,\lambda}$</td>
<td>$\eta_{k,p}$</td>
<td></td>
<td>$\eta_{k,\lambda}$</td>
<td>$\eta_{k,p}$</td>
</tr>
<tr>
<td>Equation</td>
<td>SR</td>
<td>LR</td>
<td>SR</td>
<td>LR</td>
<td>SR</td>
</tr>
<tr>
<td>A</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.</td>
<td>-8.67</td>
<td>-10.16</td>
<td>-0.78</td>
<td>-1.81</td>
<td>-7.62</td>
</tr>
<tr>
<td>2.</td>
<td>-2.70</td>
<td>-9.67</td>
<td>-0.24</td>
<td>-0.87</td>
<td>-9.39</td>
</tr>
<tr>
<td>3.</td>
<td>-7.70</td>
<td>-14.00</td>
<td>-0.69</td>
<td>-1.26</td>
<td>-8.98</td>
</tr>
<tr>
<td>4.</td>
<td>-2.89</td>
<td>-11.10</td>
<td>-0.26</td>
<td>-1.00</td>
<td>-7.40</td>
</tr>
</tbody>
</table>

Panel B - table 8 (this study). Line 1, panel B, are measured at the mean with coefficients from table 8.

- $\eta_{k,p} = \eta_{k,\lambda} (1 - \eta_{p_{c,p\text{US}}})$ are given in table 8.

Source: $\eta_{k,y}$, panel A - Sirhan and Johnson (1971), tables 3 and 5.

Panel B - table 8 (this study). Line 1, panel B, are measured at the mean with coefficients from table 8.

Equation 1, panel B, is comparable with equation 3 (U.K.). Both are linear and include a trend term. Equations 1 and 2, (panel A), are also linear. Equation 2, panel B, is comparable to equation 4 (U.K.). Both are log-linear. Their W. German equations are not comparable to the re-estimated W. German equation (panel B), because their "dependent variable is in logarithmic form, whereas independent variables are linear", (ibid, table 4).
of substitution, $\eta_{k,\lambda}$, reported in panel A, are from Sirhan and Johnson (1971). The price elasticities of market share, $\eta_{k,p}$, reported in panel A, are estimates of this parameter implied by Sirhan and Johnson (1971)'s estimates of $\eta_{k,\lambda}$. As can be seen from the table, the difference between the two parameters, $\eta_{k,\lambda}$ and $\eta_{k,p}$, is quite large. For instance, their estimated elasticity of substitution for the U.K. market (panel A, row 1) is -8.67 in the shortrun, and -20.16 in the longrun, while the implied elasticities of market share are only -.78 in the shortrun, and -1.8 in the longrun. Clearly, the degree of price sensitivity of U.S. share of the two cotton markets would be vastly overstated if one were to base one's inference on the elasticity of substitution.

In U.K., the sensitivity of cotton price of U.S. competitors to changes in U.S. cotton price is quite high. A 1% rise in U.S. cotton price induces a rise of 91 basis points in the average price of U.S. competitors. In West Germany, competitors price is much less sensitive to U.S. price. A rise of 1% in U.S. price induces only a rise of 41 basis points in competitors average price. As a result, U.S. share of the West German market is more price elastic than its share of the British market.

In summary, the parameters $\eta_{k,\lambda}$ and $\eta_{k,p}$ are substantively very different. They convey different information about the market they describe. In the present context, the elasticity of substitution, $\eta_{k,\lambda}$, gives information about the sensitivity of importers to changes in the relative prices of the various suppliers of the import commodity. It, therefore, describes the behavior of people attempting to cope with
actual budget constraints. Price elasticity of market share, on the other hand, describes the sensitivity of market share to changes in price. For this reason, it would be inappropriate to draw inferences about market share from the elasticity of substitution, or about the importer's price sensitivity from the price elasticity of market share.

3.11 **Statement of Hypotheses**

This section sets out the hypotheses to be tested. The first stated major objective of this research is to study the effect of changes in the U.S. dollar exchange rate on the competitiveness of U.S. agricultural commodity exports. To accomplish this, the following hypothesis will be tested.

(1) **U.S. agricultural export-share is sensitive to changes in the U.S. dollar exchange rate.**

This may be stated more formally as follows:

(1a) \( H_0 : \eta_{k,e} = 0 \); \( H_a : \eta_{k,e} < 0 \)

If the null hypothesis is rejected, that implies that a rise in the U.S. dollar exchange rate would reduce the competitiveness of U.S. agricultural export in the given market.

The second stated objective of this study is to examine the empirical validity of the passivity assumption. The commonly held view is that a rise in the U.S. interest rate leads to a rise in the U.S. dollar exchange rate. The theoretical validity of this point of view was shown to depend on the implicit assumption that foreign interest rate is insensitive to changes in U.S. interest rate - the passivity assumption. To examine the empirical validity of this assumption, the following hypothesis will be tested:
(2a) $H_0 : \eta_{r^*, r} = 0 ; \quad H_a : \eta_{r^*, r} > 0$

A rejection of the null hypothesis, which is a rejection of the strong version of the passivity assumption, implies that foreign interest rates respond positively to changes in U.S. interest rates and therefore, that the U.S. dollar exchange rate may very well be unaffected by changes in the U.S. interest rate. But, a rejection of this null hypothesis provides no information about the degree of responsiveness. Therefore, one cannot know, merely by rejecting the strong passivity assumption, whether or not a rise in U.S. interest rate will lead to a rise in the exchange rate. That depends on additional information from a test of the weak version of the passivity assumption.

The rejection of the strong version of the passivity assumption is a necessary, but not a sufficient condition for the insensitivity of the exchange rate to changes in domestic interest rate. That requires a rejection of both the strong and the weak versions of the passivity assumption. The weak version recognizes the responsiveness of foreign interest rates to changes in U.S. interest rate, but holds that the degree of responsiveness is less than one. A test of this version of the assumption may be stated as follows:

(2b) $H_0 : \eta_{r^*, r} = 1 ; \quad H_a : \eta_{r^*, r} < 1$

Failure to reject this null hypothesis means that the weak version of the passivity assumption is rejected. In that case, it may then be inferred that the exchange rate is insensitive to changes in the interest rate. If, however, this null hypothesis is rejected, then the weak passivity assumption is upheld. And that, in conjunction with a
rejection of the strong version, implies that the exchange rate is positively related to the domestic interest rate, in which case, it may be inferred that a rise in U.S. interest rate will lead to a rise in the U.S. dollar exchange rate.

In summary, the popular view that the recent appreciation of the U.S. dollar is largely explained by rising domestic interest rates will be upheld, first, if and only if, the strong passivity assumption, \((n_{r*,r} = 0)\), is not rejected, or secondly, if and only if, the strong version is rejected and the weak version, \((n_{r*,r} < 1)\), is not rejected.

The following logarithmic transformation of (3.2.1) will be used in testing the hypothesis that changes in the exchange rate has a significant impact on the competitiveness of U.S. agricultural exports. The main justification for this functional form is that it will yield the same elasticity measure over the entire range of the function.

\[
(3.10.1) \quad \log k = \beta_0 + \sum_{i=1}^{n} \beta_i \log k_{jt-1} + \sum_{i=0}^{2} \beta_{2i} \log \lambda_{jt-1} + \sum_{i=0}^{2} \beta_{3i} \log e_{jt-1} + \varepsilon_{jt}, \quad j = 0, 2, \ldots, m, n.
\]

\[
(3.10.2) \quad \log \lambda = \alpha_0 + \sum_{i=1}^{m} \alpha_i \log \lambda_{jt-1} + \sum_{i=0}^{2} \alpha_{2i} \log e_{jt-1} + \varepsilon_{2t}
\]

where

\[
\beta_1 > 0; \quad \beta_2, \beta_3 < 0; \quad \alpha_1 > 0; \quad \alpha_3 > 0.
\]

The model embodies the theory that the exchange rate has both a direct and indirect effects on export market share. The indirect effect operates through relative prices while the direct effect is
introduced through the variable $Z$ of equation (3.2.1). This is the logic of (3.2.1). That is:

$$\frac{d \log k}{d \log e} = \frac{\partial \log k}{\partial \log \lambda} \cdot \frac{\partial \log \lambda}{\partial \log e} + \frac{\partial \log k}{\partial \log e}$$

where the first term on the right measures the "indirect effect", and the second term, the "direct effect" of an exchange rate change on market share. The following diagram further illustrates the point:

![Figure 6. Channels of Exchange Rate Effect on Market Share](image)

Also built into the model through the variable $Z$ of equation (3.2.1), is the assumption that past export shares reflect the element of "reliability" and "product quality", at least in part. The more reliable the U.S. is as a supplier relative to other suppliers, and the better the relative quality of U.S. commodities, the larger its market share will be. Therefore, a lagged value of $k_{ij}$ is included as a proxy for reliability and product quality. It is also assumed that changes in relative price do not translate instantaneously into changes in market share. This assumption may be justified on several grounds. For instance, contractual obligations that cannot be changed in the shortrun, uncertainty about whether an observed relative price change
is temporary or permanent, or even a good track record of reliability, may slow adjustments to relative price changes especially if the change is perceived to be temporary.

Therefore, a test of the stated hypothesis consists in testing for the significance of the parameters $\beta_2$, $\beta_3$, and $\alpha_2$, from which the elasticity of market share with respect to the exchange rate will be derived.

The theoretical development of this test pointed out an alternative test. It was shown that if the elasticity of the price of U.S. competitors with respect to U.S. price is equal to one, then the effect of exchange rate changes on U.S. market share will be limited to its direct effect. Therefore, depending on the data available to the researcher, this alternative test may be used. However, this alternative test will only indicate whether or not an exchange rate change indirectly affects market share through induced relative price changes. It provides no information on the extent of the effect, if such an effect exists. So, barring data problems, the first test is to be preferred.

Another variant of the exchange rate test is a test of the proposition that, in a given market, a rise in the U.S. dollar exchange rate against the currency of a competing exporter, will reduce the competitiveness of U.S. exports relative to that of the competitor. For instance, the U.S. and Canada are major competitors in the export of wheat to Japan. The proposition is that if the U.S. dollar appreciates in value relative to the Canadian dollar, then the U.S. export share relative to that of Canada will fall. For a test of this proposition, the following model will be used:
The null hypothesis is that $\alpha_2$ equals zero, against the alternative that it is negative. If this null hypothesis is rejected, one may infer that an appreciation of the U.S. dollar against the currency of a competing exporter will reduce U.S. export share relative to that of the competitor. $X_{us}$ is the absolute volume of U.S. export and $X_c$ is that of the competitor. The $k$'s are export shares in the given market; $e_{us}$, $e_c$ are their respective exchange rates defined in terms of the importer's currency. The test will be carried out for the U.S. versus Canada.

For a test of the passivity assumption, the following model will be used:

\begin{equation}
(3.10.4) \quad \log r^* = \alpha + \sum a_i \log r^* + \sum \beta_i \log r_{t-1} + \varepsilon_t
\end{equation}

For the strong passivity assumption, the null hypothesis is that, in
the shortrun $\beta_0$ is zero, or more generally, that $\beta_i$ is zero, for all $i$, against the alternative that it is positive for, at least, one $i$.

