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BATTEN, DALLAS SANFORD

THE EFFECTS OF BILATERALISM UPON RECIPROCITY, BILATERAL TRADE FLOWS, AND THE DEMAND FOR INTERNATIONAL RESERVES

The Ohio State University

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FOR INTERNATIONAL.RESERVES

DISSERTATION

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

By
Dallas Sanford Batten, B.A., M.A.

* * * * *

The Ohio State University
1980

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To George McKeen

whom I loved like a father
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SYMBOLS USED

\( X_{ij}(ji) \), the aggregate value of exports from country \( i(j) \) to country \( j(i) \)

\( M_{ij} \), the aggregate value of imports by country \( i \) from country \( j \)

\( Y_i(j) \), the national income or domestic product of country \( i(j) \)

\( F_i(j) \), the size of the foreign sector of country \( i(j) \)

\( R_{ij}(ji) \), the trade resistance factor associated with the exporting of commodities from country \( i(j) \) to country \( j(i) \)

\( R_i \), the stock of foreign currencies held by commercial banks in country \( i \)

\( SR_i \), the sum of commercial banks' foreign currency holdings and those of the central bank of country \( i \) \((R_i + ROF_i)\)

\( ROF_i \), the stock of foreign currencies held by the central bank of country \( i \)

\( NT_{i,1938}^1 \), the percentage of country \( i \) 's total trade in 1938 that was conducted with trading partners that imposed exchange control after World War II

\( T_i \), country \( i \) 's volume of international transactions

\( r_i \), country \( i \) 's interest rate

\( DX_{ij} \), \( |X_{ij} - X_{ji}| \)

\( N_i(j) \), the population of country \( i(j) \)

\( B_{ij} \), \( \begin{cases} 2 & \text{if a bilateral payments agreement exists between countries } i \text{ and } j \\ 1 & \text{otherwise} \end{cases} \)
\[ EM_{ij} = \begin{cases} 
2 & \text{if countries } i \text{ and } j \text{ are each members of the European Payments Union} \\
1 & \text{otherwise} 
\end{cases} \]

\[ D_{ij} \], the great circle distance between major trading centers in countries \( i \) and \( j \)

\[ DUSA = \begin{cases} 
2 & \text{if trading partner is the U.S.} \\
1 & \text{otherwise} 
\end{cases} \]

\[ DCPE = \begin{cases} 
2 & \text{if trading partner is a centrally planned economy} \\
1 & \text{otherwise} 
\end{cases} \]

\[ RD_{X_{ij}} = \frac{DX_{ij}}{X_{ij} + X_{j}} \]

\[ X_{i} \], the aggregate value of country \( i \)'s exports

\[ M_{i} \], the aggregate value of country \( i \)'s imports

\[ EXC_{i} = \begin{cases} 
1 & \text{if country } i \text{ has imposed exchange control} \\
0 & \text{otherwise} 
\end{cases} \]

\[ BCA_{ij} = \begin{cases} 
2 & \text{if a bilateral clearing agreement exists between countries } i \text{ and } j \\
1 & \text{otherwise} 
\end{cases} \]

\[ ATA_{ij} = \begin{cases} 
2 & \text{if an automatic transferability agreement exists between countries } i \text{ and } j \\
1 & \text{otherwise} 
\end{cases} \]

\[ WB_{i} \], a weighted average of the number of bilateral agreements that country \( i \) has entered with all of its trading partners (trade with each partner as a percentage of \( i \)'s total trade used as weights)
CHAPTER I
INTRODUCTION

Periodically governments have used exchange control as a means to correct temporarily a balance of payments deficit. The imposition of exchange control carries with it welfare costs in the form of the mis-allocation of productive resources and a decrease in the size of the foreign sector. Bilateralism typically accompanies exchange control; it is a means by which some of the constraints of exchange control are lessened. That is, bilateralism is a second-best policy instrument designed to alleviate some of the welfare costs imposed by the use of exchange control. However, bilateralism does not completely neutralize the constraints resulting from the use of exchange control. These welfare implications of exchange control and bilateralism have never been successfully investigated.

The major reasons for this lack of success are (1) neglecting to differentiate the concept of bilateralism from reciprocity, (2) failing to measure the marginal effects of policy and nonpolicy determinants of bilateral trade flows, and (3) not recognizing that several types of bilateral payments agreements existed which differed greatly in the degree in which they affected trade. Directing one's attention to correcting the above shortcomings is paramount for a rigorous analysis of the effects of bilateralism upon trade flows.
Bilateralism is an *ex ante* government policy. The primary motivating factor leading to bilateralism is the imposition of exchange control on the part of at least one of the countries participating in the agreement. Exchange control operates simply by transferring the allocation of foreign exchange from the exchange markets to a governmental agency. This transferral creates currency inconvertibility. When a currency is accepted only by the issuing country (i.e., cannot be exchange for other currencies), this currency is inconvertible or "soft." Alternatively, when a currency is readily accepted by any country (other than the issuer) in exchange for any other currency, this currency is convertible or "hard." Without the establishment of some type of multilateral clearing mechanism (like the European Payments Union in the 1950s), exchange control completely destroys multilateral international trade through its creation of currency inconvertibility. Surpluses from trade with one partner (denominated in that country's currency) cannot be used to finance deficits from trade with another (denominated in another country's currency). Consequently, a mechanism is needed to finance trade among countries that have imposed exchange control because no country is willing to hold useless stocks of other countries' "soft" currencies. Bilateralism is such a mechanism; it is an *ex ante* policy designed to facilitate trade between exchange control trading partners and also, possibly, to cause trade to balance bilaterally.

There are several forms of bilateralism differing in degrees of restrictiveness.² The most restrictive type of bilateral agreement is the private compensation agreement which consists of barter exchanges
between private groups or firms in the partner countries. For example, a steel producer in country A might arrange to trade $X$ million worth of steel to a shoe manufacturer in country B in exchange for $X$ million worth of shoes. Or, a steel producer and a shoe importer in A might conduct a barter transaction with a steel importer and a shoe manufacturer in B; then the two domestic dealers in each country can complete the transaction in their own currencies. The popularity of this type of agreement is based on the elimination of the exchange of foreign currencies in the transaction. However, this agreement also contains the common disadvantage associated with barter transactions, i.e., the double coincidence of wants. Many agreements negotiated between centrally planned economies (CPEs) and market-type economies (MTEs) are private compensation agreements.

A second, less restrictive, type is the bilateral clearing (or payments) agreement. Bilateral clearing agreements provide a mechanism through which financial claims resulting from the trade between two countries can be settled without either country having to hold the currency of the other. This settlement is accomplished either by the establishment of an account in the central bank of either partner of the agreement or by the establishment of two accounts, one in the central bank of each partner. All payments for imports and receipts from the sale of exports (for trade between the partner countries) must pass through these accounts. This procedure simply entails accounting transactions which do not involve the exchange of foreign currencies. To illustrate, suppose that countries A and B enter into a bilateral clearing agreement. When commodities are imported by A from B,
payments are made by the importers in A's currency into B's clearing account housed in the central bank of A. This transaction involves a crediting of B's account in A's central bank. After this has been completed, the central bank of B debits A's clearing account (denominated in B currency units) and pays the exporters in B the value of their imports to A in B's currency. (This payment is made using the funds paid into A's clearing account in the central bank of B expressed in B currency units resulting when B imports from A.) Of course, some exchange rate must be used in the above transaction. The exchange rate is used only in the accounting part of the transaction; there is no exchange of currency from A to B. The rate used is usually a negotiated one (as opposed to a market-determined one). A similar transaction occurs for imports by B from A.

Since transactions made under the terms of a bilateral clearing agreement are not barter deals, it is improbable that A's exports to B and A's imports from B (and vice versa) will exactly balance at any point in time. Consequently, some type of credit arrangement must be made because the funds in the clearing account of the deficit country will be insufficient for payment to the exporters of the surplus country. The handling of this situation distinguishes pre-World War II and post-World War II bilateral clearing agreements. In the prewar agreements, when trade between partners was unbalanced, exporters in the surplus country usually were forced to wait until consumers in their country imported more from the partner (and consequently, paid domestic currency into the partner's clearing account) before they could be paid for their exports. That is, the exporters of the surplus country were
implicitly financing the imbalance. Sometimes the central bank made loans to the exporters so that the flow of exports to the partner country could be maintained. The postwar agreements were less restrictive by explicitly allowing for periodic imbalances with the inclusion of swing credit clauses in the agreements themselves. Swing credits were reciprocal credit arrangements which permitted trade between partners to be unbalanced in either direction within specified limits without settlement being mandatory. Since in most postwar agreements central banks had to hold currency balances in the central bank of the partner country, these agreements shifted the burden of financing an imbalance to the central bank of the deficit country.\textsuperscript{5}

The degree of restrictiveness of the bilateral clearing (payments) agreement, then, depended on the size of the swing credit limit agreed to in the agreement. Penalties for imbalances were imposed only after the swing credit limit had been exceeded. This type of agreement was extremely popular between two countries that had imposed exchange control since it obviated the double coincidence of wants necessary for the operation of private compensation agreements without necessitating the use of foreign currencies in international transactions.

The third major type of bilateral agreement is actually a subset of the bilateral clearing or payments agreement discussed above. It is treated individually here because it is an extremely important type of agreement for the analyses performed below. This type of agreement is the automatic transferability agreement; its unique feature is that it includes the authorization for automatically transferring the imbalances resulting from trade between partner countries to finance a
deficit that the surplus partner may have with a third country. For example, countries A, B, and C have entered into pairwise automatic transferability agreements. If A has an export surplus with B, but an import surplus with C, then A can transfer some or all of its surplus in trade with B to finance its bilateral deficit with C. Of course, this procedure is the normal way in which multilateral trade is conducted in a hard-currency world. The major difference between the automatic transferability agreement and normal multilateral trade is that the agreement only operates within a group of participants; alternatively, normal multilateral trade operates within the entire system of hard currency world markets. In essence, the automatic transferability agreement is an intermediate step between bilateralism and multilateralism. Some type of bureaucracy is needed to perform the task of transferring imbalances from country to country. Consequently, automatic transferability agreements can be negotiated only when a group of countries have organized such a bureaucracy. The European Payments Union (EPU) is an example. The EPU was composed of the same countries that formed the Organization for European Economic Cooperation (OEEC) after World War II. It was the accounting bureaucracy that handled the transferral of imbalances between partners to third countries. Most of the postwar intra-West European bilateral agreements were automatic transferability agreements and, as a result, necessitated use of the services of the EPU.

Reciprocity, on the other hand, is strictly an ex post concept. If country A's trade with each of its trading partners (regardless of reason) balances, then A's trade is completely or totally reciprocal.
If the set of countries to which A exports does not intersect the set from which it imports, then A's trade is completely or totally irre‐ciprocal. The existence of a high degree of reciprocity in the short run is neither a necessary nor a sufficient condition for the concomi‐tant existence of bilateralism. That is, many factors other than gov‐ernmental policy decisions affect the size and direction of bilateral trade flows. A country could conceivably enter into bilateral agree‐ments with some or all of its trading partners, and yet its trade with them might not balance reciprocally. In this case, other, more influ‐ential factors (causing trade to be less reciprocal) have outweighed the reciprocal-balancing effect of the bilateral agreements. Alterna‐tively, bilateral trade flows for a country may very nearly balance re‐ciprocally even though its government has not entered into bilateral agreements with the government of any of its trading partners. Consequent‐ly, it should be clear that the use of a measure of the degree of reciprocity to indicate the efficacy of bilateralism upon trade is in‐adequate since numerous factors, in addition to bilateralism, affect the degree of reciprocity present in a country's trade. However, this is the state of the art; in all previous work in this area a measure of reciprocity has been devised and used as an indication of the effect of bilateralism upon trade flows. This is my point of departure. To truly understand the effect of bilateralism upon bilateral trade flows and upon reciprocity, the marginal impact of bilateralism must be isolated. That is, a meaningful analysis of this problem must begin by first separating the effect of bilateralism from the effects of all the other variables that influence the size and direction of bilateral trade
flows. Also, since one of the primary motivating factors for the use of bilateralism is to eliminate the use of foreign exchange to finance international transactions, some attention must be directed to the effect of bilateralism upon the demand for (or use of) international currency reserves. Investigating these topics comprises most of this paper.

The paper contains four additional chapters. Chapter II is a survey of the majority of the literature concerning the measurement of reciprocity. In this chapter several measures of reciprocity (and consequently, several definitions of reciprocity) are compared; the results of each study are presented; and the shortcomings of each are discussed. As one might expect, since these studies employ a measure of reciprocity to indicate the effect of bilateralism upon trade, their results are quite often unexpected and at times, anomalous.

In Chapter III the conceptual framework of the paper is presented; this chapter is divided into four major parts. In order to be able to predict the marginal impact of bilateralism, one must first grasp why one country enters into a bilateral agreement with another. The basis for this understanding is the use of exchange control and its relationship to bilateralism. The first part of Chapter III deals with why a country might impose exchange control and how this leads to the negotiation of bilateral agreements with its trading partners. Included in this discussion is how the post-World War II economic environment motivated the use of exchange control and bilateralism as policy instruments. In the second part a gravity model of bilateral trade flows is developed in order to isolate the marginal effect of bilateralism upon
bilateral trade flows. The third part of this chapter contains my modification of the gravity model to the explanation of reciprocity. In this manner the marginal impact of bilateralism upon reciprocity can be separated from the total impact of the other variables that affect the geographic distribution of trade. In the fourth part a simple model is developed that relates the transactions demand for international reserves and the prevalence of bilateralism. Since bilateralism enables a country to engage in international exchange while conserving its stock of foreign currency reserves, one expects that the transactions demand for international reserves and the prevalence of bilateralism should be inversely related.

The estimating equations derived from the models developed in Chapter III and the results of these estimations are presented in Chapter IV. Four individual analyses are performed here. First, my method of isolating the effect of bilateralism upon reciprocity is tested and compared with results obtained by using several of the existing reciprocity indices. Second, the effect that the imposition of exchange control has on a country's aggregate trade is investigated. Third, the impact of bilateralism upon trade among countries that have imposed exchange control is examined. Finally, the relationship between the use of bilateralism and a country's transactions demand for international reserves is analyzed.

Chapter V contains a summary and the conclusions of this study. These include a comparison of the hypotheses with the empirical results as well as an investigation of the welfare ramifications and policy implications of bilateralism and exchange control.
NOTES TO CHAPTER I

1. Bilateralism is most often interpreted as an attempt to force trade between partners participating in an agreement to balance reciprocally. However, this feature of bilateral agreements is actually a by-product. The primary purpose of these agreements is to provide a means for financing trade between countries that have imposed exchange control (or at least one of the partners has imposed exchange control).


3. The bilateral clearing agreement and the bilateral payments agreement are identical only after World War II. The typical prewar clearing agreement was between two countries that each had imposed exchange control; alternatively, the typical prewar payments agreement was between an exchange control country (A) and a free exchange country (B). Country A agreed to allocate the payment for its exports to B (denominated in B's currency) to an account used for the payment of A's imports from B. In this manner A and B could still trade with each other without forcing B to hold balances of A's inconvertible currency or compelling A to pay for B exports using hard currency. Since all of the bilateral agreements entered into immediately after World War II were between exchange control countries, there is no corresponding difference between clearing and payments agreements. The two terms will be used interchangeably in this paper because my primary focus is on the effects of those bilateral agreements entered into immediately after World War II.


5. Ibid.
CHAPTER II
LITERATURE SURVEY

Introduction

In almost all of the previous investigations of the effect of bilateralism upon reciprocity, some type of reciprocity index has been used. Each of these indices aggregates the deviation in bilateral trade flows to and from country \( i \) with all \( j \) of its trading partners. The purpose of this chapter is to survey the major studies that have preceded this study, to point out their deficiencies, and to note my point of departure from the antecedent work. The deficiency shared by all of the studies employing a reciprocity index is that the authors failed to take into account that bilateralism is an \textit{ex ante} concept while reciprocity is an \textit{ex post} one. Also, many factors other than bilateralism can motivate reciprocal trade; consequently, a measure of reciprocity could quite possibly have no relationship at all to the trade policies followed by a government.

The remainder of the chapter is divided into four sections. The first section contains a survey of the four studies in which a reciprocity index was introduced. In the second section, three additional studies that used already existing indices are analyzed. Three tangential works are summarized in the third section. These works do not use reciprocity indices explicitly, but they do provide some
information concerning the effect of bilateralism upon reciprocity and upon bilateral trade flows. The final section contains some concluding remarks and also briefly delineates my departure from the existing work.

Studies that Introduce Indices

The League of Nations (LN) in a statistical review of world trade made the first attempt to measure the degree of reciprocity in world trade and to relate bilateralism with reciprocity empirically. Like almost all of the other investigators of reciprocity, the LN perceived its measure as one of the degree of bilateralism never differentiating the \textit{ex ante} nature of bilateralism and the \textit{ex post} nature of reciprocity. Its index is as follows:

\begin{equation}
T_i^{\text{LN}} = 100 \cdot \frac{\sum_j |X_{ij} - M_{ij}| - |X_i - M_i|}{(X_i + M_i) - |X_i - M_i|}
\end{equation}

where $X_{ij}$ = country i's exports to country j, 
$M_{ij}$ = country i's imports from country j, 
$X_i$ = i's total exports, 
$M_i$ = i's total imports, 
\(T_i^{\text{LN}}\) = the degree of irreciprocity in i's trade according to the LN index.

When country i's trade is completely reciprocal, \(T_i^{\text{LN}} = 0\); alternatively, when it is completely irreciprocal, \(T_i^{\text{LN}} = 100\). Even though the LN never explicitly defined reciprocity, it is interesting to derive its definition from its index. The LN defines reciprocity as the
ratio of the sum of absolute bilateral trade imbalances to total trade with both numerator and denominator adjusted by subtracting the absolute total trade imbalance. This implies that complete reciprocity can occur in one of two ways: (1) when each bilateral trade flow between \( i \) and all \( j \) of its trading partners balances and (2) when the sum of the absolute deviations of the bilateral trade flows equals the absolute total trade imbalance. (The latter situation can occur only if each bilateral imbalance has the same sign. If some bilateral imbalances are negative and some positive, the sum of the absolute bilateral trade imbalances is always greater than the absolute total trade imbalance.) This adjustment enables one to distinguish between irreciprocity caused by bilateral trade flow imbalances per se and irreciprocity caused by an overall trade imbalance. Thus, the LN index should minimize the likelihood of overstating the degree of irreciprocity for countries with overall trade imbalances due to an unsuccessful policy of bilateralism. Although this adjustment for overall trade imbalance might improve the LN index as a measure of reciprocity, the index remains an inappropriate and probably inaccurate measure of the existence of bilateralism and its effect upon trade flows. One must view the LN's results and their interpretation with this qualification in mind.

Using its index and data from the years 1929 and 1933, the LN observed that the degree of reciprocity \((1 - T_i^{LN})\) in the trade of the countries in their sample increased from 79.7 in 1929 to 83.4 in 1933. During this same period the use of exchange control and the subsequent existence of bilateral clearing and payments agreements were becoming
more pervasive. Consequently, the LN concluded that the reason for
the increased reciprocity depicted by their index must be the in-
creased use of bilateral clearing and payments agreements by the
countries in their sample. This need not be the reason; many factors
other than bilateralism could have caused this change in the degree of
reciprocity. Nevertheless, the LN did make a contribution with their
measurement of reciprocity and their attempt to link it with bilater-
alism as a causal factor. It also identified three possible negative
effects of bilateralism over which it expressed some concern. The
first was the tendency for the use of bilateralism to spread. In par-
ticular, it felt that the highly reciprocal trade induced by the ex-
istence of bilateral clearing and payments agreements would diminish
the credit pool available to finance trade with nonagreement countries.
Either decreased trade or the negotiation of a bilateral agreement
with these countries must result. Secondly, a world-wide movement
toward increased bilateralism would hurt those countries which spe-
cialize in the production of relatively few commodities for export
(e.g., primary goods) or export to a specialized market. These were
the countries that tend to benefit the most from multilateral trade
and hence, these countries were at a competitive disadvantage when
negotiating bilateral agreements either because they exported a rela-
tively low number of different products (i.e., for fulfilling the
agreement) or because they exported only to certain parts of the world
market which limited the possible number of bilateral agreements. The
third negative effect of bilateralism was that it adversely affected
domestic relative prices by distorting the market mechanism and as a
result, motivated increased domestic production of importables thereby causing a misallocation of the domestic productive resources. This third negative effect was not caused by bilateralism per se. The LN failed to recognize that bilateralism is precipitated by the imposition of exchange control on the part of at least one of the partners in the agreement. The distortion of the working of the world market was due to exchange control, not to bilateralism. In fact, bilateralism might help to promote additional trade during periods when exchange control is being utilized and thus, may help to alleviate some of the resource misallocation problems. To summarize, the LN feared the detrimental welfare effects of bilateralism. Even though its work contained both conceptual and empirical deficiencies, it does raise questions which motivate further research.

Of all the studies which introduce a reciprocity index, Marer's study dealt more with the conceptual features of bilateralism and reciprocity than did any of the others. Marer recognized the inaccuracy of using a measure of reciprocity (an ex post concept) to indicate the efficacy of bilateralism (an ex ante concept) as follows:

Multilateralism cannot be measured directly, only trade reciprocity can. Perfectly reciprocal trade, however, is consistent with multilateralism or bilateralism. With the above statement one would expect Marer to abandon reciprocity indices as an empirical tool, but he did not. He proceeded to analyze and to compare the degree of reciprocity in East-East (E-E), East-West (E-W), and West-West (W-W) trade. Because he used a reciprocity index in his analysis and because many factors other than bilateralism
affect the level of reciprocity, there is no way to determine from Marer's study why one group's trade was more or less reciprocal than another's. In this respect, Marer's study is a comparison of calculated reciprocity indices without any investigation concerning why differences or similarities in the levels of reciprocity occurred.

Marer did discuss and include in his empirical analysis three conceptual points that are worth further discussion: (1) he identified a potential weighting problem that exists in all of the other indices; (2) he dealt explicitly with the effect of long-term capital flows upon the calculated degree of reciprocity; and (3) he recognized that one year may not be a sufficiently long time period for an accurate measurement of the degree of reciprocity. Each of these requires some additional explanation.

First, each of the other three reciprocity indices discussed here uses total trade as a weight in measuring the degree of reciprocity in a country's trade. This implicitly assumes that the size of each bilateral trade imbalance is relatively more important than is the number of bilateral trade imbalances. As a result, the following question is raised: Is the trade of a country that trades relatively reciprocally with a few of its larger trading partners, but relatively irreciprocally with all the rest of its smaller trading partners more or less reciprocal than the trade of a country that trades relatively irreciprocally with a few of its larger trading partners and relatively reciprocally with the rest? The indices that employ total trade as a weight implicitly bias the overall degree of reciprocity according to the degree of reciprocity present in the trade with that
country's larger trading partners. This bias due to using total trade as a weight is not necessarily incorrect as there is no unequivocal answer to the above question. However, a standardization process that distributes the weight equally among all trading partners is most likely preferable to using total trade as the weighting factor. Marer perceived this point and developed his index so that equal weight is given to the bilateral trade flow with each partner as follows:

\[ T_i^{MA} = \frac{100}{N} \sum_{j} \left| \frac{X_{ij}}{M_{ij}} - 1 \right| \]

where \( N \) = the number of country i's trading partners,

\[ T_i^{MA} \] = the degree of irreciprocity in i's trade using Marer's index

and all other variables are defined above. However, Marer's index has two deficiencies that the others do not have. First, like the other, \( T_i^{MA} = 0 \) when i's trade is completely reciprocal. On the other hand, when i's trade is completely irreciprocal at least one \( M_{ij} \) must equal zero. In that case, Marer's index is undefined. Second, his index implicitly gives more weight to bilateral export surpluses than to bilateral import surpluses. That is, the trade of countries with relatively more or relatively larger bilateral export surpluses appears to be less reciprocal than the trade of countries with relatively more and relatively larger bilateral import surpluses.

Marer's second point was that because reciprocity indices are calculated using only merchandise trade data, capital flows that
finance bilateral imbalances in merchandise trade could bias the degree of irreciprocity upward. That is, by neglecting the financing capital flows, trade could appear to be less reciprocal than it actually was. This is a problem that has plagued all empirical work that analyzes bilateral trade because data concerning bilateral merchandise trade flows are readily available and reasonably accurate while data concerning bilateral capital flows are almost nonexistent and extremely imprecise. Also, a conceptual problem exists in tying capital flows from i to j payments for exports from j to i. In the case of E-W trade, however, Marer stated that one could more easily detect the effect of long-term capital flows since the flow of credit was primarily in one direction (from West to East), and the credit was tied almost exclusively to export sales from the creditor country. Marer proposed to test for the effect of long-term capital flows by partitioning bilateral imbalances for each Eastern country into positive and negative groups. The positive group would represent irreciprocal Eastern trade accounted for by Eastern export surpluses; the negative group would represent irreciprocal Eastern trade accounted for by Eastern import surpluses. If the negative group was "significantly" larger than the positive group, then there was more reason to suspect that long-term capital flows from West to East (i.e., Eastern indebtedness to the West) had caused the calculated reciprocity index to understate the degree of reciprocity in East-West trade.

Third, Marer proposed that even under a policy of strict bilateralism, bilateral trade flows between any two countries will seldom balance annually. (Other authors implicitly assumed that annual trade
data was sufficient to indicate the effect of bilateralism upon reciprocity. Also, the problem of how short-term capital flows affect the calculated degree of reciprocity can also be important when a time interval as short as one year is used. Consequently, reciprocity indices calculated annually could understate the actual degree of reciprocity existing in a country's trade. To remedy this, Marer segregated his twelve-year sample (1960-1971) into three four-year periods and calculated his index and the LN index over a four-year time span (instead of annually) for trade (a) among the seven CMEA (Council for Mutual Economic Assistance) countries plus Yugoslavia, (b) among eight Western European countries which are principal trading partners of the Eastern countries, and (c) between the eight Eastern countries and all OECD (Organization for Economic Cooperation and Development) countries except Iceland, Ireland, Turkey, and Portugal.

