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THEORETICAL AND EMPIRICAL APPLICATION OF \*  
THE EXCHANGE RATE VARIABLE IN ANNUAL  
ECONOMETRIC AGRICULTURAL TRADE MODELS

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# THEORETICAL AND EMPIRICAL APPLICATION OF THE EXCHANGE RATE VARIABLE IN ANNUAL ECONOMETRIC AGRICULTURAL TRADE MODELS

## INTRODUCTION

THE GROWING DEPENDENCE OF THE AGRICULTURAL SECTOR ON FACTORS BEYOND ITS BOUNDRIES HAS BEEN THE SUBJECT OF LIVELY DEBATE IN RECENT YEARS. ONE SUCH FACTOR IS THE EXCHANGE RATE. THE IMPORTANCE OF THE U.S. NOMINAL EXCHANGE RATE IMPACT ON U.S. AGRICULTURE HAS BEEN EMPHASIZED SINCE THE SHIFT TO THE FLEXIBLE EXCHANGE RATES REGIME IN 1973. HOWEVER, IN THE INVESTIGATION OF THE EXCHANGE RATE LINKAGE TO AGRICULTURE, MOST EMPIRICAL STUDIES, WITH THE EXCEPTION OF A FEW, HAVE TREATED THE EXCHANGE RATE AS FIXED.<sup>1/</sup> CHAMBERS AND JUST (1981, 1982) ENDOGENIZED THE EXCHANGE RATE, BUT THEIR FORMULATION WAS AD HOC AND THEREFORE THEORETICALLY ASSAILABLE.

THIS PAPER EMANATES FROM MY DISSERTATION, IN WHICH THE ANNUAL JAPAN-U.S. EXCHANGE HAD TO BE ESTIMATED TO ASSESS THE IMPACT OF U.S. MONETARY POLICY WITHIN A MODEL OF THE WORLD COARSE GRAIN MARKET. AS IN MY CASE, MANY EMPIRICAL AGRICULTURAL MODELS, ESPECIALLY THE TRADE MODELS, ARE ANNUAL. THIS IS PARTIALLY BECAUSE THE AGRICULTURAL PRODUCTION DATA ARE NORMALLY AVAILABLE ON AN ANNUAL BASIS. THE SPECIFIC OBJECTIVE OF THIS PAPER IS FIRST TO DISTINGUISH BETWEEN THE SHORT-RUN AND THE LONG-RUN EXCHANGE RATE DETERMINATION PROCESS WITHIN AN ASSET VIEW APPROACH, THEN, USING THE GRAFTED POLYNOMIAL<sup>2/</sup> TECHNIQUE, TO ESTIMATE THE ANNUAL JAPAN-U.S. EXCHANGE RATE COVERING BOTH THE FIXED AND FLEXIBLE PERIODS.

## THE MODEL

IN THE VIEW OF CLASSICAL ECONOMISTS<sup>3/</sup>, THE FOREIGN EXCHANGE MARKET IS DOMINATED BY THE CURRENT ACCOUNT, OR THE GOODS MARKET. THE MODERN KEYNESIAN (POST WWII) ECONOMISTS EQUALLY EMPHASIZE THE CAPITAL ACCOUNT,

OR THE ASSETS MARKET. USING THE ADDITIVITY PROPERTY OF THE BALANCE-OF-PAYMENTS ACCOUNT, THE MONETARISTS<sup>3/</sup> EMPHASIZE MONEY MARKET EQUILIBRIUM. THE ARGUMENT HERE IS THAT THE GOODS AND THE ASSETS MARKETS, I.E. THE CURRENT AND THE CAPITAL ACCOUNTS, ALSO REPRESENT THE DEMAND FOR THE STOCK OF MONEY NEEDED FOR INTERNATIONAL TRANSACTION AND SPECULATION ACTIVITIES.<sup>4/</sup> FURTHERMORE, THE OFFICIAL SETTLEMENTS ACCOUNT ENTERS AS A PART OF THE STOCK OF THE HIGH POWERED MONEY. UNDER THE PURE MONETARIST APPROACH, THE EXCHANGE RATE IS THE RELATIVE PRICE OF THE MONIES.

