Disturbances to the International Economy

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1. Identification of the Disturbances

In the second full year of operation of the international trading model built under the auspices of Project LINK we encountered the first of a series of world scale shocks, NEP (President Nixon's New Economic Policy) with the closing of the gold window, surcharging of automobile imports, and a host of domestic economic restrictions. This phase, known in Japan as Nixon shocks, led to the Smithsonian agreement on exchange rates and later dollar devaluation in 1973. This was only the beginning of a tumultuous period with many other shocks of a comparable magnitude.

The specific episodes or scenarios that I shall consider in this paper are the following:

(i) Nixon shocks and the Smithsonian agreement
(ii) Soviet grain purchases, rising food prices, rising raw material prices
(iii) Oil embargo and quadrupling of OPEC prices
(iv) Protectionism
(v) Capital transfers
(vi) Wage offensive

These are actual events or hypothetical scenarios that have been simulated through the LINK system. It is worthwhile considering some cases that have not occurred but need looking into because of the threats they impose on world stability. The added shocks are

(vii) Debt default
(viii) Speculative waves in currencies and commodities
(ix) Famine as a result of large-scale crop failure.

We do not know what the next wave of shocks will be or when it will occur. Some episodes in (i)-(vi) could be repeated or some new and quite unexpected ones could occur. Some plausible cases that have been hinted at as a result of actual developments or that have been openly discussed are being considered here under (vii)-(ix).

(i) The NEP was introduced August 15, 1971. The original edicts were temporary. The surcharge on imported cars was soon lifted and the closing of the gold window was only a prelude to a more significant move, namely, the realignment of exchange rates under the terms of the Smithsonian agreement. The stated expectation of the U.S. Secretary of Treasury, John Connally, was

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that a prompt turn-around in the U.S. trade balance, by some $8 billion, would occur. The United States was in the middle of a strong cyclical expansion phase, while many partner countries were experiencing slowdowns. This became an ideal test situation for applications of the LINK system.

(ii) Russia experienced a significant crop failure in 1972 and began systematically and quietly buying grain in the world market for delivery mainly in 1973. The circumstances of the purchase and lax surveillance on our part made the purchase a bargain at U.S. taxpayers' expense. It also depleted our grain reserves in short order. This led to sharp increases in world and domestic food prices in 1973. The situation was made worse by the ending of phase II under NEP and the weakening of controls under the disastrous phase III. In addition there was a failure in the anchovy catch off Peru. Fish meal served as a close substitute for grain in poultry and other animal feeding.

Accompanying these shocks in early 1973 were two dollar devaluations in February and March. Later, a speculative wave took over many primary commodity markets. In this situation many monetary or fiscal authorities recommended a conscious tightening of policies in order to slow the rate of expansion.

(iii) The biggest single shock was surely the oil embargo of 1973. Given that the authorities were trying to slow down their respective countries, the oil importers as a whole were vulnerable to a large-scale synchronized shock. In place of a "soft landing," there was a significant decline. When prices were increased in 1974 and held at that level, a number of serious trade imbalances were nurtured in the OECD world.

The embargo period itself was disruptive in cutting off supplies of a necessary production ingredient. The result was a sharp fall in output, since producers did not commit their reserve stock to use during the period, not knowing how long the embargo would last or not knowing that in fact significant leakages in the embargo would occur. Although oil was not itself a large component of GNP, it was a strategic one and its shortfall in the market held back many producing processes. It also led to a reduction in many components of final demand – – expenditures on gasoline and oil, household operating expenditures, purchases of automobiles, and purchases of homes.

The subsequent period of high oil prices, without the embargo, continued to be one of recession; the increase in oil prices acted like an excise tax on the economy. The general result of simulating an increased excise tax through a macro model of an industrial economy is to induce a lowering of activity and an increase of prices. When this happened, as in 1974–75, in several industrial countries simultaneously, there were international reverberation effects and the final result was worse than each individual country may have experienced had it been subjected, alone, to the price increase.

(iv) The recession of 1974–75 influenced many countries to introduce protectionist measures in order to counteract business cycle impacts. In two noteworthy cases, Germany and Japan, there were export-oriented increases to maintain domestic activity and lead the respective economies into revivals. As a consequence, both these countries realized enormous trade surpluses. When

combined with the OPEC surpluses, a large burden of adjustment faced deficit countries. Deficits there would have to be, because of the world trade identity

$$\text{World exports} = \text{World imports},$$

but they were not evenly distributed throughout the world. Those countries with large deficits looked to protectionism as a way to improve their trade accounts.

Trigger prices against Japanese and European steel imported into the United States are protectionist measures that have recently been introduced. Voluntary quotas imposed on exporters of shoes, textiles, and TV sets are another version of protectionism. Enforcement of anti-dumping laws are yet another. A more straight-forward form would be an increase in tariffs.

The move toward liberalization of trade on a multilateral basis has been set back in recent years and is likely to be set back further given the attitude of powerful industrialists who have been hurt by import competition, and by equally powerful trade unionists whose jobs have been displaced by imported goods. In some countries, an exceptional claim for protecting *infant* industries has been replaced by a claim for protection of *mature* industries. The end result reduces world trade and production because of widespread adoption of "beggar-thy-neighbor" protectionist policies.

(v) In North-South confrontations or dialogues there has long been a request for capital transfers from the former to the latter. The request is based on the argument that the poorer peoples of the world in the southern hemisphere, to a large extent, needed, on pure welfare or humanitarian grounds, capital in order to grow and enjoy some material economic benefits. Another argument is that the northern countries would benefit themselves by creating better markets for their products.

