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The major upheavals which have buffeted the world economy over the last 15 years have motivated a considerable amount of research on the question of trade stability and, notably, on commodity price and exchange rate risk. The most important policy issue addressed in this body of literature is how nations can reduce their exposure to these risks. A number of risk-conditioning policy strategies have been discussed such as buffer stocks of key raw materials and foreign exchange pegging (Massell, 1969, and Johnson and Sumner, 1976). Some analysts have suggested that futures markets may also provide a viable instrument by which nations can condition their trade-related risk (see, for example, Newbery and Stiglitz, 1981). The purpose of this paper is to explore this last option from a theoretical standpoint and then to study a hedging operation by which two low-income countries, South Korea and Egypt, may be able to offset the risk of their net import positions in wheat.

The work presented here continues along the lines first developed by Jacques Rolfo (1980) in his study of cocoa futures hedging for the African cocoa-producing countries and Brazil. Rolfo's study develops an optimal hedging strategy for these countries as a function of the cocoa price and production risks they face. He finds that, when production is risky, it is not optimal for a producer to adopt an "equal but opposite" or 100 percent hedge. Generally, depending on how risk averse he is, he will hedge substantially less than 100 percent of his expected production. In his study, Rolfo concentrates only on cocoa-related risks. In contrast, the present work attempts to locate the hedging decision within a framework which encompasses a wider view of the risks borne by the country. In particular, a country involved in international trade is subject to risk associated not only with its export products but with its imports as well. A country may, in fact, enjoy substantial risk-reduction benefits depending upon its "portfolio" of exporting and importing activities. The need to broaden the scope of studies involving commodity price instability has been mentioned by a number of authors (see Lloyd and Procter, 1983, and Gemill, 1981). The larger framework presented in this paper includes risk associated with the country's total trade picture as well as risks associated with domestic production destined for domestic use.

This theoretical approach has been used to study a possible 100 percent hedging operation in wheat for Egypt and South Korea. In so doing, we have assumed that these countries' decision-makers are mean/variance optimizers and that their welfare depends on the purchasing power of national income. This means that, after assessing the probability distributions they face, their objective is to obtain the minimum variance (or risk) of purchasing power at any given mean level of purchasing power. The hedging strategy is analyzed as a function of this assumed objective. The results show that the wheat futures contract provides South Korea with an effective hedging vehicle while hedging, in this contract, is not a very effective risk-reducing tactic for Egypt.

I. THE MODEL

We assess the desirability of futures market hedging with reference to the risk of the overall structure of national production and consumption. Basically, we approach the country's hedging problem from the standpoint of a national policymaker who wishes to minimize the uncertainty of his nation's purchasing power at any given level of national income. By focusing on purchasing power, we have chosen the broadest possible view of the risks to which the country is exposed. Under this framework, the risks faced by Rolpho's cocoa-producing nations would include not only cocoa-related risk but any risks associated with the entire production and consumption strategy adopted by the country.

In the present section, we form an expression for purchasing power in terms of the production and consumption positions of the nation's various economic sectors. This expression is then used to calculate the uncertainties associated with purchasing power as a function of the production and consumption positions across various sectors. Futhermore, uncertainties associated with production and price levels in each of the sectors are incorporated in this expression.

The expression for purchasing power uncertainty can be used to determine the risk associated with the (i) actual configuration of national production and consumption as well as with (ii) the minimum variance configuration of national production. This latter uncertainty measure is obtained from an optimization problem described in this section. These two measures, (i) and (ii), then serve as benchmarks for comparing the nation's purchasing power uncertainty after a hedge has been placed.

The model which provides the framework for our discussion of hedging assumes that the decision-maker has a mean/variance utility function defined over the purchasing power of national income. Thus, in some sense, we assume that there is a planning agent or policymaker who internalizes the risk incurred over the entire "portfolio" of production and consumption activities which are ultimately used to characterize national purchasing power.