In the long run, the null hypothesis is that $(\Sigma_i \beta_i)/(1 - \Sigma_i \alpha_i)$, or more generally, that $\beta_i$ is zero, for all $i$, against the alternative that it is positive for, at least, one $i$. A rejection of this null hypothesis is a rejection of the strong passivity assumption and implies that foreign interest rate is positively related to U.S. interest rate. But a mere rejection of this null hypothesis says nothing about the degree of that relationship. Therefore, one cannot know, on the basis of this limited information, whether or not a rise in U.S. interest rate will lead to a rise the U.S. dollar exchange rate. But, failure to reject the null provides a sufficient basis for inferring that a rise in U.S. interest rate, will tend to raise the value of the U.S. dollar.

For the weak passivity assumption, the null hypothesis is that, in the shortrun, $\beta_0$ equals one, against the alternative that it is less than one, while in the longrun, the null hypothesis is that $(\Sigma_i \beta_i)/(1 - \Sigma_i \alpha_i)$ equals one, against the alternative that it is less than one. Failure to reject this null hypothesis means that the weak passivity assumption is rejected. It may then be inferred that the U.S. dollar exchange rate is insensitive to changes in U.S. interest rates. A rejection of the null hypothesis upholds the weak passivity assumption, and that, in conjunction with a rejection of the strong version, implies that a rise in the U.S. interest rate will raise the U.S. dollar exchange rate.
CHAPTER IV

DATA, TEST RESULTS, AND ANALYSES

4.1 Tests Performed

This chapter discusses the data used and their sources; reports, and analyzes results of empirical tests. The hypotheses tested are, first, that a rise in the U.S. dollar exchange rate reduces the U.S. competitiveness in agricultural commodity trade. The concept of competitiveness is defined as the ability to gain market share. Therefore, market share is the logical dependent variable in such a test.

In order to compare their relative impacts on competitiveness, the hypothesis is also tested for price changes. The two tests are conducted for wheat, corn, and soybean in both the Japanese and world import markets. The tests are also performed for Canadian wheat in Japan so as to compare the sensitivities of the market shares of the two major and neighboring wheat exporters to Japan. For U.S. cotton, the price test is performed in two import markets: United Kingdom and West Germany.

The second hypothesis tested is the passivity assumption, namely, that foreign interest rates are insensitive, or nearly so, to changes in U.S. interest rate. This hypothesis is implicit in the argument that high U.S. interest is responsible for the relative strength of the U.S. dollar since the early 1980s. Although
intuitively appealing, only an empirical validation of the above hypothesis will substantiate the argument. If the hypothesis is validated, its important policy implication is that a rise in the U.S. interest rate will lead to a rise in the U.S. dollar exchange rate which, in turn, affects U.S. ability to export.

The theoretical basis for the argument that a rise in U.S. interest rate raises the exchange rate is that, under conditions of capital mobility across countries, a rise in the U.S. interest rate, which widens the differential between the U.S. and foreign interest rates, induces international realignments of financial assets portfolios in favor of financial assets denominated in U.S. dollar. Theoretically, it is not the rise in the U.S. interest rate per se, that induces the realignment in international portfolios of financial assets, but the differential between foreign and U.S. interest rates. However, under the null hypothesis, a rise in this interest rate differential is equivalent, or nearly equivalent, to a rise in U.S. interest rate. So, under the null hypothesis, a rise in the U.S. interest will lead to a rise in the U.S. dollar exchange rate.

This hypothesis is tested for six industrial countries: Britain, Canada, Netherlands, West Germany, Japan, and France.

4.2 Data

Wheat, corn, and soybean data for the Japanese import market

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1 Strictly, one cannot speak of "validating" a hypothesis. Therefore, "validation" is to be construed here as meaning that the null hypothesis is not rejected by the data.
are drawn from "Japan Export and Import, Commodity by Country", published by the Japan Tariff Association. The data are for the period 1950 through 1982.2

The world market data for these commodities are drawn from the "Trade Yearbook" of the United Nation's Food and Agricultural Organization, for the period 1959 through 1981. Appropriate data for earlier years were not available.

Country exchange rate data used for tests in the Japanese market are drawn from the "International Financial Statistics, Supplement on Exchange Rate, Supplement Series Number 1", IMF, 1981, pages 12-16, and from the Federal Reserve Bulletin. For the world market test, the trade-weighted exchange rate series used are derived as explained in the next section.

The price series used are unit c.i.f. import values. Cotton price and quantity data are from Sirhan (1969), pages 28-29, 31-32, and 81-84, and cover the period 1953 through 1966.

Interest rate data for the passivity assumption tests are short-term, money market rates drawn from the United Nation's Monthly Bulletin of Statistics for the period January, 1974 through July, 1984. For the U.S., Canada, and Britain, the money market rates used are Treasury Bill rates, while "call money rates" are used for Netherlands, West Germany, Japan and France. Real interest rate series used

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2 My gratitude to Ms. Lois Caplan of the ERS, USDA, Washington, D.C., for her assistance in collecting these data.
are generated from the above nominal rate series, with annual consumer price indices, "for all items", with 1974 as base. The price indices are drawn from the United Nation's Monthly Bulletin of Statistics.

4.3 Test Results

This section reports test results. Analyses of these results are taken up in the next section. The reader may wish to skip this section and refer to it as the need arises. But, it gives all empirical test results on which subsequent analyses are based.

In all that follows, unless otherwise indicated, \( k_t \) is the U.S. market share of the indicated commodity, \( \lambda_t \) is the U.S. relative price, defined as the ratio of c.i.f. unit value of imports from the U.S. to the c.i.f. unit value of imports from all U.S. competitors in the given market, and \( e_t \) is the exchange rate, more specifically defined in each case.

A single asterisk (*) on t-values indicates statistical significance at the 5% level, or better; a double asterisk (**) indicate significance at the 10% level. T-values are enclosed in parenthesis below coefficient estimates. These are one-tail tests.

Reported systems of equations are estimated using Zellner (1962)'s Seemingly Unrelated Regression procedure. Maddala (1977) gives a good and brief description of the procedure. Reported chi-square tests following such equation systems are equivalent to the

---

3 The UN CPI series used 1970 as base. These were reconstructed here with 1974 as base to bring all data within the floating exchange rate era.
likelihood ratio test in a multivariate regression model, of the hypothesis that all slope coefficients are zero. The test is described in Mood, Graybill, and Boes (1974), p. 440-442.

Each of the two equations in the system, (cf. equations (3.10.1) and (3.10.2)), could be estimated separately by ordinary least squares procedure if one were certain that there is no cross-equation correlation of errors. But, if such cross-equation error correlations exist, then, estimation by ordinary least squares will yield inefficient parameter estimates. Separate estimation of these equations generally yielded poor results for the relative price equation, \( \lambda \), which became much improved when Zellner's generalized least square procedure was used.

All reported single equation multiple regression models are estimated by the maximum likelihood procedure, incorporating a first, or second order serial correlation process as the case may be. Cochran-Orcutt type procedure was used to obtain maximum likelihood estimate of the serial correlation coefficients, with convergence equal to .001. For more on the estimating procedure, see White (1978).

4.3.1 Commodity Equations

This section presents estimated systems of equations for the impact of the exchange rate on export market share for wheat, corn, and soybean, in the Japanese and World import markets, (cf. equations (3.10.1) and (3.10.2)).

A.1. Wheat in the Japanese Import Market

1. Logarithmic Form
\[(1.1) \log k_t = 1.54 + .61 \log k_{t-1} + .71 \log \lambda_t - .321 \log e_t \]
\[\text{(1.87)* (4.68)* (2.03)* (-2.18)*} \]
\[(1.2) \log \lambda_t = -.56 + .42 \log \lambda_{t-1} + .094 \log e_t \]
\[\text{(-1.5325)** (2.68)** (1.50)**} \]

\[R^2 = .72, X^2(\alpha%, 5) = 40.89*\]

(Cross Ref. table 13, footnote "a", Japan).

2. Linear Form

\[(2.1) k_t = -.007 + .51 k_{t-1} + 5 \lambda_t - .0007 e_t \]
\[\text{(-.0433) (4.033)* (2.97)* (-2.78)*} \]

\[(2.2) \lambda_t = .45 + .45 \lambda_{t-1} + .0003 e_t \]
\[\text{(3.21)* (2.94)* (1.35)**} \]

\[R^2 = .72, X^2(\alpha%, 5) = 40.14*\]

(Cross Ref. table 13, footnote "b", Japan).

The exchange rate used in all Japanese market equations is the (¥/US$) exchange rate.

A.2. Wheat in the World Import Market

1. Logarithmic Form

\[(1.1) \log k_t = 1.9 - .041 \log k_{t-1} + 1.42 \log \lambda_t - 6 \log e_t \]
\[\text{(2.39)* (-.2586) (4.20)* (-3.34)*} \]

\[(1.2) \log \lambda_t = .42 + .35 \log \lambda_{t-1} - .10 \log e_t \]
\[\text{(.91) (1.76)* (-.9686)} \]
The short-run point elasticity of U.S. relative price with respect to the exchange rate, $\lambda_{t,e}$, measured at the mean, is 3.64. But, since relative price does not have a statistically significant impact on market share, (cf. 2.1 above) the indirect channel of exchange rate impact on market share is broken.

The exchange rate, $e_t$, used in the above world market equations, and in subsequent world market equations, is the trade-weighted exchange rate of the U.S. dollar, defined as:

$$e_t = 100 \exp \left( \sum_{i=1}^{10} w_i \ln R_{it} \right)$$

where $R_{it}$ is the ratio of base period exchange rate of currency $i$ to exchange rate of currency $i$, at time $t$; and the weight, $w_i$, is country $i$'s average share of total trade (imports plus exports) of the
ten countries for the five years 1972-1976. The exchange rates used in calculating \( R_n \) are U.S. cents per unit of the foreign currency. The base period used is March 1973, the start of the floating era for the U.S. exchange rate. The countries and trade weights used are: West Germany (.208), Japan (.136), France (.131), U.K. (.119), Canada (.091), Italy (.09), Netherlands (.083), Belgium (.064), Sweden (.042), and Switzerland (.036). The Federal Reserve Board's trade-weighted exchange rate series are derived according to equation (4.3.1).  

B.1. **Corn in the Japanese Import Market**

1. Logarithmic Form

\[
\begin{align*}
(1.1) \log k_t &= 2.57 + .53 \log k_{t-1} - 1.54 \log \lambda_t - .49 \log e_t \\
(1.143) &\quad (3.7)* &\quad (-1.0243) &\quad (-1.24)**
\end{align*}
\]

\[
(1.2) \log \lambda_t = - .69 + .0241 \log \lambda_{t-1} + .12 \log e_t \\
(-3.09)* &\quad (.1386) &\quad (3.10)*
\]

\[ R^2 = .62, \chi^2 (\alpha, 5) = 30.77^* \]

(Cross Ref. Table 14, footnote "a", Japan).

2. Linear Form

\[
(2.1) k_t = .44 + .47 k_{t-1} + .44 \lambda_t - .002 e_t \\
(.8063) &\quad (3.71)* &\quad (.6799) &\quad (-2.73)*
\]

\[ See Federal Reserve Bulletin, August 1978, p. 100. See also, Rhomberg (1976), for other approaches. \]
B.2. Corn in the World Import Market

1. Logarithmic Form

\[(1.1) \log k_t = 3.49 + 0.34\log k_{t-1} - 0.17\log \lambda_t - 0.82\log e_t\]

\[R^2 = 0.76, \chi^2(\alpha, 5) = 31.14\]

(Cross Ref. table 14, footnote "a", World).

2. Linear Form

\[(2.1) k_t = 1.02 + 0.36k_{t-1} - 0.14\lambda_t - 0.05e_t\]

\[R^2 = 0.76, \chi^2(\alpha, 5) = 31.14\]

(Cross Ref. table 14, footnote "b", Japan).