Some progress has been made in implementing capital transfers, but mainly on emergency conditions and not for general growth on a large enough scale to change the world pattern. OPEC nations have made some capital grants to other developing nations that do not have energy resources and find it difficult to pay the high world price for oil. IMF facilities and particularly the proceeds of gold auctions make limited funds available for capital transfer.

This is a shock or episode that has not yet taken place on a large scale, yet can be simulated through the LINK system.

(vi) Wage offensives took place in the United Kingdom, Scandinavia and other countries where domestic prices responded to the new high oil prices after 1973. Inflation rates of 25 percent in Britain induced large wage demands of the same order of magnitude. If wage costs go up at this high rate, prices are sure to be marked up by a similar amount in the next round and we shall have a co-ordinated wage-push effect through the world. As in other synchronized cyclical movements the effect tends to amplify, thus increasing the inflation rate. This process can also be simulated through the LINK system. It was fairly common in 1974–75 and receded only in 1976. Wage pressures lessened a bit as the world recession wore on. It is not back to the high level of 1974–75 but it is on the rise

once again. As some countries reflate, in contrast to very slow growth in the past year or two, as in the German case, trade union restiveness and assertiveness could put significant pressures on wages. If inflation rates turn up again, the rise could very well be the result of higher wage demands.

(vii) Every time a particular country gets into trouble in its debt servicing, the possibility of debt default looms. To a large extent, debt service has become a critical issue for developing countries – Peru, Zaire, Zambia are primary examples. But large amounts of outstanding debt are on the books of Mexico, Brazil, Taiwan, S. Korea and India, all of whom are much better situated for covering service costs than are the troubled countries. For this reason, the danger of a widespread wave of international bankruptcy is far-fetched, but it is a shock scenario that is worth considering.

It is not only in the area of developing countries where debt default is a live issue but several developed countries are likely to have trouble in meeting obligations. The leading cases are Spain, Portugal, and Turkey. Some centrally planned economies have been troubled by debt burdens, but it seems unlikely that they, as a group or individually, would willingly fail to honor international obligations. They have voluntarily restrained their indebtness once it became apparent that they were overextended.

(viii) In 1973 there was substantial speculation in markets for basic materials, both agricultural and industrial. Grain market prices rose by 100 percent or more and there was much speculative activity although the primary disturbance came from the large scale Soviet purchases. Later speculative waves came in 1974 (sugar) and 1976 (coffee). As for industrial commodities, speculation in copper and other nonferrous metals was significant.

These high prices had adverse effects on the import value and external balance of several consuming countries. The United Kingdom is a case in point. This kind of disturbance led to the restrictive fiscal/monetary policies that made countries highly vulnerable to the oil shock.

Currency speculation had also been evident and caused significant international disturbances. The runs on sterling and lira in early 1976 induced domestic inflation, followed by a whole train of events that impeded the United Kingdom and Italy. In the case of sterling, there was some degree of suspicion that shifts of sterling balances by OPEC countries were responsible for much of the decline in the exchange values of sterling.

(ix) Some of the most volatile prices that have risen on a scale comparable with oil prices in 1974–75 have been food prices. They doubled, while the cartel raised oil prices by a factor of 3 or 4. The principal difference from the oil case was that supply could be quickly increased and high food prices were promptly brought down as stocks were rebuilt. Thus an agricultural harvest disturbance is likely to be shorter in duration than are others, where supply is less responsive.

Nevertheless, a large crop shortfall on a world scale could bring about significant price increases for some foods perhaps by as much as 100 percent or more. If this were to occur, suddenly, the world economy could well be faced with a new crisis with dimensions as large as or larger than those experienced earlier in this decade.

2. Outline and Use of the LINK System[1]

When modeling and studying a national economy by simulation methods, it is generally assumed that export volume and import prices are exogenous variables. Export volume depends mainly on world trade or world economic activity, or import requirements of partner countries. Either export volume itself or world (foreign) activity variables, once removed, on which exports depend, are treated as exogenous. This is not strictly correct since price competitiveness, which depends on endogenous domestic behavior, also influences exports. But as a first approximation, we shall accept the usual assumption that exports are exogenous. Similarly, import prices are determined by cost and pricing decisions of partner countries. They are, therefore, treated as exogenous, too. To the extent that a major country influences its partners' pricing decisions, for competitive reasons, import prices are not wholly exogenous, but again, as a first approximation, they are treated as exogenous variables.

Import volume and export prices are both endogenous variables. The former depend on domestic activity variables and relative prices – at home and abroad. The latter depend on domestic cost and supply conditions. To the extent that a country tries to remain competitive with its partners and prices exports accordingly, or is a price taker in a world market for basic commodity exports, it may not be appropriate to classify export prices as endogenous. But the principal practice is to put import and export prices in the endogenous category.

The primary purpose of the LINK model is to endogenize export volumes and import prices. For the world trade economy, as a whole, both exports and imports, export prices and import prices are endogenous. On a world basis, there are no exogenous elements in this nexus. It may also be said that the purpose of LINK is to analyze the international transmission mechanism or to form international linkages among national econometric models.