The formal expression for national purchasing power, V, is

$$V = f(p)\,\tilde{u}'y \qquad (1)$$

where

p = random vector of sectoral prices composed of a systematic component, $\hat{p}$, and an additive random component, $\tilde{p}$, whose expectation is zero

$f(p)$ = deflator function based on the sectoral price vector

$\tilde{u}$ = vector of sectoral production disturbances, each of whose elements has an expected value of one

and

y = vector of expected or planned production with each element corresponding to planned value added in a particular sector.

Note that the definitions of $\tilde{u}$ and y imply that their product represents random national income as a sum of expected sectoral productions multiplied by the sectoral disturbance terms.

From (1), an expression for the uncertainty associated with national purchasing power, V, can be established. This expression can be derived by approximating V by a first-order Taylor's series expansion. A microeconomic identity (Roy's identity) is then used to interpret one of this expansion's coefficients (see Appendix I for a detailed discussion of this derivation). The resulting expression for purchasing power risk, S^2, is given by:

$$S^2 = f(p)^2\,[x'\,E(\tilde{p}\,\tilde{p}')\,x + y'\,E(\tilde{u}\,\tilde{u}')\,y - 2y'\,E(\tilde{u}\,\tilde{p}')\,x] \qquad (2)$$

where

x = vector of real consumption positions in each sector

$E(\tilde{p}\,\tilde{p}')$ = variance/covariance matrix of disturbances to sectoral price levels

$E(\tilde{u}\,\tilde{u}')$ = variance/covariance matrix of sectoral production uncertainty

and

$E(\tilde{u}\,\tilde{p}')$ = covariance matrix of sectoral production disturbances with sectoral prices.

Equation (2) forms the basis of our subsequent empirical work. After estimating the necessary variance/covariance matrices, we can substitute the actual levels of production and consumption into (2) in order to estimate the uncertainty associated with the country's current purchasing power strategy. Furthermore, using quadratic programming, we can determine a sectoral production configuration which provides minimum purchasing power uncertainty at any given level of national income. The consumption positions are inputs to this optimization problem. This approach is reasonable because the objective of the optimization is to reduce the risk associated with a given level and pattern of consumption by calculating a minimum variance pattern for the production activities which are used to finance this consumption. This optimization problem is performed subject to a number of constraints which assure that the solution is technically feasible, that it adheres to the usual national accounting identities, and that it does not imply unrealistically high balance-of-payments deficits or sectoral growth rates. Table I presents the full optimization problem.

TABLE I

The Optimization Problem

Minimize $_y$	$f(p)^2 \{y' E(u u') y + x' E(p p') x - 2y' E(u p') x\}$
subject to	
(1) $GO_i + M_i = W_i + I_i + C_i + EX_i$	--material balance constraint for sectors which engage in trade (eliminate EX_i and M_i for nontrading sector's material balance constraint)
(2) $y_i = -d_i GO_i$	--relation between sectoral income and gross output
(3) $\Sigma EX_i - \Sigma M_i - H \leqq \gamma \Sigma y_i$	--balance of payments constraint
(4) $a_{i,min} \leqq y_i \leqq a_{i,max}$	--minimum and maximum growth per sector
(5) $\Sigma y_i = \bar{y}$	--mean income constraint (parameterize on Y to trace out frontier)

(Continued on next page.)

TABLE I--continued.

Variables:

y = vector of sectoral valued added

x = vector of real consumption per sector

$E(u\,u')$ = variance/covariance matrix of multiplicative value-added disturbances

$E(p\,p')$ = variance/covariance matrix of sector price indexes

$E(u\,p')$ = covariance matrix of sectoral value-added and price disturbances

GO_i = sectoral gross output

M_i = sectoral imports

W_i = intermediate demand for sector i's output

I^i = investment-related demand for sector i's output

C^i = final consumption demand for sectoral output

EX_i = export demand for sector i's output

γ_i = percentage of gross national product which represents an allowable balance of payments deficit

Y = mean income (defines a specific point on the frontier)