As one might expect, E-E trade was the most reciprocal in all three sample periods. W-W trade appeared to be as reciprocal or more reciprocal (in the last two periods) than E-W trade. But, when the bilateral imbalances of the E-W indices were partitioned, the negative group is from 40 to 140 percent larger than the positive group. This implied (at least to Marer) that Western credit to the East had biased upward the calculated E-W indices. After some undescribed adjustments were made to the E-W indices, W-W trade appeared to be less reciprocal than E-W trade for the first two sample periods and to be as reciprocal in the third period. Thus, the flow of long-term capital from West to East was the only reason that Marer explicitly found empirically for differing degrees of reciprocity in E-E, E-W, and W-W trade. No other
explanation was identified. It can only be inferred from Marer's discussion in the beginning of his paper that he expected these results because of the currency and commodity inconvertibility and the central planning present in the Eastern economies. However, since he did not explain reciprocity, the above inferences were not empirically verified.

Michaely performed the most comprehensive analysis in this area. He calculated the following index for sixty-five countries over four different years (1938, 1948, 1954, and 1958):

\[ T_{i}^{MI} = \frac{100}{2} \sum_{j} \frac{X_{ij} - M_{ij}}{X_{i.} - M_{i.}} \]

where \( T_{i}^{MI} \) is the degree of irreciprocity in i's trade according to Michaely's index and all other variables are defined above. Of the sixty-five countries, sixty were non-CMEA countries whose trade composed 90 percent of non-CMEA merchandise trade. From inspecting his index, one notices that Michaely's definition of reciprocity is quite different from that of others who have developed reciprocity indices. In particular, to Michaely trade can be completely reciprocal (\( T_{i}^{MI} = 0 \)) under two sets of circumstances. Trade is completely reciprocal if each of country i's bilateral trade flows balance. However, a country's trade is also completely reciprocal when its bilateral exports as a proportion of total exports equal its bilateral imports as a proportion of total imports with each of its trading partners. The latter situation can occur even when overall trade is unbalanced. Consequently, Michaely's is the most liberal definition of reciprocity. But since his index
neglects total trade imbalances, it becomes a less accurate measure of reciprocity as the total trade imbalance increases.

One of Michaely's major contributions in this study is his discussion of the two principal empirical problems confronted in measuring reciprocity. Specifically, international economic relations include services and capital flows as well as merchandise trade flows. These two flows are the ones that create the problems in measuring reciprocity. Service flows could be incorporated into the calculation of any reciprocity index in the same manner as are merchandise trade flows, but data concerning the geographic distribution of trade in services were incomplete and unreliable. As a result, trade in services was excluded from Michaely's study and from all of the other studies as well. To incorporate capital flows in the measurement of reciprocity poses even a larger problem. Not only are data concerning the geographic distribution of international capital movements incomplete and inadequate, but also the variable length of the life of a financial asset presents a seemingly intractable conceptual problem. In particular, the exchange of commodities for financial assets (which are not liquidated by the end of the measurement period) can be either reciprocal or irreciprocal in nature. If these assets have not been liquidated (to pay for imports) by the end of the measurement period, no a priori prediction can be made as to whether these assets will be liquidated as payment for imports from the issuing country (i.e., used for reciprocal trade) or whether these assets will be liquidated as payment for imports from a third country (i.e., used for irreciprocal trade). Likewise, if a consumer in country i liquidates an asset to
purchase imports from country j, one cannot ascertain if these assets were issued by j or by a third country (say, k). In short, the lack of information between the issuing of an asset, its liquidation, and how the proceeds are used precludes the inclusion of capital flows in the measurement of reciprocity.

Like Marer, Michaely explicitly differentiated bilateralism and reciprocity but proceeded to employ a reciprocity index in an attempt to depict the effect of bilateralism upon reciprocity. Since he failed to recognize that a reciprocity index captures the effects of all the variables (not just bilateralism) that influence the degree of reciprocity, his results were quite unexpected to him. Michaely calculated his index for each country in his sample (for which data were available) for each of the four years enumerated above. He compiled three averages using the individual country calculations for each year: (a) an unweighted arithmetic mean of the calculated indices of all sixty-five countries, (b) an unweighted arithmetic mean of the calculated indices of the sixty non-CMEA countries, and (c) a weighted arithmetic mean of the calculated indices of these same sixty countries using the proportion of each country's exports to total world exports as the weight. From 1938 to 1948 all three index averages increased. Because Michaely believed that bilateral clearing and payments agreements were much more prevalent in 1948 than in 1938, this result was quite unexpected. He attempted to rationalize this result by discounting the validity of the calculated indices for 1948 because international capital flows were unusually large in relation to total merchandise trade for that year. A cursory glance
back at these two time periods does not support Michaely's contention. Bilateral clearing and payments agreements were predominant in the 1930s as governments attempted to isolate their economies from the world-wide depression and from the volatile movements of financial capital. Bilateral agreements were also widespread after World War II primarily because many countries experienced severe balance of payments deficits. Consequently, I see no reason to expect, a priori, any definite relation between the 1938 and the 1948 index averages since bilateralism was pervasive during both time periods.

When he compared the 1954 and the 1958 index average with that of 1938, Michaely again obtained an unexpected result: trade in both 1954 and 1958 was more reciprocal, on average, than was trade in 1938. Again, it is not clear that bilateralism was more widespread in 1938 than it was in the 1950s. Also, Michaely's results could have been distorted by the large short-term capital flows that occurred in the 1950s; calculating his index for a period longer than one year might have alleviated this distortion.

The central problem with Michaely's analysis is that he expected the effect of bilateralism upon reciprocity to be so large that it would overwhelm the effects of all of the other variables that influence reciprocity. That is, he expected the trade of those countries that had entered into relatively more bilateral agreements to be relatively more reciprocal than the trade of those that had entered into relatively few agreements. While it is probably true that the marginal effect of bilateralism is to cause trade to be more reciprocal, Michaely could not determine this marginal effect since his
calculated reciprocity index depicts the total effect of all the variables that affect the size and the geographic distribution of bilateral trade flows. Not recognizing the above point, Michaely concluded from his results "that foreign trade policies followed by governments probably have a weak effect on the level of multilateral balance [irreciprocity] in comparison to other forces which participate in determining this level."¹³ This statement has no theoretical or empirical foundation in Michaely's study since he did not isolate, either conceptually or empirically, the marginal impact of any government policy (which includes bilateralism) upon reciprocity.

In his study Michaely also segregated countries into groups (a) according to geographic location and (b) according to monetary regions. His results were no better in these two analyses than they were in the first. He continued to find that the trade of countries which had negotiated few, if any, bilateral agreements was more reciprocal than the trade of those countries which used bilateral agreements the most. For example, the trade of the United States and Canada and that of the Latin American dollar countries (which almost completely avoided the use of bilateral agreements) was more reciprocal than the trade of the United Kingdom and that of the continental West European countries (which had negotiated numerous bilateral agreements). Michaely also found that for all three of the monetary areas studied (the Dollar Bloc, the Sterling Area, and the continental OEEC Area) trade within the monetary area was more reciprocal than trade outside of the area. Again, since Michaely did not isolate the marginal effects of the
variables that influence reciprocity one has no way of explaining or reconciling his results.

To summarize, Michaely's study has at least three redeeming features. First, he provided an excellent discussion of the two major problems encountered in the measurement of reciprocity. Second, the very fact that his results were so poor (relative to his expectations) supports my contention that many factors other than bilateralism affect reciprocity. Consequently, the effect of each of these must be isolated in order to ascertain the marginal impact of bilateralism. Third, Michaely implicitly thought that the countries with the most reciprocal trade would also be the ones that were the most frequent partners in bilateral agreements. Because his expectations were not fulfilled he examined more closely the countries with the least reciprocal trade. These countries mainly exported primary goods, were basically underdeveloped, and were small in terms of the size of their foreign trade relative to total world trade. Although Michaely did not develop this point, his examination was an attempt to explain reciprocity using causal factors other than bilateralism—an important step in determining the marginal effect of bilateralism upon reciprocity.

The primary aim of Pryor's study was to test his hypothesis that the existence of intra-CMEA bilateral agreements did not necessarily imply that intra-CMEA trade would be relatively more reciprocal than intra-EEC (European Economic Community) trade. He noted that a relatively high degree of reciprocity need not be the result of bilateralism:

Inferring that bilateral trade [reciprocity in my terminology] will come from a system of bilateral
negotiations is a confusion of form and content. It is an empirical question whether the bilateral trade negotiations of the Soviet Bloc led to bilateral trade, and it can only be answered by means of empirical investigation.¹⁵

To test his hypothesis, Pryor developed and calculated the following index for intra-CMEA trade and for intra-EEC trade for the period 1948 to 1960:

\[
T_i^P = 100 \cdot \frac{\sum |X_{ij} - M_{ij}|}{X_i + M_i}.
\]

where \(T_i^P\) is the degree of irreciprocity in \(i\)'s trade according to Pryor's index, and all other variables are defined above. Pryor's is the simplest definition of reciprocity: the sum of the absolute bilateral trade imbalances as a proportion of total trade. There is no explicit incorporation of total trade imbalances in Pryor's index. As a result, Pryor's index tends to increase vis-a-vis Michaely's and the League of Nations' as the total trade imbalance (as a proportion of total trade) increases.

When Pryor calculated his index, he found that trade among the EEC countries was only slightly less reciprocal than was intra-CMEA trade. Since Pryor implicitly assumed that the trade among the EEC countries was the multilateral benchmark, he concluded that intra-CMEA bilateralism had little effect upon the degree of reciprocity in intra-CMEA trade. There are at least two problems with Pryor's method of testing his hypothesis. First, even though he was correct in stating that this was an empirical problem, his use of his reciprocity index did not
depict the marginal effect of bilateralism upon reciprocity. Consequently, he did not test his hypothesis at all. Second, the EEC countries were not an adequate control group. During most of the sample period currency inconvertibility and bilateralism were prevalent throughout Western Europe. Consequently, it is not clear whether or not the Common Market countries were any less bilateral in their trade policies in that period than were the CMEA countries.

Studies that Employ an Existing Index

McMillan used Michaely's index to compare the degree of reciprocity in the trade of the USSR with that in the trade of the U.S.\textsuperscript{16} He claimed that he was examining "the empirical evidence for bilateralism in the recent trade of the CMEA countries."\textsuperscript{17} In fact, he only examined the degree of reciprocity in CMEA trade. Because he did not explain reciprocity, he had no way to isolate the effect of bilateralism upon reciprocity. It is quite surprising that he employed a reciprocity index in his analysis since he explicitly noted that factors other than bilateralism can cause reciprocity:

While the attempt to balance receipts and payments under bilateral clearing agreements is characteristic of socialist trade agreements, actual balance is neither a necessary nor a sufficient condition for bilateralism. Bilateral arrangements may fail to achieve balance, while balance may occur in the absence of any bilateral agreement.\textsuperscript{18}

Calculating Michaely's reciprocity index for the USSR and the U.S. for various years between 1938 and 1970, McMillan found that the degree of reciprocity in the USSR's trade increased significantly and exceeded the degree of reciprocity in the U.S.'s trade after World War
II. By segregating the trading partners of each of these two countries into socialist countries, hard currency countries, and other countries, McMillan reported three results. First, the relatively high degree of reciprocity present in the trade of the USSR was due primarily to its extremely reciprocal trade with other socialist countries. Second, the trade of the U.S. with socialist countries was much less reciprocal than its overall trade while its trade with other hard currency countries was relatively more reciprocal. Third, the USSR's trade with hard currency countries was less reciprocal than was the U.S.'s trade with other hard currency countries. From these results, McMillan concluded that the USSR's trade was more reciprocal vis-a-vis the U.S.'s trade because of the bilateral agreements that existed between most of the socialist countries (especially the CMEA countries) and that the USSR was equally as, if not more, multilateral than the U.S. in its trade with the rest of the world (i.e., countries other than socialist countries). Unfortunately, McMillan's empirical analysis did not explicitly support this conclusion. The relatively higher degree of reciprocity in the USSR's trade with other socialist countries could be a ramification not of bilateralism per se, but of the similarities of these types of economies (in particular, central planning and commodity inconvertibility). Also, I expect that the relatively lower level of reciprocity of the USSR with hard currency countries and the relatively lower level of reciprocity of the U.S. with socialist countries are both anomalies associated with the use of Michaely's reciprocity index. It was discussed above that Michaely's index is increasingly more inaccurate as trade imbalances increased. Consequently, I believe
that the two results above are statistical aberrations caused by the large bilateral trade deficits that socialist countries typically have with the West (especially the U.S.). The deficits are produced by the large demand on the part of socialist countries for Western-produced commodities and technology accompanied by the inability of these socialist countries to produce competitive exportables for the West. Even if the socialist countries attempt to bilaterally balance their trade with the West, their inability to do this would be represented as relatively irreciprocal trade when using a reciprocity index.

Wilczynski employed Pryor's reciprocity index to compare the degrees of reciprocity in E-E, E-W, and W-W trade for the years 1938, 1948, 1957, and 1960 through 1967. He found that both W-W and E-E trade had become more reciprocal over this time period while E-W trade had become less reciprocal over the same period. In fact, 1960 E-W trade was less reciprocal (more irreciprocal) than was W-W trade. He conjectured, however, that re-exports and triangular trade agreements probably bias the calculated reciprocity indices for E-W trade resulting in an understatement of the actual degree of reciprocity in E-W trade. Although Wilczynski did enumerate some features and reforms in the Eastern European economies that may have led to this decreased reciprocity in E-W trade, his use of a reciprocity index as a measure of the effect of bilateralism upon reciprocity precludes the separation of the effect of each of these factors. Consequently, from an empirical point of view, Wilczynski's analysis is simply a comparison of calculated reciprocity indices without any explanation of the differences or similarities.
Van Brabant studied bilateralism primarily in the context of intra-CMEA trade. While most of his work was not related to mine, he did perform a sensitivity analysis using Pryor's reciprocity index. Even though Marer hypothesized that reciprocity indices were more accurate if they were calculated over a period of time longer than one year, he did not calculate his or any other index for a time period other than four years. By not using a time period of any other length, Marer could never analyze the effect of time upon the calculated level of reciprocity. Van Brabant calculated Pryor's index for time periods of various lengths greater than one year—specifically, two, three and five-year time periods. One might expect that bilateral trade imbalances can be maintained almost indefinitely in trade free from any type of bilateral agreements. Alternatively, when bilateral agreements exist, the above situation is one of disequilibrium. Consequently, over time one might expect that the trade of countries where the governments openly and frequently enter into bilateral agreements with trading partners to become more reciprocal. Van Brabant observed that almost all of the CMEA countries had negotiated bilateral agreements among themselves and no bilateral agreements existed between the original six EEC countries. As a result, one might expect that bilateral trade imbalances would be a disequilibrium in intra-CMEA trade and a natural occurrence in intra-EEC trade. Van Brabant's results supported these expectations. In particular, his calculations showed that the intra-EEC indices remained relatively more stable over time (especially for the three and five year periods) than did those of intra-CMEA trade. Also, there was a larger tendency for the intra-CMEA indices to
decrease the longer the time period analyzed. Although Van Brabant's analysis seemed to imply that reciprocity indices could be used to detect the effect of bilateralism, it did not. He simply demonstrated that the use of annual data biased the measurement of reciprocity for the trade among CMEA countries relatively more than it biased the measurement of reciprocity for the trade among the Common Market countries. Without an empirical explanation of reciprocity, the reason(s) for the above results cannot be ascertained.

**Tangential Studies**

Friedman developed an exchange model to investigate the welfare effects of the bilateral agreements which existed between Germany and Hungary from 1933 to 1938. In his study he also provided a new approach to the measurement of reciprocity. Friedman argued that the effect of bilateralism upon reciprocity can be determined by analyzing the variances of bilateral trade imbalances over time. In particular, according to Friedman there was no *a priori* reason for the variances (dispersion) of bilateral trade imbalances for countries that had not negotiated bilateral agreements with each other to change over time. Alternatively, for countries with bilateral agreements, bilateral trade imbalances should move toward zero and concomitantly, the variances of bilateral trade imbalances between these countries should also decrease. Also, if the number of countries which pursue bilateralism increased or if the proportion of commodities included in the bilateral agreements increased, the reduction in the variances should be larger for the same set of trading partners. Consequently, Friedman
argued that a change in the variance of bilateral trade imbalances should indicate the effect of bilateralism upon reciprocity. He calculated the standard deviation (SD) of the bilateral trade imbalances for twelve European countries for the period 1928 to 1938. The SDs of the bilateral trade imbalances for all twelve countries declined from 1928 to 1935. However, for the period 1935 to 1938 the Southeast European countries experienced a 15 percent decline in the SDs of their bilateral trade imbalances while the overall SDs of all twelve countries declined by only 2 percent. Since the Southeast European countries had used bilateralism more than had the other countries in the sample, Friedman concluded that this relatively larger decline in the SDs of their bilateral trade imbalances indicated the effect of bilateralism. Even though Friedman's conclusion is intuitively appealing and appears to have some support, this conclusion is not justified by Friedman's analysis. Because he never segregated the effects of the factors that influence bilateral trade imbalances (irreciprocity), he could not identify the marginal effect of bilateralism. As a result, changes in numerous variables other than bilateralism could have motivated the change in SDs that Friedman observed. Nonetheless, Friedman's method of measuring reciprocity is a refreshing alternative to the reciprocity index.

Implicitly assuming that bilateralism caused overall trade to decrease Van Brabant asked: What level of trade would have occurred in the CMEA countries if they had not entered into numerous bilateral agreements with their trading partners? To answer this question he assumed that under a more multilateral trade policy, the CMEA countries
would have behaved like similar market economies. In particular he chose the EFTA (European Free Trade Association) and the EEC countries as the market economies whose size and wealth were most like that of the CMEA countries, but whose trade policies were relatively more multilateral in nature (at least in the 1960s). Even though these two groups of countries were extremely diverse, Van Brabant concluded that the European market economies (EME) were the market economies most comparable to the CMEA countries (except, of course, for the Soviet Union). He explained the imports of EME as follows:

\[(2.5)\quad M_i = Y_i^a N_i^b u_i\]

where \(M_i\) = total imports of country \(i\),
\(Y_i\) = national income of \(i\),
\(N_i\) = population of \(i\), and
\(u_i\) = error term distributed as a log-normal random variable.

Having estimated equation (2.5) in log-linear form, Van Brabant used the parameter estimates to project the imports of the CMEA countries. He found that for the years 1955, 1960, and 1965 the CMEA countries would have imported 3 percent to 102 percent more than they actually did if they behaved like an EME. Although Van Brabant interpreted these results as depicting the effect of bilateralism upon overall trade, many other factors such as exchange control, the autarkic tendencies of the CMEA's central planning, differences in the level of economic development, different availabilities of natural resources, etc. could have caused this dissimilarity between the trade of the EME's and that of the CMEA countries.
Hewett's study does not deal with either bilateralism or reciprocity per se. He employed a gravity model of bilateral trade flows to investigate the trade between CMEA countries and also, the trade between CMEA countries and West European countries. He found that, for some reason, the trade of each CMEA country with any West European country was less than typical intra-West European trade ceteris paribus. Hewett stated that the reason for these lower trade flows in E-W trade was, most likely, some combination of policy and the planning mechanism. Even though one cannot distinguish between the effect of policy and the effect of the planning system upon bilateral trade flows in Hewett's study, his method does isolate the effects of many of the factors that influence the size and geographic distribution of trade, and his results demonstrate the possibility that bilateralism may have some effect on the size and direction of bilateral trade flows.

Conclusion

The most important conclusion to be drawn from the antecedent work is that no author has explicitly isolated the marginal effect of bilateralism upon bilateral trade flows or upon reciprocity. All studies captured the effects of all of the variables that affect the geographic distribution of trade flows, and consequently, none could identify the effect of bilateralism alone upon trade. This is readily exemplified by the reciprocity index which was used in most of the studies surveyed to indicate the impact of bilateralism upon reciprocity. If two countries' trade is equally reciprocal, nothing can be inferred concerning the role that bilateralism has played in altering the trade of either
country. The degree of reciprocity in country i's trade could be caused primarily by i's government using bilateralism as a trade policy. Alternatively, j's trade could be equally as reciprocal without j's government having negotiated any bilateral agreements at all. Reciprocity indices themselves do not reveal anything about the underlying forces that influence the degree of reciprocity. They simply measure the degree of reciprocity.

To isolate the marginal effect of bilateralism upon reciprocity, one must first be able to explain reciprocity. This is my point of departure from the existing work. In particular, I will modify the gravity model of bilateral trade flows so as to attempt to explain reciprocity. With this modification the marginal impact of bilateralism upon reciprocity can be easily isolated. Chapter III contains this development.
NOTES TO CHAPTER II


2These indices are termed reciprocity indices even though they indicate increased irreciprocity as they increase (and increased reciprocity as they decrease). This formula for the LN index is not the one found in the literature. The LN never explicitly formulated their index; Michaely formulated it from a footnote in the Review of World Trade 1933 as follows:

$$T_{1}^{LN} = 100 \cdot \frac{\sum_{j} |X_{ij} - M_{ij}|}{(X_{i.} + M_{i.}) - |X_{i.} - M_{i.}|}$$

where all variables are defined above. I have tested my formulation [equation (2.1)] using LN data from International Trade Statistics 1930, and my calculations match those of the LN. Consequently, I am quite sure that my formulation is correct and Michaely's is not.

3See Jacob Viner, Trade Relations Between Free-Market and Controlled Economies (Geneva: League of Nations, 1943) for corroboration. The major reasons for the existence of exchange control and bilateral agreements in the 1930s were the world-wide depression and the volatile flights of financial capital.

4See Viner, op. cit.


6All other indices have an upper bound of 100. That is, when trade is completely irreciprocal, the calculated value of the index is 100.

7Michaely discusses this problem in more detail. His discussion will be presented below.
Data concerning bilateral service trade flows are still inadequate. Consequently, trade in services is excluded from my study as it has been in all of the preceding work.

The reasons for the widespread existence of bilateralism after World War II will be discussed in more detail in Chapter III.

The index average for 1938 was only marginally larger than either the 1954 or the 1958 averages. If these averages are treated as random variables, it is not clear whether or not any statistically significant difference exists between the index averages for these three years.

Michaely also felt that these "other forces" were quite substantive since only for a few countries in his sample was the degree of irreciprocity in their trade greater than 50 percent (i.e., $T^\text{MI}_i > 50$). This contention has little meaning without some idea of the natural or even optimal level of irreciprocity, which Michaely never investigated.

Socialist countries included the CMEA countries plus Communist China, Cuba, North Korea, North Vietnam, and Yugoslavia. Hard currency countries included non-Communist Europe (except Finland), Japan, Malaysia, United States, Canada, and Australia.


24. Van Brabant, *op. cit.*

CHAPTER III
CONCEPTUAL DEVELOPMENT

Even though this paper is primarily an empirical investigation of the effects of bilateralism, this investigation must have a conceptual foundation. This is the purpose of this chapter. Specifically, a rationale for the use of bilateralism is developed based upon a country's imposing exchange control. Second, a simple model of bilateral trade flows is presented with which the marginal effect of bilateralism upon bilateral trade flows and also upon reciprocity can be isolated. Finally, the monetary aspects of bilateralism are investigated.

Exchange Control and the Balance of Payments

Exchange control is the raison d'être for post-World War II bilateralism. Consequently, in order to understand the reasons why a country enters into bilateral agreements with some of its trading partners and the subsequent effect of these agreements, we must first investigate why a country employs exchange control and how its existence motivates the use of bilateralism. Exchange control is one of several instruments (or policy tools) in a fixed-exchange-rate world that a government may use to help correct (either permanently or temporarily) balance of payments disequilibria. The other instruments frequently employed are expenditure switching (induced by changes in
relative prices) and expenditure reducing or increasing (i.e., altering the level of domestic import demand and possibly even the demand for your exports by changing the level of aggregate income through monetary and fiscal policies). A fourth possible alternative is for the central bank either to finance the deficit by supplying the excess demand for foreign exchange or to sterilize the surplus by demanding the excess supply of foreign exchange. However, this method does nothing to correct the balance of payments disequilibrium and can only be employed as long as the central bank has sufficient international reserve holdings to be able to enter the foreign exchange markets. Since a central bank's reserve holdings are typically far from limitless, this financing or sterilization role is only a short-term one. Also, for the time period of interest in this study, central banks' reserve holdings were much too inadequate even to attempt to finance a deficit or to sterilize a surplus. Consequently, this alternative is not considered here.

How does each instrument operate to correct a balance of payments disequilibrium? Since balance of payments deficits usually receive more attention than do balance of payments surpluses, I will couch the analysis of these instruments in terms of a balance of payments deficit. A balance of payments deficit occurs when the value (in domestic currency units) of a country's imports of goods and services plus the value of its autonomous capital outflows exceed the value of its exports of goods and services plus the value of its autonomous capital inflows. In general, expenditure switching is the employment of some device that will cause expenditure to switch away from foreign goods
and toward domestic goods. This is usually accomplished through devaluation, but can also be achieved through tax-cum-subsidy schemes and tariffs. Typically, expenditure switching involves the decline of prices of domestically produced goods and services relative to those in the rest of the world. For example, after a currency is devalued, the same amount of this currency purchases a smaller amount of any foreign currency than it did before; alternatively, the same amount of any foreign currency purchases a larger amount of this currency than it did before the devaluation. Consequently, exports are relatively less expensive to foreign consumers and imports are relatively more expensive to domestic consumers. Also, domestic financial investments appear to be relatively more profitable to foreign investors while foreign financial investments appear to be relatively less profitable to domestic investors. As a result, exports and capital inflows increase while imports and capital outflows decrease.