MUCH OF THE RECENT WORK ON FLOATING RATES FALLS UNDER THE "ASSET" VIEW; THE EXCHANGE RATE IS DETERMINED BY THE SUPPLY OF AND THE DEMAND FOR THE STOCK OF INTERNATIONAL ASSETS. CONSTRUCTION OF A LONG-RUN EXCHANGE RATE EQUATION REQUIRES US TO UNDERSTAND HOW AND WHY THE SHORT-RUN VALUES DIFFER FROM THEIR LONG-RUN EQUILIBRIUM VALUES. IN WHAT FOLLOWS, THEREFORE, I WILL FIRST PRESENT THE RATIONAL EXPECTATIONS MONETARY APPROACH (BILSON, PP. 75-80). AS WE WILL SEE, BECAUSE OF THE PERFECT PRICE FLEXIBILITY ASSUMPTION, THIS APPROACH DOES NOT MAKE A DISTINCTION BETWEEN THE SHORT-RUN AND THE LONG-RUN RATE OF EXCHANGE. BY RELAXING THIS ASSUMPTION, THEN, I WILL FOLLOW FRANKEL'S OVERSHOOTING APPROACH (1979, PP. 610-616) TO ILLUSTRATE THE EXTENT AND THE MECHANICS OF THE SHORT-RUN EXCHANGE RATE DEVIATIONS FROM ITS LONG-RUN EQUILIBRIUM VALUES.

THE FLEX-PRICE MONETARY MODEL CONSISTS PARTLY OF THE FOLLOWING EQUATIONS.

THE MONEY MARKET EQUILIBRIUM:

(1) HOME COUNTRY  $M - P = C \cdot Y - D \cdot I$

(2) FOREIGN COUNTRY  $M^* - P^* = C \cdot Y^* - D \cdot I^*$

THE PURCHASING POWER PARITY (PPP):

(3)  $P = S + P^*$

THE REAL INTEREST RATE PARITY (IRP):

(4)  $R = R^*$

THE FISHER EQUATIONS:

$$(5) \text{ HOME COUNTRY} \quad I = R + E[P_{T+1} | I(T)] - P = R + E\dot{P}$$
$$(6) \text{ FOREIGN COUNTRY} \quad I^* = R^* + E[P^*_{T+1} | I(T)] - P^* = R^* + E\dot{P}^*$$

WHERE:

- M = HOME COUNTRY MONEY SUPPLY;
- P = HOME COUNTRY GENERAL PRICE LEVEL;
- Y = HOME COUNTRY REAL INCOME;
- I = HOME COUNTRY NOMINAL INTEREST RATE;
- R = HOME COUNTRY REAL INTEREST RATE;
- E[ ] = MATHEMATICAL EXPECTATION OF A VARIABLE;
- E $\dot{P}$  = EXPECTED RATE OF INFLATION;
- S = THE SPOT VALUE OF THE FOREIGN CURRENCY.

NOTE THAT NO SUBSCRIPT REFERS TO THE CURRENT PERIOD; THAT ALL VARIABLES, EXCEPT THE INTEREST RATES, ARE EXPRESSED IN NATURAL LOGARITHM; AND THAT THE FOREIGN VARIABLES ARE DENOTED BY '\*'.

TWO CRUCIAL ASSUMPTIONS, THE PPP AND THE IRP, IN THIS APPROACH LEAD TO CONFLICTING IMPLICATIONS IN THE SHORT RUN, IN PARTICULAR, FOR THE RELATIONSHIP BETWEEN THE EXCHANGE RATE AND THE NOMINAL INTEREST RATE, WHEN COMPARED TO THE OVERSHOOTING MODEL. AS WE WILL SEE, HOWEVER, IN THE LONG RUN THE EXCHANGE RATE IS DETERMINED IDENTICALLY IN BOTH MODELS.

THE PPP CONDITION IS ASSUMED TO HOLD CONTINUOUSLY; THAT IS, PRICES ARE PERFECTLY FLEXIBLE. THIS IMPLIES THAT THE GENERAL PRICE LEVELS ARE EQUAL TO THE LONG-RUN EQUILIBRIUM PRICE LEVELS (DEFINED AS  $\bar{P}$  AND  $\bar{P}^*$ ) AT ALL TIMES. SINCE PRICES ARE ALWAYS AT EQUILIBRIUM, THE CURRENT ACCOUNT IS ALSO IN EQUILIBRIUM, WHICH MEANS THAT UNDER THE FLEXIBLE EXCHANGE RATE REGIME THE CAPITAL ACCOUNT MUST BE IN EQUILIBRIUM AS WELL. FOR THIS EQUILIBRIUM TO EXIST R CAN NOT DIFFER FROM  $R^*$ , NOR CAN THE EXCHANGE RATE DIFFER FROM THE RELATIVE PRICE. IN OTHER WORDS, AS A RESULT OF THE

FLEXIBLE-PRICE ASSUMPTION, CHANGES IN THE NOMINAL INTEREST RATE REFLECT THE EXPECTED INFLATION RATE. THAT IS, THE NOMINAL INTEREST RATE INCREASES WHEN THE HOME CURRENCY IS EXPECTED TO LOSE VALUE THROUGH INFLATION AND DEPRECIATION. THE RELATIVE INCREASE IN THE NOMINAL INTEREST RATE OF THE HOME COUNTRY RESULTS IN THE RELATIVE DECLINE IN THE REAL HOME-COUNTRY MONEY DEMAND AND AN INSTANTANEOUS DEPRECIATION OF THE HOME-COUNTRY CURRENCY.