The LINK system does this in a consistent way by imposing two accounting identities:

$$\sum_{i=1}^{n} X_i = \sum_{i=1}^{n} M_i \qquad \text{world export volume = world import volume}$$

$$\sum_{i=1}^{n} (PX)_i X_i = \sum_{i=1}^{n} (PM)_i M_i \qquad \text{world export value = world import value}$$

These identities are imposed in terms of a common numeraire unit (the U.S. dollar) at FOB valuation. The identities hold for commodity classes,

[1] See R.J. Ball, *International Linkage of National Economic Models,* J. Waelbroeck, *The Models of Project LINK,* (Amsterdam: North Holland, 1973, 1976). A third volume edited by John Sawyer is now in press.

SITC 0,1 food, beverages, tobacco

SITC 2,4 other raw materials

SITC 3 mineral fuels

SITC 5-9 manufactures and semimanufactures

The number of countries or areas (n) is presently 24.

There are

13 OECD Countries (Australia, Austria, Belgium, Canada, Finland, France, West Germany, Italy, Japan, Netherlands, Sweden, United Kingdom, United States)

7 CMEA Countries (Bulgaria, Czechoslovakia, East Germany, Hungary, Poland, Romania, U.S.S.R.)

4 Developing Regions (Africa, Asia, Latin America, Middle East) An OPEC/non OPEC split is also provided

A residual category (ROW) is not explicitly modeled, but assumed to have a constant share of world trade.[2]

A detailed way of insuring fulfillment of the accounting identities would be to model bilateral trade equations between countries for separate commodity groupings. An example would be

$$\ell\eta X_{ij} = \underset{(-6.8)}{-11.327} + \underset{(12.2)}{1.890\ell\eta M_j} - \underset{(-2.0)}{1.271}\ \frac{PX_{ij}}{PC_{ij}}$$

SITC 0,1

$R^2 = 0.973$ S.E. = 0.079 D.W. = 0.989

i = Netherlands

j = West Germany

PX_{ij} = price index of Netherlands shipments (SITC 01) to Germany

PC_{ij} = price index of competing countries' shipments (SITC 01) to Germany

This is just an example of many equations that have been estimated by P. Ranuzzi of the EEC, bilaterally, for commodity groups. It covers SITC (0,1) imports by Germany from the Netherlands. There is some evidence of serial correlation of residuals, which could be reduced on further research into the

[2] This assumption is being weakened, and small models are being built for 13 separate countries (Mainland China, Denmark, Greece, Iceland, Ireland, New Zealand, Norway, Portugal, South Africa, Spain, Switzerland, Turkey, Yugoslavia). For some, major models may be used.

time shape of reaction, but most of the bilateral equations do have a more random pattern for residuals.

There are many bilateral combinations to be determined for this number of countries or areas. To simplify the work, we estimate total (not bilateral) import equations for each model, by SITC categories. Exports are (endogenously) computed from

$$X = AM$$

where A is a world trade share matrix with element

$$A_{ij} = X_{ij}/M_j$$

$$X_{ij} = \text{exports from i to j}$$

$$M_j = \text{imports of j}$$

X is a vector of exports (across countries / areas) and M is a vector of imports (across countries / areas). As long as the column sums of A are unity, we satisfy the world trade identity. If this identity is in volume terms (constant prices), the corresponding identity in value terms (current prices) is

$$(PX)' \; AM = (PM)' \; M$$

from which we deduce

$$(PM) = A' \; (PX)$$

In the LINK system, we do not assume that the elements of A are constant. They are functions of relative prices and move through time as endogenous variables of the complete system.

The system is solved by assuming export volumes and import prices for each country / area model. The individual model solutions for M and (PX) are substituted into the above matrix equations for estimation of X and (PM). The models are then solved again for M and (PX); new values for X and (PM) are computed, and the iterative process stops when the total value of world trade does not change from iteration to iteration (approximately).

This is a highly condensed description of the LINK system. How can it be used for studying world disturbances? Each of the specific disturbances (i) – (ix) described in the previous section can be examined as a scenario or structured simulation. A base simulation is first established as a dynamic projection of the system from fixed initial conditions and exogenous inputs on a "best judgment" time path that does not include the particular disturbance. Then an alternative simulation is developed with the disturbance included, everything else unchanged from the baseline path. The difference, at each successive time point, between the scenario and baseline path provides an estimate of the effect of the disturbance.

Preliminary to the working out of scenarios, we first estimate multipliers of the system that show sensitivity to changes in exogenous variables or to exo-

genous shifts of entire relationships. It is instructive to examine the standard fiscal multiplier from a single country viewpoint and a world system viewpoint. To make matters simple let us use the two-country world model

$$y = e\ y + m^*y^* - m\ y + g$$

$$y^* = e^*y^* + m\ y - m^*y^* + g^*$$

There are two countries with output levels y and y* respectively. Output in each country is the sum of

induced spending, ey or e*y*, on consumption and capital goods

exports, m*y* or m y
less imports, m y or m*y*
exogenous government spending, g or g*

The relationships are assumed, for purposes of exposition only, to be linear and proportional. In this two-country world, the world trade identity is automatically satisfied because one country's imports (m*y*) is another country's exports. In the second country, exports (m y) are the first country's imports. It is assumed that an exchange conversion makes the units comparable in the two countries.

Taking the single-country view, in isolation, we can derive the reduced form equation for the first country as

$$y = \frac{g + m^*y^*}{1 - e + m}$$

The conventional multiplier, for a given level of exports (m*y*) is

$$\frac{dy}{dg} = \frac{1}{1 - e + m}$$

The simplest multiplier formula $\left(\frac{1}{1 - e}\right)$ is modified by the inclusion of the import leakage factor in the denominator, thus tending to reduce the multiplier's value. Indeed, countries with very high marginal propensities to import – prototypes being the United Kingdom and the Netherlands – are known to have low multiplier values, possible less than unity.