A balance of payments disequilibrium can be considered to be a monetary phenomenon. In particular, it reflects a stock disequilibrium between actual and desired real money balances. Viewing the balance of payments in this manner yields an interesting ramification; i.e., if monetary authorities do not intervene to sterilize changes in the money supply, balance of payments disequilibria are self-correcting and consequently, temporary. For example, a balance of payments deficit reflects an excess supply of money; or alternatively, actual real money balances exceed desired real money balances. As a result, consumers increase their spending (dishoarding) in order to bring actual real money balances down to the desired level. Spending is increased on all
types of foreign and domestic goods, services, and assets. If the monetary authorities do not replace this outflow of money, the deficit will last only as long as actual real money balances exceed the desired level. Once this desired level is attained, the money market is in a stock equilibrium and the external deficit no longer exists. However, devaluation can speed up the process by changing the relation of actual to desired real money balances more rapidly. Specifically, devaluation causes a rise in the general price level in the devaluing country. The domestic currency prices of importables and exportables rise due to the devaluation; the prices of nontraded goods also rise (although not as much) since demand shifts to them away from the markets for traded commodities. This general price rise causes the real value of actual money balances to fall. Consequently, less dishoarding occurs and the balance of payments deficit is corrected more quickly. This effect of a devaluation upon a balance of payments disequilibrium does not depend on the value of elasticities nor on the level of employment. Since the external disequilibrium is simply reflecting a monetary stock disequilibrium, any mechanism that helps to push the money market toward a stock equilibrium also works to correct a balance of payments disequilibrium.

This adjustment process is not without its costs. One major cost is domestic inflation since domestic currency prices of both traded and nontraded goods rise as a result of devaluation. The severity of this inflation depends inter alia upon the degree of openness of the economy and the price elasticity of money demand. A second cost of some consequence can exist. That is, the terms of trade (the ratio of the
price of exports to the price of imports) can deteriorate as a result of devaluation. Since a balance of payments deficit and the subsequent devaluation are essentially parts of a transfer problem, both the price and the income effects of a devaluation upon the terms of trade must be analyzed. In particular, if the Marshall-Lerner condition is satisfied, a devaluation will decrease the terms of trade if the domestic marginal propensity to spend on its exportables exceeds the foreign marginal propensity to spend on the home country's exportables.2

Expenditure reduction is a second means for correcting a balance of payments deficit. The expenditure switching mechanism implicitly assumes that prices (including the exchange rate) are relatively more flexible than real income. The opposite assumption is made when one employs expenditure reduction to correct an external disequilibrium. In particular, it is assumed that imports and exports are primarily functions of the levels of domestic and foreign real income respectively; also, prices and exchange rates are assumed to adjust more slowly than does income to changes in the economic environment. Consequently, this mechanism attempts to correct a balance of payments deficit by decreasing the level of aggregate domestic income (and concomitantly aggregate demand for all goods and services including imports) through the use of contractionary monetary and fiscal policies. That is, as the contractionary policies cause the level of income to fall, the level of import demand also falls and the deficit becomes smaller. However, since the sale of goods and services by the rest of the world to the deficit country generates income for those exporting
countries, the deflation of the deficit country's economy will decrease the level of income in those countries from which it imports. If this deficit country plays a sufficiently large role in international markets, then its deflation is significant enough to decrease the rest of the world's demand for its exports. In other words, expenditure reduction can both improve the deficit by decreasing import demand and also worsen the deficit through the world-wide repercussion which results in decreased demand for the deficit country's exports. This possibility of international repercussion is not the major cost incurred when expenditure reduction is used. The major cost is derived from the fact that as the economy is being deflated in order to correct the deficit, the demand for domestically produced goods and services also declines. Since wages and prices most likely do not adjust to this change as rapidly as does income, domestic unemployment should rise initially. Only after wages and prices have fallen will the level of employment rise to the pre-deflation level (if a balance of payments equilibrium is to be maintained). The size and duration of the resulting change in the rate of unemployment depends upon the degree of openness of the economy and upon the flexibility of wages and prices to changes in aggregate demand.

These first two mechanisms used to correct balance of payments disequilibria have each operated within the system of international markets. Exchange control is a third mechanism that works to correct temporarily a disequilibrium by totally circumventing the foreign exchange market. A balance of payments deficit indicates that at the current official market exchange rate the quantity of foreign
currency demanded by the deficit country (to use as payment for im-
ports and foreign securities) exceeds the quantity supplied by for-
eigners. (Foreigners supply their currencies by demanding the deficit
country's currency to purchase its exports and securities.) Devalua-
tion can be used to eliminate this excess demand by allowing the of-
official exchange rate to rise until the foreign exchange market is
 cleared. Alternatively, correcting the imbalance by reducing expec-
ditures causes the domestic demand for foreign currencies to fall until
the official rate becomes the equilibrium rate. Clearly, both of these
methods operate within the foreign exchange market to bring about an
equilibrium.

Exchange control, on the other hand, completely precludes the op-
eration of the exchange market by forcing the recipients of foreign
exchange (primarily exporters) to surrender all or part of their earn-
ings to governmental authorities at some prescribed exchange rate
(usually an undervalued one). The governmental authority then rations
its stock of foreign exchange to the demanders of it within the economy
usually by employing a system of multiple exchange rates that differ
according to the type of purchase that is going to be made with the
foreign currency. As a result, the balance of payments is in a state
of equilibrium by definition since the governmental authority can
ration only as much foreign exchange as the sale of exports and domes-
tic securities to foreigners generates. That is, the value of imports
and foreign securities purchased automatically shrinks to equal the
value of exports and domestic securities sold, once exchange control is
imposed to correct a balance of payments deficit. Of course, the
initial causes of the deficit remain; only the symptoms are treated with the use of exchange control.

As one can clearly see, exchange control is extremely costly to any economy that employs it. First, the size of the foreign sector decreases as the value of outpayments is constrained to equal the value of inpayments. Second, the decline in the value of imports implicitly protects the domestic import-competing industries in a manner similar to that resulting from the imposition of tariffs and quantitative restrictions. This protection induces resources to be artificially attracted into those industries that produce importables which results in a loss of economic efficiency. That is, the country employing exchange control is producing larger quantities of some goods and services than the international market would dictate and in fact, is probably producing some goods and services in which it has a comparative disadvantage.

If exchange control contracts the foreign sector and also misallocates productive resources, why would any country employ this mechanism to correct temporarily a balance of payments deficit when other mechanisms (compatible with the free operation of the foreign exchange market) are available? There are basically two reasons why. First, the costs of using exchange control may be small when compared with the costs incurred if an alternative mechanism were employed. Specifically, the domestic inflation, the deterioration of the terms of trade, or the increased unemployment caused by utilizing some form of expenditure switching or expenditure reduction may be much costlier than the allocative costs associated with exchange control. Second,
international markets do not adjust instantaneously. Consequently, using a mechanism which operates within the international system of markets (such as expenditure switching or expenditure reduction) to correct a disequilibrium may entail a long adjustment period. Alternatively, exchange control works very rapidly to correct a disequilibrium. To summarize, it is entirely rational for a government to employ exchange control when it feels that the costs of exchange control are relatively smaller than those of alternative mechanisms and also when it wants the disequilibrium to be corrected very rapidly.

These three mechanisms need not be mutually exclusive; they can be employed simultaneously. Exchange control can be used as a relatively fast and effective means of temporarily correcting a balance of payments deficit while expenditure switching and/or reduction are gradually implemented to correct the underlying structural causes of the disequilibrium. In this manner external equilibrium is achieved rapidly even though market signals are distorted. However, these distortions are gradually eliminated as the mechanisms operating within the foreign exchange market are slowly phased in. As enumerated above, each adjustment mechanism has a cost associated with its use. Clearly then, a combination of the three mechanisms is used such that the costs of correcting the balance of payments disequilibrium are minimized. (In general, all three mechanisms will be employed.) In particular, the cost-minimizing combination of exchange control, expenditure switching, and expenditure reduction is the one at which the marginal products of each mechanism in the production of a balance of payments equilibrium per marginal cost of use are equal. If the cost
of using one of these adjustment mechanisms increases *ceteris paribus*, then the relative importance of this mechanism is the optimal mix decreases vis-a-vis the others. That is, the use of one mechanism will be substituted for another as the relative costs of using these mechanisms change.

The period after World War II until the late 1950s provides a good economic environment within which we can casually "test" the above model. After World War II the use of exchange control was widespread. The productive capacities of most of the European countries had been seriously eroded both from the wartime destruction and from the neglect of the real capital stock during the war. The composition of the populations changed; numerous commodities had not been produced since before the war. Inventories of raw materials, intermediate inputs, and consumer durables were extremely low or completely depleted. Consequently, the major objectives of each of these countries were to reconstruct the war-damaged productive capacity and to reconvert the remaining capacity away from the production of war-related products. In other words, these countries wanted to begin the movement toward general economic recovery. Since the U.S. economy was the least affected (in terms of postwar productive abilities and inventories, it was the primary source of the resources that the European economies desired for reconstructing their production facilities. However, these countries had few exportables to offer the U.S. in return. As a result, the European countries began to incur large balance of payments deficits, especially with the U.S. Expenditure reduction as a remedy was out of the question. The primary task of each of these countries was to rebuild its economy; deflation used to correct a balance of payments deficit would hardly be consistent with this internal objective. Expenditure switching might have been feasible since there was
much unemployed labor. However, with the shortage of other resources for the production of import substitutes, the switching of expenditures from foreign to domestically produced goods and services would probably have added more to inflation than to employment. Also, a problem existed as to how to implement expenditure switching. First, these countries had just signed the Bretton Woods agreement which stated, in part, that these countries would maintain the price of their currencies at par values unless a fundamental external disequilibrium occurred. Since the European countries believed that the current deficit was only a temporary phenomenon and would disappear once productive capacities were returned to prewar levels, they did not want to devalue their currencies. Also, their price elasticities of demand for imports were probably sufficiently low such that a very large devaluation would be needed in order to correct the deficit. Second, they hesitated to employ tariffs or quantitative restrictions for fear of returning to the trade-restricting protectionism of the 1930s. Consequently, expenditure switching was not an appealing mechanism to use to correct the deficit.

The European economies wanted an international insulator so that they could dichotomize their efforts to solve their internal and external problems. They also wanted an adjustment mechanism that would work rapidly to correct the external disequilibrium so that attention could be channelled to internal problems immediately. Exchange control performed these tasks for them and was more effective relative to its costs than were the alternatives. Consequently, as one would expect, since the marginal productivity of exchange control (in
correcting an external disequilibrium) per marginal cost of use was high relative to those of the alternatives, exchange control was employed relatively more than was expenditure switching or reduction to correct a balance of payments disequilibrium (at least temporarily) during this time period.

How does exchange control lead to bilateralism? Exchange control, as discussed above, is a mechanism employed to eliminate temporarily an excess demand for foreign currencies especially when the central bank's stock of foreign currency reserves is inadequate to supply this excess demand. It has also been noted that exchange control constrains international trade to a point where the value of out-payments can only be as large as the value of foreign currency in-payments. Furthermore, the currency incovertibility created by the imposition of exchange control does not allow importers to purchase goods, services, or securities from any country; they can only purchase from countries that will accept the currencies generated by the sale of their exports and domestic securities. (Of course, trade can be consummated with convertible currencies, but the shortage of these currencies is one of the primary motivating factors for the use of exchange control.) Consequently, a device is needed that helps to finance trade among exchange control countries, but yet conserves the relatively scarce convertible currencies that these countries must have in order to trade with hard currency countries. Bilateralism is this device. By entering into bilateral clearing or payments agreements with trading partners that have imposed exchange control, a country can finance trade with these partners without having to use any
of its valuable hard currency reserves or without having to hold use-
less stocks of the soft currencies of these trading partners. In
general, these agreements facilitate the financing of trade with the
establishment of clearing accounts and swing credit arrangements.
Trade between partners in such an agreement is conducted through these
accounts simply as accounting transactions without the actual exchange
of currencies ever taking place. Only when the swing credit limit
(specified in each agreement) is exceeded does an exchange of either
gold or hard currency occur. That is, bilateralism enables exchange
control countries to conserve their hard currencies to finance trade
with countries that will accept only hard currencies while maintaining
its export and import markets with other exchange control countries.

The Gravity Model

In order to successfully isolate the marginal impact of bilateral-
ism upon bilateral trade flows, the determinants of the size and direc-
tion of bilateral trade flows must be identified. Fortunately, a
relatively well-developed model explaining the geographic distribution
of bilateral trade flows already exists: the gravity model.

Equilibrium bilateral trade flows are assumed to be determined in
a general equilibrium system of supply of exports and demand for im-
ports. Import demand and export supply are treated as excess demand
and excess supply functions respectively which is implicitly assuming
a high degree of substitutability, in aggregate, between domestically
produced importables (exportables) and imports (exports). This as-
sumption permits the exclusion of internal trade flows (i.e., within a
country) from the analysis. For any country, the actual size of aggregate import demand or aggregate export supply depends upon the level of domestic production (or income), relative prices of importables, and the size of the foreign sector. Since these are equilibrium bilateral trade flows, relative world prices sought by all exporters are equal and constant for any sufficiently short period of time. With prices equal and constant across countries, differences in the composition of productive resources among countries cause differences in the level of output produced or in the size of the foreign sectors. Consequently, these dissimilarities affect the demand for imports and the supply of exports and, therefore, alter the geographic distribution of bilateral trade. This point is intuitively appealing since it conforms very nicely with the Heckscher-Ohlin theory of trade.

Even though relative prices sought by exporters are the same world-wide, the prices paid by importers for identical commodities will diverge in various countries due to the differential effect of natural and artificial barriers to trade. Natural barriers include transport costs, cultural differences, language barriers, and different degrees of information dissemination. Artificial barriers include tariffs, quantitative restrictions, membership in preferential trading groups, and bilateralism (accompanied by exchange control). As a result, the trade flow between countries i and j depends not only on the demand and supply conditions in each, but also on the trade resistance factors (both natural and artificial) between i and j. These factors can be quite influential in affecting the distribution of world trade and can distort the pattern of comparative advantage determined by a
comparison of pure relative prices. The gravity model's ability to incorporate trade resistance factors explicitly is of extreme importance for this paper. This feature enables one to isolate the marginal impact of bilateralism upon bilateral trade flows and subsequently, upon reciprocity.

To summarize the preceding discussion, the gravity model can be expressed as follows:

\[(3.1) \quad X_{ij} = f(Y_i, Y_j, F_i, F_j, R_{ij}) \quad i \neq j\]

where \(X_{ij}\) = the aggregate value of exports from country \(i\) to country \(j\),
\(Y_i(j)\) = the national income or product of country \(i\) (\(j\)),
\(F_i(j)\) = the size of the foreign sector of country \(i\) (\(j\)),
\(R_{ij}\) = the trade resistance factor associated with the exporting of commodities from country \(i\) to country \(j\).

The expected sign of the marginal effect of each explanatory variable is as follows:

\[
\frac{\partial X_{ij}}{\partial Y_i(j)} > 0 , \quad \frac{\partial X_{ij}}{\partial F_i(j)} > 0 , \quad \frac{\partial X_{ij}}{\partial R_{ij}} < 0 .
\]

The reasons for these expected signs are deduced in a straightforward manner from the demand and supply framework that supports the gravity model. An increase in the output of country \(i\) (the exporting country) signifies an increase in the supply of importables to all countries that import from \(i\) (which includes country \(j\)). Also, since commodities, in general, are normal goods, an increase in \(j\)'s income causes \(j\)'s demand for all goods including importables to increase. Consequently, an increase in the income (or output) of either the exporting
or the import country should cause the trade between these countries to increase. An expansion of the foreign sector implies that this country's economy is becoming more open to international trade; i.e., it desires to export and to import more. Therefore, an increase in the foreign sector of either trading partner should motivate increased foreign trade with all countries in general. The expected sign of the effect of the trade resistance factors depends on the nature of each individual factor. In particular, if the resistance factor is membership in a preferential trading group, then the expected sign of the effect of this arrangement is positive since the basis for the existence of these groups is *inter alia* to promote trade among members. Alternatively, if these factors are transport costs, tariffs, quantitative restrictions, or language or cultural barriers, an increase in any of these will have a negative effect upon trade flows. The reason is that an increase in any of these resistance factors raises the effective price of i's exports to j relative to the price of importables produced in j and those produced in countries other than i. Consequently, j will substitute either domestically produced importables or imports from countries other than i for the commodities that it had previously imported from i resulting in a decrease in trade flow from i to j.

Of course, exchange control accompanied by bilateralism is also a trade resistance factor; however, deducing the expected sign of this effect upon bilateral trade flows is not as straightforward as it was for the other explanatory variables. The imposition of exchange control automatically constrains a country's ability to import in
aggregate, but there is no a priori reason why bilateral trade flows between two soft currency countries should be, ceteris paribus, any larger or smaller than those between two hard currency countries or than those between a hard currency country and a soft currency country. Also, even though bilateralism promotes additional trade over and above the level resulting from the constraints of exchange control, how this additional trade is distributed among a country's trading partners is not discernible conceptually. No country wants to hold the currency of a soft currency trading partner because a soft currency can only be used to purchase goods and services from the issuing country. Consequently, since bilateral agreements enable countries to trade with each other without necessitating the use (and holding) of foreign currencies, bilateral trade between soft currency countries that have entered into bilateral agreements with each other should be larger than bilateral trade between soft currency countries who have not entered into any type of bilateral agreement.

When one looks at a world composed of both hard and soft currency countries, the effect of bilateralism upon bilateral trade flows becomes ambiguous. In particular, if a country's stock of hard currency reserves is extremely low (implying that this country's ability to import from hard currency countries is also low), bilateral agreements may motivate additional bilateral trade between the partners in these agreements vis-a-vis bilateral trade with other hard and soft currency countries. Alternatively, it is also possible that bilateral agreements may not promote any additional trade between the partners in the agreements. Instead, the freeing of hard currency reserves
(formerly used to finance trade with other soft currency countries) may enable a soft currency country to trade relatively more with hard currency countries than with its partners with whom it has bilateral agreements. This is possible on the import side of trade if payment for imports from hard currency countries is the highest valued alternative use for hard currency reserves. On the export side there is no a priori reason why entering a bilateral agreement with some soft currency trading partners should cause exports to be diverted away from hard currency markets to soft currency ones because the opportunity cost (in terms of lost hard currency earnings) of such a diversion would further constrain that country's ability to import from hard currency markets. The conclusion that one should draw from the above scenario is that bilateralism should promote additional trade over the level resulting from the imposition of exchange control. However, the distribution of this additional trade between hard and soft currency trading partners is unclear. (That is, this is essentially an empirical problem with no unambiguous theoretical solution.)

**Reciprocity and the Gravity Model**

From the anomalous results of earlier work, it is clear that variables other than bilateralism also affect the level of reciprocity. Since reciprocity is simply a weighted deviation of two bilateral trade flows (the flow from country i to country j and the flow from j to i), it is a rather straightforward procedure to adapt the gravity model to the explanation of reciprocity.
Exporters and importers within a country are typically independent groups; consequently, the analysis of reciprocity can be dichotomized into the analysis of the bilateral trade flow from i to j and the trade flow from j to i. Specifically, the variables that explain \( X_{ij} \) should explain \( X_{ji} \) equally as well. If reciprocity is defined as the absolute deviation between \( X_{ij} \) and \( X_{ji} \), the gravity model can be modified to explain reciprocity as follows:

\[
(3.1) \quad X_{ij} = f(Y_i, Y_j, F_i, F_j, R_{ij}) \quad i \neq j
\]

\[
(3.2) \quad X_{ji} = g(Y_j, Y_i, F_j, F_i, R_{ji}) \quad j \neq i
\]

\[
(3.3) \quad |X_{ij} - X_{ji}| = f(Y_i, Y_j, F_i, F_j, R_{ij}) - g(Y_j, Y_i, F_j, F_i, R_{ji}) \quad i \neq j
\]

\[
(3.4) = h(Y_i, Y_j, F_i, F_j, R_{ij}, R_{ji}) \quad i \neq j
\]

where all variables are defined above. The progression from equation (3.1) to equation (3.4) is based on the assumption that if the same set of variables explain both \( X_{ij} \) and \( X_{ji} \), then this set of variables should also explain the absolute deviation of \( X_{ij} \) and \( X_{ji} \).

There are two major differences between equations (3.1) and (3.2) and equation (3.4). First, each \( Y_k \) and \( F_k \) in equation (3.4) represents both a demand and a supply variable. Consequently, the expected sign of the effect of a change in either \( Y_k \) or \( F_k \) is ambiguous. For example, an increase in \( Y_i \) also stimulates increased demand in i for all commodities including imports (i.e., \( X_{ji} \) increases). If both \( X_{ij} \) and \( X_{ji} \) increase as a result of an increase in \( Y_i \), the absolute deviation can either increase, decrease, or remain constant depending on
which trade flow increases relatively more than the other. Second, two trade resistance factors are included in equation (3.4) because, in general, the resistance associated with trade from i to j will be different from that associated with trade from j to i. (For example, country i's tariff structure may be different from country j's.) The expected signs of the effect of the trade resistance factors are also ambiguous for the same reasons enumerated above. As one readily notices, bilateralism is not a trade resistance factor that differs for the trade from i to j and the trade from j to i. Consequently, the effect of bilateralism can be unambiguously predicted. Since bilateral agreements are negotiated to finance trade between partners but also not to let this trade become too imbalanced (depending upon the size of the swing credit limit), the existence of bilateralism should have a positive impact upon reciprocity. That is, a bilateral agreement between two trading partners should cause the trade between them (from i to j and from j to i) to deviate less than the trade between two countries without any bilateral agreement.

Bilateralism and International Reserves

International transactions involve two flows: the flow of real goods and services from exporter to importer and the financial flow from the importer to the exporter representing payment. This financial flow can be either in the form of currency (acceptable to the seller) or in the form of a promise to pay at some later date (i.e., extension of credit). The imposition of exchange control (and the corresponding currency inconvertibility) adversely affects the acceptability of the
imposing country's currency. In particular, hard currencies are often
demanded as payment for imports. However, a shortage of these cur-
crencies (at the official exchange rate) is a major factor contributing
to the imposition of exchange control. When exchange control is im-
posed, the ability to import is limited to the ability to export.
Participation in bilateral agreements serves as a means of expanding
import markets without necessitating the use of foreign (especially
hard) currencies. That is, bilateral agreements act as substitutes for
foreign currency reserves in transacting international trade.

Because the holding of international reserves for transactions
purposes is analogous to an individual's holding of money balances for
transactions purposes, the analysis of the transactions demand for in-
ternational reserves is analogous to that of the transactions demand
for money. In particular, the two primary determinants of the demand
for international reserves should be the volume of international trans-
actions and the opportunity cost of holding stocks of foreign cur-
rencies.\footnote{Implicit in the formulation of equation (3.5) is the fact that the de-
mand for reserves is a derived demand; it is derived from the demand
for imports or foreign securities which reserves are used to purchase.}

\begin{equation}
R = f(T, r)
\end{equation}

where \( \frac{\partial R}{\partial T} > 0, \quad \frac{\partial R}{\partial r} > 0, \)

\[ R \equiv \text{a country's foreign exchange holdings,} \]
\[ T \equiv \text{a country's volume of international transactions, and} \]
\[ r \equiv \text{an interest rate.} \]
When a country (A) imposes exchange control, other countries' holdings of A's currency can be used only for purchasing A's exports or securities. Consequently, exporters of commodities or securities to A would prefer to be paid in a currency other than A's that would be accepted as payment for commodities or securities by countries other than A. However, the reason that A imposed exchange control initially was a balance of payments deficit which meant that (at the prevailing pegged exchange rate) A had experienced a shortage of these foreign currencies demanded as payment by the countries from which it imported. As more and more countries impose exchange control, they find themselves in a similar situation as was A in the preceding case. To circumvent the unacceptability of currencies made inconvertible through the imposition of exchange control, bilateral clearing and payments agreements are negotiated, almost totally eliminating the use of currency in international transactions among exchange control countries. In other words, these bilateral agreements enable an exchange control country to economize on its use of scarce hard-currency reserves for financing its trade with other soft-currency countries. This meant that a country's stock of hard currency reserves could finance relatively more international transactions the greater the extent of that country's participation in bilateral payments agreements. As a result, any exchange-control country's transactions demand for reserves is going to depend upon its use of bilateralism. That is, equation (5) for exchange-control countries should be rewritten as follows:

\[ R = g(T, r, B) \]
where \( \frac{\partial R}{\partial B} < 0 \),

\[ B \equiv \text{the average participation rate in bilateral agreements weighted by trade with each partner}, \]

all other variables are defined above. The bilateralism variable in equation (3.6) is a shift parameter. As bilateral agreements cover a larger percentage of a country's trade, that country's stock of hard-currency reserves can finance a larger volume of international transactions due to the conservation of reserves made possible by the negotiation of these agreements. Figure 1 depicts this relationship between bilateralism, reserves, and international transactions. The two lines in Figure 1 representing the relationship between reserves and international transactions are drawn for a given opportunity cost of holding reserves \( (r_0) \) and two different participation rates in bilateral agreements. 10 In particular, \( B_1 \) is greater than \( B_0 \) indicating that this country conducts a larger percentage of its trade through bilateral agreements in state of the world one than in state of the world zero. The conservation of the use reserves resulting from conducting relatively more trade through bilateral agreements \( (B_1 \text{ vs } B_0) \) enables a given stock of reserves \( (R_0) \) to finance a larger volume of transactions \( (\text{from } T_0 \text{ to } T_1) \); or alternatively, the same level of transactions \( (\text{say, } T_1) \) can be financed by using less reserves \( (R_0 \text{ as opposed to } R_1) \). In other words, the marginal effect of bilateralism upon the transactions demand for international reserves is negative because bilateralism enables an exchange control country to trade with other exchange control countries yet still conserve valuable hard currency reserves.
Figure 1

Bilateralism and the Transactions Demand for International Reserves
NOTES TO CHAPTER III


3 For example, during the "dollar shortage" in the 1950s, West European countries had to conserve their stocks of hard currencies to be able to import from the United States, since the U.S. would not accept soft currencies as payment.