The shortrun point elasticity of U.S. relative price with respect to the exchange rate, \(\eta_{\lambda,e}\), measured at the mean, is 0.14. But since relative price does not have a statistically significant impact on market share, (cf. 2.1 above), the indirect channel of exchange rate impact on market share is broken.
\[ (2.2) \lambda_t = .45 - .09\lambda_{t-1} + .005e_t \]

\[ (2.1)* \quad (-.4392) \quad (2.18)* \]

\[ \bar{R}^2 = .81, \chi^2(\alpha%, 5) = 36.11* \]

(Cross Ref. table 14, footnote "b", World)

The short-run point elasticity, \( n_{\lambda_s e} \), measured at the mean is .57.

C.1 Soybean in Japanese Import Market

1. Logarithmic Form

\[ (1.1) \log k_t = .66 + .09 \log k_{t-1} - .32 \log \lambda_t - .14 \log e_t \]

\[ (1.52)** \quad (.93) \quad (-2.47)* \quad (-1.85)* \]

\[ (1.2) \log \lambda_t = -.8 + .56 \log \lambda_{t-1} + .13 \log e_t \]

\[ (-1.86)* \quad (3.94)* \quad (1.77)* \]

\[ \bar{R}^2 = .52, \chi^2(\alpha%, 5) = 23.69* \]

(Cross Ref. table 15, footnote "a", Japan).

2. Linear Form

\[ (2.1) k_t = 1.17 + .15 k_{t-1} - .31 \lambda_t - .0004e_t \]

\[ (7.15)* \quad (1.37)** \quad (-2.60)* \quad (-1.74)* \]

\[ (2.2) \lambda_t = .25 + .58 \lambda_t + .0004 e_t \]

\[ (1.96)* \quad (4.19)* \quad (1.74)* \]

\[ \bar{R}^2 = .56, \chi^2(\alpha%, 5) = 26.41* \]
The shortrun point elasticity, $\eta_{\lambda,e}$, measured at the mean, is .14.

C.2  Soybean in the World Import Market  

1. Logarithmic Form

(1.1) $\log k_t = 4.95 - .02 \log k_{t-1} - .51 \log \lambda_t + .63 \log e_t$

\[ (-2.3)^* \quad (-.43) \quad (-25.4)^* \quad (2.18)^* \]

$\varepsilon_t = .53 \varepsilon_{t-1} - .16 \varepsilon_{t-2}$

\[ (2.52)^* \quad (-.76) \]

$R^2 = .97$, SEE = .087, $h = -.097$

(Cross Ref. Table 15, footnote "a", World)

(1.2) $\log \lambda_t = 26.3 - .12 \log \lambda_{t-1} - 6.04 \log e_t$

\[ (3.20)^* \quad (-.5992) \quad (-3.17)^* \]

$\varepsilon_t = .52 \varepsilon_{t-1} - .61 \varepsilon_{t-2}$

\[ (3.08)^* \quad (3.61)^* \]

$R^2 = .29$, SEE = .79, $h = .70$

(Cross Ref. Table 15, footnote "a", World)

5 Separate estimation for the two equations (3.10 1) and (3.10.2), with adjustments for serial correlation, yielded better results for soybean in this market.
2. Linear Form

\[(2.1) \quad k_t = 1.08 - 0.31 k_{t-1} - 0.014 \lambda_t + 0.005 e_t \]
\[(2.13)^* \quad (-2.61) \quad (-10.39) \quad (1.92)^* \]

\[\varepsilon_t = 0.06 \varepsilon_{t-1} + 0.42 \varepsilon_{t-2} \]
\[(.31) \quad (2.17)^* \]

\[R^2 = 0.86, \quad \text{SEE} = 0.88, \quad h = 0.25 \]

\[(2.2) \quad \lambda_t = 98.8 - 0.4 \lambda_{t-1} - 0.85 e_t \]
\[(3.51)^* \quad (-3.30)^* \quad (-2.16)^* \]

\[\varepsilon_t = 0.49 \varepsilon_{t-1} - 0.52 \varepsilon_{t-2} \]
\[(2.69)^* \quad (-2.86)^* \]

\[R^2 = 29, \quad \text{SEE} = 12.2, \quad h = 0.05 \]

(Cross Ref. table 15, footnote "b", World)

The two sets of soybean equations in the world market were initially estimated as systems of seemingly unrelated regression equations using Zellner (1962)'s procedure. Standard tests revealed serious autocorrelation. As a result, each equation was re-estimated separately, using the maximum likelihood method, and incorporating the second order serial correlation. As the Durbin h-statistic shows, the null hypothesis of zero serial correlation could no longer be rejected.

Two unexpected results are worth noting. U.S. share of world soybean import market turned out to be positively related to the trade-weighted exchange rate, and the relative price of soybean turned out to be negatively related to the exchange rate.
Of all commodities studied, only soybean world market share responded in this "perverse" manner. This leads me to wonder whether the response is necessarily perverse, or whether it reflects the peculiarities of the commodity in the world market that may warrant additional future study.

D. Canadian Wheat Share in Japanese Import Market

(1.1) \[ \log k_t = -1.09 + 0.69 \log k_{t-1} - 1.36 \log \lambda_t + 0.15 \log e_t \]
\[ (-1.34)^* (8.58)^* (-3.77)^* \]

(1.2) \[ \log \lambda_t = 0.37 + 0.51 \log \lambda_{t-1} - 0.06 \log e_t \]
\[ (1.21) (3.20)* (-1.12) \]

\[ R^2 = 0.89, \chi^2(\alpha, 5) = 71.45^* \]

(Cross Ref. table 16)

The parameters, \( \frac{\partial \log k_t}{\partial \log e_t} \) and \( \frac{\partial \log \lambda_t}{\partial \log e_t} \), although insignificant, have unexpected signs which persisted in experiments with several functional forms.

4.3.2 Competitor's Price Adjustment Equations

Equation (3.3.1) postulates a positive relation between the commodity price of an exporting country and those of its competitors in a given market. The underlying assumption is that the commodity originating from any of the exporting countries, is, from the importer's point of view, a substitute for the same commodity originating from other exporting countries. So, "Canadian wheat" is seen by the
importer, as a substitute for "U.S. wheat", etc., but not necessarily as perfect substitutes.

This relation is important for estimating the price elasticities of market share in a given market. Estimates for U.S. competitors' price adjustment elasticities for wheat, corn, and soybean, in the Japanese and world markets, are presented in tables 10 and 11. In all such equations, the dependent variable, \( P_c \), is the average c.i.f. price of all U.S. competitors in the given market, and the independent variable, \( P_{US} \), is the U.S. c.i.f. price of the commodity.

The sensitivity of competitors' prices to changes in Canadian wheat price in Japan was estimated as follows:

\[
(4.3.1) \quad \log P_c(t) = -0.07 + 0.76\log P_c(t-1) + 1.0\log P_{CA}(t) - 79\log P_{CA}(t-1)
\]

\[
(-1.844)^* (7.852)^* (22.79)^* (-7.51)^*
\]

\[
e_t = -0.61e_{t-1}
\]

\[-4.37]^*

\[
R^2 = 0.99, \quad h = 1.96^*
\]

(Cross Ref. table 16)

4.3.3 The Passivity Assumption

Estimated equations for the passivity assumption test are reported in table 11. Analyses of the results are taken up in the next section.
Table 10: U.S. Competitors Price Adjustment Equations

in Japanese and World Market

Japanese Market

<table>
<thead>
<tr>
<th></th>
<th>Wheat</th>
<th>Corn</th>
<th>Soybean</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \beta_0 )</td>
<td>.064</td>
<td>1.4533**</td>
<td>-.17</td>
</tr>
<tr>
<td>( \beta_1 )</td>
<td>.63</td>
<td>5.5387*</td>
<td>.04</td>
</tr>
<tr>
<td>( \beta_2 )</td>
<td>1.03</td>
<td>21.389*</td>
<td>1.12</td>
</tr>
<tr>
<td>( \beta_3 )</td>
<td>-.64</td>
<td>-5.008*</td>
<td>-.11</td>
</tr>
<tr>
<td>( \rho )</td>
<td>-.42</td>
<td>-2.65*</td>
<td>-.24</td>
</tr>
<tr>
<td>( R^2 )</td>
<td>.99</td>
<td>.99</td>
<td>.97</td>
</tr>
<tr>
<td>( h )</td>
<td>1.55</td>
<td>.09</td>
<td>.12</td>
</tr>
<tr>
<td>( SEE )</td>
<td>.056</td>
<td>.03</td>
<td>.07</td>
</tr>
</tbody>
</table>

World Market

<table>
<thead>
<tr>
<th></th>
<th>Wheat</th>
<th>Corn</th>
<th>Soybean</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \beta_0 )</td>
<td>.035</td>
<td>.7151</td>
<td>.17</td>
</tr>
<tr>
<td>( \beta_1 )</td>
<td>-.009</td>
<td>-.0456</td>
<td>.23</td>
</tr>
<tr>
<td>( \beta_2 )</td>
<td>.56</td>
<td>3.8693*</td>
<td>.77</td>
</tr>
<tr>
<td>( \beta_3 )</td>
<td>.41</td>
<td>1.6511*</td>
<td>.07</td>
</tr>
<tr>
<td>( \rho )</td>
<td>.33</td>
<td>1.6147*</td>
<td>-.26</td>
</tr>
<tr>
<td>( R^2 )</td>
<td>.89</td>
<td>.94</td>
<td>.05</td>
</tr>
<tr>
<td>( h )</td>
<td>1.11</td>
<td>-.57</td>
<td></td>
</tr>
<tr>
<td>( SEE )</td>
<td>.103</td>
<td>.128</td>
<td>.96</td>
</tr>
</tbody>
</table>

*The general form of the equations is:

\[
\log P_C(t) = \beta_0 + \beta_1 \log P_C(t-1) + \beta_2 \log P_{US}(t) + \beta_3 \log P_{US}(t-1) + \varepsilon_t
\]

\[
\varepsilon_t = \rho \varepsilon_{t-1} + \nu_t, \text{ where } \nu_t \sim iid N(0, \sigma^2_{\nu}).
\]
Table 11: U.S. Competitors Price Adjustment

Equations in Japanese Market

<table>
<thead>
<tr>
<th></th>
<th>Wheat</th>
<th>Corn</th>
<th>Soybean</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\beta_0$</td>
<td>-.004</td>
<td>-1.5073**</td>
<td>-2.2</td>
</tr>
<tr>
<td>$\beta_1$</td>
<td>.40</td>
<td>2.6074*</td>
<td>.21</td>
</tr>
<tr>
<td>$\beta_2$</td>
<td>1.13</td>
<td>17.315*</td>
<td>1.2</td>
</tr>
<tr>
<td>$\beta_3$</td>
<td>-.45</td>
<td>-2.3992*</td>
<td>-.31</td>
</tr>
<tr>
<td>$\rho$</td>
<td>-.28</td>
<td>-1.6479*</td>
<td>-.72</td>
</tr>
<tr>
<td>$R^2$</td>
<td>.98</td>
<td>.99</td>
<td>.99</td>
</tr>
<tr>
<td>h</td>
<td>.11</td>
<td>.01</td>
<td>-.43</td>
</tr>
<tr>
<td>SEE</td>
<td>.01</td>
<td></td>
<td>11.9</td>
</tr>
</tbody>
</table>

\[ aP_c(t) = \beta_0 + \beta_1 P_c(t-1) + \beta_2 P_{us}(t) + \beta_3 P_{us}(t-1) + \epsilon_t \]

\[ \epsilon_t = \rho \epsilon_{t-1} + \nu_t, \text{ where } \nu_t \sim iid N(0, \sigma^2) \]
4.4 Analyses of Results

The analyses here will focus more on the substance and policy implications of the results than on statistical details. Estimated equations and statistical details on estimation procedure are reported in the preceding section. The goal in separating the two is not to minimize the importance of such statistical details, but to avoid befogging substantive issues.