H = total noncompetitive imports

d_i = income share in sectoral gross output

$a_{i,min}$, $a_{i,max}$ = growth constraint parameters

Two alternative measures of S^2 serve as benchmarks for comparison with a specific hedging strategy. The first benchmark is based on actual production while the second is based on "optimal" production. Both of these are computed under the assumption that no hedging takes place. S^2 is then recomputed assuming that a hedge is imposed. If the hedging operation reduces purchasing power uncertainty at a fixed level of national income, we say that the hedging operation is successful and desirable. Clearly, the decision maker wants to reduce uncertainty as much as possible at any given level of national income.

II. THE EMPIRICAL METHODOLOGY AND RESULTS

The empirical application of the theoretical framework just presented has been performed for South Korea and Egypt. These two countries were chosen because they exhibit radically different purchasing power strategies, with South Korea emphasizing export-oriented manufacturing and Egypt maintaining a strong agricultural orientation. The data used in this empirical work consist of time series for real sectoral consumption and for sectoral production and the net positions in wheat.[1] Time series of futures market price quotes for several maturities of wheat futures contracts and of exchange rates were also used. The data set is described in detail in Appendix II.

The empirical work takes us through a number of steps. These are described in sequence below:

1. Sectoral value added and price level uncertainty are characterized by estimating equations for sectoral production (based on sectoral capital and labor inputs) and for price levels (modeled either as first- or second-order moving average or as random processes with trends). The moving average models where selected using Box and Jenkins' procedure (Box and Jenkin, 1971) of

identification, estimation and diagnostic checking. It was necessary to use the "seemingly unrelated equations" estimation methods (Zellner, 1962) for these equations since errors between equations are likely to be correlated. The residuals from these estimates form the basis of our characterization of uncertainty. The correlation matrix associated with the variance and covariance matrices arising from this procedure appears in Table II. The presence in both cases of large off-diagonal elements indicates that potential benefits from diversification between sectors are large.

2. The actual sectoral production and consumption figures for 1978[2] are applied to these variance/covariance matrices in the manner indicated in equation (2) in order to estimate the uncertainty, S^2, associated with the countries' actual 1978 positions. The uncertainties associated with these positions are presented in Table III (where they appear as the square root of S^2). Our estimates indicate that Egypt's purchasing power uncertainty is about 8.3 percent of 1978 national income while South Korea's is only 4.2 percent.

3. The quadratic optimization necessary to obtain the minimum variance production configuration which corresponds to the same income level as that actually prevailing in 1978 is also performed as indicated in Table III. The results show that both countries' actual purchasing power risk is slightly higher than those indicated by the optimization program. The optimization values also appear in Table III.

4. The returns from the hedging operation are calculated in dollars under the assumption that the country adopts the following simple hedging strategy for each country: Long positions are assumed by both countries in June and July of each year since the results of the wheat harvest are reasonably well

TABLE II

Correlations Between Zellner Equations' Residuals (Egypt)

	Value-added equations				
	Agri-culture	Manufac-turing	Construc-tion	Transpor-tation	Services
Value-added equations					
Agriculture	1.000	0.819	0.498	0.046	0.589
Manufacturing	0.819	1.000	-0.682	0.049	0.720
Construction	0.498	0.682	1.000	0.161	0.729
Transportation	0.046	-0.049	0.161	1.000	0.214
Services	0.508	0.720	0.723	0.215	1.000
Price equations					
Agriculture	0.189	-0.031	-0.006	0.339	0.222
Manufacturing	0.314	0.208	0.143	0.202	0.695
Construction	0.154	0.076	0.132	0.216	0.632
Transportation	0.180	0.280	0.319	0.108	0.480
Services	0.112	0.150	0.057	0.180	0.210
	Price equations				
Value-added equations					
Agriculture	0.189	0.314	0.154	0.180	0.112
Manufacturing	-0.031	0.207	0.076	0.281	0.150
Construction	-0.006	0.143	0.132	0.319	0.057
Transportation	0.339	0.202	0.216	0.103	0.180
Services	0.222	0.695	0.631	0.480	0.204
Price equations					
Agriculture	1.000	0.335	0.276	-0.330	-0.293
Manufacturing	0.335	1.000	0.905	0.368	0.253
Construction	0.276	0.905	1.000	0.443	0.169
Transportation	-0.338	0.869	0.443	1.000	0.504
Services	-0.293	0.253	0.169	0.504	1.000

TABLE II--continued.