4 I am analyzing the geographic distribution of world trade, not the commodity composition of world trade.


6 There were no bilateral agreements negotiated immediately after World War II between a hard currency country and a soft currency country. (This did occur in the 1930s.) That is, the only bilateral agreements negotiated immediately after World War II were between soft currency countries.

7 I am not concerned that the signs of most of the explanatory variables in equation (3.4) cannot be unambiguously predicted since these variables do not appear in any of the important hypotheses tested.

8 This does not imply anything about the effect of bilateralism upon the trade flow from i to j and that from j to i. Only the absolute deviation is explained by equation (3.4). The size and direction of individual trade flows are described by equations (3.1) and (3.2).

The lines in Figure 1 may be linear which implies a transactions elasticity of demand for reserves of one. The lines drawn in Figure 1 are concave from below reflecting a transactions elasticity of demand for reserves that is less than one. This is the Baumol-Patinkin hypothesis transferred from the transactions demand for cash balances to the transactions demand for international reserves. Of course, both possibilities must be tested.
CHAPTER IV
EMPIRICAL RESULTS

Introduction

The major purpose of this chapter is to present the estimating equations derived from the conceptual development in Chapter III and to report the results obtained from estimating these equations. The models presented here were estimated using trade flows that occurred during 1954. This year was chosen because it was one of the most stable and typical years after World War II during which the use of exchange control and bilateralism were widespread. By 1954, almost all of the major postwar bilateral payments agreements that were to be negotiated had been negotiated. In fact, the majority of the agreements had been in effect for four to six years so that it is safe to assume that trade flows had adjusted to the existence of bilateralism by this year. Since 1954 was two to four years before the movement toward internal or external convertibility by the majority of the countries in the sample, this year should be early enough to avoid the discrete changes in the international markets caused by this movement toward convertibility.

The sample consists of the trade of twenty-six countries with their principal trading partners, which totals 1016 bilateral trade flows. The countries comprising the sample are Argentina, Austria,
Belgium–Luxembourg, Brazil, Canada, Denmark, Egypt, Finland, France, West Germany, Greece, India, Italy, Japan, Mexico, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, Thailand, Turkey, United Kingdom, United States, and Yugoslavia. These countries were chosen to be a representative sample of the postwar world economy. The sample is extremely heterogeneous including both developed and underdeveloped economies and countries that had imposed exchange control as well as those that had not. The composition of the sample is centered around the countries of Western Europe primarily because each imposed exchange control after World War II and subsequently entered into numerous bilateral agreements with their trading partners.

All monetary variables used in the estimation procedures were either originally denominated in U.S. dollars or were converted to U.S. dollars using official exchange rates as the conversion factors. This method of converting to a common currency could pose a potential problem—the maintenance of purchasing power parity. Geraci and Prewo in their work with and modification of the gravity model performed a sensitivity analysis using official exchange rate conversion and two different conversion procedures that maintained purchasing power parity during the conversion process. They concluded that using official exchange rates as conversion factors did not lead to any serious bias in estimation. Supported by this result, I have not dealt with the issue of purchasing power parity in my analysis.

The remainder of the chapter is divided into three sections. The second section contains the results of my analysis of the marginal impact of bilateralism upon reciprocity. Also included is an individual
country analysis and a comparison of the results of my estimation to the results of studies using reciprocity indices. The third section contains an investigation of the effects of exchange control and bilateralism upon trade flows. In particular, the impact of the imposition of exchange control on a country's aggregate trade is examined. Second, the marginal impact of bilateralism upon bilateral trade flows is isolated using several sub-samples. Finally, the fourth section includes an analysis of the impact of bilateralism upon a country's transactions demand for international reserves.

Results Concerning Reciprocity

The gravity model was explained and extended to the explanation of reciprocity in the last chapter. However, no mention was made of the functional form of the model nor of the proxy variables that are necessary for estimation. The gravity model has usually been estimated in log-linear form since this form has been found to fit the data best. Little, if any, theoretical justification has been given for the use of the functional form. Recently, however, Anderson has derived a model very similar to the log-linear form of the gravity model through the use of Cobb-Douglas expenditure functions. Consequently, estimating the gravity model in log-linear form appears to have both a theoretical and an empirical justification. The estimating equation of reciprocity is as follows:

\[ DX_{ij} = a_0 + a_1 Y_i' + a_2 Y_j' + a_3 N_i' + a_4 N_j' + a_5 B_{ij} + a_6 EM_{ij}' + a_7 D_{ij}' + u_{ij} \]

where \( DX_{ij} = |X_{ij} - X_{ji}| \)
\[ X_{ij}(ji) \equiv \text{exports from country } i(j) \text{ to country } j(i) \text{ measured in millions of U.S. $}, \]

\[ Y_{i(j)} \equiv \text{the national income or domestic product of country } i(j) \text{ measured in billions of U.S. $}, \]

\[ N_{i(j)} \equiv \text{the population of country } i(j) \text{ measured in thousands}, \]

\[ B_{ij} \equiv \begin{cases} 
2 & \text{if a bilateral payments agreement exists between } i \text{ and } j \\
1 & \text{otherwise} \end{cases} \]

\[ E_{M_{ij}} \equiv \begin{cases} 
2 & \text{if } i \text{ and } j \text{ are both members of the European Payments Union (EPU)} \\
1 & \text{otherwise} \end{cases} \]

\[ D_{ij} \equiv \text{the great circle distance between major trading centers in } i \text{ and } j \text{ measured in statute miles}, \]

\[ u_{ij} \equiv \text{the classical error term distributed as a log-normal random variable}, \]

\[ \ln \] denotes natural logarithm.

The variables \( X_{ij}, X_{ji}, Y_{ij}, \) and \( Y_j \) are the same as those in the theoretical specification of the model and are measured directly. The populations of countries \( i \) and \( j \) (\( N_i \) and \( N_j \) respectively) are proxy variables for the size of the foreign sectors of \( i \) and \( j \) respectively. The rationale for this is that countries with relatively larger populations have relatively more diversified economies. Consequently, these countries can fulfill relatively more of their domestic demands from domestic production and hence, are relatively less open to international trade than are countries with relatively smaller populations. Problems do arise when using population as a proxy for the size of the foreign sector. For example, employing the above rationale for the use of population, India's economy should be more diverse \textit{ceteris}
paribus than that of the United States; and the Netherlands should have a smaller foreign sector than does Portugal. Nevertheless, I use population (at least initially) primarily so that I can compare the explanatory power of the gravity model applied to the explanation of reciprocity to that of other uses of the gravity model. The binary variable ($B_{ij}$) indicating the existence of a bilateral agreement between trading partners is self-explanatory. This variable enables me to isolate the marginal impact of bilateralism upon reciprocity. On the other hand, the binary variable ($EM_{ij}$) denoting membership in the EPU requires further explanation: The EPU was an organization conceived by the OEEC (Organization for European Economic Cooperation) countries in the 1950s. Its purpose was to transfer bilateral trade imbalances between two members to a third member. This function eliminated the concern by each member country to maintain near-bilateral balance with other member trading partners. In essence, the EPU "multilateralized" the network of bilateral payments among the OEEC countries. Each member had only to be concerned with its overall payments balance with the members of the Union collectively, not with respect to each member individually. With the advent of the EPU the automatic transferability type of bilateral agreement became increasingly more popular among OEEC countries. Finally, the distance between country $i$ and country $j$ ($D_{ij}$) is a proxy variable for transport costs: the greater the distance between $i$ and $j$, the greater the costs of transporting commodities from $i$ to $j$.

The signs of the estimate coefficients of $Y_i$, $Y_j$, $N_i$, $N_j$, and $D_{ij}$ cannot be predicted unambiguously. Each of these variables represents
both a demand and a supply variable in equation (4.1). For example, an increase in $Y_i$ indicates an increase in country $i$'s supply of exports to any trading partner (i.e., $X_{ij}$ should increase). This increase in $Y_i$ also stimulates increased demand in $i$ for all commodities, in general, including imports (i.e., $X_{ji}$ should increase). If both $X_{ij}$ and $X_{ji}$ increase as a result of an increase in $Y_i$, their absolute deviation can either increase, decrease, or remain constant depending on the relative size of the changes. Consequently, the sign of the estimated coefficient could be either negative or positive. Alternatively, the signs of the estimated coefficients of $B_{ij}$ and $E_{ij}$ can be predicted unambiguously. Bilateral agreements were negotiated to facilitate the financing of trade between partners; also included in these agreements were provisions for maintaining relatively balanced bilateral trade between partners. Consequently, the existence of a bilateral agreement should have a negative effect upon reciprocity. That is, a bilateral agreement between countries $i$ and $j$ should cause the trade between them (from $i$ to $j$ and from $j$ to $i$) to deviate less, *ceteris paribus*, than the trade between two trading partners that have not entered into an agreement with each other. The estimated coefficient of $E_{ij}$ should be positive. Since the EPU was an organization originated to circumvent one of the primary constraining features of bilateralism (i.e., bilaterally balanced trade), trade between two EPU members should be less reciprocal, *ceteris paribus*, than trade between a member and a nonmember or than trade between two nonmembers.

Table 1 contains the ordinary least squares (OLS) coefficient estimates, their standard errors, the coefficient of determination, and
TABLE 1
Estimation of Equation (4.1)
Dependent Variable = $D X_{ij}$

<table>
<thead>
<tr>
<th>Explanatory Variable</th>
<th>Estimated Coefficient</th>
<th>Standard Error</th>
</tr>
</thead>
<tbody>
<tr>
<td>$Y_i$</td>
<td>.741*</td>
<td>.056</td>
</tr>
<tr>
<td>$Y_j$</td>
<td>.344*</td>
<td>.043</td>
</tr>
<tr>
<td>$N_i$</td>
<td>-.003</td>
<td>.060</td>
</tr>
<tr>
<td>$N_j$</td>
<td>.033</td>
<td>.050</td>
</tr>
<tr>
<td>$B_{ij}$</td>
<td>-.769*</td>
<td>.168</td>
</tr>
<tr>
<td>$EM_{ij}$</td>
<td>1.364*</td>
<td>.169</td>
</tr>
<tr>
<td>$D_{ij}$</td>
<td>-.206*</td>
<td>.049</td>
</tr>
<tr>
<td>Intercept</td>
<td>.641</td>
<td>.716</td>
</tr>
</tbody>
</table>

$R^2 = .333$

$F(7, 1008) = 71.94$

$n = 1016$

*Significantly different from zero at the 5 percent level using a two-tailed test.
the F-statistic for testing the significance of the regression for equation (4.1). All coefficients are statistically significant except those of \( N_i \), \( N_j \), and the intercept. The two coefficients of importance (those of \( B_{ij} \) and \( EM_{ij} \)) also have the expected sign. In particular, the absolute deviation of the trade between two countries that have entered into a bilateral agreement was, *ceteris paribus*, 59 percent of the absolute deviation of the trade between two countries without any bilateral agreement. Also, the absolute deviation of the trade between EPU members was, *ceteris paribus*, 2.57 times greater than that between a member and a nonmember or that between two nonmembers.

As was mentioned above, it is not clear that population is a good proxy for the size of the foreign sector. This doubt appears to be supported by the results from the estimation of equation (4.1) as neither the estimated coefficient of \( N_i \) nor that of \( N_j \) are statistically significant. To insure that their inclusion is not seriously biasing the other coefficient estimates, equation (4.1) was estimated again excluding \( N_i \) and \( N_j \) as explanatory variables. The results of this estimation are reported in Table 2. Except for the estimated intercept, no significant changes occur in the estimation of either the coefficients or their standard errors when \( N_i \) and \( N_j \) are excluded from equation (4.1).

Even though the method developed above for isolating the marginal impact of bilateralism upon reciprocity appears to work reasonably well, it is necessary to test the robustness of this method through (1) analyzing a sub-sample composed entirely of countries that had imposed exchange control and (2) introducing two additional binary variables that reflect two important factors that influenced trade during 1954.


**TABLE 2**

Estimation of Equation (4.1)
Excluding \( N_i \) and \( N_j \)

Dependent Variable = \( DX_{ij} \)

<table>
<thead>
<tr>
<th>Explanatory Variable</th>
<th>Estimated Coefficient</th>
<th>Standard Error</th>
</tr>
</thead>
<tbody>
<tr>
<td>( Y_i )</td>
<td>.738*</td>
<td>.039</td>
</tr>
<tr>
<td>( Y_j )</td>
<td>.363*</td>
<td>.032</td>
</tr>
<tr>
<td>( B_{ij} )</td>
<td>-.761*</td>
<td>.166</td>
</tr>
<tr>
<td>( EM_{ij} )</td>
<td>1.364*</td>
<td>.167</td>
</tr>
<tr>
<td>( D_{ij} )</td>
<td>-.202*</td>
<td>.048</td>
</tr>
<tr>
<td>Intercept</td>
<td>.867*</td>
<td>.412</td>
</tr>
</tbody>
</table>

\( R^2 = .333 \)

\( F(5, 1010) = 100.78 \)

\( n = 1016 \)

*Significantly different from zero at the 5 percent level using a two-tailed test.*
There were basically two important groups of nations during the 1950s. One group was composed of the countries that chose to impose exchange control (mainly due to balance of payments disequilibrium) and consequently entered into bilateral agreements with many of their trading partners. The second group was composed of countries that did not impose exchange control. Since these countries did not employ exchange control, there was no necessity for them to enter into bilateral agreements with any of their partners. These two groups were reasonably different; consequently, it is useful to divide the sample and to isolate on the bilateral trade flows between exchange control countries only.

Furthermore, trade with the United States and with centrally planned economies was not the same for most countries as was trade with other trading partners. In particular, because the U.S. lost little in terms of its productive capacity during World War II, it was the primary supplier of the resources that the West European countries demanded to reconstruct their war-torn economies. For other countries, the U.S. was the major alternative source to supply goods and services previously provided by the West European countries. As a result, trade with the U.S. was generally given a higher priority vis-a-vis trade with other countries in the 1950s. Also, trade with centrally planned economies (CPEs) was (and still is) not conducted in the same manner as was trade with market economies. Specifically, foreign consumers could not enter any domestic market within a CPE and purchase goods and services; they could only choose from the goods and services that the planning bodies had designated for export. This phenomenon is
called commodity inconvertibility; i.e., surpluses held by foreign consumers in CPEs could not be converted into any commodity that the consumer wanted but only converted into a commodity that was allowed to be exported. In order to identify the effects of trading with the U.S. and with CPEs upon reciprocity, the following two additional binary variables are constructed:

\[
\begin{align*}
D_{\text{USA}} &= \begin{cases} 
2 & \text{if trading partner is the U.S.} \\
1 & \text{otherwise.} 
\end{cases} \\
D_{\text{CPE}} &= \begin{cases} 
2 & \text{if trading partner is a CPE.} \\
1 & \text{otherwise.} 
\end{cases}
\end{align*}
\]

Table 3 contains the OLS coefficient estimates, their standard errors, the coefficient of determination, and the F-statistic for testing the significance of the regression for equation (4.1) excluding \(N_i\) and \(N_j\) but only for trade between exchange control countries. There are minor changes in several coefficients, but none of any significance. The two coefficients of importance (those of \(b_{ij}\) and \(E_{M_{ij}}\)) again have the expected sign and are significantly different from zero. In particular, the absolute deviation of trade between two exchange control partners in a bilateral agreement was, _ceteris paribus_, 60 percent of the deviation of trade between two exchange control countries without any agreement. Also, among exchange control countries, the absolute deviation of the trade between EPU members was, _ceteris paribus_, 2.52 times greater than trade between a member and a nonmember or than trade between two nonmembers.
### TABLE 3

Estimation of Equation (4.1) Excluding $N_i$ and $N_j$ for Inter-Exchange-Control-Country Trade

Dependent Variable = $D_{Xij}$

<table>
<thead>
<tr>
<th>Explanatory Variable</th>
<th>Estimated Coefficient</th>
<th>Standard Error</th>
</tr>
</thead>
<tbody>
<tr>
<td>$Y_i$</td>
<td>.731*</td>
<td>.051</td>
</tr>
<tr>
<td>$Y_j$</td>
<td>.299*</td>
<td>.040</td>
</tr>
<tr>
<td>$B_{ij}$</td>
<td>-.729*</td>
<td>.208</td>
</tr>
<tr>
<td>$EM_{ij}$</td>
<td>1.336*</td>
<td>.168</td>
</tr>
<tr>
<td>$D_{ij}$</td>
<td>-.192*</td>
<td>.049</td>
</tr>
<tr>
<td>Intercept</td>
<td>.912*</td>
<td>.422</td>
</tr>
</tbody>
</table>

$R^2 = .272$

$F(5, 811) = 60.56$

$n = 817$

*Significantly different from zero at the 5 percent level using a two-tailed test.
Some of the information contained in the estimated coefficient of $B_{ij}$ could also reflect the fact that most of the countries in the sample had also entered into bilateral agreements with CPEs. Due to commodity inconvertibility, consumers in market-type economies (MTEs) typically did not want trade surpluses with CPEs. Also, demand in CPEs for Western goods and services usually exceeded their ability to export to these countries; consequently, it was unlikely that many CPEs had very many bilateral trade surpluses with MTEs. As a result, even without a bilateral agreement between them, one would expect the trade between a CPE and a MTE to be relatively more reciprocal than the trade between two MTEs. That is, the estimated coefficient of $B_{ij}$ could actually be indicating more reciprocity in trade between CPEs and MTEs, not between partners in a bilateral agreement. To separate these two possibilities, the binary variable constructed above denoting trade with a CPE is added to the revised form of equation (4.1) (i.e., the form excluding $N_i$ and $N_j$). Table 4 contains the OLS coefficient estimates, their standard errors, the coefficient of determination, and the F-statistic for testing the significance of the regression for the revised form of equation (4.1) with the addition of DCPE. The signs of the three important coefficients (those of $B_{ij}$, $EM_{ij}$, and DCPE) all meet expectations and are statistically significant.

When comparing the estimations of equation (4.1) with and without DCPE, three points are of interest. First, the marginal effect of bilateralism decreased (in absolute value) when DCPE was added. (The absolute deviation of trade between two partners in a bilateral agreement was 68 percent of the deviation between two partners without any
TABLE 4

Estimation of Equation (4.1) Excluding \( N_i \) and \( N_j \) and Adding DCPE for Inter-
Exchange-Control-Country Trade

Dependent Variable = \( DX_{ij} \)

<table>
<thead>
<tr>
<th>Explanatory Variable</th>
<th>Estimated Coefficient</th>
<th>Standard Error</th>
</tr>
</thead>
<tbody>
<tr>
<td>( Y_i )</td>
<td>.735*</td>
<td>.049</td>
</tr>
<tr>
<td>( Y_j )</td>
<td>.347*</td>
<td>.039</td>
</tr>
<tr>
<td>( B_{ij} )</td>
<td>-.547*</td>
<td>.202</td>
</tr>
<tr>
<td>( EM_{ij} )</td>
<td>-.346*</td>
<td>.051</td>
</tr>
<tr>
<td>( D_{ij} )</td>
<td>-.346*</td>
<td>.237</td>
</tr>
<tr>
<td>DCPE</td>
<td>-1.868*</td>
<td></td>
</tr>
<tr>
<td>Intercept</td>
<td>2.239*</td>
<td>.441</td>
</tr>
</tbody>
</table>

\( R^2 = .324 \)

\( F(6, 810) = 64.64 \)

n = 817

*Significantly different from zero at the 5 percent level using a two-tailed test.
agreement when DCPE was included. Without DCPE, the absolute deviation of trade between two MTE partners in a bilateral agreement was 60 percent of the deviation between two MTE partners without any agreement.) This fact implies that the bilateralism variable was depicting both the effect of bilateralism upon reciprocity and also, some of the trade-constraining features of exchange between a MTE and a CPE. Second, trade between a CPE and a soft currency MTE was more reciprocal than trade between two soft currency MTE partners in a bilateral agreement. (In general, the absolute deviation of trade between a CPE and a soft currency MTE was 27 percent of that between two soft currency MTEs. Alternatively, the absolute deviation of trade between two soft currency MTE partners in a bilateral agreement was 68 percent of that between two soft currency MTEs without any agreement.) Finally, when DCPE is added to the revised form of equation (4.1), the estimated coefficient of $E_{M}^{ij}$ decreases by almost 50 percent. I really have no explanation for this occurrence except that intra-EPU trade was not as irreciprocal as it initially appeared when the effect of trade with CPEs is explicitly represented in the model. That is, one of the reasons for the relatively large estimated coefficient of $E_{M}^{ij}$ before the inclusion of DCPE was that intra-EPU trade was extremely irreciprocal vis-a-vis trade between a MTE and a CPE; once MTE-CPE trade was explicitly included, the coefficient of $E_{M}^{ij}$ simply compares the degree of reciprocity of trade between non-EPU MTEs vis-a-vis that between MTEs that were members of the EPU.

The revised form of equation (4.1) with the addition of DCPE is also estimated for the entire sample (i.e., including both hard and
soft currency countries). The OLS coefficient estimates, their standard errors, the coefficient of determination, and the F-statistic for testing the significance of the regression are presented in Table 5. The results are very similar to those obtained when the sample was composed of only exchange control countries. Of interest again is the fact that trade between a MTE and a CPE was relatively more reciprocal than was trade between two MTE partners in a bilateral agreement.

It was mentioned above that the United States was a very special trading partner for most countries during this time period. To see how this special relationship affected the degree of reciprocity, the binary variable denoting trade with the U.S. (DUSA) is added to the revised form of equation (4.1). The results obtained by estimating this equation for the entire sample are contained in Table 6. Again, the estimated coefficients of $B_{ij}$ and $EM_{ij}$ have the expected sign and are statistically significant. Both coefficients decrease slightly (in absolute value) when DUSA is added, but neither change is significant. Also, the estimated coefficient of DUSA is positive and significantly different from zero; in fact, the absolute deviation of trade between any country and the U.S. was 2.91 times greater than that between any other two countries. Of course, the largeness of this coefficient and also, the small decrease in the coefficients of $B_{ij}$ and $EM_{ij}$ is due, in part, to the fact that the U.S. was the largest trading partner for most of the countries in the sample. However, this result might also indicate that a typical country's demand for U.S. exports greatly exceeded its ability to export to the U.S.
### TABLE 5

**Estimation of Equation (4.1) Excluding \( N_i \) and \( N_j \) and Adding DCPE for Entire Sample**

**Dependent Variable = \( DX_{ij} \)**

<table>
<thead>
<tr>
<th>Explanatory Variable</th>
<th>Estimated Coefficient</th>
<th>Standard Error</th>
</tr>
</thead>
<tbody>
<tr>
<td>( Y_i )</td>
<td>.738*</td>
<td>.038</td>
</tr>
<tr>
<td>( Y_j )</td>
<td>.394*</td>
<td>.031</td>
</tr>
<tr>
<td>( B_{ij} )</td>
<td>-.483*</td>
<td>.164</td>
</tr>
<tr>
<td>( EM_{ij} )</td>
<td>.730*</td>
<td>.179</td>
</tr>
<tr>
<td>( D_{ij} )</td>
<td>-.364*</td>
<td>.050</td>
</tr>
<tr>
<td>DCPE</td>
<td>-1.943*</td>
<td>.231</td>
</tr>
<tr>
<td>Intercept</td>
<td>2.239*</td>
<td>.430</td>
</tr>
</tbody>
</table>

\( R^2 = .377 \)

\( F(6, 1009) = 101.55 \)

\( n = 1016 \)

*Significantly different from zero at the 5 percent level using a two-tailed test.*
TABLE 6

Estimation of Equation (4.1) Excluding $N_i$ and $N_j$ and Adding DUSA for Entire Sample

Dependent Variable = $DX_{ij}$

<table>
<thead>
<tr>
<th>Explanatory Variable</th>
<th>Estimated Coefficient</th>
<th>Standard Error</th>
</tr>
</thead>
<tbody>
<tr>
<td>$Y_i$</td>
<td>.742*</td>
<td>.039</td>
</tr>
<tr>
<td>$Y_j$</td>
<td>.313*</td>
<td>.036</td>
</tr>
<tr>
<td>$B_{ij}$</td>
<td>-.649*</td>
<td>.169</td>
</tr>
<tr>
<td>$EM_{ij}$</td>
<td>1.346*</td>
<td>.167</td>
</tr>
<tr>
<td>$D_{ij}$</td>
<td>-.213*</td>
<td>.048</td>
</tr>
<tr>
<td>DUSA</td>
<td>1.539*</td>
<td>.499</td>
</tr>
<tr>
<td>Intercept</td>
<td>.959*</td>
<td>.411</td>
</tr>
</tbody>
</table>

$R^2 = .339$

$F(6, 1009) = 86.28$

$n = 1016$

*Significantly different from zero at the 5 percent level using a two-tailed test.
In order to investigate, simultaneously, the special effects of trading with the U.S. and with CPEs upon reciprocity, the revised form of equation (4.1) is estimated with the addition of both DCPE and DUSA. Table 7 contains the results of this estimation. The estimated coefficients of importance (those of $B_{ij}$, $EM_{ij}$, DCPE, and DUSA) have the expected sign and are statistically significant. Also, the estimated coefficients of both $B_{ij}$ and $EM_{ij}$ decrease (in absolute value) as they did when DCPE and DUSA were added individually. When the effects of trading with CPEs and the U.S. are explicitly represented in the model, trade between two partners is relatively less reciprocal than when DCPE and DUSA are not included, or when either is included individually. In particular, the absolute deviation of trade between partners in a bilateral agreement (with the inclusion of DCPE and DUSA in the model) was 76 percent of that between two countries without any agreement. This value is higher than the one obtained when DCPE and DUSA are excluded (59 percent) or when either is included individually (72 percent and 64 percent respectively).