From the estimated coefficients reported in the preceding section, the reported exchange rate elasticities of market share are calculated as follows:

\[
\frac{\partial \log k}{\partial \log e} = \frac{\partial \log k}{\partial \log \lambda} \times \frac{\partial \log \lambda}{\partial \log e} + \frac{\partial \log k}{\partial \log e}
\]

or equivalently,

\[
(4.4.1b) \quad \eta_{k,e} = \eta_{k,\lambda} \times \eta_{\lambda,e} + \epsilon_{k,e}
\]

where \( \epsilon_{k,e} \) is the direct exchange rate elasticity of market share, \( \eta_{k,\lambda} \) the exchange rate elasticity of the U.S. relative price of the commodity, in the market under study. It is the indirect channel through which the exchange rate affects market share. The parameter \( \eta_{\lambda,e} \) is the price elasticity of substitution between U.S. wheat, or corn, or soybean, and those of U.S. competitors in the market under study.
Table 12: Estimated Equations for The Passivity Assumption Test

<table>
<thead>
<tr>
<th></th>
<th>Canada</th>
<th>Britain</th>
<th>Netherlands</th>
<th>W. Germany</th>
<th>Japan</th>
<th>France</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A</td>
<td>B</td>
<td>A</td>
<td>B</td>
<td>A</td>
<td>B</td>
</tr>
<tr>
<td>$\beta_0$</td>
<td>-.02</td>
<td>-.03</td>
<td>-.31</td>
<td>-.31</td>
<td>-.09</td>
<td>.13</td>
</tr>
<tr>
<td>$t$</td>
<td>-.504</td>
<td>-.72</td>
<td>-2.33*</td>
<td>-2.23*</td>
<td>-.116</td>
<td>.16</td>
</tr>
<tr>
<td>$\beta_1$</td>
<td>.83</td>
<td>.85</td>
<td>.71</td>
<td>.71</td>
<td>.16</td>
<td>.16</td>
</tr>
<tr>
<td>$t^2$</td>
<td>22.05*</td>
<td>22.4*</td>
<td>11.6*</td>
<td>11.03*</td>
<td>1.864*</td>
<td>1.82*</td>
</tr>
<tr>
<td>$\beta_2$</td>
<td>.38</td>
<td>.42</td>
<td>.16</td>
<td>.23</td>
<td>-.41</td>
<td>-.33</td>
</tr>
<tr>
<td>$t^3$</td>
<td>8.33*</td>
<td>8.73*</td>
<td>.76</td>
<td>1.08</td>
<td>-.315</td>
<td>-.26</td>
</tr>
<tr>
<td>$\beta_3$</td>
<td>-.23</td>
<td>-.29</td>
<td>-.03</td>
<td>-.07</td>
<td>1.25</td>
<td>1.3</td>
</tr>
<tr>
<td>$t^4$</td>
<td>-4.53*</td>
<td>-5.36*</td>
<td>-.13</td>
<td>-.33</td>
<td>.959</td>
<td>.98</td>
</tr>
<tr>
<td>$R^2$</td>
<td>.96</td>
<td>.96</td>
<td>.66</td>
<td>.67</td>
<td>.09</td>
<td>.09</td>
</tr>
<tr>
<td>$h$</td>
<td>-1.14</td>
<td>-.96</td>
<td>-.86</td>
<td>-.76</td>
<td>-.15</td>
<td>-.17</td>
</tr>
<tr>
<td>$d$</td>
<td>2.14</td>
<td>2.11</td>
<td>2.11</td>
<td>2.07</td>
<td>2.004</td>
<td>2.0</td>
</tr>
<tr>
<td>SEE</td>
<td>.04</td>
<td>.24</td>
<td>.24</td>
<td>.24</td>
<td>1.32</td>
<td>1.32</td>
</tr>
</tbody>
</table>

*The form of the Equations is:

$$
\log Y_{it} = \beta_0 + \beta_1 \log Y_{it-1} + \beta_2 \log X_t + \beta_3 \log X_{t-1} + \varepsilon_t
$$

where $Y_i$ is the interest rate of foreign country $i$, and $X$ is U.S. interest rate. Column A gives the equation for nominal, and B for real interest rate. Each equation incorporates a first order serial correlation: $\varepsilon_t = \rho \varepsilon_{t-1} + \nu_t$. 


Price elasticities of market share are calculated as follows:

\[
\frac{d \log k}{d \log P^*} = \frac{a \log k}{a \log \lambda} \left(1 - \frac{a \log P^*}{a \log P^*_{US}}\right)
\]

or equivalently,

\[
\frac{n_{k,P^*_{US}}}{n_{k,\lambda}} = \frac{n_{p^*_{c^*US}}}{n_{p^*_{c^*US}}} \quad (1 - n_{p^*_{c^*US}})
\]

where \( n_{k,\lambda} \) is as defined above, while \( n_{p^*_{c^*US}}, n_{p^*_{c^*US}} \) is the elasticity of the average c.i.f. price of U.S. competitors, with respect to the U.S. c.i.f. price of the commodity in question. Finally, \( n_{k,P^*_{US}} \) is the "price elasticity" of U.S. market share.

The relative size of these two parameters is an empirical matter which depends crucially on the underlying dynamics of the particular market under study. To see this, subtract equation (4.4.2b) from (4.4.1b) to get:

\[
(n_{k,e} - n_{k,P^*_{US}}) = n_{k,\lambda} [n_{\lambda,e} + n_{p^*_{c^*US}} - 1] + c_{k,e} > 0
\]

where, theoretically, \( n_{k,\lambda}, c_{k,e} < 0, \) and \( n_{\lambda,e}, n_{p^*_{c^*US}}, n_{p^*_{c^*US}} > 0.\)

4.4.1 Results for Wheat

Test results for the effect of the exchange rate of the U.S. dollar on U.S. wheat market share are summarized in table 13. Salient among the results are, first, the data do not reject the hypothesis that a rise in the U.S. dollar exchange rate reduces U.S. competitiveness in wheat exports. However, the response of market share to exchange rate changes is relatively inelastic, but with increasing intensity over time. Overall, a 1% rise in the exchange
### Table 13: Price and Exchange Rate Elasticities of U.S. Wheat Export Market Share

<table>
<thead>
<tr>
<th></th>
<th>Japan</th>
<th></th>
<th>World</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>a</td>
<td>a</td>
<td>b</td>
<td>b</td>
</tr>
<tr>
<td></td>
<td>SR</td>
<td>LR</td>
<td>SR</td>
<td>LR</td>
</tr>
<tr>
<td>$\eta_{k,e}^c$</td>
<td>-.26</td>
<td>-.52</td>
<td>-.33</td>
<td>-.53</td>
</tr>
<tr>
<td>$\epsilon_{k,e}$</td>
<td>-.32</td>
<td>-.81</td>
<td>-.42</td>
<td>-.86</td>
</tr>
<tr>
<td>$\eta_{k,p^*_us}^c$</td>
<td>-.02</td>
<td>-.10</td>
<td>-.06</td>
<td>-.15</td>
</tr>
<tr>
<td>$\eta_{k,\lambda}$</td>
<td>.71</td>
<td>1.78</td>
<td>.93</td>
<td>1.9</td>
</tr>
<tr>
<td>$\eta_{p^<em>_c,p^</em>_us}$</td>
<td>1.03</td>
<td>1.05</td>
<td>1.08</td>
<td>1.09</td>
</tr>
</tbody>
</table>

Source: Section 4.3.1, Subsection A.1 and A.2.

SR = Shortrun, LR = Longrun.

- Elasticities under these columns are estimated with log-linear functions. So, they are constant over the entire range of the function.
- Elasticities under these columns are measured at the mean. Coefficients used are estimated with linear functions.
- Since $\eta_{k,e} = \eta_{k,\lambda} \times \eta_{\lambda,e} + \epsilon_{k,e}$, whenever $\eta_{k,e}$ equals $\epsilon_{k,e}$ in the table, it is because either $\eta_{k,\lambda}$ or $\eta_{\lambda,e}$ is statistically zero.
- Estimated equation not reliable.
rate reduces market share by 26 to 53 basis points in the Japanese import market, and 60 to 76 basis points in the world import market.

Next, a rise in the exchange rate has a much stronger negative impact on market share than an equivalent rise in wheat price. This is an interesting finding because, before seeing these results, one might have suspected the opposite. In the shortrun, for instance, a 1% rise in the Yen-U.S. dollar exchange rate reduces the U.S. wheat market share in Japan by thirteen times as much as an equivalent rise in the c.i.f. price of U.S. wheat, and five times as much in the longrun. The lower ratio of relative impact in the longrun is due to the fact that the negative effect of a price rise increases at a faster rate over time than the exchange rate effect. The generally smaller relative impact of a price rise is explained in part by the fact that a 1% rise in U.S. wheat price in Japan induces a rise of 1.03% to 1.09% in the average wheat price of U.S. competitors in that market. The effect of this price adjustment is to reduce the negative effect on U.S. market share of the initial rise in U.S. price. Stated differently, this finding shows that, in the shortrun, it will take a 13% reduction in U.S. wheat price in Japan to induce an equivalent rise in market share as would result from only a 1% reduction in the Yen-dollar exchange rate. This result contradicts assumptions in the literature that an x% fall in price is equivalent to an x% fall in the exchange rate. Clearly, they are equivalent only in size, not in impact. Therefore, one may infer that a policy of reducing the exchange rate will have a far more favorable effect on U.S. wheat export market share than a policy of price reduction.

---

6 See equation (4.4.2c), p.122.
Next, the effect of the exchange rate on U.S. wheat export market share is stronger in the world market than in the Japanese market. Therefore, the U.S. share of the world wheat import market is more sensitive to changes in the U.S. dollar exchange rate than its share of the Japanese market.

In Japan, the direct negative impact of the exchange rate on market share is much stronger than the combined direct and indirect impacts. This is due to an unexpected positive indirect effect, caused by a positive price elasticity of substitution between U.S. wheat and those of all U.S. competitors in that market. This has the effect of reducing the negative direct effect. In the world market, although the price elasticity of substitution between U.S. wheat and those of other exporters is also positive, it does not diminish the negative direct impact of the exchange rate on world market share because, \( \eta \lambda_e \), the indirect channel of exchange rate impact, is zero.

The observed positive elasticity of substitution does not fit theoretical expectation. I have no rigorous explanation for this finding, except to suggest that in Japan, a desire to sustain the good historical trade relations between the two countries, or some other institutional rigidities that do not respond easily to market forces, may explain the unexpected price response. In the past few years, for instance, the balance of trade between the U.S. and Japan has been growing in Japan's favor. This generated political pressure on Japan to improve the trade balance by buying more from, or selling less, to the U.S. In response, Japan instituted some "voluntary" restraint on the volume of its exports to the U.S., especially, automobile exports. In
the same vein, Japan may be buying more wheat from the U.S. inspite of rising relative price of U.S. wheat. This kind of non-market response could distort normal market price signals.