FRANKEL (1979) ARGUED THAT PRICES ARE STICKY RATHER THAN PERFECTLY FLEXIBLE. AS A RESULT, IN THE SHORT RUN, GENERAL PRICE LEVELS DIFFER FROM THEIR EQUILIBRIUM VALUES. UNDER THE FLEXIBLE EXCHANGE RATE REGIME, PRESENCE OF NON-EQUILIBRIUM PRICE LEVELS IMPLIES THAT THE CURRENT ACCOUNT IS IN IMBALANCE, AND THEREFORE, EQUAL TO THE CAPITAL ACCOUNT IMBALANCE IN ABSOLUTE VALUES. PUT DIFFERENTLY, BECAUSE OF DEVIATIONS IN PPP, THE IRP DOES NOT HOLD IN THE SHORT RUN EITHER.

WHILE ASSUMING EQUATIONS (1)-(6), FRANKEL DEMONSTRATES THAT IF PRICES ARE STICKY AND THE RATE OF CHANGE OF PRICES CAN BE EXPRESSED AS A FUNCTION OF EXCESS DEMAND AND DOMESTIC COST INFLATION, THE EXPECTED RATE OF DEPRECIATION CAN BE REPRESENTED AS :

$$(7) \quad E[s_{T+1} | I(T)] - s = -k(s - \bar{s}) + (\dot{E}P - \dot{E}P^*),$$

WHERE  $s$  IS THE LONG-RUN EQUILIBRIUM EXCHANGE RATE. EQUATION (7) SAYS THAT THE EXPECTED DEPRECIATION IN THE SHORT-RUN IS PROPORTIONAL TO THE GAP BETWEEN THE CURRENT SPOT RATE AND ITS LONG-RUN EQUILIBRIUM VALUE. IN THE LONG RUN, WHEN  $s = \bar{s}$ , IT IS EXPECTED TO CHANGE AT THE EXPECTED INFLATION DIFFERENTIAL.

NOTICE THAT EQUATIONS (3)-(6) REDUCE INTO:

$$(8) \quad i - i^* = E[s_{T+1} | I(T)] - s$$

IN OTHER WORDS, EQUATION (3)-(6) REPRESENT THE MARKET EFFICIENCY CONDITION KNOWN AS UNCOVERED INTEREST PARITY IN THE REDUCED FORM AS IN (8).

COMBINING (7) AND (8) YIELDS (9):

$$(9) \quad s - \bar{s} = -\frac{1}{K} [(I - \dot{E}P) - (I^* - \dot{E}P^*)]$$

NOTICE THAT IN THE LONG-RUN WE HAVE :

$$(10) \quad \bar{I} - \bar{E}P = I^* - \dot{E}P^* \text{ OR}$$

$$(10') \quad \bar{I} - \bar{I}^* = \bar{E}P - \dot{E}P^*$$

WHERE (-) INDICATES THE LONG-RUN EQUILIBRIUM VALUES. USING (10'), (9) CAN BE RE-WRITTEN AS :

$$(9') \quad s - \bar{s} = -\frac{1}{K} [(I - I^*) - (\bar{I} - \bar{I}^*)]$$

INTUITIVELY, (9') SAYS THAT, IN THE SHORT-RUN, TIGHT MONETARY POLICY, FOR EXAMPLE, CAUSES THE NOMINAL INTEREST RATE DIFFERENTIAL TO RISE OVER ITS EQUILIBRIUM VALUE. THE CORRESPONDING INFLOW OF CAPITAL CAUSES THE EXCHANGE RATE TO OVERSHOOT ITS EQUILIBRIUM VALUE.

TO SUMMARIZE, UNDER THE STICKY PRICE ASSUMPTION<sup>5/</sup>, IN THE SHORT-RUN, BECAUSE PRICES ADJUST SLOWLY, A PERMANENT CHANGE IN THE MONEY SUPPLY CAUSES THE NOMINAL INTEREST RATE DIFFERENTIAL TO TEMPORARILY DIFFER FROM THE EXPECTED INFLATION DIFFERENTIAL. THIS HAPPENS BECAUSE IN THE SHORT RUN PRICES DO NOT CHANGE AT THE EXPECTED RATE OF INFLATION AND, AS A RESULT, THE NOMINAL INTEREST RATE DIFFERENTIAL DIFFERS FROM ITS LONG-RUN EQUILIBRIUM ( $\bar{I} - \bar{I}^*$ ). THEREFORE, IN THE SHORT RUN AND THROUGH THE INTERNATIONAL MOVEMENT OF CAPITAL, THE EXCHANGE RATE OVERSHOOTS ITS LONG-RUN EQUILIBRIUM VALUE. IN THE LONG RUN, WHEN PRICES ARE PERFECTLY FLEXIBLE, THE REAL INTEREST RATE DIFFERENTIAL IS ZERO AND THE EXCHANGE RATE IS DETERMINED BY THE RELATIVE EXPECTED INFLATION DIFFERENTIAL.