In all of the above analyses, the estimated coefficient of $D_{ij}$ has been negative and statistically significant. There is no a priori reason why this should occur. It is possible that this result represents a scale phenomenon. That is, the further apart two countries are, the less they trade with each other (due to relatively higher transport costs) and, therefore, the lower the absolute deviation of their trade. In order to investigate this possibility, equation (4.1)
TABLE 7
Estimation of Equation (4.1) Excluding N_i and N_j and Adding DCPE and DUSA for Entire Sample
Dependent Variable = DX_{ij}

<table>
<thead>
<tr>
<th>Explanatory Variable</th>
<th>Estimated Coefficient</th>
<th>Standard Error</th>
</tr>
</thead>
<tbody>
<tr>
<td>Y_i</td>
<td>.741*</td>
<td>.038</td>
</tr>
<tr>
<td>Y_j</td>
<td>.354*</td>
<td>.035</td>
</tr>
<tr>
<td>B_{ij}</td>
<td>-.400*</td>
<td>.167</td>
</tr>
<tr>
<td>EM_{ij}</td>
<td>.730*</td>
<td>.178</td>
</tr>
<tr>
<td>D_{ij}</td>
<td>-.369*</td>
<td>.050</td>
</tr>
<tr>
<td>DCPE</td>
<td>-1.898*</td>
<td>.231</td>
</tr>
<tr>
<td>DUSA</td>
<td>1.230*</td>
<td>.485</td>
</tr>
<tr>
<td>Intercept</td>
<td>2.281*</td>
<td>.429</td>
</tr>
</tbody>
</table>

R^2 = .380
F(7, 1008) = 88.43
n = 1016

*Significantly different from zero at the 5 percent level using a two-tailed test.
is estimated again first excluding \( D_{ij} \) as an explanatory variable and second, substituting \( RDX_{ij} \) for \( DX_{ij} \) as the dependent variable where \[
RDX_{ij} = \frac{DX_{ij}}{X_{ij} + X_{ji}}.
\]

Tables 8 and 9 contain the results of re-estimating equation (4.1) excluding \( D_{ij} \) with and without \( N_i \) and \( N_j \) included respectively for the entire sample. Comparing these results to those contained in Tables 1 and 2, the intercept and the coefficient of \( B_{ij} \) are the only parameters significantly affected. In particular, they both decline in absolute value when \( D_{ij} \) is excluded. That is, when the effect of distance is removed, the effect of bilateralism upon reciprocity declines. Similar results are obtained when the sample is only composed of exchange control countries.

Table 10 contains the results of re-estimating equation (4.1) substituting \( RDX_{ij} \) for \( DX_{ij} \) as the dependent variable for the entire sample. All coefficient estimates are statistically significant at least at the 10 percent level. The two coefficients of importance (those of \( B_{ij} \) and \( EM_{ij} \)) have the expected sign. Specifically, the absolute deviation of bilateral trade between two partners is a bilateral agreement as a percentage of their total bilateral trade is 69 percent of that between two partners that have not entered into an agreement. One would expect that the estimated coefficient of \( D_{ij} \) would be statistically insignificant if \( D_{ij} \) does represent a scale phenomenon. However, this is not the case. Consequently, the estimating using \( RDX_{ij} \) does not seem to support the above hypothesis. A possible
TABLE 8

Estimation of Equation (4.1)
Excluding \( D_{ij} \)

Dependent Variable = \( DX_{ij} \)

<table>
<thead>
<tr>
<th>Explanatory Variable</th>
<th>Estimated Coefficient</th>
<th>Standard Error</th>
</tr>
</thead>
<tbody>
<tr>
<td>( Y_i )</td>
<td>.740*</td>
<td>.057</td>
</tr>
<tr>
<td>( Y_j )</td>
<td>.363*</td>
<td>.044</td>
</tr>
<tr>
<td>( N_i )</td>
<td>-.038</td>
<td>.060</td>
</tr>
<tr>
<td>( N_j )</td>
<td>.002</td>
<td>.050</td>
</tr>
<tr>
<td>( B_{ij} )</td>
<td>-.568*</td>
<td>.163</td>
</tr>
<tr>
<td>( EM_{ij} )</td>
<td>1.453*</td>
<td>.169</td>
</tr>
<tr>
<td>Intercept</td>
<td>-.460</td>
<td>.670</td>
</tr>
</tbody>
</table>

\( R^2 = .322 \)

\( F(6, 1009) = 79.72 \)

\( n = 1016 \)

*Significantly different from zero at the 5 percent level using a two-tailed test.
TABLE 9

Estimation of Equation (4.1)  
Excluding Dij, N1, Nj

Dependent Variable = DXij

<table>
<thead>
<tr>
<th>Explanatory Variable</th>
<th>Estimated Coefficient</th>
<th>Standard Error</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yij</td>
<td>.714*</td>
<td>.039</td>
</tr>
<tr>
<td>Yj</td>
<td>.365*</td>
<td>.032</td>
</tr>
<tr>
<td>Bij</td>
<td>-.575*</td>
<td>.162</td>
</tr>
<tr>
<td>EMij</td>
<td>1.469*</td>
<td>.167</td>
</tr>
<tr>
<td>Intercept</td>
<td>-.755*</td>
<td>.151</td>
</tr>
</tbody>
</table>

R² = .322
F(4, 1011) = 119.69
n = 1016

*Significantly different from zero at the 5 percent level using a two-tailed test.
### TABLE 10

Estimation of Equation (4.1)

Dependent Variable = $RDX_{ij}$

<table>
<thead>
<tr>
<th>Explanatory Variable</th>
<th>Estimated Coefficient</th>
<th>Standard Error</th>
</tr>
</thead>
<tbody>
<tr>
<td>$Y_i$</td>
<td>-.249*</td>
<td>.040</td>
</tr>
<tr>
<td>$Y_j$</td>
<td>-.147*</td>
<td>.031</td>
</tr>
<tr>
<td>$N_i$</td>
<td>.139*</td>
<td>.043</td>
</tr>
<tr>
<td>$N_j$</td>
<td>.062**</td>
<td>.036</td>
</tr>
<tr>
<td>$B_{ij}$</td>
<td>-.581*</td>
<td>.120</td>
</tr>
<tr>
<td>$EM_{ij}$</td>
<td>.417*</td>
<td>.121</td>
</tr>
<tr>
<td>$D_{ij}$</td>
<td>.187*</td>
<td>.035</td>
</tr>
<tr>
<td>Intercept</td>
<td>-3.837*</td>
<td>.513</td>
</tr>
</tbody>
</table>

$R^2 = .109$

$F(7, 1008) = 17.588$

$n = 1016$

*Significantly different from zero at the 5 percent level using a two-tailed test.

**Significantly different from zero at the 10 percent level using a two-tailed test.
The explanation of this occurrence is that the further away partners are, the less similar are their tastes. Consequently, the deviation in their bilateral trade relative to their total bilateral trade is large compared to that of two partners that are closer to each other. Also, the trade of most countries in the sample with the U.S. was relatively irreciprocal, and the U.S. was relatively far from these countries. This fact could have imparted a positive bias on the estimated coefficient of $D_{ij}$ in Table 10. However, the suspicion was not confirmed when DUSA was added. In particular, the estimated coefficient of $D_{ij}$ remained positive and statistically significant.

Finally, in antecedent work an attempt has been made to correlate (at least casually) the degree of reciprocity measured by a reciprocity index and the extent of bilateralism. The method developed here explicitly measures the marginal impact of bilateralism upon reciprocity. Consequently, to complete this analysis it is interesting to compare my results to those of studies employing a reciprocity index. In order to isolate the marginal impact of bilateralism upon reciprocity for each country, the following equation is estimated for twenty-four countries in the sample:

$$\Delta X'_{ij} = \alpha_0 + \alpha_1 Y'_{ij} + \alpha_2 B'_{ij} + \alpha_3 EM'_{ij} + \alpha_4 D'_{ij} + u_{ij}$$

where all variables are defined above. Since equation (4.2) is estimated individually for each country in the sample, $Y_i$ cannot be included because it is constant for each exporting country for any given year. Inclusion of $Y_i$ would create exact multicollinearity resulting in a solution of the normal equations that
is not unique. Consequently, the effect of $Y_i$ is included in the estimated intercept ($\alpha_0$). Table 11 contains the OLS estimates of the coefficient of $B_{1j}$ ($\alpha_2$) in equation (4.2), and calculated reciprocity indices using Michaely's, Pryor's, and the League of Nations' (LN) definitions for each country for which the estimation of equation (4.2) is significant at the 10 percent level.¹⁰ (Egypt is the only country that failed to satisfy the above criterion.) The remaining countries are ranked (1) in descending order according to the estimated value of $\alpha_2$ (i.e., in ascending order with respect to the size of the marginal impact of bilateralism upon reciprocity) and (2) in descending order for each of the three calculated reciprocity indices. (All of these orderings are from least reciprocal to most reciprocal trade.) The focus of this analysis is to compare the ordering of the marginal effects of bilateralism upon reciprocity with the orderings of the degrees of reciprocity obtained by using the three reciprocity indices. The purpose is to see whether or not the ordering according to the reciprocity indices accurately reflects the actual impact of bilateral agreements upon reciprocity obtained from my analysis above.

In the ordering of the estimated coefficients of $B_{1j}$ ($\alpha_2$) in equation (4.2), Argentina, Austria, and Japan are ranked first, second, and third respectively because the effect of bilateralism is positive and significantly greater than zero at the 15 percent level (using a one-tailed test). The next nine countries tie for the fourth position either because they had entered into no bilateral agreements (the case for the U.S. and Canada) or because their estimated $\alpha_2$'s are not significantly different from zero at the 15 percent level (the case for
**TABLE 11.**

Reciprocity Analysis for Countries Individually

Dependent Variable = DX_{ij}

<table>
<thead>
<tr>
<th>Country</th>
<th>Estimated $\alpha_2$</th>
<th>Michaeley's Reciprocity Index</th>
<th>Pryor's Reciprocity Index</th>
<th>LN Reciprocity Index</th>
</tr>
</thead>
<tbody>
<tr>
<td>Argentina</td>
<td>2.963**</td>
<td>26.0</td>
<td>20.4</td>
<td>18.8</td>
</tr>
<tr>
<td>Austria</td>
<td>1.774**</td>
<td>21.4</td>
<td>22.8</td>
<td>18.5</td>
</tr>
<tr>
<td>Japan</td>
<td>1.660**</td>
<td>38.9</td>
<td>42.2</td>
<td>28.3</td>
</tr>
<tr>
<td>Netherlands</td>
<td>.591</td>
<td>21.3</td>
<td>23.3</td>
<td>13.8</td>
</tr>
<tr>
<td>Finland</td>
<td>.397</td>
<td>22.1</td>
<td>22.8</td>
<td>21.7</td>
</tr>
<tr>
<td>Denmark</td>
<td>.201</td>
<td>23.8</td>
<td>22.8</td>
<td>12.3</td>
</tr>
<tr>
<td>W. Germany</td>
<td>.038</td>
<td>21.8</td>
<td>22.2</td>
<td>16.3</td>
</tr>
<tr>
<td>Spain</td>
<td>.018</td>
<td>24.2</td>
<td>27.7</td>
<td>8.4</td>
</tr>
<tr>
<td>U.S.</td>
<td>.0</td>
<td>18.2</td>
<td>20.3</td>
<td>12.4</td>
</tr>
<tr>
<td>Canada</td>
<td>.0</td>
<td>18.5</td>
<td>19.8</td>
<td>17.3</td>
</tr>
<tr>
<td>Thailand</td>
<td>-.378</td>
<td>36.3</td>
<td>35.9</td>
<td>30.5</td>
</tr>
<tr>
<td>Portugal</td>
<td>-.494</td>
<td>29.2</td>
<td>34.3</td>
<td>19.3</td>
</tr>
<tr>
<td>Bel-Lux</td>
<td>-.784*</td>
<td>21.9</td>
<td>23.0</td>
<td>18.0</td>
</tr>
<tr>
<td>Switzerland</td>
<td>-.865*</td>
<td>19.4</td>
<td>21.1</td>
<td>17.7</td>
</tr>
<tr>
<td>Sweden</td>
<td>-.949*</td>
<td>20.9</td>
<td>21.9</td>
<td>16.6</td>
</tr>
<tr>
<td>India</td>
<td>-1.342*</td>
<td>29.6</td>
<td>27.5</td>
<td>22.9</td>
</tr>
<tr>
<td>Mexico</td>
<td>-1.508*</td>
<td>35.6</td>
<td>28.7</td>
<td>13.7</td>
</tr>
<tr>
<td>Italy</td>
<td>-1.730*</td>
<td>24.3</td>
<td>30.8</td>
<td>12.4</td>
</tr>
<tr>
<td>Yugoslavia</td>
<td>-1.839*</td>
<td>29.4</td>
<td>29.2</td>
<td>13.9</td>
</tr>
<tr>
<td>Turkey</td>
<td>-2.005*</td>
<td>17.8</td>
<td>23.0</td>
<td>6.1</td>
</tr>
<tr>
<td>Greece</td>
<td>-2.019*</td>
<td>21.9</td>
<td>39.5</td>
<td>5.4</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>-2.158*</td>
<td>21.0</td>
<td>22.5</td>
<td>11.2</td>
</tr>
<tr>
<td>France</td>
<td>-2.476*</td>
<td>28.3</td>
<td>28.3</td>
<td>27.2</td>
</tr>
<tr>
<td>Brasil</td>
<td>-2.493*</td>
<td>17.7</td>
<td>16.7</td>
<td>16.6</td>
</tr>
<tr>
<td>Norway</td>
<td>-2.823*</td>
<td>21.6</td>
<td>35.0</td>
<td>9.7</td>
</tr>
</tbody>
</table>

**Significantly greater than zero at 15 percent level.**

*Significantly less than zero at 15 percent level.*
Netherlands, Finland, Denmark, West Germany, Spain, Thailand, and Portugal). The remainder of the ordering is self-explanatory. Spearman's rank correlation coefficient is calculated for each of the three pairwise comparisons to test the independence of each pair of orderings. These results are presented in Table 12. None of the calculated rank correlation coefficients are significantly different from zero at the 5 percent level. In other words, the hypothesis that the ranking according to the marginal effect of bilateralism and the ranking according to any one of the three reciprocity indices is independent cannot be rejected. Because this analysis explicitly measures the marginal effect of bilateralism upon reciprocity, and since the ranking according to this measurement is independent of that obtained by using any one of the three reciprocity indices, it must be concluded that, at least for 1954, the reciprocity index has no useful interpretation as a measure of the actual effect of bilateralism upon reciprocity. This is not an unexpected result because the reciprocity index implicitly measures the total impact of all explanatory variables (including bilateralism) upon reciprocity while my analysis isolates the marginal impact of bilateralism alone upon reciprocity.

Exchange Control, Bilateralism, and Trade

Even though the above analysis clearly demonstrates that the existence of bilateralism causes trade to be relatively more reciprocal, nothing can be concluded from this analysis concerning the marginal impact of exchange control and bilateralism upon the size of trade. Consequently, our attention must now turn to investigating these two issues. As discussed in Chapter III, the imposition of exchange control
TABLE 12
Spearman Rank Correlation Coefficients for Individual Country Analysis

<table>
<thead>
<tr>
<th>Ordering According to:</th>
<th>Ordering According to $a_2$'s</th>
</tr>
</thead>
<tbody>
<tr>
<td>Michaely's Index</td>
<td>.222</td>
</tr>
<tr>
<td>Pryor's Index</td>
<td>-.196</td>
</tr>
<tr>
<td>LN Index</td>
<td>.370</td>
</tr>
</tbody>
</table>
necessarily limits a nation's ability to import and to purchase foreign securities to its ability to export and to sell domestic securities in foreign markets. Also, since exchange control is usually imposed to correct temporarily a balance of payments to deficit, its imposition should cause the value of a country's imports to decline in the aggregate. That is, the aggregate imports of a country that has imposed exchange control should be, ceteris paribus, lower than those of a country that has not imposed exchange control.

To test this hypothesis the following equation is estimated:

\[
\ln M_i = \beta_0 + \beta_1 \ln Y_i + \beta_2 \ln N_i + \beta_3 \text{EXC}_i + \epsilon_i
\]

where \( M_i \equiv \) the aggregate value of country \( i \)'s imports measured in billions of U.S. dollars,

\[
\text{EXC}_i = \begin{cases} 
1 & \text{if country } i \text{ has imposed exchange control} \\
0 & \text{otherwise.}
\end{cases}
\]

and all other variables are defined above. The signs of the estimated coefficients can be easily predicted. The coefficient of \( Y_i \) should be positive reflecting that, in general, as income rises, the ability to import increases. The coefficient of \( N_i \) should be negative. Population is a proxy variable for the size of country \( i \)'s foreign sector: the larger the population, the larger the domestic market from which to purchase goods and services. Consequently, as population rises, the foreign sector should shrink and imports should decrease ceteris paribus. For reasons enumerated above, the sign of the coefficient of \( \text{EXC}_i \) should be negative. Table 13 contains the OLS coefficient estimates, their standard errors, the coefficient of determination, and
TABLE 13

Estimation of Equation (4.3)

Dependent Variable = $M_i$

<table>
<thead>
<tr>
<th>Explanatory Variable</th>
<th>Estimated Coefficient</th>
<th>Standard Error</th>
</tr>
</thead>
<tbody>
<tr>
<td>$Y_i$</td>
<td>.846*</td>
<td>.095</td>
</tr>
<tr>
<td>$N_i$</td>
<td>-.241*</td>
<td>.101</td>
</tr>
<tr>
<td>EXC$_i$</td>
<td>-.398*</td>
<td>.186</td>
</tr>
<tr>
<td>Intercept</td>
<td>-.795*</td>
<td>.229</td>
</tr>
</tbody>
</table>

$R^2 = .860$

$F(3, 22) = 44.95$

$n = 26$

*Significantly different from zero at the 5 percent level using a two-tailed test.
the F-statistic for testing the significance of the regression for equation (4.3). All estimated coefficients are statistically significant and have the expected signs. In particular, the imports of a country that had imposed exchange control were, ceteris paribus, 67 percent of the value of imports of a country that had not.

Measuring the effect of bilateralism upon bilateral trade flows is a straightforward task. The functional form of the gravity model estimated is as follows:

\[
X_{ij}^\prime = b_0 + b_1Y_i^\prime + b_2Y_j^\prime + b_3N_i^\prime + b_4N_j^\prime + b_5B_{ij}^\prime + b_6\text{EM}_{ij} + b_7D_{ij} + u_{ij}
\]

\[
M_{ij}^\prime = c_0 + c_1Y_i^\prime + c_2Y_j^\prime + c_3N_i^\prime + c_4N_j^\prime + c_5B_{ij}^\prime + c_6\text{EM}_{ij} + c_7D_{ij} + u_{ij}
\]

where \( M_{ij}^\prime \) is imports by country i from country j measured in millions of U.S. $, and all other variables are defined above. Unlike the model of reciprocity, the signs of the coefficients in equations (4.4) and (4.5) can be unambiguously predicted. For reasons presented in Chapter III, the coefficients of \( Y_i^\prime \) and \( Y_j^\prime \) should both be positive. Since a larger population implies a smaller foreign sector and a less open economy, the coefficients of \( N_i^\prime \) and \( N_j^\prime \) should both be negative. The sign of the coefficient of \( B_{ij}^\prime \) can be unambiguously predicted only if the sample analyzed consists solely of exchange control countries. If the sample is composed of both hard and soft currency countries, it is not clear how bilateralism affects bilateral trade flows. The existence of a
bilateral agreement between two partners could promote additional trade between them vis-a-vis all other partners. However, this same agreement might not promote any additional trade between the partners in it but, alternatively, enable these soft currency countries to conserve their hard currency reserves so that their trade with hard currency countries could possibly increase vis-a-vis that with partners in bilateral agreements. This ambiguity is removed when hard currency countries are excluded from the sample. When trade among soft currency countries is analyzed, bilateralism should encourage additional trade. The reason for this is that the existence of a bilateral agreement removes the necessity of using international currencies to finance international exchanges. As a result, the full cost of trading with partners in bilateral agreements is smaller than that with other soft currency countries because no soft or hard currencies have to be used when trading with partners in a bilateral agreement.\textsuperscript{13} The sign of the coefficient of $EM_{ij}$ should be positive. That is, the members of the EPU should trade relatively more with each other since this institution was originated to help alleviate some of the constraints imposed by exchange control and the resulting bilateralism. The sign of the coefficient of $D_{ij}$ should be negative. The greater the geographic distance between countries $i$ and $j$, the greater are the costs of transporting commodities from $i$ to $j$ (and from $j$ to $i$). Because a higher transport cost raises the effective price of $j$'s imports from $i$ (and exports to $i$), the greater the distance from $i$ to $j$, the smaller is the demand by $j$ for $i$'s exports and by $i$ for $j$'s exports. Consequently, both $M_{ij}$ and
\( X_{ij} \) should be smaller, the further \( i \) and \( j \) are from each other ceteris paribus.

Table 14 contains the OLS coefficient estimates, their standard errors, the coefficient of determination, and the F-statistic for testing the significance of the regression for equation (4.4) estimated using only trade flows between exchange control countries. The same information for equation (4.5) using the same sample is presented in Table 15. In each equation, the signs of the statistically significant coefficient estimates are those expected. However, in both equations, neither the estimated coefficient of \( N_j \) nor that of \( B_{ij} \) are statistically different from zero at the 5 percent level using a two-tailed test. (In fact, the sign of \( B_{ij} \) in equation (4.4) is unexpected, and the sign of \( N_j \) in equation (4.5) is also unexpected.)

The problem with the estimated coefficient of \( N_j \) is not uncommon to studies employing the gravity model. The primary reason for this problem is that the countries composing the group of country \( i \)'s in this sample are substantially more homogeneous in terms of level of development and industrialization than are those countries composing the group of country \( j \)'s. Consequently, population is a better proxy of the size of the foreign sector for the country \( i \)'s than it is for country \( j \)'s in this sample.

The statistical insignificance of the coefficient of \( B_{ij} \) could be due to collinearity. In particular, all of the members of the EPU had entered into bilateral agreements with each other. These were a very special type of agreement (automatic transferability agreement) that was substantially different from the type of agreement negotiated
**TABLE 14**

Estimation of Equation (4.4) for Inter-Exchange-Control-Country Trade

Dependent Variable = $X_{ij}$

<table>
<thead>
<tr>
<th>Explanatory Variable</th>
<th>Estimated Coefficient</th>
<th>Standard Error</th>
</tr>
</thead>
<tbody>
<tr>
<td>$Y_i$</td>
<td>1.277*</td>
<td>.073</td>
</tr>
<tr>
<td>$Y_j$</td>
<td>.367*</td>
<td>.051</td>
</tr>
<tr>
<td>$N_i$</td>
<td>-.327*</td>
<td>.067</td>
</tr>
<tr>
<td>$N_j$</td>
<td>-.005</td>
<td>.055</td>
</tr>
<tr>
<td>$B_{ij}$</td>
<td>-.064</td>
<td>.212</td>
</tr>
<tr>
<td>$EM_{ij}$</td>
<td>.660*</td>
<td>.172</td>
</tr>
<tr>
<td>$D_{ij}$</td>
<td>-.500*</td>
<td>.051</td>
</tr>
<tr>
<td>Intercept</td>
<td>5.630*</td>
<td>.785</td>
</tr>
</tbody>
</table>

$R^2 = .420$

$F(7, 809) = 83.56$

$n = 817$

*Significantly different from zero at the 5 percent level using a two-tailed test.
TABLE 15

Estimation of Equation (4.5) for Inter-Exchange-Control-Country Trade

Dependent Variable = $M_{ij}$

<table>
<thead>
<tr>
<th>Explanatory Variable</th>
<th>Estimated Coefficient</th>
<th>Standard Error</th>
</tr>
</thead>
<tbody>
<tr>
<td>$Y_i$</td>
<td>1.042*</td>
<td>.077</td>
</tr>
<tr>
<td>$Y_j$</td>
<td>.422*</td>
<td>.053</td>
</tr>
<tr>
<td>$N_i$</td>
<td>-.232*</td>
<td>.071</td>
</tr>
<tr>
<td>$N_j$</td>
<td>.007</td>
<td>.057</td>
</tr>
<tr>
<td>$B_{ij}$</td>
<td>.042</td>
<td>.222</td>
</tr>
<tr>
<td>$E_{ij}$</td>
<td>.955*</td>
<td>.181</td>
</tr>
<tr>
<td>$D_{ij}$</td>
<td>-.399*</td>
<td>.054</td>
</tr>
<tr>
<td>Intercept</td>
<td>4.141*</td>
<td>.824</td>
</tr>
</tbody>
</table>

$R^2 = .353$

$F(7, 809) = 62.99$

$n = 817$

*Significantly different from zero at the 5 percent level using a two-tailed test.
between an EPU member and a nonmember or between two nonmembers. (The agreements negotiated immediately after World War II between an EPU member and a nonmember or between two nonmembers were almost entirely bilateral clearing agreements. These were discussed above.) Consequently, whenever $EM_{ij}$ equals two, so does $B_{ij}$. That is, $B_{ij}$ and $EM_{ij}$ are very highly correlated. Also, since any bilateral agreement is represented by a value of $B_{ij}$ equal to two, there is no way to differentiate this very special automatic transferability agreement from the more typical bilateral clearing agreement with this specification of the model. In order to differentiate the effects of the two types of agreements mentioned above and also, to ease the collinearity problem, equations (4.4) and (4.5) are respecified as follows:

\[(4.6) \quad X_{ij} = b_0 + b_1 Y_{i} + b_2 Y_{j} + b_3 N_{ij} + b_4 N_{j} + b_5 BCA_{ij} + b_6 ATA_{ij} + b_7 D_{ij} + u_{ij}\]

\[(4.7) \quad M_{ij} = c_0 + c_1 Y_{i} + c_2 Y_{j} + c_3 N_{ij} + c_4 N_{j} + c_5 BCA_{ij} + c_6 ATA_{ij} + c_7 D_{ij} + u_{ij}\]

where

\[BCA_{ij} \equiv \begin{cases} 
2 & \text{if } i \text{ and } j \text{ have entered into a bilateral clearing agreement} \\
1 & \text{otherwise} 
\end{cases}\]

\[ATA_{ij} \equiv \begin{cases} 
2 & \text{if } i \text{ and } j \text{ have entered into an automatic transferability agreement} \\
1 & \text{otherwise} 
\end{cases}\]
and all other variables are defined above. The signs of the estimated coefficients of both $BCA_{ij}$ and $ATA_{ij}$ should be positive reflecting the fact that bilateralism does promote additional trade between exchange control partners relative to other exchange control trade.