In summary, the main findings are, first, that a rise in the exchange rate lowers U.S. market share in the two wheat markets studied, although the response is relatively inelastic in both markets. Secondly, the exchange rate is found to have a much stronger negative impact on market share than price. Finally, the U.S. share of the world wheat market is found to be more sensitive to exchange rate changes than its share of the Japanese wheat market. In general, therefore, a policy of lowering the exchange rate will not only improve U.S. competitiveness in world wheat markets, but it will be more effective in doing so than a policy of an equivalent price reduction.

4.4.2 Results for Corn

The results for corn are summarized in table 14. Again, exchange rate is found to have a significant negative impact on the competitiveness of U.S. corn trade in both markets studied. Compared to wheat, corn market share is more sensitive to exchange rate changes in both markets. A 1% rise in the exchange rate will, in the shortrun, reduce U.S. share of Japanese corn import market by 49 to 91 basis points, and 104 to 172 basis points in the longrun. In the world market, the corresponding ranges are 82 to 95 basis points in the shortrun, and 124 to 147 basis points in the longrun. As in the case of wheat, U.S. share of world corn market is more sensitive to changes in the exchange rate than its share of the Japanese corn market. As for the relative impact of price and the exchange rate, price has no significant effect on U.S. share of the corn markets studied. This
Table 14: Price and Exchange Rate Elasticities of U.S. Share of Corn Export Markets

|        | Japan | | | World | | | |
|--------|-------|-----|-----|-------|-----|-----|-----|-----|-----|
|        | SR\textsuperscript{a} | LR\textsuperscript{a} | SR\textsuperscript{b} | LR\textsuperscript{b} | SR\textsuperscript{a} | LR\textsuperscript{a} | SR\textsuperscript{b} | LR\textsuperscript{b} |
| η\textsubscript{k,e} | -.49 | -1.04 | -.91 | -1.72 | -.82 | -1.24 | -.95 | -1.47 |
| ε\textsubscript{k,e} | -.49 | -1.04 | -.91 | -1.72 | -.82 | -1.24 | -.84 | -1.31 |
| η\textsubscript{c,k,p*}\textsubscript{us} | .0 | .0 | .0 | .0 | .0 | .0 | -.20 | -.31 |
| η\textsubscript{c,k,λ} \textsubscript{c,p*}\textsubscript{us} | .0 | .0 | .0 | .0 | .0 | .0 | -.20 | -.31 |
| η\textsubscript{p*}\textsubscript{c,p*}\textsubscript{us} | 1.12 | 1.05 | 1.15 | 1.07 | .77 | 1.10 | n/a | n/a |

Source: Section 4.3.1, Subsections B.1 and B.2.

\textsuperscript{a}Elasticities under these columns are estimated with log-linear functions, and are, therefore, constant over the entire range of the function.

\textsuperscript{b}Elasticities under these columns are measured at the mean. Coefficients used are estimated with linear functions.

\textsuperscript{c}As a rule, if an estimated coefficient is statistically insignificant, at least, at the 10\% level, the associated elasticity is taken to be zero. The reader should note, however, that the rule of statistical significance could sometime be misleading, especially if the estimated coefficients or parameters are large. For instance, in Japan, the estimate of η\textsubscript{k,λ} is -1.54 in the shortrun, and -3.28 in the longrun, but both are statistically very insignificant.

\textsuperscript{d}See footnote "c", p.123.
again points out the relative importance of policies aimed at keeping the exchange rate down.

4.4.3 Results for Soybean

Results for soybean are summarized in table 15. In the Japanese market, the results are consistent with the findings for wheat and corn. The exchange rate has a much stronger negative effect on market share than price. A 1% rise in the exchange rate of the Yen against the U.S. dollar reduces U.S. share of the Japanese soybean market by 18 to 29 basis points, while an equivalent rise in U.S. soybean price in Japan will reduce U.S. share of that market by 3 to 5 basis points. Although the response of soybean market share to changes in price and the exchange rate is relatively inelastic, the exchange rate remains the variable with the more adverse impact on market share. Furthermore, for soybean, the direct and indirect channels of exchange rate impact on market share reinforce each other. In the case of wheat, the two channels of impact tended to counteract each other, while for corn, the indirect effect was zero.

In the world market, a 1% rise in the price of U.S. soybean reduces U.S. share of the market by 51 basis points. On the other hand, a 1% rise in the exchange rate would, paradoxically, raise U.S. share of the market by as much as 371 basis points.

This positive exchange rate elasticity of soybean market share results from two factors. First, the direct exchange rate elasticity of the U.S. share of the world soybean market, $e_{k,e}$, turned out positive rather than negative. Secondly, a rise in the trade-weighted value of the U.S. dollar tended to reduce, rather than
Table 15: Price and Exchange Rate Elasticity of U.S. Share of Soybean Export Markets

<table>
<thead>
<tr>
<th></th>
<th>Japan</th>
<th>World</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$S_R^a$</td>
<td>$LR^a$</td>
</tr>
<tr>
<td>$\eta_{k,e}$</td>
<td>-.18</td>
<td>-.24</td>
</tr>
<tr>
<td>$\varepsilon_{k,e}$</td>
<td>-.14</td>
<td>-.14</td>
</tr>
<tr>
<td>$\eta_{k,p_{us}^*}$</td>
<td>-.03</td>
<td>.03</td>
</tr>
<tr>
<td>$\eta_{k,\lambda}$</td>
<td>-.32</td>
<td>-.32</td>
</tr>
<tr>
<td>$\eta_{p_{c}^<em>,p_{us}^</em>}$</td>
<td>.90</td>
<td>1.09</td>
</tr>
</tbody>
</table>

Source: Section 4.3.1, Subsections C.1 and C.2.

*Elasticities under these columns are estimated with log-linear functions, and are, therefore, constant over the entire range of the function.*

*bElasticities under these columns are measured at the mean. Coefficients used are estimated with linear functions.*
increase, the relative price of U.S. soybean in the world market. Although paradoxical, I am reluctant to dismiss these results as mere statistical aberrations until refuted by independent studies, over the same period. It is possible that a rise in the trade-weighted value of the dollar could induce a higher percentage increase in the average soybean price of U.S. competitors than it does on U.S. soybean price. If that is the case, then there is no longer a paradox.

4.4.4 Summary of Commodity Results

A central point of the results so far is that, compared to commodity price, the exchange rate has a much stronger negative impact on U.S. share of the two import markets studied, except for soybean in the world market, where the exchange rate is positively related to market share. Therefore, policies that keep prices down at the cost of higher exchange rates, do more harm to agricultural trade than policies that sustain higher prices but lower exchange rates. The ideal, of course, is to keep both price and the exchange rate down.

4.4.5 The U.S. and Canada Compared

Results comparing the effects of price and exchange rate changes on Canadian share of Japanese wheat market with those of the U.S. are summarized in table 15. The results indicate that Canadian share of the market is insensitive to changes in the Yen-Canadian dollar exchange rate. And, only in the longrun is Canada's share of Japan's wheat market sensitive to changes in the price of Canadian wheat. Thus, the U.S. appears more vulnerable in this market than its
number one competitor.

Table 16: Price and Exchange Rate Elasticity of U.S. and Canadian Wheat Market Shares Japanese Import Market (A Comparison)

<table>
<thead>
<tr>
<th>Shortrun</th>
<th>Longrun</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\eta_{k,e}$</td>
<td>$\sum_{k,e}$</td>
</tr>
<tr>
<td>U.S.</td>
<td>-.26</td>
</tr>
<tr>
<td>CA</td>
<td>.0</td>
</tr>
</tbody>
</table>

Source: For the U.S.: table 12, for Canada, Section 4.3.1, Subsection D.

4.4.6 The Passivity Assumption

The issue here is whether a rise in the U.S. interest rate may be expected to lead to a rise in the value of the U.S. dollar.

The following result was obtained for Australia, the second most important U.S. Competitor:

$$k_t = -.08 + .4k_{t-1} + .27 \lambda_t - .0002 e_t$$
$$(-.53) \hspace{1cm} (2.72)^* \hspace{1cm} (1.849)^* \hspace{1cm} (-1.23)$$

$$\lambda_t = 1.16 - .22 \lambda_{t-1} - .0001 e_t$$
$$(6.5)^* \hspace{1cm} (-1.29) \hspace{1cm} (-.55)$$

$$R^2 = .34, \chi^2(\alpha, 5) = 13.41^*$$
This will happen if, first, the U.S. dollar is floating, second, capital is mobile across countries, and finally, foreign interest rates are insensitive, or nearly so, to changes in the U.S. interest rate.

To accommodate the first condition, the test uses monthly data drawn from the floating period, (January, 1974-July, 1984). As argued previously, world money and capital markets are now so highly integrated that it seems safe to assume that the second condition is also satisfied. Only the third condition is at issue.

Tests of the third condition, with nominal and real interest rates, were conducted for six industrial countries and results are summarized in table 17.

<table>
<thead>
<tr>
<th>No.</th>
<th>Canada</th>
<th>U.K.</th>
<th>Netherlands</th>
<th>W. Germany</th>
<th>Japan</th>
<th>France</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>SR</td>
<td>LR</td>
<td>SR</td>
<td>LR</td>
<td>SR</td>
<td>LR</td>
</tr>
<tr>
<td>1</td>
<td>.38</td>
<td>.88</td>
<td>.0</td>
<td>.0</td>
<td>1.79</td>
<td>.0</td>
</tr>
<tr>
<td>2</td>
<td>.42</td>
<td>.87</td>
<td>.23^a</td>
<td>.55^a</td>
<td>.0</td>
<td>1.47</td>
</tr>
</tbody>
</table>

Source: Table 12.

^a Statistically insignificant at the 10% level. Treated as zero.

^b Line 1 - Nominal Interest rate; Line 2 - real interest rate.

Both the nominal and real interest rate data do not reject the strong passivity assumption for U.K., Netherlands, Japan, and France. Thus, ceteris paribus, a rise in the U.S. interest rate will induce capital inflows from these countries, which will tend to raise the exchange rate of the U.S. dollar against these currencies.
For Canada, the strong passivity assumption is strongly rejected, but the weak version is not rejected. In other words, Canada's money market interest rate is not insensitive to changes in the U.S. money market interest, but the degree of sensitivity is less than one. A 1% rise in U.S. nominal money market interest rate will in the short-run (current month), lead to a rise of 38 basis points in its Canadian counterpart, and 88 basis points in the longrun. For the real interest rate, the response is virtually the same. The shortrun response of real Canadian money market rate to a 1% rise in real U.S. money market rate is 42 basis points, and 87 basis points in the longrun. Most of the response is completed in only a few months. On the average, 83% of the induced longrun rise in nominal Canadian money market rate is completed in about five months, while 50% of the rise is completed in about four months. For real rates, 50% of the induced rise is completed in about four months, and 85% in about 5 1/2 months. So, since the Canadian data rejected the strong passivity assumption but

Recall that the strong passivity assumption states that $n_{r^*, r} = 0$, while the weak version states that $0 < n_{r^*, r} < 1$, where $r^*$ is foreign, and $r$ is domestic interest rate respectively.

Average lag length is estimated by $\hat{\beta}/(1 - \hat{\beta})$, where $\hat{\beta}$ is the estimated coefficient of the lagged endogenous variable, and measures the percent impact absorbed.

The median length of time necessary for the absorption of 50% of total longrun impact is estimated as $(\log 1/2)/(\log \hat{\beta})$, see Pindyck and Rubinfeld (1981), pp. 232-234.
not the weak version, a rise in U.S. interest rate is expected to raise the exchange rate of the U.S. dollar against the Canadian dollar— but not as much as would have occurred were the strong version not rejected.