In the two-country case, the reduced form is

$$y = \frac{(1 - e^* + m^*)\ g + m^*g^*}{(1 - e + m)\ (1 - e^* + m^*) - m\ m^*},$$

and the multiplier is

$$\frac{dy}{dg} = \frac{1}{1 - e + m - \dfrac{m\ m^*}{1 - e^* + m^*}}$$

By including the term

$$- \frac{m\ m^*}{1 - e^* + m^*}$$

in the denominator, we have increased the size of the multiplier. Thus the world model is more sensitive to a disturbance when intra-country trade effects are taken into account in the model. If the second country also stimulates by moving g*, there is another effect to be added, namely

$$\frac{m^*}{(1 - e + m)\ (1 - e^* + m^*) - m\ m^*}$$

provided g* moves pari passu with g. This result shows not only that international repercussion effects exist as well as direct country effects, but also that synchronized effects intensify movements in both countries simultaneously. It shows, moreover, that one country is sensitive to policy changes in another. In this example, y depends on (partial) movements in g*. These are indirect effects.

In LINK simulations, synchronized effects and indirect policy effects have been examined across countries. Simultaneous fiscal changes; inventory drawdowns in a crisis, such as the oil embargo; simultaneous wage-push increases; simultaneous limitations on imports (protectionism) have all been studied.

Multipliers have been calculated for the LINK system without synchronization; i.e., by changes, one at a time, to fiscal variables in a given model. Both direct and indirect effects on other countries are studied in these multiplier scenarios. Although these are not simultaneously introduced, for multiplier calculations, the effects are simultaneously spread over several OECD economies at once.

Oil price increases are not synchronized except to the extent that all the countries in OPEC, plus outsiders that are large producers, will have imposed on other economies an equivalent of a world excise tax. The synchronization of this case is in the movements of the oil-importing economies.

Apart from some strictly controlled prices, like the cartel-determined oil price, domestic costs or world competition largely govern the determination of export prices. These prices are then converted into import prices (exogenous to a single country), by means of a transformation using the world trade matrix. If the world inflation rate increases, it will result from higher export prices. This is the counterpart of the strategic importance of imports in determining the volume of world trade. By using the row elements of a trade-share matrix to convert imports into each component of exports, we are doing essentially the

same thing as transforming changes in export prices into changes in import prices. In this latter case, columns of the trade matrix are weights in the transformation process.

An important aspect of the present stage of the LINK system has not yet been explained, namely the role of exchange rates. They are, at the present time, exogenous in the LINK system. They are not constant because frequently they are exogenously changed in the middle of a LINK simulation. Only now have we been able to turn our attention to analysis of exchange rates and endogenize them for projection and simulation analysis. Since the Smithsonian Agreement we have gained enough experience to examine the body of data available from 1971 to date in order to make first attempts at estimating equations that try to explain exchange rates – as functions of country interest rate differentials, growth rate differentials, inflation rate differentials, changes in reserves, and levels of wealth.

As imports and export prices are endogenously generated by the solution of each model, they are expressed in local currency units, which are different for nearly every country.[3] In order to use these series in the LINK algorithm with dollar-denominated trade flows, we must convert imports and export prices from dollar denominations into exports and import prices, also in dollar quotations. As imports and export prices leave individual models, expressed in local currency units, we multiply them all by a series of exogenous exchange rates into dollar-denominated totals. The operational formulas are:

$$M\ (L)\ Ex\ (\$/L) = M\ (\$)$$

$$(PX)\ (L)\ Ex\ (\$/L) = PX\ (\$)$$

The right-hand side variables are all expressed in dollar terms. The trade matrix is based on dollar valuations; so it should be multiplied into either M($) or PX($), imports and export prices in dollar units. These multiplications generate

$$X\ (\$)$$

$$PM\ (\$)$$

i.e., dollar valuations of exports and import prices. Before these variables can be reinserted into individual models, for the next iterative step in the system solution process, they must be converted back into local currency units appropriate to each model. This step takes the form

$$X\ (\$)\ /\ Ex\ (\$/L) = X(L)$$

$$(PM)\ (\$)\ /\ Ex\ (\$/L) = (PM)\ (L)$$

[3] Developing countries are treated by area grouping. Area models are based on dollar-denominated variables, aggregated over countries.

Exchange rates, used in this way, have significant impacts on the entire solution. So exchange rates play important roles; they are simply in need of endogenization.

By and large, when persistent deficits or surpluses appear in country accounts for simulation exercises, we find that the former lead to currency depreciation while the latter lead to currency appreciation. After exchange rates are changed, either exogenously or endogenously, on the basis of a solution, we have feed-back information for altering the solution.

In SITC groups 0,1 and 2,4, the relevant prices are determined in world markets, balancing supply and demand. For the most part, primary producing countries are "price takers." In order to obtain good estimates of export prices for such countries, it is necessary to couple the LINK system with systems of simultaneous equations to explain commodity markets, either major agricultural crops and other products, or markets for industrial materials. The principal feedback on the LINK system is through determination of price for producing countries, and, consequently, export earnings in these commodity lines. Some twenty-odd commodity models have been estimated by F.G. Adams and others for combination with the LINK models.[4] They have estimated equations of the form

$$(PX01) = f(P_1, P_2, \ldots P_n)$$

$$(PX24) = g(Q_1, Q_2, \ldots Q_m)$$

PX01 = export price index of group SITC 0,1

PX24 = export price index of group SITC 2,4

P_i = world price of i-th food commodity

Q_i = world price of i-th industrial commodity

These equations have been estimated for each primary producing country or area.