Table 16 contains the OLS coefficient estimates, their standard errors, the coefficient of determination, and the F-statistic for testing the significance of the regression for equation (4.6) using only trade flows between exchange control countries. The same information for equation (4.7) is presented in Table 17. Notice that the explanatory power of the new specification is larger than that of the original specification. Also, except for the coefficient of $N_j$, all estimated coefficients have the expected sign and are statistically significant. In particular, exports to a partner in a bilateral clearing agreement (BCA) were 91 percent larger, ceteris paribus, than those to any other exchange control country with which no type of agreement had been negotiated; exports to a partner in an automatic transferability agreement (ATA) were 110 percent larger, ceteris paribus, than those to any other exchange control country with which no type of agreement had been negotiated. Also, imports from a partner in a BCA were 91 percent larger, ceteris paribus, than those from any other exchange control country with which no type of agreement had been negotiated; imports from a partner in an ATA were 162 percent larger, ceteris paribus, than those from any other exchange control country with which no type of agreement had been negotiated. Since the ATAs removed most of the pressures of bilaterally balancing
### TABLE 16

Estimation of Equation (4.6) for Inter-Exchange-Control-Country Trade

Dependent Variable = \( X_{ij} \)

<table>
<thead>
<tr>
<th>Explanatory Variable</th>
<th>Estimated Coefficient</th>
<th>Standard Error</th>
</tr>
</thead>
<tbody>
<tr>
<td>( Y_i )</td>
<td>1.285*</td>
<td>.072</td>
</tr>
<tr>
<td>( Y_j )</td>
<td>.352*</td>
<td>.050</td>
</tr>
<tr>
<td>( N_i )</td>
<td>-.352*</td>
<td>.067</td>
</tr>
<tr>
<td>( N_j )</td>
<td>.006</td>
<td>.054</td>
</tr>
<tr>
<td>( BCA_{ij} )</td>
<td>.932*</td>
<td>.192</td>
</tr>
<tr>
<td>( ATA_{ij} )</td>
<td>1.068*</td>
<td>.184</td>
</tr>
<tr>
<td>( D_{ij} )</td>
<td>-.528*</td>
<td>.050</td>
</tr>
<tr>
<td>Intercept</td>
<td>5.658*</td>
<td>.761</td>
</tr>
</tbody>
</table>

R^2 = .437

\( F(7, 809) = 89.49 \)

n = 817

*Significantly different from zero at the 5 percent level using a two-tailed test.*
### TABLE 17

Estimation of Equation (4.7) for Inter-Exchange-Control-Country Trade

Dependent Variable = $M_{ij}$

<table>
<thead>
<tr>
<th>Explanatory Variable</th>
<th>Estimated Coefficient</th>
<th>Standard Error</th>
</tr>
</thead>
<tbody>
<tr>
<td>$Y_i$</td>
<td>1.054*</td>
<td>.076</td>
</tr>
<tr>
<td>$Y_j$</td>
<td>.413*</td>
<td>.053</td>
</tr>
<tr>
<td>$N_i$</td>
<td>-.258*</td>
<td>.070</td>
</tr>
<tr>
<td>$N_j$</td>
<td>.016</td>
<td>.057</td>
</tr>
<tr>
<td>$BCA_{ij}$</td>
<td>.936*</td>
<td>.202</td>
</tr>
<tr>
<td>$ATA_{ij}$</td>
<td>1.390*</td>
<td>.193</td>
</tr>
<tr>
<td>$D_{ij}$</td>
<td>-.430*</td>
<td>.053</td>
</tr>
<tr>
<td>Intercept</td>
<td>4.251*</td>
<td>.800</td>
</tr>
</tbody>
</table>

$R^2 = .371$

$F(7, 809) = 68.02$

$n = 817$

*Significantly different from zero at the 5 percent level using a two-tailed test.
trade among the participants in this type of agreement, one might ex-
pect that ATAs would have a relatively larger impact upon bilateral
trade flows than would BCAs. This contention is supported by the
estimation of equations (4.6) and (4.7). However, one should note
that participants in ATAs were primarily members of the EPU and that
the EPU consisted primarily of West European countries. Consequently,
the estimated coefficient of ATAJ might also be capturing some de-
velopmental, cultural, or demand similarities that might have existed
among these countries. Even with this reservation, the respecifica-
tion of the model (represented by equations (4.6) and (4.7)) enables
us to gain additional insight into the effects of bilateralism upon
bilateral trade flows.

Because of the autarkic tendencies of CPEs and the commodity in-
convertibility present in their economies, it is likely that trade
between a CPE and a MTE is less than that between two MTEs ceteris
paribus. (Hewett has demonstrated this in a study analyzing 1970
trade flows.) In order to test the above hypothesis for our sample,
DCPE (defined above) is added to equations (4.6) and (4.7). Tables
18 and 19 contain the results of the estimation of these augmented
equations again using a sample composed of only exchange control
countries. Except for the coefficient of Nj all coefficient estimates
are statistically significant at least at the 10 percent level and
have the expected sign. In particular, exports from a MTE to a CPE
are 36 percent of those from a MTE to another MTE ceteris paribus.
Imports by a MTE from a CPE are 39 percent of those by a MTE from
**TABLE 18**

Estimation of Augmented Equation (4.6) for Inter-Exchange-Control-Country Trade

Dependent Variable = $X_{ij}$

<table>
<thead>
<tr>
<th>Explanatory Variable</th>
<th>Estimated Coefficient</th>
<th>Standard Error</th>
</tr>
</thead>
<tbody>
<tr>
<td>$Y_i$</td>
<td>1.320*</td>
<td>.071</td>
</tr>
<tr>
<td>$Y_j$</td>
<td>.385*</td>
<td>.050</td>
</tr>
<tr>
<td>$N_i$</td>
<td>-.377*</td>
<td>.066</td>
</tr>
<tr>
<td>$N_j$</td>
<td>.017</td>
<td>.053</td>
</tr>
<tr>
<td>$BCA_{ij}$</td>
<td>.371**</td>
<td>.219</td>
</tr>
<tr>
<td>$ATA_{ij}$</td>
<td>.414**</td>
<td>.222</td>
</tr>
<tr>
<td>$D_{ij}$</td>
<td>-.615*</td>
<td>.052</td>
</tr>
<tr>
<td>DGPE</td>
<td>-1.461*</td>
<td>.288</td>
</tr>
<tr>
<td>Intercept</td>
<td>6.739*</td>
<td>.779</td>
</tr>
</tbody>
</table>

$R^2 = .454$

$F(8, 808) = 83.90$

$n = 817$

*Significantly different from zero at the 5 percent level using a two-tailed test.

**Significantly different from zero at the 10 percent level using a two-tailed test.
TABLE 19

Estimation of Augmented Equation (4.7) for Inter-Exchange-Control-Country Trade

Dependent Variable = \( M_{ij} \)

<table>
<thead>
<tr>
<th>Explanatory Variable</th>
<th>Estimated Coefficient</th>
<th>Standard Error</th>
</tr>
</thead>
<tbody>
<tr>
<td>( Y_i )</td>
<td>1.109*</td>
<td>.079</td>
</tr>
<tr>
<td>( Y_j )</td>
<td>.501*</td>
<td>.055</td>
</tr>
<tr>
<td>( N_i )</td>
<td>-.256*</td>
<td>.074</td>
</tr>
<tr>
<td>( N_j )</td>
<td>-.011</td>
<td>.059</td>
</tr>
<tr>
<td>( BCA_{ij} )</td>
<td>.534*</td>
<td>.243</td>
</tr>
<tr>
<td>( ATA_{ij} )</td>
<td>.811*</td>
<td>.247</td>
</tr>
<tr>
<td>( D_{ij} )</td>
<td>-.568*</td>
<td>.058</td>
</tr>
<tr>
<td>DCPE</td>
<td>-1.364*</td>
<td>.321</td>
</tr>
<tr>
<td>Intercept</td>
<td>5.499*</td>
<td>.866</td>
</tr>
</tbody>
</table>

\( R^2 = .389 \)

\( F(8, 808) = 64.15 \)

\( n = 817 \)

*Significantly different from zero at the 5 percent level using a two-tailed test.
another MTE *ceteris paribus*. Consequently, it appears that Hewett's results are also confirmed in this sample.

As was stated above, it is not clear conceptually what the impact of bilateralism upon bilateral trade flows is when a sample composed of both hard and soft currency countries is analyzed. This is essentially an empirical question. In order to see this impact, augmented versions of equations (4.6) and (4.7) are estimated for the full sample. Tables 20 and 21 contain the results of these estimations. (The binary variable DUSA is included because, as mentioned above, trade with the U.S. during this time period was especially important for most of the countries in the sample.) Except for the coefficient of $N_j$, all coefficient estimates are statistically significant at the 5 percent level. The estimated coefficient of DUSA is positive, confirming the contention that the U.S. was a special and disproportionately large trading partner. The estimated coefficient of DCPE is negative reflecting the fact that, in general, both hard and soft currency countries prefer trading with other MTEs over trading with CPEs *ceteris paribus*. Of primary interest are the signs of the coefficient estimates of $BCA_{ij}$ and $ATA_{ij}$. In each equation, the signs of both variables are positive. This indicates that an exchange control country's trade with a partner in a bilateral payments agreement was larger *ceteris paribus* than its trade with a partner with which it had no agreement. The latter set includes hard currency countries. That is, the existence of a bilateral payments agreement promoted additional trade between participants even when compared to their trade with hard currency trading partners.
TABLE 20

Estimation of Augmented Equation (4.6)
for the Entire Sample

Dependent Variable = $x_{ij}$

<table>
<thead>
<tr>
<th>Explanatory Variable</th>
<th>Estimated Coefficient</th>
<th>Standard Error</th>
</tr>
</thead>
<tbody>
<tr>
<td>$y_i$</td>
<td>1.293*</td>
<td>.057</td>
</tr>
<tr>
<td>$y_j$</td>
<td>.388*</td>
<td>.046</td>
</tr>
<tr>
<td>$N_i$</td>
<td>-.361*</td>
<td>.061</td>
</tr>
<tr>
<td>$N_j$</td>
<td>.016</td>
<td>.050</td>
</tr>
<tr>
<td>BCA$_{ij}$</td>
<td>.730*</td>
<td>.185</td>
</tr>
<tr>
<td>ATA$_{ij}$</td>
<td>.775*</td>
<td>.191</td>
</tr>
<tr>
<td>$D_{ij}$</td>
<td>-.648*</td>
<td>.052</td>
</tr>
<tr>
<td>DCPE</td>
<td>-1.127*</td>
<td>.268</td>
</tr>
<tr>
<td>DUSA</td>
<td>2.808*</td>
<td>.502</td>
</tr>
<tr>
<td>Intercept</td>
<td>6.656*</td>
<td>.734</td>
</tr>
</tbody>
</table>

$R^2 = .504$

$F(9, 1006) = 113.33$

$n = 1016$

*Significantly different from zero at the 5 percent level using a two-tailed test.
TABLE 21

Estimation of Augmented Equation (4.7) for the Entire Sample

Dependent Variable = $M_{ij}$

<table>
<thead>
<tr>
<th>Explanatory Variable</th>
<th>Estimated Coefficient</th>
<th>Standard Error</th>
</tr>
</thead>
<tbody>
<tr>
<td>$Y_i$</td>
<td>1.041*</td>
<td>.058</td>
</tr>
<tr>
<td>$Y_j$</td>
<td>.466*</td>
<td>.047</td>
</tr>
<tr>
<td>$N_i$</td>
<td>-.216*</td>
<td>.062</td>
</tr>
<tr>
<td>$N_j$</td>
<td>-.006</td>
<td>.052</td>
</tr>
<tr>
<td>$BCA_{ij}$</td>
<td>.581*</td>
<td>.189</td>
</tr>
<tr>
<td>$ATA_{ij}$</td>
<td>1.004*</td>
<td>.196</td>
</tr>
<tr>
<td>$D_{ij}$</td>
<td>-.516*</td>
<td>.053</td>
</tr>
<tr>
<td>DCPE</td>
<td>-1.126*</td>
<td>.275</td>
</tr>
<tr>
<td>DUSA</td>
<td>2.824*</td>
<td>.516</td>
</tr>
<tr>
<td>Intercept</td>
<td>4.883*</td>
<td>.753</td>
</tr>
</tbody>
</table>

$R^2 = .446$

$F(9, 1006) = 89.91$

$n = 1016$

*Significantly different from zero at the 5 percent level using a two-tailed test.
Finally, the coefficient estimate of $N_j$ has characteristically been statistically insignificant in this analysis. It has been argued that the heterogeneity of the country j's is the primary reason for this. In order to insure equal degrees of homogeneity in both the country i's and the country j's, equations (4.6) and (4.7) are estimated using only the bilateral trade flows between the twenty-three exchange control countries in the sample; i.e., all of the original sample except the U.S., Canada, and Mexico. In other words, the set of country i's and the set of country j's are identical. This sample consists of 442 of the possible 506 intra-sample bilateral trade flows. (The remainder are not large enough to be considered as trade between principal trading partners.) Tables 22 and 23 contain the results of estimating equations (4.6) and (4.7) for this sample. All coefficient estimates are statistically significant at the 5 percent level and all have the expected sign. The explanatory power of each equation is larger than it was when a larger, more heterogeneous sample was used. Specifically, the coefficient estimate of $N_j$ is negative and statistically significant in each equation. Consequently, it appears that when a more consistently homogeneous sample is used, population behaves as a reasonable proxy variable for the size of the foreign sector.

Bilateralism and Reserve Demand

Since bilateralism enables trade to occur, in general, without the necessary use of foreign exchange, an exchange control country's demand for international reserves for transaction purposes should be
TABLE 22

Estimation of Equation (4.6) for Intra-Sample Trade

Dependent Variable = $X_{ij}$

<table>
<thead>
<tr>
<th>Explanatory Variable</th>
<th>Estimated Coefficient</th>
<th>Standard Error</th>
</tr>
</thead>
<tbody>
<tr>
<td>$Y_i$</td>
<td>1.274*</td>
<td>0.082</td>
</tr>
<tr>
<td>$Y_j$</td>
<td>0.815*</td>
<td>0.084</td>
</tr>
<tr>
<td>$N_i$</td>
<td>-.423*</td>
<td>0.077</td>
</tr>
<tr>
<td>$N_j$</td>
<td>-.247*</td>
<td>0.074</td>
</tr>
<tr>
<td>$BCA_{ij}$</td>
<td>1.200*</td>
<td>0.284</td>
</tr>
<tr>
<td>$ATA_{ij}$</td>
<td>1.172*</td>
<td>0.308</td>
</tr>
<tr>
<td>$D_{ij}$</td>
<td>-.554*</td>
<td>0.068</td>
</tr>
<tr>
<td>Intercept</td>
<td>8.065*</td>
<td>0.922</td>
</tr>
</tbody>
</table>

$R^2 = .572$

$F(7, 434) = 82.86$

$n = 442$

*Significantly different from zero at the 5 percent level using a two-tailed test.
### TABLE 23

Estimation of Equation (4.7) for Intra-Sample Trade

Dependent Variable = $M_{ij}$

<table>
<thead>
<tr>
<th>Explanatory Variable</th>
<th>Estimated Coefficient</th>
<th>Standard Error</th>
</tr>
</thead>
<tbody>
<tr>
<td>$Y_i$</td>
<td>.930*</td>
<td>.077</td>
</tr>
<tr>
<td>$Y_j$</td>
<td>1.191*</td>
<td>.078</td>
</tr>
<tr>
<td>$N_i$</td>
<td>-.232*</td>
<td>.072</td>
</tr>
<tr>
<td>$N_j$</td>
<td>-.529*</td>
<td>.069</td>
</tr>
<tr>
<td>$BCA_{ij}$</td>
<td>.534*</td>
<td>.266</td>
</tr>
<tr>
<td>$ATA_{ij}$</td>
<td>.580*</td>
<td>.288</td>
</tr>
<tr>
<td>$D_{ij}$</td>
<td>-.505*</td>
<td>.063</td>
</tr>
<tr>
<td>Intercept</td>
<td>8.986*</td>
<td>.862</td>
</tr>
</tbody>
</table>

$R^2 = .564$

$F(7, 434) = 80.02$

$n = 442$

*Significantly different from zero at the 5 percent level using a two-tailed test.*
dependent on the extent of its use of bilateralism. In particular, the larger the percentage of a country's trade that it conducts with partners in bilateral agreements, the smaller should be its transactions demand for international reserves *ceteris paribus*. This hypothesis is tested by estimating the following equation:

$$(4.8) \quad R_i' = d_0 + d_1 M_i' + d_2 W_{Bi} + u_i$$

where

- $R_i'$ is the foreign exchange holdings of commercial banks in country $i$ measured in millions of U.S. $\$
- $M_i'$ is the aggregate value of country $i$'s imports measured in millions of U.S. $\$
- $W_{Bi}$ is the weighted average of the number of bilateral agreements that country $i$ has entered with all of its trading partners (trade with each partner as a percentage of total trade used as weight), and all other variables are defined above.\(^{19}\) Table 24 contains the OLS coefficient estimates, their standard errors, the coefficient of determination, and the F-statistic for testing the significance of the regression for equation (4.8) using only the exchange control countries in the sample whose combined commercial banks reported foreign currency holdings. Obviously, including hard currency countries would greatly distort the analysis since these countries did not experience the same balance of payments problems as did those countries that resorted to the use of exchange control. The signs of the coefficient estimates are those expected, although the estimated coefficient of $W_{Bi}$ is not statistically significant at the 5 percent level. One possible reason for this is that the dependent variable ($R_i'$) specified in equation (4.8) actually understates the amount of foreign
TABLE 24

Estimation of Equation (4.8)
Dependent Variable = $R_i$

<table>
<thead>
<tr>
<th>Explanatory Variable</th>
<th>Estimated Coefficient</th>
<th>Standard Error</th>
</tr>
</thead>
<tbody>
<tr>
<td>$M_i$</td>
<td>.932*</td>
<td>.269</td>
</tr>
<tr>
<td>$WB_i$</td>
<td>-.370</td>
<td>.243</td>
</tr>
<tr>
<td>Intercept</td>
<td>-3.264</td>
<td>1.760</td>
</tr>
</tbody>
</table>

$R^2 = .362$

$F(2, 32) = 9.08$

$n = 35$

*Significantly different from zero at the 5 percent level using a two-tailed test.
currencies available for conducting international transactions that is held by exchange control countries. Foreign currencies are typically held for two reasons—precautionary and transaction purposes. Usually, the central bank holds stocks of international currencies for precautionary reasons in order to support its currency during period of temporary balance of payments deficits; its stock of foreign currencies held to finance international transactions is insignificant. On the other hand, commercial banks do not hold international reserves for precautionary reasons; all of their foreign currency holdings are for the financing of international transactions. As a result, commercial banks' foreign currency holdings are those typically used in an analysis of the transactions demand for international reserves. However, since most foreign exchange earned by exporters in an exchange control country must be surrendered to the central monetary authority, the central bank holds foreign exchange for both precautionary and transactions' purposes. (As a part of the exchange control procedure, the central bank rations this surrendered foreign exchange to importers.) Consequently, part of the central bank's holdings of foreign exchange should be added to the holdings of commercial banks in order to measure more accurately the amount of foreign currency available in exchange control countries to finance international transactions. There is no way to ascertain what percentage of central bank reserve holdings is for transaction purposes. Since low precautionary stocks is a primary motivating factor for the imposition of exchange control, I assumed that the level of reserves held by central banks for precautionary reasons in exchange control
countries is insignificant and simply add the central bank's foreign exchange holdings to those of the commercial banks to create a new dependent variable \(SR_1\). This variable should be a more accurate measure of the foreign exchange holdings of an exchange control country for financing international transactions.

Table 25 contains the OLS results of estimating equation (4.8) with \(SR_1\) substituted for \(R_1\) as the dependent variable. The signs of the coefficient estimates are those expected, and all are statistically significant at the 5 percent level. Also, the explanatory power of equation (4.8) with \(SR_1\) as the dependent variable is much greater than when \(R_1\) is used as the dependent variable. This suggests that the sum of commercial banks' and the central bank's foreign currency holdings is a better measure of reserves available to finance international transactions for exchange control countries than are the holdings of commercial banks alone. The estimated coefficient of importance is that of \(WB_1\): it states that a 1 percent increase in the proportion of a country's trade conducted with partners in bilateral agreement leads to a .25 percent decrease in the amount of international reserves demanded for transactions purposes. That is, more extensive use of bilateralism does enable a given stock of international reserves to finance a larger value of international transactions.\(^{20}\)

Furthermore, by combining work by Baumol, Baltensperger, and Patinkin, Officer has hypothesized that the transactions elasticity of demand for reserves should be between 0.5 and one.\(^{21}\) In particular, Baumol's work was an inventory-theoretic approach to the transactions demand for cash balances. When he minimized the cost of holding cash
**TABLE 25**  
Estimation of Equation (4.8)  
Dependent Variable = SR_1

<table>
<thead>
<tr>
<th>Explanatory Variable</th>
<th>Estimated Coefficient</th>
<th>Standard Error</th>
</tr>
</thead>
<tbody>
<tr>
<td>M_i</td>
<td>.878*</td>
<td>.126</td>
</tr>
<tr>
<td>WB_i</td>
<td>-.248*</td>
<td>.114</td>
</tr>
<tr>
<td>Intercept</td>
<td>-.913</td>
<td>.823</td>
</tr>
</tbody>
</table>

R^2 = .671  
F(2, 32) = 32.64  
n = 35

*Significantly different from zero at the 5 percent level using a two-tailed test.
balances, he found that the elasticity of demand for cash balances with respect to the number of transactions (with the size of each transaction held constant) is 0.5. Baltensperger and Patinkin have shown that, if the number of transactions is held constant, the elasticity of demand for cash balances with respect to the size of the transaction is one. Consequently, since aggregate data include changes in both the size and the number of transactions, Officer hypothesized that the transactions' elasticity of aggregate demand for reserves should be between 0.5 and one. The value of the estimated coefficient of $M_i$ (the proxy variable for the number and size of transactions) supports this hypothesis.

One of the factors that motivates a country to impose exchange control (and subsequently to enter into bilateral agreements with some of its trading partners) is a shortage of international reserves. Consequently, $WB_i$ in equation (4.8) may not be exogenous, but rather endogenous. The result of not treating $WB_i$ as an endogenous variable is that the coefficient estimates will be biased and inconsistent. In order to correct this situation, the model must be expanded to explain $WB_i$ as well as $SR_i$. Identifying the determinants of $WB_i$ can be rather involved. Essentially, the important question to ask is: what causes an exchange control country to negotiate an agreement with some trading partners and not with others? Approaching this problem at this level of analysis is outside the focus of this study. Alternatively, the issue can be approached in a more aggregated manner. There are two primary forces which motivate a country to negotiate bilateral agreements with particular trading partners. The first is a shortage of international reserves; this is a general explanatory
variable which totally overlooks the question of with which partners are agreements negotiated. The second motivating factor is the fact that each country has a set of "natural" trading partners. This natural set may be determined by geographical proximity, cultural similarities, political union, etc. (In this study, we are not concerned with how this natural set of trading partners is determined, but simply that it exists.) If many of the countries comprising a country's natural set of trading partners impose exchange control, this country is more likely to enter into relatively more bilateral agreements than is a country whose natural trading partners do not impose exchange control.

This model is expressed more formally as follows:

\[(4.9)\] \[SR_{it} = \alpha_0 + \alpha_1 M_{it} + \alpha_2 WB_{it} + \epsilon_i\]

\[(4.10)\] \[WB_{it} = \beta_0 + \beta_1 ROF_{it} + \beta_2 ROF_{it-1} + \beta_3 ROF_{it-2} + \ldots + \beta_{k+1} ROF_{it-k} + \beta_{k+2} NT_{i,1938} + \epsilon_i\]

where
- \(SR_{it}\) \(\equiv\) the sum of the foreign exchange holdings of commercial banks and the central bank of country \(i\) in time period \(t\) measured in millions of U.S. 
- \(M_{it}\) \(\equiv\) the aggregate value of \(i\)'s imports in time period \(t\) measured in millions of U.S. 
- \(WB_{it}\) \(\equiv\) the weighted average of the number of bilateral agreements that \(i\) has entered with all of its trading partners in time period \(t\)
- \(ROF_{it}\) \(\equiv\) the foreign exchange holdings of \(i\)'s central bank in time period \(t\) measured in millions of U.S. 
- \(NT_{i,1938}\) \(\equiv\) the percentage of \(i\)'s total trade in 1938 conducted with partners that imposed exchange control after World War II.
and all other variables are defined above. The lag structure is employed because it is more likely that the level of the central bank's foreign exchange holdings for several preceding years would affect the extent of the use of bilateralism this year. (Note that no simultaneity exists and OLS has the desired properties if the lag structure in equation (4.10) does not contain ROF\textsubscript{it}). The variable NT\textsubscript{i,1938} represents the effect of the existence of natural trading partners on the use of bilateralism. In particular, the larger NT\textsubscript{i,1938}, the larger should be a country's use of bilateralism. The reason for this is that an increase in NT\textsubscript{i,1938} indicates that relatively more of this country's natural trading partners have imposed exchange control. Consequently, the least costly way of maintaining its trade with these partners is to enter into bilateral agreements with them. The year 1938 is chosen because it is widely believed that 1938 was the latest pre-World War II year during which international trade was "normal."\textsuperscript{22}

Table 26 contains the two stage least squares (2SLS) estimates and the asymptotic standards errors of the coefficients in equation (4.9). The results are not substantially different from those contained in Table 25. More extensive use of bilateralism still has a negative impact on the transactions demand for international reserves. Also, the estimated transactions elasticity is .820, which again supports the Baumol-Baltensperger-Patinkin hypothesis.