FOR THE LONG-RUN EXCHANGE RATE DETERMINATION, THEREFORE, WE HAVE THE FOLLOWING EQUATIONS:

$$(1) \quad M - P = C \cdot Y - D \cdot I$$

$$(2) \quad M^* - P^* = C \cdot Y^* - D \cdot I^*$$

$$(10') \quad \bar{I} - \bar{I}^* = \bar{E}P - \dot{E}P^*$$

$$(11) \quad \bar{s} = \bar{p} - \bar{p}^*$$

WHERE ALL VARIABLES ARE DEFINED AS BEFORE.

SUBTRACTING (2) FROM (1) GIVES:

$$(12) \quad P - P^* = M - M^* - C \cdot (Y - Y^*) + D \cdot (I - I^*)$$

DENOTING THE EQUILIBRIUM VALUES BY BARS IN (12) AND SETTING (12) EQUAL TO (11):

$$(13) \quad \bar{S} = \bar{M} - \bar{M}^* - C \cdot (\bar{Y} - \bar{Y}^*) + D \cdot (\bar{I} - \bar{I}^*)$$

SUBSTITUTING FROM (10') FOR  $(\bar{I} - \bar{I}^*)$  AND ASSUMING THAT THE CURRENT EQUILIBRIUM MONEY SUPPLIES AND INCOME LEVELS ARE GIVEN BY THEIR CURRENT ACTUAL LEVELS THE SPOT RATE IS:

$$(14) \quad S = M - M^* - C \cdot (Y - Y^*) + D \cdot (\dot{E}P - \dot{E}P^*)$$

THIS IS THE BASIC EQUATION FOR THE EMPIRICAL LONG-RUN JAPAN-U.S. EXCHANGE RATE IN THE NEXT SECTION.

#### ECONOMETRIC RESULTS

THE ASSUMPTION THAT THE MONEY DEMAND ELASTICITIES ARE THE SAME IN BOTH COUNTRIES, IF NOT JUSTIFIED, RESULTS IN ESTIMATION OF NOT ONLY BIASED ESTIMATES BUT ALSO OF INCORRECT SIGNS (HAYNES AND STONE, 1981). THEREFORE, EQUATION (14) WAS ESTIMATED AS<sup>6</sup>:/:

$$(15) \quad S = A + B \cdot M - B^* \cdot M^* - C \cdot Y + C^* \cdot Y^* + D \cdot \dot{E}P - D^* \cdot \dot{E}P^* + U,$$

WHERE S IS IN YEN/\$ AND THE U.S. IS TREATED AS THE FOREIGN COUNTRY AND, THUS, THE '\*' DENOTES THE U.S. VARIABLES.

THE MOTIVATION FOR CHOOSING THIS EXCHANGE RATE LIES BEHIND AN ANNUAL INTERNATIONAL WORLD COARSE GRAIN TRADE MODEL WHICH REQUIRED ENDOGENIZING THIS EXCHANGE RATE FOR THE PERIOD 1960-1983. THIS PERIOD CONSISTS OF BOTH FIXED AND FLEXIBLE EXCHANGE RATE REGIMES. IN ADDITION, THE FLEXIBLE REGIME WAS ADOPTED OFFICIALLY IN 1973; A TRANSITION FROM A FIXED TO FLEXIBLE EXCHANGE RATE SYSTEM OCCURRED BETWEEN 1971 AND 1973 DURING WHICH CURRENCY DEVALUATIONS BECAME THE COMMON ALTERNATIVE TO GOVERNMENT INTERVENTIONS TO KEEP EXCHANGE RATES FIXED. CONSEQUENTLY, THE RATES OVER THE FIXED PERIOD (1960-1970) WERE NOT DETERMINED BY THE EXPLANATORY



VARIABLES IN EQUATION (15). ESTIMATION OVER THE ENTIRE RANGE WITHOUT MAKING APPROPRIATE MODIFICATION IS MEANINGLESS. AT THE SAME TIME, ESTIMATION OVER THE FLEXIBLE PERIOD (1974-1983) RESULTS IN ONLY THREE DEGREES OF FREEDOM.

AN ALTERNATIVE APPROXIMATION IS TO ESTIMATE DISCRETE NONLINEAR AND/OR LINEAR SEGMENTS OF A FUNCTION AND THEN JOIN THOSE SEGMENTS TO FORM A CONTINUOUS FUNCTION. THIS FUNCTION IS REFERRED TO AS A GRAFTED POLYNOMIAL (FULLER, 1976).