The commodity models are solved, for primary price determination, on the basis of input values for demand or other factors from the LINK system. The prices estimated from the commodity models are then inserted into f and g, above, to estimate new values of (PX01) and (PX24). The LINK system is resolved with these new estimates of export prices, and the commodity models are solved in another iteration. This procedure continues until convergence is attained. This extended model and program is known as COMLINK.

[4] F.G. Adams, "Primary Commodity Markets in a World Model System," *Stabilizing World Commodity Markets,* ed. by F.G. Adams and S.A. Klein, (Lexington: Lexington Books, 1978), 83–104.

3. Some Empirical Results.

A number of LINK studies have examined, in the past, many of the issues raised in the first section, using the procedures and systems in the second section.

Increases in basic commodity prices (hypothetically) during 1975-76, interpreted as an increase in export prices of developing countries by an extra 10 percent over a baseline case, produced the following deviations from the baseline values of GNP, GNP deflator, consumer price deflator, and trade balance.

It is evident from studying the left panel of Table 1 that higher export prices in primary producing countries in the developing world would generally increase inflation rates in the industrial (using) countires. Of the two measures of inflation presented here – GDP deflator and consumer price deflator – the latter is probably more suitable, because price increases in imports can often lead to *lower* GNP prices. This is because imports enter negatively in the GNP identity. A clearer picture of domestic inflation is given by the consumer price deflator. Mainly domestic goods are being priced in this index measure. A few countries stand to make trade gains, but these are a minority, and most of the significant changes are losses, on trade account. Only the LINK OECD countries are included in Table 1. Although these are the largest countries and the ones that dominate the world economy, not all important countries are included. The results are clearest and most reliable for the major countries that are specifically modeled; those are the ones listed in Table 1.

The payment of higher prices to primary producing countries is not all negative, however. The developing countries earn some extra purchasing power since many primary products are price-inelastic. With the extra purchasing power in the hands of some developing countries, they are able to increase their imports from the industrial countries. This accounts for some of the "perverse" signs – rising GDP in the face of higher primary input prices.

The right-hand panel is possibly more interesting. It induces more pronounced changes since it is a scenario that is far from what actually happened. What if there had been no oil embargo and no forceful setting of world oil prices by OPEC? The increases in GDP rates and the fall in inflation rates are considerably bigger than those in the left panel, when prices are changed by a mere factor of 10 percent. In the case of the other simulation, oil price is, hypothetically, held constant at its 1973 value way into 1976.

Large oil-importing countries have significant declines registered in their prices as a result of having held the line on oil prices. It shows how important energy is in the pricing decision. The inflation rate is substantially down in every country except Australia and Austria. At the same time that price would have been held down in this "what if" scenario, real output rose, with the exceptions of Australia, Austria, Canada, and Finland. Canada is, of course, an energy exporter, but on a small scale. Austria is more in a swapping posture, importing and exporting energy, but Australia has real GNP gains, against the tide of most partner countries.

TABLE 1

Effects of Commodity Price Increase and Constant Oil Price
(Percentage Deviation from baseline except
Trade Balance, Value of Deviation, billions of U.S. dollars)

		Higher Export Prices Developing Countries				Constant Oil Price (1973 value)			
		GNP	GNP Deflator	Consumer Price Deflator	Trade Balance	GNP	GNP Deflator	Consumer Price Deflator	Trade Balance
Australia	1974					−4.2	2.7	0.7	−0.35
	75	1.2	−0.7	−0.2	0.16	−3.9	4.0	1.6	0.35
	76	1.9	−1.1	−0.5	0.03	−5.5	3.4	1.5	0.74
Austria	1974					−0.9	−0.4	−1.4	0.12
	75	0.2	0.1	0.3	−0.03	0.6	−0.2	−1.3	0.24
	76	0.1	0.2	0.3	−0.04	2.2	0.7	−0.8	0.21
Belgium	1974					0.0	−3.1		−0.61
	75		0.5		0.02	2.0	−4.0		−0.78
	76	−0.1	0.6		0.01	2.9	−4.1		−1.00
Canada	1974					−3.6	−1.2	−1.3	−3.44
	75	0.9	0.5	0.6	0.85	−2.5	−3.0	−2.3	−4.14
	76	0.6	1.0	1.0	0.97	−1.8	−4.4	−3.5	−4.19
Finland	1974					−1.5	−1.5	−4.5	0.53
	75	0.5	0.3	0.8	−0.05	−1.4	−2.0	−5.4	0.90
	76	0.7	0.6	1.2	−0.09	−0.6	−3.4	−5.8	1.17
France	1974					1.3	−6.9	−6.4	0.61
	75	−0.4	1.2	1.3	−0.03	4.4	−7.0	−6.7	0.26
	76	−0.6	1.3	1.4	0.02	4.8	−7.5	−7.0	1.60
Germany	1974					0.4	−0.7	−0.7	−0.92
	75	−0.1	0.3	0.3	0.43	0.1	−0.3	−0.3	0.90
	76	0.1	0.6	0.7	1.00	0.3	0.5	0.5	3.20
Italy	1974					0.2	−3.9	−8.8	2.71
	75	0.5	−0.1	0.7	−0.43	3.9	−11.8	−16.6	1.35
	76	0.2	0.4	1.3	−1.17	5.3	−8.3	−12.7	−1.52
Japan	1974					0.9	−0.3	−2.5	6.93
	75	0.0	0.0	0.6	−1.25	5.1	−5.2	−5.4	7.97
	76	−0.7	1.2	1.3	−1.29	10.1	−8.8	−7.3	8.87
Netherlands	1974					0.3	−7.0		0.68
	75	−0.1	1.4		−0.11	2.0	−9.8		0.36
	76	−0.2	2.1		0.04	3.9	−11.1		0.19
Sweden	1974					−0.5		−2.0	−0.50
	75	0.1		0.4	0.11	0.5		−2.2	−0.06
	76	0.1		0.4	0.06	1.8		−2.5	0.09
U.K.	1974					0.3	−3.8	−6.7	7.67
	75	−0.2	1.3	1.7	−1.58	1.5	−8.3	−11.3	9.85
	76	−0.3	2.1	2.6	−1.84	2.6	−10.6	−13.9	12.30
U.S.	1974					−1.0	0.3	−0.5	6.95
	75	0.3	−0.1	0.2	−1.54		−0.3	−1.1	15.01
	76	0.3	−0.1	0.3	−2.52	1.4	−1.1	−2.0	19.72