The final step in this analysis is to investigate how changes in an exchange control country's stock of international reserves affect its trade with hard currency partners. This investigation is carried
TABLE 26

Estimation of Equation (4.9)

Dependent Variable = SR_t

<table>
<thead>
<tr>
<th>Explanatory Variable</th>
<th>Estimated Coefficient</th>
<th>Standard Error</th>
</tr>
</thead>
<tbody>
<tr>
<td>M_it</td>
<td>.820*</td>
<td>.131</td>
</tr>
<tr>
<td>WB_it</td>
<td>-.357*</td>
<td>.164</td>
</tr>
<tr>
<td>Intercept</td>
<td>-.705</td>
<td>.827</td>
</tr>
</tbody>
</table>

n = 35

*Significantly different from zero at the 5 percent level using a two-tailed test.
out by estimating the following equation only for trade between hard
and soft currency countries:

\[(4.11) \quad M_{i,HC,t}^{'} = \alpha_0 + \alpha_1 Y_{it}^{'} + \alpha_2 Y_{HC,t}^{'} + \alpha_3 D_{i,HC}^{'}
+ \alpha_4 SR_{it-1}^{'} + u_i\]

where \(M_{i,HC,t}^{'}\) = the imports of soft currency country \(i\) from a
hard currency partner in time period \(t\) measured
in millions of U.S. $.

and all other variables are defined above. One would expect that an
increase in a soft currency country's stock of international reserves
would enable it to increase its trade with hard currency partners.

Table 27 contains the results of estimating equation (4.11). Of par­
ticular interest is the fact that the estimated coefficient of \(SR_{it-1}^{'}\)
is positive and statistically significant as hypothesized.
TABLE 27
Estimation of Equation (4.11)
Dependent Variable = $M_{1,HC,t}$

<table>
<thead>
<tr>
<th>Explanatory Variable</th>
<th>Estimated Coefficient</th>
<th>Standard Error</th>
</tr>
</thead>
<tbody>
<tr>
<td>$Y_{it}$</td>
<td>.777*</td>
<td>.200</td>
</tr>
<tr>
<td>$Y_{1,HC,t}$</td>
<td>.786*</td>
<td>.060</td>
</tr>
<tr>
<td>$D_{1,HC}$</td>
<td>-.205</td>
<td>.566</td>
</tr>
<tr>
<td>$SR_{it-1}$</td>
<td>.524*</td>
<td>.237</td>
</tr>
<tr>
<td>Intercept</td>
<td>-2.882</td>
<td>5.226</td>
</tr>
</tbody>
</table>

$R^2 = .698$

$F(4, 95) = 54.779$

$n = 100$

*Significantly different from zero at the 5 percent level using a two-tailed test.
NOTES TO CHAPTER IV

1Principal trading partners are those defined by the United States in its Yearbook of International Trade Statistics, 1955. In particular, if either exports to or imports from a country are greater than 0.5 of the unit of measure (usually millions of currency units), then this country is considered a principal trading partner.


4The model has also been estimated in linear form. This specification had substantially less explanatory power than did the log-linear form.

5Appendix B contains a comparison of alternative proxy variables of the size of the foreign sector.

6These countries' currencies were usually pegged to the U.S. dollar which was the major convertible currency during this time period.

7That is, all bilateral trade flows between a soft currency country and a hard currency country or those between two hard currency countries are excluded from the sample. The result is a sample containing 817 bilateral trade flows between soft currency countries.

8It is not clear why the results in Table 10 do not support the hypothesis that distance is a scale variable. This is especially confusing when the pairwise correlations between $D_{ij}$ and $X_{ij}$, $X_{ji}$, and $(X_{ij} + X_{ji})$ respectively are investigated. In particular, these correlations are all negative and statistically significant indicating that distance does represent a scale effect.
Equation (4.2) is not estimated for Canada and the United States since neither had entered into a bilateral agreement with any of its trading partners. Consequently, the coefficient of $B_{ij}$ is assigned a value of zero to be used in subsequent analysis. Also, the explanatory variable $EM_{ij}$ is omitted from equation (4.2) when it is estimated for country i's that were not members of EPU.

The F-test based on $R^2$ is used to test the significance of the regression for each equation.

I do not have any explanation for the estimated values of $\alpha_2$ in Table 11. Obviously each country's estimated $\alpha_2$ reflects how its trade has reacted to bilateralism. To rationalize the pattern of the estimates obtained one would have to perform a less aggregated analysis than the one performed in this study in order to ascertain the effect of bilateralism on an individual country's trade. The larger than traditional level of significance was chosen because the estimation of the coefficient of $B_{ij}$ in equation (4.2) for each country individually was substantially less accurate (and consequently, test statistics were smaller) than when the entire sample was used in toto. This larger level of significance helps to support the power of the test given the higher degree of inaccuracy in estimation.

As $N_i$ rises with $Y_i$ remaining constant, per capita income ($Y_i/N_i$) falls. Consequently, an alternative interpretation of the negative estimated coefficient of $N_i$ in equation (4.3) is that relatively poorer countries have less ability to buy everything including imports. To investigate this possibility further the following equations were estimated:

\[
\begin{align*}
(4.3a) \quad \frac{M_i}{Y_i} & = 0.2075 - 0.006N_i - 0.0734 \text{EXC}_i \\
& \quad (9.97) \quad (2.71) \quad (2.21) \\
(4.3b) \quad \ln \left[ \frac{M_i}{Y_i} \right] & = -0.826 - 0.357 \ln N_i - 0.297 \text{EXC}_i \\
& \quad (3.51) \quad (4.92) \quad (1.65) \\
(4.3c) \quad \frac{M_i}{(Y_i/N_i)} & = 0.0043 - 0.008 \text{EXC}_i \\
& \quad (3.86) \quad (0.40) \\
(4.3d) \quad \ln \left[ \frac{M_i}{(Y_i/N_i)} \right] & = -5.849 - 0.147 \text{EXC}_i \\
& \quad (28.43) \quad (0.40)
\end{align*}
\]
(4.3e) \[ \ln M_i = -3.29 + 0.600 \ln \left( \frac{Y_i}{N_i} \right) - 0.432 \text{ EXCI} \]

(2.86) (3.37) (1.18)

where t-statistics are reported in parentheses. These results do tend to support the alternative interpretation. In particular, the average propensity to import declines when population decreases, and imports fall with per capita income ceteris paribus.

13 This statement assumes that the swing credit limit specified in the bilateral agreement has not been reached.

14 This collinearity problem is not as prevalent in the reciprocity analysis because bilateralism and membership in the EPU have substantially different effects on reciprocity, but extremely similar effects on bilateral trade flows. When equation (4.1) is respecified in the same way as equations (4.4) and (4.5) are, the estimated coefficients of \( B_{CA_{ij}} \) and \( A_{TA_{ij}} \) are -0.796 and 0.592 respectively. (Each is statistically significant at the 5 percent level.)

15 By construction \( B_{CA_{ij}} \) and \( A_{TA_{ij}} \) are mutually exclusive in the sense that both can never equal two simultaneously.

16 The difference between the estimated coefficients of \( B_{CA_{ij}} \) and \( A_{TA_{ij}} \) as reported in Table 16 is not statistically significant at the 5 percent level. However, the difference between these same coefficients as reported in Table 17 is statistically significant at the 5 percent level. This indicates that BCAs and ATAs had approximately the same effect on bilateral exports, but ATAs had a relatively larger trade-promotion effect on bilateral imports.


18 In all previous estimations the set of country j's was composed of all the country i's plus the additional principal trading partners of the country i's as determined by the United Nations.

19 Equation (4.8) was also estimated in linear form. The log-linear form was chosen because of its superior explanatory power.

20 It is not clear how this additional trade is distributed between hard currency and soft currency trading partners. Two possible hypotheses exist. First, the use of bilateralism may free some of this
country's hard currency reserves from financing trade with other soft currency partners. Consequently, bilateralism should motivate additional trade with hard currency partners. On the other hand, bilateralism could simply open up additional export and import markets with other soft currency partners and therefore, motivate additional trade with soft currency partners. I have not been able to differentiate these two hypotheses empirically.


22 Of course, it is impossible to define "normal." In some aspects, the year 1938 was not "normal" either. Several countries, especially Germany, were using bilateralism as an offensive policy instrument. Also, competitive devaluations and trade barriers had been employed frequently during this decade as an attempt to correct domestic depression and unacceptably high levels of unemployment.
CHAPTER V
SUMMARY AND CONCLUSION

This study has been an investigation, both conceptually and empirically, of the rationale behind bilateralism and how bilateralism affects reciprocity, bilateral trade flows, and the demand for international reserves. From the analysis contained in Chapter III it is obvious that bilateralism was a necessary part of international trade for the decade immediately after World War II. Many countries desired an instant insulator that would enable them to separate their attempts to solve their internal and external problems resulting primarily from the War. Exchange control was such an insulator. However, the imposition of exchange control was not without its costs. In particular, exchange control constrained the ability to import to each country's ability to export. Bilateralism provided a means by which countries that had imposed exchange control could lessen the constraints of exchange control. Specifically, bilateralism decreased the costs of intra-exchange-control-country trade by enabling these countries to conduct trade among themselves without the necessity of using hard currencies or of having to hold stocks of other soft currencies in order to finance these transactions. In this context, bilateralism was a type of "second best" alternative designed to alleviate some of the trade impediments created by the imposition of exchange control.
The above development was supported by the empirical analysis contained in Chapter IV. In particular, the marginal impact of exchange control on aggregate imports was found to be negative indicating that the imposition of exchange control did cause a contraction of imports. Second, the marginal impact of bilateralism upon bilateral trade flows was isolated by using a gravity model which explained the geographic distribution of trade flows. In analyzing the effect of bilateralism upon bilateral trade flows, two types of bilateral payments agreements were identified—bilateral clearing agreements (BCAs) and automatic transferability agreements (ATAs). The ATAs were relatively less restrictive than were the BCAs since the negotiation of an ATA between trading partners required that these countries be members of the European Payments Union (EPU), a bureaucracy developed to reallocate bilateral trade imbalances among its members. While the existence of either type of agreement had a positive influence upon bilateral trade ceteris paribus, ATAs had a relatively larger marginal impact than did BCAs. This was not unexpected since ATAs did not include the bilateral trade balancing clauses that BCAs did. Consequently, participants in ATAs had only to be concerned with their trade balance with respect to all members of the EPU, not with respect to each member individually. Third, the hypothesis that more extensive use of bilateralism enabled a given stock of international reserves to finance a relatively larger value of imports, ceteris paribus, could not be rejected. It is not clear, however, how this additional trade is distributed between hard and soft currency trading partners. The use of bilateralism could free a country's hard currency reserves from financing trade with soft
currency partners and therefore, enable this country to trade relatively more with hard currency partners. Alternatively, bilateralism may simply open up new markets or enlarge existing ones with soft currency partners. Also, since the highest-valued alternative use of an exchange control country's hard currency reserves was to finance trade with hard currency partners, one would expect that countries with relatively larger stocks of hard currency reserves would trade more with their hard currency partners ceteris paribus. This contention was also supported by the evidence contained in Chapter IV.

Bilateralism was not a costless policy instrument; its use imposed a type of welfare loss. In particular, when the gravity model was modified to explain reciprocity, the empirical analysis demonstrated that bilateralism caused trade to be relatively more reciprocal ceteris paribus. That is, even though bilateralism promoted additional trade, the distribution of this trade was altered resulting in a welfare loss similar to the trade-diversion effect of the formation of a customs union. The reason for this welfare loss was that bilateralism constrained the choices of its users to the set of countries with which bilateral agreements had been negotiated. In other words, bilateralism constrained and distorted the search for the highest-price export market and for the lowest-price import market. This result was robust when sub-samples were analyzed and when the model was expanded to explicitly reflect trade with CPEs and the United States. An interesting result obtained from the expanded model was that trade between a CPE and an MTE was relatively more reciprocal ceteris paribus than was trade between two MTEs that had entered into a bilateral agreement.
A second important result of the reciprocity analysis was that reciprocity indices were an inappropriate measure of the effect of bilateralism upon reciprocity. In all antecedent work some measure of reciprocity (called a reciprocity index) had been calculated. These indices were typically a weighted average of the absolute deviation of a country's bilateral trade with all of its trading partners. After these indices were calculated, the authors then attempted to casually relate their perception of the extent of each country's use of bilateralism to that country's measured degree of reciprocity. Their results rarely met their expectations primarily because they had failed to incorporate in their analysis the fact that variables other than bilateralism determine the degree of reciprocity present in a country's trade. The methodology developed in this study explicitly identified some of these other explanatory variables (including bilateralism) and consequently, isolated the marginal impact of bilateralism upon reciprocity. In other words, the reciprocity index was an inaccurate indicator of the effect of bilateralism upon reciprocity because it implicitly measured the total impact of all variables (including bilateralism) upon reciprocity while the method in this study identified the marginal effect of bilateralism (as well as that of other explanatory variables) alone upon reciprocity.

Finally, when interpreting the results of this study, it is imperative to remember the time period analyzed. The period studied was the decade immediately after World War II. This period was chosen primarily because of the extensive use of bilateralism by industrialized nations (mostly those of Western Europe) during this period.
Because of the specific characteristics of the types of bilateral agreements negotiated and the special economic environment resulting from World War II, the results of this study cannot be easily extrapolated to other time periods when types of agreements and the economic environment were substantially different from the post-World War II international economy. In particular, the 1930s was also a time period during which bilateralism was extensively used. However, the motivations for entering into bilateral agreements then were different when compared to those in the late 1940s and early 1950s. Bilateralism was a policy instrument in the 1930s used largely to help maintain a country's position in an international economy plagued by increased protectionism and competitive devaluation of currencies. Bilateralism accompanied by exchange control was not the rule as it was in the post-World War II international scene. Likewise, the bilateralism that may (or may not) be present in East-West trade is not directly comparable to that in the 1950s. The most striking dissimilarity is that very few explicit bilateral agreements exist between Eastern and Western nations. That is, this type of bilateralism is primarily implicit and consequently, cannot be measured and analyzed as readily as could bilateralism in the 1950s. This dissimilarity does not preclude the use of the method developed in this study, however. It simply means that the effect of bilateralism upon reciprocity and bilateral trade flows could not be differentiated from the effects of other omitted explanatory variables. Nevertheless, the caveat stated is that many motivations exist for bilateralism; this study has isolated on only one—
lessening the constraints of exchange control. Directly applying these results to bilateralism motivated by other factors would be inappropriate.¹
That the results of this study cannot be directly extended to other time periods does not imply that the method developed cannot be extended to analyzing the effects of bilateralism in other time periods. That is, the method presented here can be used to study the cases specified above. The warning concerns the extension of the results, not the applicability of the methodology.
APPENDIX A

AN ANALYSIS OF RECIPROCITY INDICES

In surveying the four reciprocity indices, at least three questions arise. First, how are these indices related? Second, what causes each index to attain its extreme values? Third, since reciprocity is a relative concept, do these indices rank countries differently according to the degree of reciprocity? This appendix attempts to answer these three questions.

There is a simple, exact relationship between the LN index and Pryor's index. Rewriting the LN index yields the following:

\[
T_{i}^{LN} = 100 \left[ \frac{\sum_{j} X_{ij} - M_{ij}}{X_{i.} + M_{i.}} - \frac{X_{i.} - M_{i.}}{X_{i.} + M_{i.}} \right]
\]

\[
X \left[ \frac{X_{i.} + M_{i.}}{X_{i.} + M_{i.} - |X_{i.} - M_{i.}|} \right]
\]

\[
= T_{i}^{P} \left[ \frac{X_{i.} + M_{i.}}{X_{i.} + M_{i.} - |X_{i.} - M_{i.}|} \right]
\]

\[-100 \left( \frac{|X_{i.} - M_{i.}|}{X_{i.} + M_{i.}} \right) \left( \frac{X_{i.} + M_{i.}}{X_{i.} + M_{i.} - |X_{i.} - M_{i.}|} \right) .
\]

136
Simplifying and defining \( \frac{X_{ij} - M_{ij}}{X_{ij} + M_{ij}} \) as \( k_i \), equation (A-1) can be rewritten as follows:

\[
(A-2) \quad T_i^{LN} = (T_i^P - 100 k_i) \left( \frac{1}{1 - k_i} \right).
\]

Rearranging and solving for Pryor's index yields:

\[
(A-3) \quad T_i^P = T_i^{LN} = k_i (100 - T_i^{LN}).
\]

Since \( 0 \leq k_i \leq 1 \) and \( 0 \leq T_i^{LN} \leq 100 \), the LN index must always be smaller than Pryor's index. Also, when overall trade is balanced (i.e., \( X_i = M_i \)) then \( k_i = 0 \) and \( T_i^P = T_i^{LN}. \)

No other exact relationships exist; however, Michaely's index can be written in a form that facilitates comparison with Pryor's index as follows:

\[
(A-4) \quad T_i^{MI} = \frac{100}{2} \left( 1 + \frac{M_i}{X_i} \right) \sum_{j} \frac{X_{ij} - M_{ij}}{X_{ij} + M_{ij}} + \frac{M_{ij}}{X_{ij} + M_{ij}} \left( 1 - \frac{X_{ij}}{M_{ij}} \right).
\]

The first term in the summation resembles Pryor's index. By inspecting equation (A-4), it can be concluded that Michaely's index tends to be less than Pryor's. Since this point is not obvious, a little explanation should make it clearer. If country \( i \) has an overall export surplus (i.e., \( X_i > M_i \)), then \( 1 - \frac{X_i}{M_i} < 0 \). Also, when country \( i \) experiences an export surplus, \( X_{ij} \) should, in general, be greater than \( M_{ij} \).
for more j's than $X_{ij} < M_{ij}$. Consequently, in general, the two terms in the summation have opposite signs. Alternatively, if $i$ has an overall surplus (i.e., $X_i < M_i$), then $(1 - \frac{X_i}{M_i}) > 0$. However, in this case, one expects that usually $X_{ij} < M_{ij}$ for more j's than $X_{ij} > M_{ij}$.

Consequently, the two terms in the summation again have opposite signs in general. Since in both of the cases enumerated above the two terms in the summation have opposite signs in general and since the first term resembles Pryor's index, Michaely's index tends to be smaller than Pryor's. If overall trade is balanced, Pryor's and Michaely's indices are equivalent. Overall trade balance means that $X_i = M_i$; when this occurs $(1 + \frac{M_i}{X_i}) = 2$ and $(1 - \frac{X_i}{M_i}) = 0$. Substituting these two evaluations into equation (A-4) yields:

\[(A-5) \quad T_{MI} = \frac{100}{2} \left( \sum_j \left| \frac{X_{ij} - M_{ij}}{X_i + M_i} + \frac{M_{ij}(0)}{X_i + M_i} \right| \right) \]

\[= 100 \sum_j \left| \frac{X_{ij} - M_{ij}}{X_i + M_i} \right| \]

\[= 100 \frac{\sum_j X_{ij} - M_{ij}}{X_i + M_i} \]

\[= T_i^P \]

Since Pryor's index and the LN index are equivalent when overall trade is balanced, it can be concluded that Michaely's index and the LN index are also equivalent when overall trade is balanced.
In a similar manner, Marer's index can be compared with Pryor's. First, by observing an intermediate step in the rewriting of Marer's index, one can explicitly see the inverse weight given to bilateral imports, a deficiency of Marer's index discussed in Chapter II.

\[(A-6) \quad T_{i}^{\text{MA}} = \frac{100}{N} \sum_{j} \left( \frac{X_{ij} - M_{ij}}{M_{ij}} \right) \frac{1}{M_{ij}}.\]

One additional transformation yields a form which can be compared with Pryor's index:

\[(A-7) \quad T_{i}^{\text{MA}} = \frac{X_{i.} + M_{i.}}{N} \left[ 100 \sum_{j} \frac{X_{ij} - M_{ij}}{X_{i.} + M_{i.}} \right].\]

Since Marer's index is unbounded from above and since the size effect of \(\frac{X_{i.} + M_{i.}}{N}\) is probably greater than the effect of \(\frac{1}{M_{ij}}\) summed over all trading partners, Marer's index is typically larger than Pryor's. Also, since Pryor's index is usually larger than both the LN and Michaely's indices, Marer's must be the largest of the four indices in general. Other than this, no explicit comparisons can be made among Marer's, Michaely's, and the LN indices.

Second, what causes each index to reach its extreme values? The lower bound for all four indices is zero. The upper bound for Michaely's, Pryor's and the LN indices is 100; Marer's index is unbounded from above (i.e., the largest attainable value is \(\infty\)). For Pryor's index to equal zero, its numerator \(\sum_{j} |X_{ij} - M_{ij}|\) must equal zero. Since \(X_{ij} \geq 0\) and \(M_{ij} \geq 0\ \forall j\), the only way that the numerator
can equal zero is if \( X_{ij} = M_{ij} \ \forall j \). That is, for Pryor's index to equal zero, all bilateral trade imbalances must equal zero. This is termed completely reciprocal trade. Alternatively, for Pryor's index to equal 100 the numerator and denominator must be equal.

That is:

\[
(A-8) \quad \sum_j |X_{ij} - M_{ij}| = X_i + M_i.
\]

Employing a property of the sum of absolute values, the left hand side of equation (A-8) can be rewritten as:

\[
(A-9) \quad \sum_j |X_{ij} - M_{ij}| \leq \sum_j |X_{ij}| + \sum_j |M_{ij}|
\]

\[
\leq X_i + M_i.
\]

The only way in which \( \sum_j |X_{ij} - M_{ij}| \) can equal \( X_i + M_i \) is if for every \( X_{ij} \neq 0 \), the corresponding \( M_{ij} = 0 \ \forall j \) and vice versa. This situation depicts complete irreciprocity; i.e., the set of countries to which \( i \) exports does not intersect the set of countries from which \( i \) imports. To summarize, Pryor's index attains its upper and lower bounds only when bilateral trade is completely irreciprocal and completely reciprocal respectively.

The LN index equals zero under two conditions. First, if overall trade is unbalanced, \( \sum_j |X_{ij} - M_{ij}| \) must equal \( |X_i - M_i| \). This will occur only if each bilateral imbalance is an export surplus or if each is an import surplus. Second, if overall trade is balanced, the LN index equals zero under the same condition that is necessary for Pryor's
index to equal zero; i.e., \( \sum_j |X_{ij} - M_{ij}| = 0 \). The LN index equals 100 when the numerator and denominator are equal; i.e., when:

\[
\sum_j |X_{ij} - M_{ij}| = |X_{i.} - M_{i.}| = X_{i.} + M_{i.} - |X_{i.} - M_{i.}|
\]

or equivalently:

\[
\sum_j |X_{ij} - M_{ij}| = X_{i.} + M_{i.}
\]

which is the same condition for Pryor's index to reach its upper bound.

Michaely's index equals zero if

\( \sum_j \frac{X_{ij}}{X_{i.}} - \frac{M_{ij}}{M_{i.}} \)

which implies that:

\[
\frac{X_{ij}}{X_{i.}} = \frac{M_{ij}}{M_{i.}} \quad \forall j
\]

since \( X_{ij} \) and \( M_{ij} \) are, in general, greater than zero. The typical condition for complete reciprocity is for bilateral trade to and from each trading partner to balance (i.e., \( X_{ij} = M_{ij} \quad \forall j \)). This condition for complete reciprocity is met by Michaely's index only if overall trade is balanced. Michaely's index will equal zero when overall trade is unbalanced if the condition represented by equation (A-12) is met. For Michaely's index to reach its upper bound of 100:

\[
\sum_j \left| \frac{X_{ij}}{X_{i.}} - \frac{M_{ij}}{M_{i.}} \right| = 2
\]

which can occur only if for every \( X_{ij} \neq 0 \), the corresponding \( M_{ij} = 0 \quad \forall j \) and vice versa. To summarize, Michaely's index attains its upper bound under the same condition as do Pryor's and the LN indices. When
overall trade is balanced, it also attains its lower bound under similar conditions to those for Pryor's and the LN indices. However, if overall trade is unbalanced Michaely's index denotes complete reciprocity differently; specifically, when the proportion of bilateral exports to total exports equals the proportion of bilateral imports to total imports for all bilateral trade flows.

Marer's index has the same lower bound (zero) as do the other three indices, but its upper bound is undefined. For it to equal zero:

\[(A-14) \sum_{j} \left| \frac{X_{ij}}{M_{ij}} - 1 \right| = 0\]

which implies that:

\[(A-15) \frac{X_{ij}}{M_{ij}} = 1 \quad \forall j\]

or

\[(A-16) \quad X_{ij} = M_{ij} \quad \forall j\]

which is the same condition that Pryor's index must meet and one of the conditions that Michaely's index and the LN index can meet to attain their lower bounds. When any \(M_{ij}\) equals zero, Marer's index become undefined. However, this occurrence has no direct relationship with the degree of reciprocity. In particular, it is conceivable that one \(M_{ij}\) could equal zero while all of the remaining bilateral trade flows balance. According to Marer's index, this trade would appear to be extremely irreciprocal, while in reality, it was not. Since an increase in the value of Marer's index does not necessarily indicate a relatively
higher level of irreciprocity, it appears to be less useful than the other indices.