For West Germany, both nominal and real interest rates respond to changes in U.S. interest rate with a lag of one month. But, in the longrun, the induced rise in West German interest rate tends to exceed the initial rise in U.S. interest rate. A 1% rise in U.S. interest rate induces no change in West German interest rate in the current month, but in the longrun, it leads to a rise of 179 basis points in West German nominal interest rate and 147 basis points in real interest rate. Fifty percent of the induced rise is completed in about 4 1/2 months, while 86% of the increase, on the average, is completed in slightly over six months. For the real rate, 50% of the induced rise is completed in four months, while 85% is completed in 5 1/2 months, on the average. Thus, the strong passivity assumption is not rejected in the shortrun, but in the longrun, both the strong and weak versions of the assumption are soundly rejected. Therefore, a rise in U.S. interest rate is expected to lead to a rise in the exchange rate of the U.S. dollar against the deutsch mark in the shortrun. But, in the longrun, a more than proportionate rise in the West German money market rate will tend to reverse the exchange rate relationship.

In summary, the strong passivity assumption, namely, that foreign interest rate is insensitive to changes in U.S. interest rate, is not rejected for four of the six countries examined: Britain, France, Netherlands, and Japan. Of the remaining two countries, Canada and West Germany, Canadian data strongly rejected the strong passivity assump-
tion, but did not reject the weak version of the assumption, namely, that foreign interest rates are sensitive to changes in U.S. interest rates, but only in a relatively inelastic manner. For West Germany, the data did not reject the strong passivity assumption in the shortrun, but, in the longrun, even the weak version was soundly rejected.

Thus, a rise in U.S. interest rate is expected to raise the exchange rate of the U.S. dollar against the currencies of these countries in varying degrees of intensity and timing. The intensity of impact will be stronger for Britain, Japan, France, and the Netherlands, than for Canada and West Germany. For West Germany, the results indicate that a rise in U.S. interest rate will, in the longrun, lead to an appreciation of the deutch mark against the U.S. dollar.

These conclusions are, of course, valid to the extent that the conditioning premises are valid, namely, that capital is freely mobile between these countries and the U.S., and that the demand of international financial assets portfolio holders for U.S. dollar denominated assets are sensitive to interest rate differentials between the U.S. and these countries. But, as was previously argued, high capital mobility, engendered by the increasing integration of major world money and capital markets, itself the result of great advances in electronic communication technology, is a present day reality. The great ease with which funds can now be transferred across countries has also made international financial assets portfolio demand more sensitive to interest rate differentials. This is not to suggest that these investors are concerned only about interest rate differentials. They also worry about overall economic and political stability. But given all that, interest rate differentials play the paramount role.
It is against this background that the above conclusions are given. These developments in international financial markets, coupled with the floating of major currencies and the low sensitivity of foreign interest rate to changes in U.S. interest rate, bring the implication of rising U.S. interest rate for U.S. agricultural trade into sharp focus.

In a recent study, Cassese and Lothian (1983), using quarterly nominal money market interest rates, covering the period 1958II-1971III, for the same set of countries studied here, rejected the strong passivity assumption for Britain, Netherlands, and France, among others. They tested the hypotheses that U.S. interest rate has no effect on foreign interest rates, (and that there is no feedback from foreign to U.S. interest rate). For the first hypothesis they used the equation:

\[ Y_t = \alpha + \sum \beta_i Y_{t-i} + \sum \gamma_j X_{t-j} + \epsilon_t \]

where \( Y \) is foreign, and \( X \) is U.S. money market interest rate—all in first difference. They performed an F-test of the null hypothesis that the parameter \( \gamma_j \) are, as a group, equal to zero. This indeed, is the passivity assumption tested in the text. They rejected this null hypothesis for Britain, Netherlands, and France. (They also found no feedback from foreign to U.S. interest rate). In contrast, the present study does not reject this null hypothesis for these three countries. Both studies are in agreement with respect to Japan—for which the null is not rejected and also Canada and W. Germany—for which the null hypothesis is rejected. The differences in findings may stem from differences in data set used (quarterly versus monthly), period covered (non-floating versus floating era), and lag structure employed.

However, rejecting the above hypothesis for these three countries provides only a necessary, but not a sufficient basis for rejecting the central tenet of the passivity assumption, namely, that high U.S. interest rates is accountable for the relative strength of the dollar. That requires a further rejection of the weak version of the assumption.


4.4.7 Effect of Monetary Policy Change

On October 29, 1979, the Fed changed from interest rate targeting as an instrument of monetary policy to controlling monetary aggregates, allowing interest rate to find its own path in response to changes in monetary aggregates and general credit market conditions. What effect, if any, did this change in approach to monetary policy have on the sensitivity of foreign interest rates to changes in U.S. interest rates, and therefore, on the exchange rate, and ultimately, on the competitiveness of U.S. agricultural commodity trade?

To explore this question, I tested the null hypothesis that the degree of sensitivity of foreign interest rates to changes in U.S. interest is the same before and after the change in approach to monetary policy. Two types of tests were performed, and this hypothesis was rejected only for Canada. Only the results of the test for Canada is reported here.

To perform the first test, three separate regressions were obtained, one over the entire sample (January, 1974 to July, 1984), the second covering the subperiod before the policy change (January, 1974 to October, 1979), and the final regression covered the subperiod following the policy change (November, 1979 to July 1984). The estimated equations, using ordinary least squares procedure, are summarized in table 18.

In general, the usual Durbin-Watson statistic "d" is not a reliable test-statistic for the null of zero first order serial correlation when a lagged dependent variable is included as an explanatory variable. In such cases, the Durbin (1970) test statistic,
Table 18: Monetary Policy and the Passivity Assumption

Estimated Equation by Period

<table>
<thead>
<tr>
<th></th>
<th>1/74 - 7/84</th>
<th>1/74 - 10/79</th>
<th>11/79 - 7/84</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A</td>
<td>B</td>
<td>C</td>
</tr>
<tr>
<td>( \beta_0 )</td>
<td>-.01</td>
<td>.05</td>
<td>.19</td>
</tr>
<tr>
<td>( t )</td>
<td>-.153</td>
<td>.57</td>
<td>3.6*</td>
</tr>
<tr>
<td>( \beta_1 )</td>
<td>.89</td>
<td>.94</td>
<td>.75</td>
</tr>
<tr>
<td>( t )</td>
<td>32.95*</td>
<td>25.38*</td>
<td>15.69*</td>
</tr>
<tr>
<td>( \beta_2 )</td>
<td>.45</td>
<td>.31</td>
<td>.52</td>
</tr>
<tr>
<td>( t )</td>
<td>9.612*</td>
<td>3.8*</td>
<td>10.58*</td>
</tr>
<tr>
<td>( \beta_3 )</td>
<td>-.35</td>
<td>-.24</td>
<td>-.21</td>
</tr>
<tr>
<td>( t )</td>
<td>-6.74*</td>
<td>-2.81*</td>
<td>-2.924*</td>
</tr>
<tr>
<td>SSE</td>
<td>.2493</td>
<td>.1198</td>
<td>.0803</td>
</tr>
<tr>
<td>( R^2 )</td>
<td>.98</td>
<td>.94</td>
<td>.98</td>
</tr>
<tr>
<td>( F(3,n) )</td>
<td>1730.8*, (122)</td>
<td>342.0*, (65)</td>
<td>733.2*, (52)</td>
</tr>
<tr>
<td>( d )</td>
<td>1.5*</td>
<td>1.33*</td>
<td>1.87</td>
</tr>
<tr>
<td>( h )</td>
<td>2.95*</td>
<td>2.9*</td>
<td>1.32</td>
</tr>
</tbody>
</table>

\(^a\) \( \log Y_t = \beta_0 + \beta_1 \log Y_{t-1} + \beta_2 \log X_t + \beta_3 \log X_{t-1} + \epsilon_t \)

where \( Y \) is nominal Canadian money market interest rate and \( X \) the analogous variable for the U.S.
The parameter $\sigma^2$ is the variance of the coefficient of the lagged dependent variable, and $\rho$ is the coefficient of first order serial correlation and $n$ is sample size. Interestingly, for all three equations reported in table 18, both $d$ and $h$ yield the same inferences. In the first two equations, both rejected the null hypothesis of zero first order serial correlation, while in the third equation, they do not reject the null. Apparently, the inclusion of a lagged dependent variable did not bias the statistic $d$ in this case.

These three equations provide the basis for a test of the hypothesis stated previously, namely:

$$H_0 : \beta_{11} = \beta_{12} \quad , \quad i = 1, 2$$

$$H_1 : \beta_{11} \neq \beta_{12} \quad , \quad \text{for at least one } i$$

where $\beta_{11}$ and $\beta_{12}$ are the coefficients of $X$ in the equations for the first subperiod (1/74 - 10/79) and the second subperiod (11/79 - 7/84), respectively, (table 18). They measure the degree of sensitivity of Canadian interest rate to U.S. interest rate in the respective subperiod. The null hypothesis asserts that the change in approach to monetary policy did not change the way foreign interest rates react to changes in U.S. interest rate; while the alternative asserts that there has been a change in the way foreign interest rates respond to change.
in current, or lagged U.S. interest rate, or both, as a result of the change in approach to monetary policy.

The test statistic for the null hypothesis is:

\[
\frac{(\text{SSE}_A - \text{SSE}_B - \text{SSE}_C) / \phi}{(\text{SSE}_B + \text{SSE}_C) / (n - 2\phi)} \sim F(\phi, n - 2\phi)
\]

where \( \phi \) is the number of slope coefficients estimated and \( n \) is sample size. If the null is true, the numerator of the test-statistic will not be significantly different from zero. But if the null is not true, the test-statistic will be significantly different from zero.

Using information from table 18, the estimated value of the test statistic is

\[
F(3, 120) = 9.84
\]

which is significantly different from zero at the 1% level. The null hypothesis is therefore rejected for Canada.

However, because of the presence of first order serial correlation in two of the three equations used in the above test, the null hypothesis was re-tested by an alternative approach as a check on the above test. First, a maximum likelihood estimate of the coefficient of first-order serial correlation, \( \hat{\rho} \), was used to correct for the observed serial correlation by applying a generalized differencing of the type

\[
z_t = z_t - \hat{\rho} z_{t-1}
\]

to the original data.
Then, using the transformed data series, a new regression equation was estimated over the entire sample, but now, a dummy variable was added to test the hypotheses that both the slope coefficients and intercept term are unchanged after the change in approach to monetary policy. The estimating equation, using the corrected data, and incorporating the dummy variable is:

\[
(4.4.3) \text{Log } y_t = \beta_0 + \beta_1 D + \beta_2 \text{Log } y_{t-1} + \beta_3 \text{Log } x_t + \\
+ \beta_4 \text{Log } x_{t-1} + \beta_5 \text{Log } (Dx_t) + \epsilon_t
\]

where

\[D = 1 \text{ for the period 11/79 - 7/84} \]
\[= 0 \text{ otherwise.}\]

The null hypotheses are that \(\beta_1 = \beta_5 = 0\), against the alternative that they are non-zero.