Correlations Matrix Between Residuals Pertaining to Value-Added and Price Equations (South Korea)

	Value-added equations				
	Agri-culture	Manufac-turing	Construc-tion	Commerce	Transpor-tation
Value-added equations					
Agriculture	1.000	0.233	0.086	0.200	-0.241
Manufacturing	0.233	1.000	-0.337	0.524	0.030
Construction	0.086	0.337	1.000	-0.304	0.545
Commerce	0.200	-0.524	-0.304	1.000	-0.294
Transportation	-0.241	0.030	0.334	-0.294	1.000
Price equations					
Agriculture	-0.025	-0.301	0.339	-0.137	0.354
Manufacturing	-0.602	0.007	-0.073	0.283	0.351
Construction	0.102	-0.265	0.218	-0.085	1.105
Commerce	0.271	0.211	-0.153	0.125	-0.139
Transportation	0.327	-0.040	0.053	0.313	-0.265
	Price equations				
Value-added equations					
Agriculture	-0.025	-0.602	0.103	0.271	0.327
Manufacturing	-0.301	0.007	-0.265	0.211	-0.040
Construction	0.340	-0.073	0.218	-0.153	0.054
Commerce	-0.137	0.283	-0.085	0.730	0.313
Transportation	0.354	0.351	0.105	-0.140	-0.266
Price equations					
Agriculture	1.000	0.347	0.868	0.216	0.582
Manufacturing	0.347	1.000	0.189	0.201	0.097
Construction	0.858	0.189	1.000	0.289	0.674
Commerce	0.216	0.201	0.289	1.000	0.605
Transportation	0.562	0.097	0.624	0.605	1.000

TABLE III

Estimates of Current and Minimum Variance Purchasing Power Uncertainties

	South Korea million won	Egypt million pounds
Standard Deviation(s)		
Based on 1978 production weights	763.6	645.5
Based on minimum variance production weights	720.8	626.3
With 100 percent hedge of wheat imports	716.5	626.3
1978 national income	18,387.5	7,809.0

known at this point; therefore, a good estimate of import needs can be made. These import requirements, which are taken to be the countries' expected net import positions in wheat, are hedged in June and July by assuming equal positions in the September, December, March, and May contracts. The positions are then lifted in the delivery months. Note that the total position in the futures market equals the expected wheat imports for the year.

The dollar returns per bushel from this hedging strategy are reported in Table IV where they are also converted into Korean won and Egyptian pounds. Notice that the sum of the total dollar (U. S.) gains column indicates that, rather than having to pay for this insurance, they would have netted a total of $2.33 (U. S.) per bushel over the 18 years covered in the study.[3] The uncertainties associated with these returns are estimated as the residuals of estimated first-order moving average processes. A new variance/covariance matrix is then formed on the basis of these residuals which is analogous to that developed in step one except that rows and columns have been appended. After adding the row and column associated with the hedging instrument, we can express the variance of purchasing power uncertainty in matrix notation as follows:

$$S_h^2 = f(p)\ [-x',\ y',\ h'] \begin{bmatrix} E(p\ p') & E(\tilde{u}\ \tilde{p}') & E(v\ p') \\ E(p\ u') & E(\tilde{u}\ \tilde{u}') & E(v\ u') \\ E(p\ u) & E(u\ v) & E(v\ v) \end{bmatrix} \begin{bmatrix} x \\ y \\ h \end{bmatrix} f(p) \qquad (3)$$

where

v = disturbance terms associated with hedging returns

$E(v) = 0$

and

h = futures market position.