THE APPLICATION OF THE GRAFTED POLYNOMIAL (GP) IN THE ESTIMATION OF THE MEAN FUNCTION OF THE EXCHANGE RATE EQUATION IS BASED ON THE ASSUMPTION THAT THE TIME SERIES CAN BE DIVIDED INTO THREE SEGMENTS: (1) FIXED EXCHANGE RATES (1960-1970), (2) AN ADJUSTMENT PERIOD (1971-1973), AND (3) FLEXIBLE RATES (1974-1980). THE "GRAFTED POLYNOMIAL VARIABLE", Z, IS DEFINED TO BE:

$$z_T = \begin{cases} 0, & \forall & T \leq 1970 \\ T - 1970, & \forall & 1971 \leq T \leq 1973 \\ 4 & \forall & \text{OTHERWISE.} \end{cases}$$

THE GRAFTED EQUATION, THEN, INCLUDES Z AND ALL OTHER RIGHT HAND SIDE VARIABLES MULTIPLIED BY Z. INCLUSION OF THE Z VARIABLE PREVENTS ARBITRARY CODING OF THE THE EXPLANATORY VARIABLES (FULLER, PP. 394-397). THE APPLICATION OF THE GP TECHNIQUE IS ADVANTAGEOUS IN TWO REGARDS. FIRST, IN THE CONTEXT OF A LARGE AGRICULTURAL TRADE MODEL, THE GP TECHNIQUE ALLOWS FOR A SIMULTANEOUS ESTIMATION OF THE MODEL OVER BOTH PERIODS OF THE FIXED AND FLEXIBLE EXCHANGE RATES; AND SECOND, IT WILL INCREASE THE ASSOCIATED DEGREES OF FREEDOM (DF). HOWEVER, IN THIS PARTICULAR CASE, THE GAIN IN THE DF WILL BE FOR THE 1971-1973 PERIOD ONLY; I.E., THREE ADDITIONAL DF.

THE SOURCE OF THE DATA USED IN THIS STUDY IS THE INTERNATIONAL MONETARY FUND, INTERNATIONAL FINANCIAL STATISTICS (IFS) OF VARIOUS YEARS. THE IFS ANNUAL AVERAGE SERIES (LINE RF) WAS USED TO REPRESENT THE EXCHANGE RATE (YEN/\$).

THE MONETARY AGGREGATES USED ARE OF M1 DEFINITION (LINE 34). USING LINE 63, THE WHOLESALE PRICE INDEX, THE EXPECTED INFLATION RATES WERE APPROXIMATED BY THE AVERAGE LOGARITHMIC RATE OF CHANGE OVER PRECEEDING YEAR. THE REAL INCOME VARIABLES WERE CALCULATED USING LINES 99B AND 63.

THE ESTIMATION RESULTS ARE REPORTED IN TABLE 1. THE APPLICATION OF ORDINARY LEAST SQUARES RESULTS IN INSIGNIFICANT ESTIMATES, EXCEPT THE INTERCEPT, WITH INCORRECT SIGN OF THE U.S. INCOME VARIABLE, TABLE 1, EQUATION 1. IT IS LIKELY THAT BOTH THE MONEY SUPPLY AND INCOME VARIABLES ARE ENDOGENOUS. THE INSTABILITY OF THE MONEY DEMAND FUNCTION AND THE CENTRAL BANKS INTERVENTIONS, AS FRANKEL (1979 AND 1981) POINTS OUT, RESULT IN AN ENDOGENOUS MONEY SUPPLY PROCESS. ERRORS IN MONEY DEMAND EQUATIONS ARE KNOWN TO HAVE BEEN LARGE. BECAUSE THESE ERRORS ARE CORRELATED WITH THE MONEY SUPPLY, THEY WOULD BIAS THE ESTIMATES. UNDER MANAGED FLOATING, THE GOVERNMENT INTERVENTION ALSO RESULTS IN AN ENDOGENOUS MONEY SUPPLY, IF THE INTERVENTION IS NOT STERILIZED. SIMILARLY, THE INCOME VARIABLES IN THE MONEY DEMANDS CAN BE VIEWED AS ENDOGENOUS AND LIKELY CORRELATED WITH THE ERRORS IN THE EXCHANGE RATE EQUATION. FRANKEL (1981) POINTS OUT THAT IF THE VARIABLES FOLLOW A RANDOM WALK ON LEVELS AND TRENDS, THEN THE USE OF CURRENT LEVELS AS LEVELS AS THE EQUILIBRIUM VALUES ARE VALID. OTHERS EXPLICITLY CONSIDERING THE INCOME AND MONEY SUPPLY PROCESSES, SUCH AS DRISKILL AND SHEFFRIN (1981), GOT POOR RESULTS. HOWEVER, IF WE ACCEPT THE ASSUMPTION THAT IN THE LONG-RUN THE SYSTEM IS HOMOGENEOUS OF DEGREE ZERO IN THE EXCHANGE RATE AND THE MONEY SUPPLY, THE MONEY SUPPLY DIFFERENTIAL COEFFICIENTS CAN BE CONSTRAINED TO 1. IN DOING SO, FRANKEL INDICATES THAT THE ERRORS DUE TO UNSTABLE DEMANDS WOULD GO TO THE LEFT HAND SIDE AND THUS IMPROVE THE CONSISTENCY AS WELL AS THE EFFICIENCY.