On balance, the trade accounts would have moved toward surplus. The right-hand side column is dotted with negative entries. Some of these are due to the fact that 1973 oil prices would allow most countries to grow. Those that do, sometimes import so much that trade becomes unsettled again.

Oil is basically a traded commodity, albeit, a highly strategic one. What would have been the disturbance to the world commodity if Saudi Arabia had not been persuaded by the U.S. authorities to use its power to freeze oil prices in 1978?

The sensitivity of the world economy to further price shocks is examined by simulating the LINK system, 1978–79, for different oil price rises – 0, $2, and $4 per barrel.[5] To carry out this calculation, the export prices for group 3 SITC was increased for the oil-exporting countries. The variable appears now as an index, and its level in 1978 was assumed to stand for $14.00 per barrel of crude oil. It was then either held constant or increased by 2/14 or 4/14 for the appropriate case being studied. The increases were implemented for the Middle East, those parts of Latin America, South and East Asia, and Africa corresponding to the inclusion of OPEC countries (Venezuela, Ecuador, Indonesia, and Nigeria), and for Canada. At the time of this calculation it was thought that the increase would come to about $1.00 per barrel, and that figure was used in the standard projections. As it turned out, the case of zero increase, which was one variant on the low side, could best have served as a baseline case. In the present circumstance, we use that as a base case to study the effect of price increases, but it probably will not be the best control position to assume now for 1979.

The clearest story is told by the global totals in Table 2. Oil priced at $2 per barrel higher in 1978 and again in 1979 is the first alternative. The increments are $4 in each year in the second alternative simulation. Each price increase lowers the estimated value of real world output and real world trade. At the same time, inflation rates go up, whether measured by the unit value of exports, the GNP deflator, or the consumer price index. The positive and negative offsets are less than perfect, but the influence of an increase in an import price is more clearly and strikingly shown in the estimates of consumer prices. Estimated inflation goes up by a full percentage point between the no-change and $2 alternative case. This is clearly a potential contribution to global inflation rates. The increase from $2 to $4 per barrel contributes less to overall inflation than does the increase from no change to $2 per barrel. It appears that the large German and Japanese external surpluses are severely reduced as the price of oil rises by an amount from $0.00 to $4.00 per barrel. The changes affect most, but not all, countries in similar ways. The results for a number of countries (LINK countries) are shown in Table 2.

The U.S. trade balance is considerably worsened, as is the real growth rate. The other locomotive countries, Germany and Japan, would be similarly affected, but large trade surpluses would not be wiped out. The U.K. deficit would improve in 1979 but deteriorate in 1978. Other oil-producing or ex-

[5] Dr. Vincent Su of the LINK research staff prepared these simulations of alternative oil prices, 1978–79.

TABLE 2

Effects of Increasing Oil Prices, 1978–1979

(Percentage Point Deviation from No-Change Case,
Except Trade Balance, Value of Deviation, billions of U.S. dollars)