TABLE IV

Annual Gains from the Hedging Strategy[a]

Year	Gains				
	June	July	Total[b]	South Korea	Egypt
	dollars (U. S.) per bushel			won per bushel	pounds per bushel
1978	.073	.112	.184	89.25	.0253
1977	-.195	-.425	- .620	-300.08	.0160
1976	-.118	-.170	- .288	-138.0	-.0184
1975	.095	-.095	- .0003	-000.15	-.0109
1974	.718	.531	1.249	506.6	.0134
1973	.757	.746	1.503	599.0	.0104
1972	.185	.176	.361	133.4	.0300
1971	.049	.037	.085	29.81	-.0677
1970	.090	.089	.179	55.62	-.1066
1969	-.053	-.026	- .080	- 22.9	-.0347
1968	-.152	-.092	- .244	- 67.4	.0783
1967	-.086	-.069	- .155	- 41.59	.0372
1966	.049	.020	.069	18.41	.1575
1965	.002	.022	.024	5.98	.6568
1964	.010	.021	.031	7.00	.8743
1963	-.016	-.009	- .025	- 4.69	-.2191
1962	-.017	-.026	- .042	- 6.184	-.2016
1961	.031	.015	.046	50.87	-.433
1960	.033	.025	.058	3.698	.1291

[a]The total gain over the period is $2.33 per bushel.

[b]Hedging strategy assumes that equal long positions are taken in the September, December March, and May contracts during the months of June and July for every year.

Thus, the hedging market operation adds a row and a column to the original variance/covariance matrix. These reflect covariances between hedging returns disturbances and disturbances to sectoral production and sectoral price levels. The correlations corresponding to these appear in Table V.

5. Based on these expanded variance/covariance matrices, it is possible to calculate the new purchasing power uncertainty, S_h^2, under the assumption that 100 percent of the net wheat position is hedged. This post-hedge purchasing power uncertainty may be compared with its value without the hedge by evaluating row three of Table III relative to row one (a comparison based on actual production weights which would give the two countries minimum purchasing power uncertainty).

III. INTERPRETATION OF RESULTS

In comparing the reduction of purchasing power uncertainty obtained from the 100 percent hedge against South Korea and Egypt's net import positions in wheat, we find that, while South Korea reaps substantial benefits from the hedging operation, Egypt's benefits are negligible. As Table III indicates, the Korean hedge reduces the standard deviation of its purchasing power from 720.8 million won to 716.5 million won. This is surprising in view of South Korea's small net import position in wheat (78,488 bushels).

The effectivenes of the hedge for Korea stems from a number of sources. First, a high negative correlation (-.42) exists between manufacturing disturbances and hedging return disturbances. Obviously, this negative correlation is advantageous from the standpoint of reducing purchasing power risk. It is also exactly what one would expect to observe between two "assets" effectively counterbalanced in a hedge.

TABLE V

Correlations Between Hedging Return Residuals and Sectoral Price and Production Residuals

	Sector					
	Agriculture	Manufacturing	Construction	Commerce	Transportation	Service
Correlation of hedging returns disturbances with:						
Production						
South Korea	.604	-.423	.030	-.027	-.093	
Egypt	-.304	-.487	-.468	a	.318	-.205
Price						
South Korea	.264	.038	.299	.018	.246	
Egypt	.072	.326	.241		.297	.403

[a]Blanks indicate not available.

What are the possible explanations of the above high negative correlation? The most likely explanation is that wheat prices and the manufacturing sector respond in opposite ways to some third random variable which injects shocks into the world system. For example, a general inflationary impulse caused by excessive international liquidity may be transmitted rapidly into the highly competitive raw materials markets. This transmission may take place before manufacturers have the opportunity to adjust output prices and production techniques to the new input prices, thereby provoking a squeeze on profits.