If the null is true, the estimating equation collapses to

\[
(4.4.4) \text{Log } y_t = \beta + \beta_2 \text{Log } y_{t-1} + \beta_3 \text{Log } x_t + \beta_4 \text{Log } x_{t-1} + \epsilon_t
\]

Otherwise, the estimating equation is

\[
(4.4.5) \text{Log } y_t = (\beta + \beta_1) + \beta_2 \text{Log } y_{t-1} + (\beta_3 + \beta_5) \text{Log } x_t + \\
+ \beta_4 \text{Log } x_{t-1} + \epsilon_t
\]

The estimated equation for Canada is
\[
\begin{align*}
(4.4.6) \quad \log y_t &= -0.35 + 0.43D + 0.8\log y_{t-1} + 0.29\log x_t - \\
&\quad (-2.48)^* (3.7)^* (21.7)^* (5.81)^* \\
&\quad + 0.2\log x_{t-1} + 0.18\log (Dx_t) \\
&\quad (-3.98)^* (3.85)^* \\
\epsilon_t &= 0.32\epsilon_{t-1}, \text{ (therefore } \hat{\rho} = 0.32). \\
&\quad (3.83)^*
\end{align*}
\]

\[R^2 = 0.97, \quad d = 2.09, \quad h = -0.94, \quad \text{SEE} = 0.04\]

As both test-statistics, \(d\) and \(h\) indicate, the problem of serial correlation has been taken care of, and the equation rejects both the hypothesis of no shift in the relation between U.S. and Canadian interest rates as a result of the change in approach to monetary policy, (i.e. \(\beta_1 = 0\)), and that of no change in the degree of sensitivity of Canadian interest rate to changes in U.S. interest rate as a result of the change in approach to U.S. monetary policy, (i.e. \(\beta_5 = 0\)).

The implied equation for the subperiod before the change in monetary policy (1/74 - 10/79) is

\[
(4.4.7) \quad \log y_t = -0.35 + 0.8\log y_{t-1} + 0.29\log x_t - 0.2\log x_{t-1}
\]

\[\text{since the estimated equation is based on the transformed data series, the resulting intercept term must be divided by } (1 - \hat{\rho}) \text{ to obtain the original intercept term. This transformation has been made and is reflected on the reported intercept term. Slope coefficients are unaffected by the data transformation.}\]
and for the period after the policy change (11/79 - 7/84), the equation is

\[ \text{Log } y_t = 0.08 + 0.8 \text{log } y_{t-1} + 0.47 \text{log } x_{t-1} \]

Two distinct effects of the change in U.S. monetary policy on the relation between U.S. and Canadian interest rates are evident from equations (4.4.7) and (4.4.8). First, there is a tremendous upward shift in the entire relation - from an intercept of -0.35 to 0.08. Secondly, a 1% rise in nominal U.S. money market interest rate induces a much larger percentage rise in Canadian interest rate in the period following the policy shift than before it. These points are illustrated in figures 7 and 8.

The test was also performed for real interest rates, with the following results:

\[ \text{Log } y_t^r = -0.28 + 0.39D + 0.82 \text{log } y_{t-1}^r + 0.35 \text{log } x_t^r \]

\[ -0.25 \text{log } x_{t-1}^r + 0.16 \text{log } (Dx_t^r) \]

\[ \epsilon_t = 0.24 \epsilon_{t-1}, \text{ (therefore } \hat{\rho} = 0.24) \]

\[ R^2 = 0.96, \ d = 2.08, \ h = 0.78, \ SEE = 0.043 \]

Again, the result soundly rejects the null hypotheses of no change in both the slope coefficients and intercept term between the two sub-periods.
Figure 7: Monetary Policy Induced Shortrun Change in U.S.-Canadian Nominal Interest Rate Relations

Figure 8: Monetary Policy Induced Longrun Change in U.S.-Canadian Nominal Interest Rate Relation
The implied equation for the subperiod (1/74 - 10/79) is:

\[(4.8.10) \log y'_t = -0.28 + 0.82 \log y'_{t-1} + 0.35 \log x'_t - 0.25 \log x'_{t-1}\]

and for the subperiod (11/79 - 7/84):

\[(4.8.11) \log y'_t = 0.11 + 0.82 \log y'_{t-1} + 0.51 \log x'_t - 0.25 \log x'_{t-1}\]

These are also illustrated in figures 8 and 9.

4.4.8 Conclusion

Of the six countries studied, only Canadian interest rate was found to have become more sensitive to changes in U.S. interest rate as a result of the change in approach to U.S. monetary policy. This means that the exchange rate of the U.S. dollar against the Canadian dollar is less sensitive to changes in U.S. interest rate under the new approach to monetary policy. For the other countries, the opposite holds. Therefore, given the previous finding of a generally low sensitivity of foreign interest rate to changes in U.S. interest rate, the new approach to monetary policy, aimed at containing inflation, is keeping the dollar stronger than it might have been by keeping U.S. interest rate higher. In view of the finding that the exchange rate has a more severe negative impact on U.S. export market share than price, the new approach to monetary policy, with its focus on controlling inflation, is more unfavorable to U.S. agricultural trade than the former approach of interest rate targeting. The ideal, of course, is to keep both price and exchange rate down. In this era of floating exchange rates and increasing competition in world markets,
Figure 9: Monetary Policy Induced Shortrun Change in U.S.-Canadian Real Interest Rate Relation

Figure 10: Monetary Policy Induced Longrun Change in U.S.-Canadian Real Interest Rate Relations
barriers to the prevailing free trade philosophy is unlikely to take the traditional forms of tariffs and quotas. Instead, they are more likely to be in the more subtle, but no less potent, form of controlling domestic interest rates and credit markets, with a view to managing the floating exchange rates. Consequently, agricultural policy, with its emphasis on controlling supply, is likely to become even more ineffective if it remains isolated from monetary and fiscal policies. Changing conditions, such as the increasing integration of world money markets, the resulting higher capital mobility and increased interest rate sensitivity of international financial portfolios, floating exchange rates, etc., all seem to suggest that a more co-ordinated policy framework in which agricultural policy is treated as an integral part of a whole economic policy package, is the way to go.

Finally, since Canadian interest rate is generally more sensitive to U.S. interest rate than those of the other countries studied—with the possible exception of West Germany, and since it has become even more sensitive following the new approach to U.S. monetary policy, the U.S. is less likely to lose its share of an export market to Canada on account of changes in their exchange rates.

A rough check on this last point is provided by the following test of their relative shares of the Japanese wheat import market.

\[
(4.4.12) \quad \left( \frac{k_{US}}{k_{CA}} \right)_t = 5.38 + 0.72 \left( \frac{k_{US}}{k_{CA}} \right)_{t-1} - 4.86 (p^*_{US})_{t-1} - 0.34 (e)_{t-1}
\]

\[
(2.91)^* \quad (9.53)^* \quad (-4.31)^* \quad (-0.334)
\]
\[
\left( \frac{p^*}{p^*} \right)_t = 0.55 + 0.57 \left( \frac{p^*}{p^*} \right)_{t-1} - 0.13 e_t \\
(1.822)^* \quad (3.43)^* \quad (-0.76)
\]

\[ R^2 = 0.89, \quad \chi^2(\alpha, 5) = 71.2^* \]

where \( e_t \) is the exchange rate of the Canadian dollar per U.S. dollar, measured in terms of the yen. Durbin's h-test for the individual equations could not reject the null hypothesis of zero serial correlation. As evident from the above result, U.S. wheat is strongly perceived as a substitute for Canadian wheat by the Japanese importer. But the exchange rate has neither a direct or indirect effect on the U.S. share of the market relative to that of Canada.
This is a summary chapter. The tested hypotheses are briefly restated. Test results, discussed in detail in Chapter IV, are summarized and their policy implications further amplified. Suggestions for further research on the subject are also given.

5.1 Tested Hypotheses

The study tested the hypothesis that increases in the U.S. dollar exchange rate, or commodity price, reduces U.S. competitiveness in world agricultural commodity import markets. A rise in the exchange rate is said to reduce competitiveness if it leads to a loss of market share. This is a stronger and more testable notion of competitiveness than that which suggests that a rise in the exchange rate per se, amounts to a loss of competitiveness. The concept is analogously defined for increases in price, production cost, or any other variable of interest.

Related tests examine the null hypothesis that a change in U.S. interest rate does not affect the value of the U.S. dollar exchange rate. This hypothesis is referred to in earlier chapters as the "passivity assumption" because of its implication that foreign interest rates are insensitive, or nearly insensitive, to changes in
U.S. interest rates. Since interest rate changes are closely linked to credit market conditions, which are themselves directly affected by the mix of monetary and fiscal policies being pursued, if this hypothesis is rejected, then it follows that the interest rate is one channel through which monetary and fiscal policies transmit their impact on agricultural commodity trade.

5.2 Results and Policy Implications

The major findings, discussed in detail in Chapter IV, are summarized here.

For wheat, the first major finding is that a rise in the exchange rate reduces U.S. share of the Japanese and world markets. But the response of market share to exchange rate changes is relatively inelastic in both markets. Secondly, an increase in the exchange rate is found to have a much stronger adverse impact on wheat market share than an equivalent rise in wheat price. Finally, U.S. share of the world wheat market is found to be more sensitive to exchange rate changes than its share of the Japanese wheat market.

For corn, the exchange rate is also found to have a significant adverse impact on U.S. share of the Japanese and world corn import markets. Compared to wheat, corn market share is more sensitive to exchange rate changes in both markets. Also, U.S. share of the world corn market is more sensitive to changes in the exchange rate than its
share of the Japanese corn import market. Concerning the relative impact of price and the exchange rate, again, the exchange rate has the more adverse impact in both markets.

The results for soybean in the Japanese market are similar to the finding for wheat and corn. The exchange rate has a much stronger negative effect on market share than price. One difference is that both the direct and indirect channels of exchange rate impact on U.S. share of the Japanese soybean import market reinforce each other. For wheat, the two channels of impact tend to counteract each other, while for corn, the indirect impact is found to be zero.

In the world soybean import market, a rise in U.S. soybean price reduces U.S. market share, but a rise in the exchange rate, paradoxically, increases U.S. market share. This result persisted in experiments with various functional forms. Perhaps it reflects the peculiarities of the world soybean market. Further independent investigations will certainly shed more light on this matter. For instance, this seemingly paradoxical result may not be paradoxical after all, if a rise in the U.S. dollar exchange rate induces a higher percentage increase in the average c.i.f. soybean price of U.S. competitors than it does on U.S. c.i.f. soybean price.

Thus, in general, the main findings for the commodities are, first, that the exchange rate has a much stronger adverse impact on U.S. share of the two commodity markets studied. Second, that the U.S. is less competitive in the world market, with respect to the exchange rate, than it is in the Japanese market. In other words, the U.S. is
more likely to lose its share of the world market than its share of the Japanese market, on account of changes in the exchange rate.

These findings imply that a policy of keeping down the exchange rate will be more favorable to agricultural commodity exports than a policy of an equivalent reduction in commodity price. There is, currently, a strong appeal to reduce commodity price supports as part of the effort to reduce the federal deficit, and more fundamentally, as part of the prevailing "free market" philosophy. At the same time, there is comparatively less interest in actively seeking to lower the exchange rate, except for sporadic interventions in the foreign exchange market. Instead, the dollar's strength is considered secondary to the primary goal of "fighting" inflation. Or more conveniently, it is ascribed to the relative weakness of West European economies vis-a-vis the U.S. economy, with the veiled suggestion that "they" need to act.