		$2/Barrel Increase				$4/Barrel Increase			
		GDP	GDP Deflator	Consumer Price Deflator	Trade Balance	GDP	GDP Deflator	Consumer Price Deflator	Trade Balance
Australia	78	−0.2	0.0	0.0	−0.25	−0.3	−0.1	0.1	−0.54
	79	−0.2	0.0	0.1	−0.64	−0.4	−0.1	0.1	−1.31
Austria	78	−0.6	−0.1	0.2	−0.29	−0.7	−0.2	0.3	−0.53
	79	−1.2	−0.2	0.2	−0.63	−2.1	−0.4	0.3	−1.04
Belgium	78	−0.9	0.4	0.7	−0.21	−2.1	1.0	1.5	−0.46
	79	−1.6	0.6	1.1	−0.67	−2.6	0.9	1.7	−1.23
Canada	78	0.0	0.5	0.3	0.15	−0.1	1.1	0.6	0.24
	79	−0.1	0.9	0.7	0.10	−0.4	1.8	1.4	0.14
Finland	78	−0.1	0.2	0.3	−0.13	−0.2	0.3	0.6	−0.25
	79	−0.3	0.3	0.5	−0.32	−0.7	0.5	0.8	−0.55
France	78	−0.6	1.6	1.9	−1.87	−1.3	2.9	3.5	−3.71
	79	−0.9	1.9	2.3	−4.31	−1.5	2.8	3.4	−7.59
Germany	78	−0.8	−0.3	– – –	−1.61	−1.8	−0.8	– – –	−3.75
	79	−1.1	−0.7	– – –	−4.18	−1.9	−1.2	– – –	−7.54
Italy	78	−0.6	−0.1	0.4	−1.18	−1.4	−0.3	0.8	−2.39
	79	−0.8	−0.1	0.6	−2.28	−1.2	0.0	1.0	−3.72
Japan	78	−2.3	1.0	6.6	−6.04	−4.9	2.0	7.6	−12.44
	79	−4.0	1.1	6.0	−13.00	−7.1	1.7	6.3	−22.27
Netherlands	78	−0.9	−1.0	0.5	−1.71	−2.4	−2.7	0.9	−2.46
	79	−0.4	−0.2	0.5	−2.86	0.0	−1.6	0.3	−4.80
Sweden	78	0.0	– – –	0.6	−0.66	0.0	– – –	1.2	−1.36
	79	−0.2	– – –	0.7	−1.60	−0.4	– – –	1.0	−2.86
U.K.	78	−0.4	0.4	0.6	−0.24	−0.8	0.8	1.2	−0.45
	79	−0.5	1.2	1.2	0.09	−0.8	2.1	2.0	0.38
U.S.	78	−0.4	0.0	0.2	−6.66	−0.7	0.1	0.4	−14.10
	79	−0.5	0.0	0.2	−15.49	−0.9	0.1	0.4	−30.68
	TWXV		78	$10 b.		$26 b.			
			79	$18 b.		$41 b.			
	PWX		78	4.36%		7.42%			
			79	2.08%		4.92%			
	TWXR		78	$−15.0 b.		$−25.0 b.			
			79	$−25.0 b.		$−43.0 b.			
	GDP (13)		78	$−10.0 b.		$−29.0 b.			
			79	$−32.0 b.		$−73.0 b.			
	PGDP (13)		78	0.25%		0.49%			
			79	0.32%		0.53%			
	PC (13)		78	1.10%		1.49%			
			79	1.08%		1.35%			

TWXV = Nominal value of world trade, billions of US$
PWX = Unit Value of world exports, 1970: 1.0, US$ denomination
TWXR = Real value of world trade, billions of US$ 1970
GDP (13) = Percentage change real GDP, 13 LINK countries, billions of 1970 US$
PGDP (13) = Percentage change GDP deflator, 13 LINK countries, 1970: 1.0
PC (13) = Percentage change consumer deflator, 13 LINK countries, 1970: 1.0

porting countries such as Canada and Netherlands (refined products) would benefit one way or another, the former on trade account and the latter in terms of GNP growth. But on the whole, it is good for the world economy that the line has been held on oil prices for 1978.

Simulations with the LINK system, reported in Tables 1 and 2, provide estimates of the world effect of changes in petroleum and other basic material prices. There are few, if any, systematic world-linked estimates available for verification or validation purposes, but there is a careful study of unlinked estimates of the effects on the U.S. economy alone by a staff team of the Federal Reserve Board.[6] They conclude that consumer price rises between 1971 and 1974 were strongly influenced by dollar depreciation and extraordinarily large increases in export/import prices (mainly food and fuel). About 15 percent of the consumer price rise was accounted for by decline in the dollar's exchange value and 25 percent by the price disturbance. In the simulation of Table 1, with oil prices held constant at their 1973 levels, we estimated that the overall effect on the world inflation rate was about 20 percent of the total price increase in 1974. As an order of magnitude estimate, considering that only one commodity's price rise is being held constant, that only the 1974 effect is being compared, and that the effect is world-wide, the Federal Reserve judgment and the LINK judgment are consistent with each other.

The Federal Reserve team also emphasizes that it is necessary to take into account which prices were affected and why they have risen in order to assess the effect on the domestic inflation rate. If the inflationary impulses come from external sources, stagflation, i.e., rising prices with rising unemployment, can be produced. Demand impulses, internally generated, can produce the standard trade-off relation of falling unemployment and rising prices.[7] The external shock acts like an excise tax, reducing demand, increasing unemployment, and generating inflation. This is a familiar macroeconometric result.

Among the remaining shock scenarios that have been investigated on previous occasions, let us examine capital transfers (v).[8] This case has been worked

[6] R. Berner, P. Clark, J. Enzler, and B. Lowrey, "International Sources of Domestic Inflation", *Studies in Price Stability and Economic Growth,* Joint Economic Committee, U.S. Congress (Washington, D.C.: U.S. Government Printing Office, August 5, 1975), pp. 1-41.

[7] Similar conclusions were reached with Wharton Model simulations by L.R. Klein, "The Longevity of Economic Theory," *Quantitative Wirtschaftsforschung,* ed. by Horst Albach, et al., (Tubingen: J.C.B. Mohr, 1977), 411-19. The Federal Reserve team used the Federal Reserve model.

[8] Protectionism is taken up in L.R. Klein and V. Su, "Protectionism: An Analysis from Project LINK," *Journal of Policy Modeling,* I(1978) 1-30, and wage offensive is in L.R. Klein and K. Johnson, "Stability in the International Economy: The LINK Experience," *International Aspects of Stabilization Policies,* ed. by A. Ando et al., (Boston: Federal Reserve Bank of Boston, 1975). Protectionism generally reduces world trade and growth, with more inflation. Some countries gain but losses outweigh gains. In the case of simultaneous wage pushes in many countries, together, there is noticeable amplification of the final result on price inflation but somewhat less regular than in the case of a quantity shock as occurred in the oil embargo.

out by Carl Weinberg of the LINK staff. He assumed that $20 billion per year, 1976–78, is transferred to the developing countries of Africa, Latin America and South/East Asia. No capital transfer was (assumed to be) made to the Middle East countries. The objective was to examine the effects on growth in the recipient nations but also to estimate the feedback effect on the developed industrial countries to see how prosperity in the developing world induces imports that originate with exports of the developed world. This scenario was worked out on the assumption that the transfer did not arise as a cost item for the developed industrial country. It could presumably have been a transfer within the developing world – as if from OPEC reserves – or from the assets of world organizations such as the IMF. The other case, in which there is a genuine donor's cost, needs to be worked out. It is in process but has not been completed.