Another, less likely, explanation involves the foreign exchange aspect of the hedge. Since the hedging operation earns money over the 18-year period studied [$2.33 (U. S.) per bushel is the cumulative gain over the period], the hedge entails a slightly long position in the dollar. Thus, it is possible to explain the negative correlation between manufacturing and hedging disturbances if the manufacturing sector is long in the Korean won. This would be reasonable if, for example, the Koreans pay for a large proportion of their inputs in dollars. However, given the heavy export orientation of the Korean manufacturing sector, it is not likely that the sector is long in its own currency. Therefore, the foreign exchange aspect of the hedge probably tends to dampen the size of this correlation rather than to strengthen it.

Also contributing to the hedge's effectiveness for South Korea is the .26 correlation between the agricultural price index and hedging returns residuals. However, because the manufacturing weight is extremely large and because of the extremely high negative correlation with hedging residuals, the manufacturing production-hedging operation interaction contributes more to the hedge's effectiveness than the hedge's interaction with the agricultural price index.

For Egypt, the hedging operation provides only a very marginal reduction of the minimum variance position in spite of the fact that their net consumption position (150,650 bushels of wheat) in 1978 was over twice as large as Korea's in the same year. The estimated change in purchasing power uncertainty after the imposition of the hedge is a mere 10 million Egyptian pounds squared. It is interesting to note that the correlation matrix generated by the estimated equations for this analysis again shows that the highest negative correlation for the hedging equation residuals occurs with the industrial value-added residuals (-.49). However, since the industrial value added weight applied to this covariance is relatively small, the Egyptian economy still exhibits a strong agricultural emphasis. Again, the correlation with the agricultural price index is small and slightly positive (.07). The small value of this latter correlation may be due to agricultural policies which successfully insulate domestic prices from external shocks. Thus, the hedging operation has very little effect.

IV. CONCLUSION

We have developed a framework for analyzing country hedging which admits an expanded view of the risks faced by a country. Essentially, this framework incorporates all risks incurred (via production and consumption) in the entire portfolio of economic activities by which a country seeks to secure for itself a certain level of purchasing power. This approach also assumes that there is a single economic agent, presumably a national economic policymaker, whose objective function actually reflects risks related to all of the economic activities in which the country participates. Also, in focusing on national aggregates, our study ignores what may be important distributional impacts inasmuch as risks faced by the various economic classes may not be similar.

The present study could be expanded in a number of worthwhile directions. First, the model should be expanded to include optimization over the hedged position rather than to analyze only the desirability of a 100 percent hedge. Secondly, a poorly diversified primary exporter could be studied to see if hedging in export product is useful given the diversification benefits the exporter may enjoy through its import products (such as foodstuffs and manufactured items). Finally, certain practical issues need to be addressed such as whether or not market volumes on the exchanges are sufficiently large to support this type of hedging activity.

APPENDIX I

Derivation of Expression for Purchasing Power Uncertainty

We begin with the expression for real income or purchasing power:

$$V = f(p)\,\tilde{u}'\,y = f(p)\,Y \tag{A1}$$

where

$f(p)$ = deflator function based on the random vector, p, whose elements correspond to sectoral price levels; these can be decomposed into a systematic component, $\hat{p}$, and a random addition disturbance term, $\tilde{p}$, such that $p = \hat{p} + \tilde{p}$ and $E(\tilde{p}) = 0$

$\tilde{u}$ = multiplicative disturbances to which sectoral production is subject; these disturbance terms incorporate elements related to producer price uncertainty, production risk, and so forth

y = vector of planned production (measuread as nominal income) in each sector

and

$Y = \tilde{u}'y$ = total nominal income for the nation.