But, as the results indicate, it will require a much larger percentage reduction in commodity prices than in the exchange rate to induce a given percentage improvement in the U.S. share of both the world and Japanese markets for wheat, corn, and soybeans. For instance, it will require a 13% reduction in wheat prices to induce the same percentage increase in the U.S. share of the Japanese market as would result from a mere 1% reduction in the exchange rate. Thus, if one is to choose between price and exchange rate reductions, the choice is clear. But, an ideal policy is one that attempts to keep both price and the exchange rate down.
As for the finding that U.S. share of the world market is more sensitive to changes in the exchange rate than its share of the Japanese market, additional studies will be necessary to "explain" the finding, as a pre-condition for appropriate policy action. For instance, it could be that the U.S. faces competition from more exporters in the world market than it does in the Japanese market. Or, special trade arrangements and political alliances between the two countries could explain the lower sensitivity of U.S. share of the Japanese market. A clearer understanding of the forces at work is essential for appropriate policy action. Further studies in this respect is, therefore, suggested.

A comparison of the effects of price and exchange rate changes on Canadian and U.S. shares of the Japanese wheat market shows that Canadian share of that market is insensitive to changes in the yen-Canadian dollar exchange rate, and that only in the longrun is it sensitive to changes in Canadian wheat price. This could be due to the relative small size of Canadian share of the market. In any case, the U.S. appears more vulnerable in this market than Canada. Data constraints barred similar comparative analysis for other commodities and markets.

On the effect of interest rate changes on the exchange rate, the results indicate that a rise in U.S. interest rates would be expected to raise the exchange rate of the U.S. dollar against the currencies of all six industrial countries studied, but in varying degrees of intensity and timing. The intensity of impact will be stronger for Britain, Japan, France, and the Netherlands, than for Canada and West Germany. For West Germany, a rise in U.S. interest
rate will, in the longrun, lead to an appreciation of the deutch mark against the U.S. dollar. Foreign interest rate has, generally, been either only moderately sensitive, or not sensitive at all, to changes in U.S. interest rates since the floating of the U.S. dollar. This means that a rise in U.S. interest rates widens the differential between U.S. and foreign interest rates which, in turn, puts upward pressure on the U.S. dollar exchange rate as international investors adjust their portfolios in favor of U.S. dollar denominated assets. All these forces operate through the demand side to worsen the excess supply problem of the agricultural sector.

Related tests explored the proposition that the change in October 1979, in approach to U.S. monetary policy, which allowed U.S. interest rates to respond freely to changes in monetary aggregates and to credit market conditions, has altered the degree of sensitivity of foreign interest rates to changes in U.S. interest rates, and therefore, the sensitivity of U.S. dollar exchange rate to changes in U.S. interest rates, and ultimately, U.S. ability to compete in world markets. Of all six countries studied, only Canadian interest rate was found to have become significantly more sensitive to changes in U.S. interest rates as a result of the change in the conduct of monetary policy. This implies that the U.S. dollar exchange rate against the Canadian dollar is less sensitive to changes in U.S. interest rate under the new approach to monetary policy than under the pre-October, 1979 approach. A given rise in U.S. interest rate under the new policy induces a much larger rise in Canadian interest rate, which makes their interest rate differential smaller than it might have been. This, in
turn, dampens the upward pressure on the exchange rate of the U.S. dollar against the Canadian dollar.

But, by allowing U.S. interest rates to rise faster, the new approach to monetary policy raises the differentials between U.S. interest rate and those of the other countries, which tends to make the exchange rate of the dollar against their currencies higher than they might have been.

Therefore, given the finding that Canadian and West German interest rates are only moderately sensitive to changes in U.S. interest rates, while those of the other countries are not sensitive at all, since the floating of the U.S. dollar, this new approach to monetary policy, which exerts more upward pressure on interest rate than the approach it replaced, if continued, will mean more hard times for U.S. agricultural commodity exports. ¹

This potentiality is made more likely by the growing federal deficit which puts more upward pressure on interest rates. So far, some of this deficit has been financed by foreign capital inflows, encouraged by rising U.S. interest rate differentials. This has helped dampen the upward pressure on U.S. interest rates which, otherwise, might have been higher than they are. But, this inflow of foreign capital will not continue, ad infinitum. If the federal deficit is not reduced thereby lowering public sector borrowing needs before the inflow slows down or stops, and unless domestic savings rise enough to accommodate the federal deficit, a new and higher global threshold for

¹ There has been a slight modification of the policy adopted in October, 1979. See Solomon (Winter 1984-85), and Axilrod (1985), for instance.
interest rates will be reached. As U.S. interest rates continue to rise under the combined pressure of increased public sector borrowing, inflation-directed tight monetary policy, and the need of foreign countries to discourage further capital outflows, foreign interest rates will have to rise, with the potential for a decline in global economic activity - and ultimately, further decline in U.S. agricultural exports.

The unmistakeable implication of all this is that U.S. real interest rates will have to begin heading down soon. This may require a more direct incorporation of the interest rate factor in monetary policy formulation. The new "tripartite" approach adopted early in 1983, is certainly to be preferred to the approach adopted in October, 1979, where interest rates are allowed to find their own paths in response to deviations of monetary aggregates from targets. This latest approach factors in the overall performance of the economy, and targets net free reserves (excess reserve less borrowed reserves), thus according interest rates an indirect role in monetary policy formulation. By controlling member-bank borrowings, policy implicitly sets a range for the federal funds rates which in turn moderates the fluctuation in market interest rates.

But, to be effective, some complementary action is necessary on the fiscal side. A reduction in the federal deficit will reduce public sector demand for credit, which will ease the pressure on

^2^ Solomon (Winter 1984-85), op cit.
interest rates. Federal subsidization of personal and business borrowings through tax-deductibility of interest payments, reduces the effective borrowing costs to borrowers and thus stimulates increased demand for credit. This additional source of pressure on interest rate could be eliminated, although it might dampen aggregate demand somewhat. In general, as monetary policy seeks to ease the pressure on interest rate from the supply side, appropriate fiscal policy tools ought to be used to complement monetary policy by easing credit demand pressures - until, at least, the U.S. dollar softens to a more tolerable level.

In conclusion, let me recall the analogy drawn in Chapter I between traditional supply-oriented agricultural policy and a one-blade scissor. Used alone, they are ineffective (not unnecessary) for their intended purpose. For agricultural policy, the missing complementary blade is a set of policies aimed at the demand side of the excess supply problem of the agricultural sector. At a minimum, the goal of such policies should be to sustain existing demand, foreign and domestic, for agricultural commodities. This will require a more co-ordinated policy framework in which agricultural policy is treated as an integral part of a whole economic policy package. Some degree of consistency between agricultural policy, monetary policy, and fiscal policy, has become necessary. Changing conditions, such as the increasing integration of world money markets, the resulting higher

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capital mobility, increased interest rate elasticity of international financial portfolios, floating exchange rates, and increased competition from other exporters, all seem to suggest that this is the logical path for future agricultural policy. A strong demand for agricultural products will not only ease the problems of the sector; it will also reduce the strain on the federal budget, and the average tax rate.

5.3 Suggestions for Further Study

A major constraint on the scope of this study is data - a constraint imposed by very limited resources. It would have been more fruitful, for instance, to cover more commodities and markets. This, therefore, would be a natural way to extend the study. Other variables, such as differential costs of agricultural production, or differences in agricultural productivity, all of which may be expected to affect competitiveness, provides fruitful avenues of extending the present study.

Further studies might also shed more light on the effect of exchange rate volatility on agricultural import market shares, and why agricultural input prices have, historically, tended to rise faster than output prices.

Ultimately, the problem of the U.S. agricultural sector comes down to a problem of inadequate demand. Research, in the past, focused on improving production technology. The challenge of future research is on expanding demand.
APPENDIX

This appendix shows the derivation of equation (3.6.1) in the text. The relevant equations from Chapter III are reproduced here for easy reference.

A1. \[ x_j = \sum_{i} k_{ij} E_{ij} \]

A2. \[ k_{ij} = k_{ij} (\lambda, Z) \]

A3. \[ \lambda_j = \frac{p^*_u s_j}{c_j} \]

A4. \[ E_{ij} = D_{ij} (p^*_1, \ldots, p^*_n) - S_{ij} (p^*_1, \ldots, p^*_n) \]

\[ = D_{ij} (p^*_r) - S_{ij} (p^*_r), \ r = 1, \ldots, j, \ldots, n \]

Equation A4 is very general and "r" is an index of commodities, one of which is \( j \).

A5. \[ p^*_f = h(p^*_u), \quad \frac{\partial h}{\partial p^*_u} \geq 0 \]

A6. \[ p^*_u = e p^*_u \]

\( p^*_f \) is foreign price. Two sets of foreign prices are involved here. One is \( p^*_c \), the average price of U.S. competitors in the given

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market for commodity j, and the other is \( P^*_i \), the domestic market price of the \( r \)th commodity in the importing country, \( i \), and an asterisk (*) indicates that the prices are denominated in the importer's currency.

From A1:

\[
A7. \quad dX_j = \sum_{i} \left( k_{ij}^\ast dE_{ij} + E_{ij} dk_{ij} \right)
\]

From A2:

\[
A8. \quad dk_{ij} = \frac{ak_{ij}}{a\lambda_j} d\lambda_j + \frac{ak_{ij}}{aZ} dZ
\]

\[
= k_{ij} \eta_{j,\lambda} \lambda_j^\ast + \frac{ak_{ij}}{aZ} dZ
\]

In general, for a variable \( V \), \( \dot{V} = \frac{dV}{V} \)

From A4:

\[
A9. \quad dE_{ij} = dD_{ij} - dS_{ij}
\]

\[
= \sum_{r} \left( \frac{dD_{ij}^r}{ap_{ir}^*} dP_{ir}^* - \frac{dS_{ij}^r}{ap_{ir}^*} dP_{ir}^* \right)
\]

\[
= \sum_{r} \left( D_{ij} \eta_{ij} \tilde{P}_{ir}^* - S_{ij} \eta_{ij} \tilde{P}_{ir}^* \right)
\]
Substituting $A8$ and $A9$ into $A7$

\[ A10. \quad d x_j = \sum_1 \sum_1 \left( k_{ij} \eta D, p^* - \alpha_{ij} \eta S, p^* \right) + \]

\[ \left( k_{ij} \eta k, \lambda \lambda_j + \frac{\partial k_{ij}}{\partial z} dZ \right) x_{ij}^{ij} \]

From $A10$:

\[ A11. \quad \hat{x}_j = \sum_1 \left( k_{ij} \eta D, p^* - \alpha_{ij} \eta S, p^* \right) + \]

\[ \left( k_{ij} \eta k, \lambda \lambda_j + \frac{\partial k_{ij}}{\partial z} dZ \right) \]

where $a_{dij} = \frac{d}{x_j}$, $\alpha_{sij} = \frac{S_{ij}}{x_j}$, $\hat{x}_j = \frac{dX_j}{x_j}$

If let $dZ = 0$, then

\[ A12. \quad \eta x_j, p^* = \frac{\lambda}{x_j} = \sum_1 \left( k_{ij} \eta D, p^* - \alpha_{ij} \eta S, p^* \right) n_{ij} p^* + \eta p^* \]

\[ + \left( k_{ij} \eta k, \lambda \lambda_j + \frac{\partial k_{ij}}{\partial z} \right) x_{ij} \]

This is the price elasticity of U.S. export of commodity $j$ in very general form, incorporating cross-price effects.
From A11:

\[ n_{x_j,e} = \sum_{i,j} \{ (k_{ij} \eta_{k,\lambda, e}) - (S_{ij} \eta_{x_j,e}) \} \]

Substituting A14 and A15 into A13 and factoring out \((1 + n_{p_{us_j,e}})\) yields the desired result

\[ n_{x_j,e} = (1 + n_{p_{us_j,e}}) n_{x_j,p^*_{us_j}} \]
BIBLIOGRAPHY


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