EQUATION (2) IN TABLE 1 PRESENTS THE RESULTS OF THE CONSTRAINED CASE IN WHICH ALL COEFFICIENTS HAVE THE CORRECT SIGN AND THE T-STATISTICS

HAVE IMPROVED SIGNIFICANTLY. CORRECTING FOR AUTOCORRELATION USING THE COCHRANE-ORCUTT PROCEDURE, RESULTS IN EQUATION (3) IN TABLE 1. THE AUTOREGRESSIVE PARAMETER ( $\rho$ ) IS INSIGNIFICANT; THE SIGNS REMAIN CORRECT; AND THE T-STATISTICS ERODE. THE REPORTED STATISTICS IN TABLE 1 ARE ADJUSTED FOR THE DEGREES OF FREEDOM. THE ADJUSTMENT IS NEEDED BECAUSE Z HAS TO BE DEFINED AS ZERO FOR THE PERIOD 1960-1970; THAT IS, THE VALUES OF THE EXPLANATORY VARIABLES ARE ZERO OVER THIS PERIOD. THIS IN EFFECT REMOVES THE POSSIBILITY OF ESTIMATING ANY RESIDUAL FOR EACH OBSERVATION OF THE PERIOD 1960-1970.

THE ANNUAL EXCHANGE RATE OBSERVATIONS ARE TAKEN TO REPRESENT THE LONG-RUN EQUILIBRIUM VALUES. IF ONE YEAR IS NOT A LONG ENOUGH TIME FOR SHORT-RUN RATES TO REACH THEIR LONG-RUN EQUILIBRIUM VALUES, THEN FRANKEL'S REAL INTEREST RATE MODEL WILL HAVE TO BE APPLIED. THIS MEANS THAT THE NOMINAL INTEREST RATES MUST BE INCLUDED TO ACCOUNT FOR THE REAL INTEREST RATE DIFFERENTIAL EFFECT. EQUATION (4) IN TABLE 1 REPORTS THE RESULTS OF THIS OPERATION. THE INTEREST RATE VARIABLES ARE THE LONG-RUN GOVERNMENT BOND YIELDS, WHICH ARE COLLECTED BY MORGAN GUARANTY AND TRUST CO. AND REPORTED IN WORLD FINANCIAL MARKETS. THE INTEREST RATE VARIABLES ARE INSIGNIFICANT; AND THE SIGN OF JAPAN'S INTEREST RATE VARIABLE IS INCORRECT. THE T-STATISTICS OF THE COEFFICIENTS OF THE EXPECTED INFLATION VARIABLES DECLINE. THIS INDICATES EXISTENCE OF A HIGH DEGREE OF CORRELATION BETWEEN THESE VARIABLES. IN FACT, THE CORRELATION BETWEEN THE EXPECTED INFLATION AND INTEREST RATE DIFFERENTIALS IS .92, INDICATING THAT ONE YEAR MAY BE A LONG ENOUGH TIME FOR THE EXPECTED INFLATION DIFFERENTIAL TO BE EQUAL TO THE INTEREST RATE DIFFERENTIALS.

OTHER PROXIES WERE TRIED IN PLACE OF BOTH THE EXPECTED INFLATION AND THE INTEREST RATES VARIABLES. HOWEVER, RESULTS WERE NOT AS GOOD AS THE REPORTED RESULTS IN TABLE 1.