Finally, since reciprocity is a relative concept and also since these reciprocity indices are interrelated, one must test whether or not these indices rank countries differently according to the degree of reciprocity present in their trade. Marer and Van Brabant did calculate several indices using the same data, but they never attempted to compare the rankings and also, they both used Michaely's incorrect formulation of the LN index. Consequently, no comparison of how each index ranks countries has been made. I am omitting Marer's index from my comparison for reasons discussed above. I calculated the LN and Pryor's indices for forty-three of the sixty-five countries that Michaely included in his study for the year 1954 using approximately the same data set as did Michaely. The forty-three countries included in this comparison are the U.S., Canada, the Latin American dollar countries, the Sterling Area, and the OEEC countries. I also calculated the absolute overall trade imbalance as a proportion of total trade. I ranked each index and the trade imbalance statistic in descending order and used the Spearman rank correlation coefficient to test the pairwise independence of each ranking. The results appear in Table 28. All of the indices rank the countries according to degree of reciprocity in approximately the same way. That is, the hypothesis of pairwise independence is rejected when comparing all three indices with each other. As mentioned in Chapter II, neither Michaely's nor Pryor's index incorporates the overall trade imbalance. As a result, both of these indices might be correlated with the absolute trade imbalance as a proportion of total
### TABLE 28
Spearman Rank Correlations

<table>
<thead>
<tr>
<th></th>
<th>$T_i^{LN}$</th>
<th>$T_i^{MI}$</th>
<th>$T_i^P$</th>
<th>$\frac{X_i^1 - M_i}{X_i^1 + M_i}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$T_i^{LN}$</td>
<td>1.000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$T_i^{MI}$</td>
<td>.766</td>
<td>1.000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$T_i^P$</td>
<td>.649</td>
<td>.877</td>
<td>1.000</td>
<td></td>
</tr>
<tr>
<td>$\frac{X_i^1 - M_i}{X_i^1 + M_i}$</td>
<td>-.241*</td>
<td>.234*</td>
<td>.469</td>
<td>1.000</td>
</tr>
</tbody>
</table>

*Not significantly different from zero at the 1 percent level using a two-tailed test.

Note: Tied observations were assigned the arithmetic mean of the relevant ranks.

trade. In other words, Michaely's and Pryor's indices could be biased upward simply because total trade is unbalanced. From the table one sees that Pryor's index is correlated with the overall trade imbalance while Michaely's is not. That is, part of the level of irreciprocity depicted by Pryor's index is actually due to overall trade imbalance, not bilateral trade imbalance. To conclude, it appears that there is no difference in the rankings of the three indices. Also, Pryor's index is biased by overall trade imbalances, while the other two are not.
APPENDIX B

AN INVESTIGATION OF POPULATION AS A PROXY VARIABLE
FOR THE SIZE OF THE FOREIGN SECTOR

The quality of the results obtained using population as a proxy variable for the degree of openness of an economy has been mixed. In particular, although the estimated coefficient of country i's population has almost always had the hypothesized sign and has been statistically significant, the estimated coefficient of country j's population has been statistically insignificant and at times has had the opposite sign from that hypothesized. It has been conjectured that this mixed quality has been due to a relatively homogeneous group of country i's and a relatively heterogeneous group of country j's. This conjecture was supported by the results reported in Tables 22 and 23. Nonetheless, an investigation of the appropriateness of population as a proxy variable for the size of the foreign sector is called for. This is the purpose of this appendix.

The rationale for the use of population as a proxy for the degree of openness is that countries with relatively larger populations have relatively larger and more diverse domestic markets. Consequently, they have less reason and desire to enter international markets than do countries with relatively smaller populations whose domestic markets are supposedly less diversified. Two questions are raised based on
this rationale. First, is population negatively related to the degree of openness of an economy? Second, is population positively related to the degree of diversification of an economy?

To answer the first question the ratio of country i's merchandise trade to its gross domestic product (\(TRGDP_i\)) is regressed on its population (\(POP_i\)) in both linear and log-linear functional forms for approximately 70 percent of the countries in the sample.\(^1\) The ratio of total merchandise trade to gross domestic product is a frequently used measure of the openness of an economy. The results are as follows:

\[
\begin{align*}
(B-1) \quad TRGDP_i &= .5552 - .0047 \, POP_i \\
&\quad (0.0014) \\
R^2 &= .20 \\
F(1, 47) &= 11.78 \\
n &= 49 \\
\end{align*}
\]

\[
\begin{align*}
(B-2) \quad \ln TRGDP_i &= -.2916 - .3915 \ln POP_i \\
&\quad (.0971) \\
R^2 &= .26 \\
F(1, 47) &= 16.26 \\
n &= 49 \\
\end{align*}
\]

where standard errors are reported in parentheses. Testing the hypothesis that the coefficient estimate of \(POP_i\) in equation (B-1) (or of \(\ln POP_i\) in equation (B-2)) is different from zero is equivalent to testing the hypothesis that the simple correlation of \(TRGDP_i\) and \(POP_i\) (or of \(\ln TRGDP_i\) and \(\ln POP_i\)) is different from zero. In other words, testing the above hypothesis is actually testing the hypothesis that population and the degree of openness of an economy are uncorrelated. As one can
see from the information contained in equations (B-1) and (B-2) this hypothesis must be rejected in each functional form estimated. That is, the negative correlation between openness and population is statistically significant (at the 5 percent level).

The presence of centrally planned economies (CPEs) in the sample could have biased the preceding results. Specifically, CPEs are typically less open to international trade than are similar market economies because of the unwanted uncertainty that participation in international markets adds to the planning process. In order to separate the correlation of openness and population from the correlation of openness and being a CPE, a binary variable reflecting CPEs is added to equations (B-1) and (B-2). The results are as follows:

\[(B-3) \quad TRGDP_i = 0.6121 - 0.0050 \, POP_i - 0.4944 \, CPE_i \]

\[
R^2 = 0.44 \\
F(2, 46) = 17.73 \\
n = 49
\]

\[(B-4) \quad \ln TRGDP_i = -0.1813 - 0.3266 \, \ln POP_i - 2.4681 \, CPE_i \]

\[
R^2 = 0.74 \\
F(2, 46) = 67.14 \\
n = 49
\]

where \( CPE_i = \begin{cases} 1 & \text{if country } i \text{ is a CPE} \\ 0 & \text{otherwise} \end{cases} \)

and standard errors are reported in parentheses. Again, the negative correlation between openness and population is statistically significant (at the 5 percent level).
The second question to investigate is does a relatively larger population imply a relatively more diversified economy? A measure of diversification is needed to answer this question. The Herfindahl Index (HI) is such a measure. It is defined as follows:

\[
H_I^i = \frac{\sum_{j=1}^{N} \left( \frac{X_{j}^i}{T^i} \right)^2}{N}
\]

where \( N \) is the number of productive sectors within an economy, \( X_{j}^i \) is the absolute size of productive sector \( j \) in country \( i \), and \( T^i \) is gross domestic product (GDP) of country \( i \).

The range of the HI is from \( \frac{1}{N} \) to one; the larger the calculated HI, the less diversified is the economy. The HI is calculated for the following sectoral breakdown of gross domestic product: (a) agriculture, (b) mining, (c) manufacturing, (d) construction, (e) electricity, gas, and water, (f) transportation and communication, (g) wholesale and retail trade, (h) banking, insurance, and real estate, (i) ownership of dwellings, (j) public administration, and (k) services. Then HI\( _i \) is regressed on POP\( _i \) and CPE\( _i \). (CPE\( _i \) is included because the domestic production of CPEs is not reported in as many sectoral breakdowns as it is for market economies. That is, CPE\( _i \) is included to partially correct the positive bias of the CPEs' HI resulting from fewer sectoral
breakdowns.) The results using both a linear and a log-linear functional form are as follows:

\[(B-6) \quad H_{1} = 0.1866 + 0.0004 \text{POP}_{1} + 0.1841 \text{CPE}_{1} \]
\[\quad (0.0003) \quad (0.0264)\]
\[R^2 = 0.52\]
\[F(2,46) = 24.96\]
\[n = 49\]

\[(B-7) \quad \ln H_{1} = -1.7761 + 0.0499 \ln \text{POP}_{1} + 0.6489 \text{CPE}_{1} \]
\[\quad (0.0248) \quad (0.1126)\]
\[R^2 = 0.47\]
\[F(2,46) = 20.30\]
\[n = 49\]

where standard errors are reported in parentheses. If, as hypothesized, larger populations imply relatively more diversified economies, then coefficient estimate of \(\text{POP}_{1}\) (or \(\ln \text{POP}_{1}\)) in equation (B-6) (or (B-7)) should be negative. However, both coefficient estimates are positive, although the estimated coefficient of \(\text{POP}_{1}\) in equation (B-6) is statistically insignificant (at the 5 percent level). Thus, the hypothesis that countries with relatively larger populations have relatively more diversified economies cannot be accepted.

Finally, the ultimate test of the acceptability of population as a proxy variable for openness must be made by substitution \(H_{1}\) and \(\text{TRGDP}_{1}\) for population in the gravity equation estimated in Chapter IV. The \(H_{1}\) can be calculated for only 70 percent of the sample countries since the remainder do not report sectoral breakdowns of their GDP. Consequently, to make this analysis consistent, the gravity equation in
the form estimates in Chapter IV must be estimated again using the sub-
sample. Tables 29 and 30 contains these results only for those exchange
control countries that reported sectoral breakdowns of their GDP.²
These results are very similar to those obtained when the entire sample
of exchange control countries was used. All of the coefficient esti-
mates except for that of $N_j$ (country j's population) have the expected
sign and are statistically significant. The coefficient estimate of $N_j$
has the expected sign in each equation but is not statistically sig-
nificant in either. It has been discussed above that trade with CPEs
might bias some of the estimated coefficients. In order to observe the
effect of trade with CPEs in this sub-sample, the gravity equation is
estimated again in its original form with the addition of DCPE. Tables
31 and 32 contain these results. There is little significant change;
the coefficient estimates of both $BCA_{ij}$ and $ATA_{ij}$ are smaller with the
inclusion of DCPE indicating that these estimates initially reflected
both the effect of bilateral agreements and the effect of trading with
CPEs on bilateral trade flows. There is no significant change in the
coefficient estimates of $N_i$ or $N_j$ in either equation. That is, the
absence of DCPE from the model did not appear to bias the estimated co-
efficients of $N_i$ and $N_j$.

The gravity equation must now be estimated substituting first TRGDP
and then HI for population in order to observe the relation between the
explanatory power of these variables and that of population. Tables
33 and 34 contain the results of estimating the gravity equation with
$TRGDP_i$ and $TRGDP_j$ substituted for $N_i$ and $N_j$ respectively. (DCPE is
also added because of the potential bias that may exist if it were
TABLE 29

Estimation of Gravity Equation for Exchange Control Countries Reporting Sectoral Breakdown of GDP

Dependent Variable = $X_{ij}$

<table>
<thead>
<tr>
<th>Explanatory Variable</th>
<th>Estimated Coefficient</th>
<th>Standard Error</th>
</tr>
</thead>
<tbody>
<tr>
<td>$Y_i$</td>
<td>1.225*</td>
<td>.079</td>
</tr>
<tr>
<td>$Y_j$</td>
<td>.517*</td>
<td>.071</td>
</tr>
<tr>
<td>$N_i$</td>
<td>-.320*</td>
<td>.076</td>
</tr>
<tr>
<td>$N_j$</td>
<td>-.118</td>
<td>.072</td>
</tr>
<tr>
<td>$BCA_{ij}$</td>
<td>1.222*</td>
<td>.215</td>
</tr>
<tr>
<td>$ATA_{ij}$</td>
<td>1.325*</td>
<td>.216</td>
</tr>
<tr>
<td>$D_{ij}$</td>
<td>-.491*</td>
<td>.062</td>
</tr>
<tr>
<td>Intercept</td>
<td>5.936*</td>
<td>.864</td>
</tr>
</tbody>
</table>

$R^2 = .471$

$F(7, 598) = 76.02$

$n = 606$

*Significantly different from zero at the 5 percent level using a two-tailed test.*
TABLE 30
Estimation of Gravity Equation for Exchange Control Countries Reporting Sectoral Breakdown of GDP

Dependent Variable = $M_{ij}$

<table>
<thead>
<tr>
<th>Explanatory Variable</th>
<th>Estimated Coefficient</th>
<th>Standard Error</th>
</tr>
</thead>
<tbody>
<tr>
<td>$Y_i$</td>
<td>.963*</td>
<td>.085</td>
</tr>
<tr>
<td>$Y_j$</td>
<td>.628*</td>
<td>.076</td>
</tr>
<tr>
<td>$N_i$</td>
<td>-.226*</td>
<td>.082</td>
</tr>
<tr>
<td>$N_j$</td>
<td>-.048</td>
<td>.077</td>
</tr>
<tr>
<td>$BCA_{ij}$</td>
<td>1.168*</td>
<td>.231</td>
</tr>
<tr>
<td>$ATA_{ij}$</td>
<td>1.398*</td>
<td>.232</td>
</tr>
<tr>
<td>$D_{ij}$</td>
<td>-.461*</td>
<td>.067</td>
</tr>
<tr>
<td>Intercept</td>
<td>4.459*</td>
<td>.930</td>
</tr>
</tbody>
</table>

$R^2 = .400$

$F(7, 598) = 56.98$

$n = 606$

*Significantly different from zero at the 5 percent level using a two-tailed test.
TABLE 31
Estimation of Gravity Equation plus DCPE for
Exchange Control Countries Reporting
Sectoral Breakdown of GDP
Dependent Variable = $X_{ij}$

<table>
<thead>
<tr>
<th>Explanatory Variable</th>
<th>Estimated Coefficient</th>
<th>Standard Error</th>
</tr>
</thead>
<tbody>
<tr>
<td>$Y_{i}$</td>
<td>1.255*</td>
<td>.078</td>
</tr>
<tr>
<td>$Y_{j}$</td>
<td>.554*</td>
<td>.070</td>
</tr>
<tr>
<td>$N_{i}$</td>
<td>-.329*</td>
<td>.075</td>
</tr>
<tr>
<td>$N_{j}$</td>
<td>-.123</td>
<td>.071</td>
</tr>
<tr>
<td>$BCA_{ij}$</td>
<td>.688*</td>
<td>.245</td>
</tr>
<tr>
<td>$ATA_{ij}$</td>
<td>.696*</td>
<td>.258</td>
</tr>
<tr>
<td>$D_{ij}$</td>
<td>-.571*</td>
<td>.064</td>
</tr>
<tr>
<td>DCPE</td>
<td>-1.454*</td>
<td>.339</td>
</tr>
<tr>
<td>Intercept</td>
<td>6.934*</td>
<td>.883</td>
</tr>
</tbody>
</table>

$R^2 = .487$

$F(8, 597) = 70.76$

$n = 606$

*Significantly different from zero at the 5 percent level using a two-tailed test.
TABLE 32

Estimation of Gravity Equation plus DCPE for Exchange Control Countries Reporting Sectoral Breakdown of GDP

Dependent Variable = $M_{ij}$

<table>
<thead>
<tr>
<th>Explanatory Variable</th>
<th>Estimated Coefficient</th>
<th>Standard Error</th>
</tr>
</thead>
<tbody>
<tr>
<td>$Y_i$</td>
<td>.996*</td>
<td>.084</td>
</tr>
<tr>
<td>$Y_j$</td>
<td>.668*</td>
<td>.076</td>
</tr>
<tr>
<td>$N_i$</td>
<td>-.236*</td>
<td>.081</td>
</tr>
<tr>
<td>$N_j$</td>
<td>-.054</td>
<td>.076</td>
</tr>
<tr>
<td>$BCA_{ij}$</td>
<td>.594*</td>
<td>.264</td>
</tr>
<tr>
<td>$ATA_{ij}$</td>
<td>.723*</td>
<td>.278</td>
</tr>
<tr>
<td>$D_{ij}$</td>
<td>-.548*</td>
<td>.069</td>
</tr>
<tr>
<td>DCPE</td>
<td>-1.562*</td>
<td>.364</td>
</tr>
<tr>
<td>Intercept</td>
<td>5.531*</td>
<td>.950</td>
</tr>
</tbody>
</table>

$R^2 = .418$

$F(8, 597) = 53.60$

$n = 606$

*Significantly different from zero at the 5 percent level using a two-tailed test.
TABLE 33

Estimation of Gravity Equation with TRGDP Substituted for Population for Exchange Control Countries Reporting Sectoral Breakdown of GDP

Dependent Variable = X_{ij}

<table>
<thead>
<tr>
<th>Explanatory Variable</th>
<th>Estimated Coefficient</th>
<th>Standard Error</th>
</tr>
</thead>
<tbody>
<tr>
<td>Y_{i}</td>
<td>1.154*</td>
<td>.053</td>
</tr>
<tr>
<td>Y_{j}</td>
<td>.662*</td>
<td>.052</td>
</tr>
<tr>
<td>TRGDP_{i}</td>
<td>.972*</td>
<td>.095</td>
</tr>
<tr>
<td>TRGDP_{j}</td>
<td>.603*</td>
<td>.077</td>
</tr>
<tr>
<td>BCA_{ij}</td>
<td>.751*</td>
<td>.228</td>
</tr>
<tr>
<td>ATA_{ij}</td>
<td>.037</td>
<td>.244</td>
</tr>
<tr>
<td>D_{ij}</td>
<td>-.580*</td>
<td>.055</td>
</tr>
<tr>
<td>DCPE</td>
<td>.310</td>
<td>.370</td>
</tr>
<tr>
<td>Intercept</td>
<td>4.526*</td>
<td>.471</td>
</tr>
</tbody>
</table>

R^2 = .574

F(8, 597) = 100.50

n = 606

*Significantly different from zero at the 5 percent level using a two-tailed test.
TABLE 34

Estimation of Gravity Equation with TRGDP Substituted for Population for Exchange Control Countries Reporting Sectoral Breakdown of GDP

Dependent Variable = $M_{ij}$

<table>
<thead>
<tr>
<th>Explanatory Variable</th>
<th>Estimated Coefficient</th>
<th>Standard Error</th>
</tr>
</thead>
<tbody>
<tr>
<td>$Y_i$</td>
<td>.917*</td>
<td>.059</td>
</tr>
<tr>
<td>$Y_j$</td>
<td>.803*</td>
<td>.058</td>
</tr>
<tr>
<td>TRGDP$_i$</td>
<td>.655*</td>
<td>.107</td>
</tr>
<tr>
<td>TRGDP$_j$</td>
<td>.573*</td>
<td>.086</td>
</tr>
<tr>
<td>BCA$_{ij}$</td>
<td>.568*</td>
<td>.256</td>
</tr>
<tr>
<td>ATA$_{ij}$</td>
<td>.147</td>
<td>.275</td>
</tr>
<tr>
<td>$D_{ij}$</td>
<td>-.543*</td>
<td>.067</td>
</tr>
<tr>
<td>DCPE</td>
<td>.065</td>
<td>.415</td>
</tr>
<tr>
<td>Intercept</td>
<td>4.124*</td>
<td>.529</td>
</tr>
</tbody>
</table>

$R^2 = .474$

$F(8, 597) = 67.12$

$n = 606$

*Significantly different from zero at the 5 percent level using a two-tailed test.
omitted. This is discussed above.) The majority of the coefficient estimates have the expected sign and are statistically significant. Of particular interest are the coefficient estimates of TRGDP$_i$ and TRGDP$_j$. As expected, both coefficient estimates are positive; that is, the more open either partner is, the larger the bilateral trade flow between them ceteris paribus. Also of interest is the fact that the coefficient estimates of ATA$_{ij}$ and DCPE are both statistically insignificant. (The coefficient of DCPE even has the opposite sign from that hypothesized.) I can think of no specific reason for this occurrence. However, this could be a ramification of the basic problem concerned with using TRGDP as an explanatory variable—simultaneous equation bias. In particular, since $X_{ij}$ (the bilateral trade flow from $i$ to $j$) is part of the calculation of TRGDP$_i$ and TRGDP$_j$, these explanatory variables each have an endogenous component. Consequently, using the technique of ordinary least squares (OLS) to estimate the gravity equation with TRGDP$_i$ and TRGDP$_j$ included as explanatory variables yields coefficient estimates that are biased (and also inconsistent). In order to understand the size and sign of the bias one would have to specify a model that included equations explaining TRGDP$_i$ and TRGDP$_j$. In this case the costs of such a project most likely exceed the expected benefits.

Finally, Tables 35 and 36 contain the results of estimating the gravity equation substituting HI$_i$ and HI$_j$ for $N_i$ and $N_j$ respectively. Again the majority of the coefficient estimates have the hypothesized sign and are statistically significant. However, the coefficient of DCPE is not statistically significant in either equation, and the
TABLE 35

Estimation of Gravity Equation with HI Substituted for Population for Exchange Control Countries Reporting Sectoral Breakdown of GDP

Dependent Variable = $X_{ij}$

<table>
<thead>
<tr>
<th>Explanatory Variable</th>
<th>Estimated Coefficient</th>
<th>Standard Error</th>
</tr>
</thead>
<tbody>
<tr>
<td>$Y_i$</td>
<td>1.003*</td>
<td>0.055</td>
</tr>
<tr>
<td>$Y_j$</td>
<td>0.498*</td>
<td>0.052</td>
</tr>
<tr>
<td>HI$_{i}$</td>
<td>-1.711*</td>
<td>0.326</td>
</tr>
<tr>
<td>HI$_j$</td>
<td>-0.986*</td>
<td>0.244</td>
</tr>
<tr>
<td>BCA$_{ij}$</td>
<td>0.488*</td>
<td>0.244</td>
</tr>
<tr>
<td>ATA$_{ij}$</td>
<td>0.594*</td>
<td>0.254</td>
</tr>
<tr>
<td>D$_{ij}$</td>
<td>-0.629*</td>
<td>0.059</td>
</tr>
<tr>
<td>DCPE</td>
<td>-0.609</td>
<td>0.386</td>
</tr>
<tr>
<td>Intercept</td>
<td>-0.763</td>
<td>0.849</td>
</tr>
</tbody>
</table>

$R^2 = .504$

$F(8, 597) = 75.79$

$n = 606$

*Significantly different from zero at the 5 percent level using a two-tailed test.
TABLE 36
Estimation of Gravity Equation with HI Substituted for Population for Exchange Control Countries Reporting Sectoral Breakdown of GDP
Dependent Variable = $M_{ij}$

<table>
<thead>
<tr>
<th>Explanatory Variable</th>
<th>Estimated Coefficient</th>
<th>Standard Error</th>
</tr>
</thead>
<tbody>
<tr>
<td>$Y_i$</td>
<td>0.814*</td>
<td>0.059</td>
</tr>
<tr>
<td>$Y_j$</td>
<td>0.661*</td>
<td>0.055</td>
</tr>
<tr>
<td>$HI_i$</td>
<td>-1.555*</td>
<td>0.349</td>
</tr>
<tr>
<td>$HI_j$</td>
<td>-1.153*</td>
<td>0.261</td>
</tr>
<tr>
<td>$BCA_{ij}$</td>
<td>0.390</td>
<td>0.261</td>
</tr>
<tr>
<td>$ATA_{ij}$</td>
<td>0.610*</td>
<td>0.271</td>
</tr>
<tr>
<td>$D_{ij}$</td>
<td>-0.576*</td>
<td>0.064</td>
</tr>
<tr>
<td>DCPE</td>
<td>-0.599</td>
<td>0.413</td>
</tr>
<tr>
<td>Intercept</td>
<td>-1.057</td>
<td>0.907</td>
</tr>
</tbody>
</table>

$R^2 = 0.455$

$F(8, 597) = 59.94$

$n = 606$

*Significantly different from zero at the 5 percent level using a two-tailed test.
coefficient of \( B_{ij} \) is also insignificant in the second equation. Surprisingly, the estimated coefficients of \( H_i \) and \( H_j \) are negative and statistically significant in each equation indicating that the more concentrated the economies of trading partners are, the smaller the bilateral trade flow between them. This result is somewhat counter-intuitive and a direct contradiction of the rationale behind using population as a proxy variable. However, this result could mean that as economies become more diversified, they more actively seek foreign markets for their production and hence, their foreign sectors are larger, not smaller as is usually hypothesized.

To summarize and conclude, it appears that population is an acceptable proxy variable for the size of the foreign sector (or degree of openness). However, the typical rationale given for this use is inappropriate. Specifically, the data do not support the hypothesis that the larger the population, the more diverse the economy, and consequently, the smaller the desire to engage in international trade. A more feasible rationalization is that small economies regardless of their degree of diversification cannot supply all of the demands of their domestic consumers; therefore, these consumers look to international markets to meet their excess demands. This alternative explanation is supported by the results of estimating the gravity equation using the three sets of proxy variables analyzed. Also, since the case of \( TRGDP \) presents simultaneity problems and the use of \( HI \) yields counter-intuitive results, it seems that population is the most suitable proxy variable (of these three alternatives) to use in the analyses performed in the body of the paper.
NOTES TO APPENDIX B

1 These are the countries that reported sectoral breakdowns of gross domestic product necessary for the analysis of the relation between population and the degree of diversification in an economy.

2 The functional forms of the gravity equation estimated here are those specified by equations (4.6) and (4.7) in Chapter IV. The sample contains only those countries which reported sectoral breakdowns of their GDP resulting in a sample size of 606 bilateral trade flows.
APPENDIX C
DATA SOURCES

Bilateral Trade Flows: Yearbook of International Trade Statistics. Bilateral imports to and exports from CMEA countries are mirror statistics using data reported by the exporting and importing nations respectively.


Population: Demographic Yearbook.


Distance: The distances were calculated as point to point great circle distances from geographical coordinates of major ports or trading centers of the respective countries. The major port or trading center was determined by taking the city within a country which handled the most tonnage of freight on an annual basis. (The only exception was the United States. In this case, one port on each of the east and west coasts was chosen.) The computer algorithm used was developed by the
The major ports or trading centers of the countries used in this study are as follows:

<table>
<thead>
<tr>
<th>Country</th>
<th>Major Port or Trading Center</th>
</tr>
</thead>
<tbody>
<tr>
<td>Algeria</td>
<td>Algiers</td>
</tr>
<tr>
<td>Angola</td>
<td>Luanda</td>
</tr>
<tr>
<td>Argentina</td>
<td>Buenos Aires</td>
</tr>
<tr>
<td>Australia</td>
<td>Sydney</td>
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Total Imports: International Financial Statistics.

Reserves: International Financial Statistics.

LIST OF REFERENCES


Taplin, Grant B. "Models of World Trade." International Monetary Fund Staff Papers, 14 (November, 1967), 433-53.