Equation (A1) is a function of two random variables. It can be approximated by means of a first-order Taylor's series approximation using $\tilde{p} = p - \hat{p}$ and $du = \tilde{u} - \hat{u}$ as the increments of the expansion

$$V \doteq V(\hat{p}, \hat{u}) + (V', V_Y Y_u) \begin{pmatrix} \tilde{p} \\ u - \hat{u} \end{pmatrix} \tag{A2}$$

$$V = V(\hat{p}, \hat{u}) + V_Y \begin{pmatrix} \frac{V'_p}{V_Y}, \frac{V_Y}{V_Y} Y_u \end{pmatrix} \begin{pmatrix} \tilde{p} \\ u - \hat{u} \end{pmatrix} \tag{A3}$$

$$V = V(\hat{p}, \hat{u}) + V_Y\left(\frac{V_p'}{V_Y}, Y_u\right)\begin{pmatrix}\tilde{p} \\ \tilde{u} - \hat{u}\end{pmatrix}. \quad \text{(A4)}$$

Notice that subscripts denote partial derivatives, and this approximation treats the u and the p vectors as being analytically (though not statistically) separate. If this were not the case, we would need terms in the expansion such as Y_p. In effect, disturbances in the p vector pertain to households and disturbances; and for the u vector, it pertains to firms and production.

We now use Roy's identity which states that $-V_p'/V_y$ is equal to x, the household's vector of consumption positions in each sector. Substituting this into equation (A4), we get the following:

$$V \doteq V(\hat{p}, \hat{u}) + V_Y(-x, Y_u)\begin{pmatrix}\tilde{p} \\ \tilde{u} - \hat{u}\end{pmatrix}. \quad \text{(A5)}$$

Substituting our specific functional form for V, equation (A5) becomes:

$$V \doteq f(\hat{p})\,\hat{u}\,\hat{y} + f(p)\,(-x, y)\begin{pmatrix}\tilde{p} \\ u - \tilde{u}\end{pmatrix}. \quad \text{(A6)}$$

The variance of V on purchasing power, which we label S^2, can then be expressed directly as

$$S^2 = f(\hat{p})^2\,[x'\,E(\tilde{p}\,\tilde{p}')\,x + y'\,E(\tilde{u}\,\tilde{u})\,y - 2x'\,E(\tilde{p}\,\tilde{u}')\,y] \quad \text{(A7)}$$

APPENDIX II

Data Set for South Korea and Egypt, 1950-1978

Variable	Source of data	Comments
Sectoral gross domestic product, 1950-1978	United Nations (1971, 1975, 1978), Yearbook of National Account Statistics (YNAS)	
Sectoral price indices, 1950-1978	YNAS	
Sectoral capital stocks and labor forces, 1950-1978	Egypt: sectoral capital stocks calculated by Boutros-Ghali and Taylor (1980), received in phone conversation, 1981; capital flow data and labor data from YNAS South Korea: capital/output ratios and output figures from Thorbecke and Svenjar (1973); capital flow data and employment figures from YNAS	The capital stock for a base year was obtained and capital flows were added or subtracted to get yearly capital stocks
Social accounting matrices, 1968	Egypt: The World Bank South Korea: Thorbeck and Svenjar (1973)	We used an aggregated form of the input/output matrix taken from these sources. These aggregated matrices can be found in Appendix II.
Real sectoral consumption, 1978	YNAS	
Nominal total final demand, 1978	YNAS	

(Continued on next page.)

APPENDIX II--continued.

Variable	Source of data	Comments
Net wheat imports	Food and Agricultural Organization Trade Yearbook	
Wheat futures quotes	Wall Street Journal	Chicago Board of Trade prices

Sources:

For the Wall Street Journal, see Commodity Research Board, Inc. (1978); for the Chicago Board of Trade prices, see Chicago Board of Trade (1978).

FOOTNOTES

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[1]It should be noted that the accuracy of aggregate data of this type, especially for developing countries, is open to question.

[2]The reference year chosen was 1978 because it was the most recent year for which complete national accounts data had been published by the United Nations.

[3]The reader will also note the strong serial correlation in the pattern of the yearly gains and losses, indicating that an active strategy in which they would stop hedging after a string of abnormally high return years would have been preferable.

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