SUMMARY AND CONCLUSIONS

MOST AGRICULTURAL TRADE MODELS HAVE TREATED EXCHANGE RATES AS FIXED. RECENTLY, IN APPRECIATION OF THE INTERDEPENDENCY OF THE AGRICULTURAL SECTOR AND THE INTERNATIONAL MACROECONOMY, SOME HAVE ENDOGENIZED EXCHANGE RATES IN WHAT MIGHT BE CALLED A "MACROAGRICULTURAL" FRAMEWORK. HOWEVER, MORE OFTEN THAN NOT THE THEORETICAL CONSIDERATIONS OF LONG-RUN EXCHANGE RATE DETERMINATION HAVE BEEN OVERLOOKED IN ANNUAL MODELS OF THIS SORT. BECAUSE OF THE ANNUAL NATURE OF AGRICULTURAL PRODUCTION, HOWEVER, ONE WOULD NEED TO ESTIMATE THE LONG-RUN (ANNUAL) EXCHANGE RATES. THIS DOES NOT MEAN THAT ONE CAN NOT USE QUARTERLY AGRICULTURAL MODELS AS AN EXAMPLE. DUMMY VARIABLES CAN BE USED TO INCORPORATE THE ANNUAL AGRICULTURAL PRODUCTION DATA INTO QUATERLY MODELS.

IN THIS PAPER, THE DISTINCTION BETWEEN THE SHORT-RUN AND THE LONG-RUN EXCHANGE RATE DETERMINATION PROCESSES WAS DISCUSSED THEORETICALLY. SPECIFICALLY, IN THE SHORT RUN, BECAUSE OF THE STICKY PRICE ASSUMPTION THE EXCHANGE RATE IS PARTLY A FUNCTION OF THE SHORT-RUN REAL INTEREST RATE DIFFERENTIAL. IN THE LONG-RUN, HOWEVER, BECAUSE ALL PRICES ARE PERFECTLY FLEXIBLE, THE REAL INTEREST DIFFERENTIAL VANISHES AND THE LONG-RUN EXCHANGE RATE CAN PARTIALLY BE EXPRESSED AS A FUNCTION OF EXPECTED INFLATION DIFFERENTIAL.

APPLYING THE (GP) TECHNIQUE, THE VALUE OF THE DOLLAR IN JAPANESE YEN WAS EMPIRICALLY EXAMINED DURING BOTH FIXED AND FLEXIBLE EXCHANGE RATE REGIMES (1960-1983). ALL ESTIMATED PARAMETERS HAD THEORETICALLY SOUND SIGNS. HOWEVER, BECAUSE OF THE SPECIFIC VALUES OF THE GRAFTED POLYNOMINAL VARIABLE, THE T-STATISTICS HAD TO BE ADJUSTED FOR THE DEGREES OF FREEDOM.

TABLE 1. ESTIMATION RESULTS (DEPENDENT VARIABLE: LOG OF YEN-DOLLAR RATE)<sup>1</sup>

EQUATION	1	M	M*	M-M*	Y	Y*	E <sup>P</sup>	E <sup>P*</sup>	I	I*	Z
1. UNRESTRICTED DF=5 R <sup>2</sup> =.96 DW=2.65	5.89 (212.8) <sup>2</sup>	.000002 (.523)	-.0002 (-.411)		-.198 (-.335)	-.407 (-.615)	.136 (.611)	-.565 (-1.39)			2.71 (1.32)
2. CONSTRAINED DF=7 R <sup>2</sup> =.99 DW=1.69	5.91 (89.3) <sup>2</sup>			1.00 (325.6) <sup>4</sup>	-.824 (-2.507) <sup>2</sup>	1.03 (1.463) <sup>3</sup>	.415 (1.142)	-.863 (-1.314)			-2.173 (-1.74) <sup>3</sup>
3. COCHRANE- ORCUTT DF=6 R <sup>2</sup> =.98 RHO=.12 (.59)	5.9 (75.48) <sup>2</sup>			1.00 (CONST.)	-.825 (-2.225) <sup>2</sup>	.989 (1.276)	.349 (.946)	-.778 (-1.211) <sup>2</sup>			-2.038 (-1.44) <sup>3</sup>
4. REAL INTEREST DIFFERENTIAL DF=5 R <sup>2</sup> =.99 DW=2.52	5.89 (98.19) <sup>2</sup>			1.00 (CONST.)	-1.269 (-3.293) <sup>2</sup>	1.548 (1.934) <sup>3</sup>	.159 (.358)	-.829 (-1.298)	.018 (.578)	.016 (1.341)	-.71 (-.394)

1/ NUMBERS IN PARENTHESES ARE THE ADJUSTED T-STATISTICS.

2/ STATISTICALLY ACCEPTABLE AT 5% SIGNIFICANCE LEVEL FOR A ONE SIDED TEST.

3/ STATISTICALLY ACCEPTABLE AT 10% SIGNIFICANCE LEVEL FOR A ONE SIDED TEST.

4/ F-TEST STATISTIC (ADJUSTED FOR DF) FOR THE HYPOTHESIS THAT THE COEFFICIENT OF (M-M\*) IS EQUAL TO ONE.

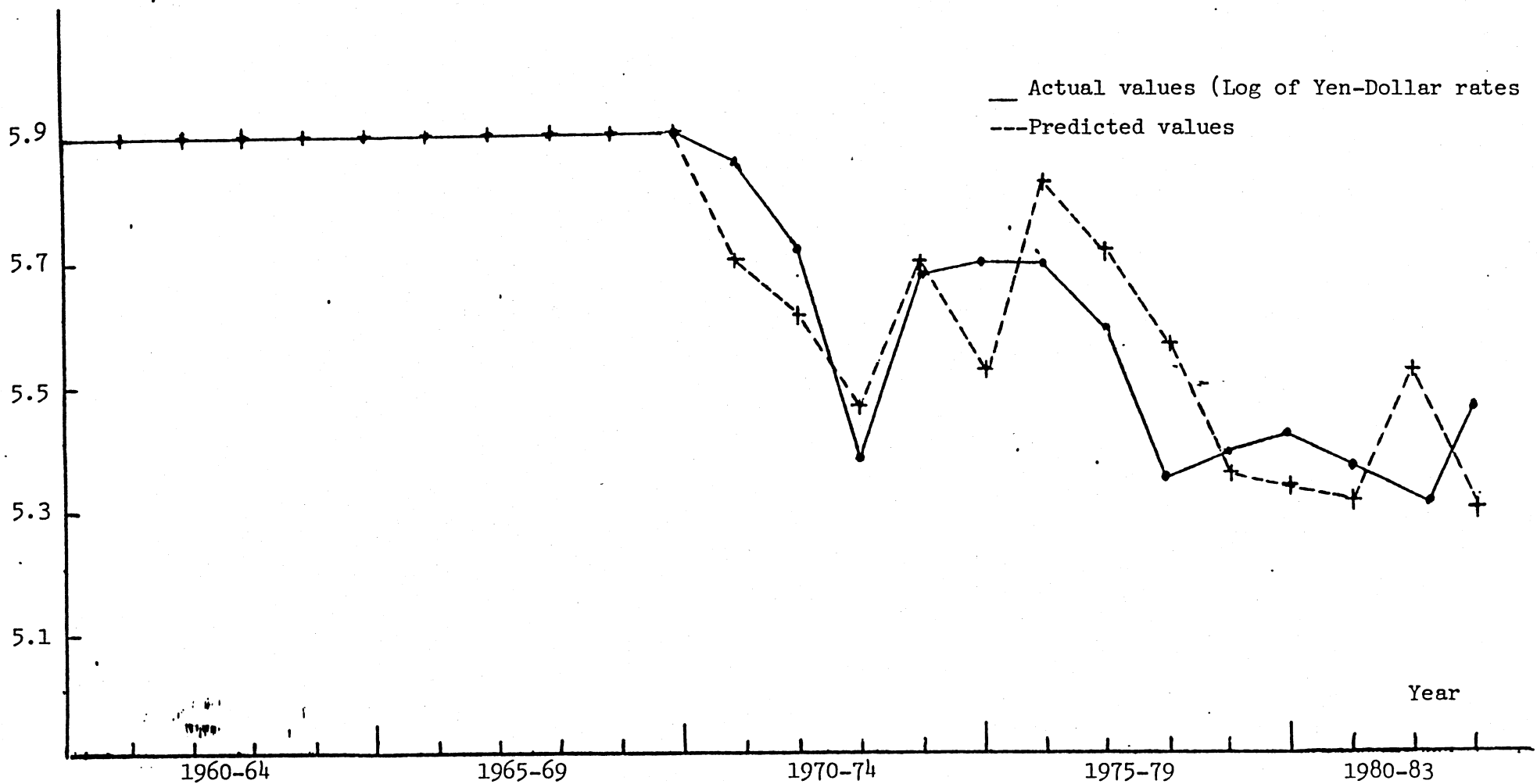


Figure 1. Actual and predicted values of equation (2) in Table 1.

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FOOTNOTES

- 1/ LONGMIRE AND MOREY (1983), AND SHEI (1978) ARE TWO EXAMPLES OF FIXED TREATMENT OF EXCHANGE RATE.
- 2/ SEE FULLER (1976), P. 393-399.
- 3/ FOR A GOOD AND IN DEPTH ANALYSIS SEE ARGY (1981).
- 4/ NOTICE THAT CURRENT AND CAPITAL ACCOUNTS ARE FLOW VARIABLES, BUT MONEY DEMAND IS A STOCK VARIABLE.
- 5/ THE IDEA WAS FIRST ADVANCED BY DORNBUSCH (1976), IN WHICH SECULAR INFLATION WAS NOT A FACTOR; THAT IS, THE INFLATION DIFFERENTIAL ALWAYS EQUALED TO ZERO.
- 6/ THE COEFFICIENTS OF THE MONEY SUPPLIES DO NOT DEPEND ON THE DEMAND FUNCTIONS, AND THUS CAN BE LEFT IN RELATIVE FORM.

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