In the developing country models there is a variable representing financial inflows. The increment to these flows is distributed to the three developing regions according to their shares of capital inflows historically. It was done for a single year and for three years running. The latter case is analyzed here.

The developing nations gain most clearly and by largest amounts. Among developed nations, the Netherlands stands out. Most countries are grouped from 0.3 to 0.8 percent, as percentage deviations from the baseline case. The developed world gains from the prosperity of the developing countries, but the larger gains are with the latter.

The next world shock could come through a harvest failure.[9] This case is represented by a large price increase for agricultural exports by the big grain-exporting countries – United States, Canada, Australia, Argentina, France. We have assumed for this scenario that prices double in the first year (1978) but slacken as new acreage is brought under cultivation in a supply response.[10] The doubling in 1978 is followed by an increase of 75 percent (over the baseline PX01) in 1979 and by 25 percent in 1980.

The grain-producing countries will have higher export prices for SITC 0,1. Grain-importing countries are assumed to have demand elasticity with respect to price at the low figure of 0.25. Import values of food and imports, generally, rise greatly in the consuming countries. Inflation goes up faster, however, than nominal values; consequently, real magnitudes fall. This holds for both real trade volume and real gross domestic product. Also, the lags in import relationships, as well as at other places of the macro economy, make the time pattern of reaction a bit slow. Larger effects are noted for the second year, 1979, than 1978. The effects are larger in the second year, in spite of the fact that we assumed a supply response adequate to hold PX01 to 75 percent (second year, 1979) and to 25 percent (third year, 1980) increments over the baseline.

[9] "Scenario of a Worldwide Grain Shortage," with Vincent Lee and Mino Polite, LINK memorandum, July 1978.

[10] France and Australia have somewhat lower export price rises since grain exports account for only 30 and 47 percent of total agricultural exports, respectively.

TABLE 3

EFFECTS OF CAPITAL TRANSFERS OF $20 BILLION ON GDP

Percentage deviation from baseline

	1976	1977	1978
AUSTRALIA	0.5	0.7	0.4
AUSTRIA	0.6	1.1	0.5
BELGIUM	0.6	0.6	0.3
CANADA	0.4	0.4	0.3
FINLAND	0.8	0.8	0.7
FRANCE	0.6	0.5	0.3
GERMANY	0.5	0.4	0.4
ITALY	0.7	0.6	0.5
JAPAN	1.0	1.1	0.9
NETHERLANDS	0.8	1.7	1.8
SWEDEN	0.5	0.8	0.3
U.K.	0.7	0.8	0.5
U.S.	0.3	0.4	0.2
AFRICA	3.1	3.4	2.8
SOUTHEAST ASIA	0.7	0.9	0.8
LATIN AMERICA	2.8	2.8	2.3
TWXV	2.6	2.6	2.0
PWX	−0.4	−0.2	0.3
TWXR	3.0	2.8	1.8
GDP (13)	0.5	0.6	0.4
GDP (DEVE)	1.7	1.8	1.5

On a global scale, PX0-9, the export unit value index for all merchandise trade goes up by at most 2.4 percent in the first year, while PX0,1, the export unit value for food, beverages and tobacco goes up by 24.9 percent maximum – also reached in the first year.

The decline in GDP, for 13 major LINK countries in the OECD group, is held to less than 1.0 percent. In the third year, there is some slight relief in the trade surplus for Germany and Japan. In Germany the relief shows up as early as 1978, for this simulation exercise. The United States, as the world's largest grain exporter, gets enough export stimulus to make its GNP slightly larger than in the baseline solution. The U.S. trade deficit is, on balance, a gainer in this scenario. The main anomaly in Table 4 is the United Kingdom. Prices both overall and in the consumer sector are lower in the case of the harvest failure. The movement of GDP and the trade balance are as expected, but the price movement is not.

Inflation goes up slightly in the harvest failure scenario. The overall index of inflation, measured by GDP prices, is about 0.2 above the baseline values in the first two years. In the individual country tabulations, we often find that consumer price inflation is more sensitive to the external price than is the overall deflator. This is perhaps one of the most dangerous and inadequately appreciated aspects of the external shock to the price system.

In the case of the oil embargo, followed by raising of oil prices, there were larger and more dramatic effects on the economy of the whole world, as well as for many national parts. Supply response to fill a gap between supply and demand was weaker in the petroleum case. Also, petroleum has a more extensive interindustry (intermediate processing) use. This makes for bottlenecks and production substitutions. Hence, the oil crisis was able to send the world economy into recession, but this particular agricultural scenario merely slows down growth by fractional points. There is, of course, a great deal of difference between one year's doubling, in the case of grain price, and many years' quadrupling of price in the petroleum case. Although the assumptions may have been large in scope, the final result appears to be fairly mild. It follows a predictable path, and the main value of the LINK exercise is to put empirical magnitudes in proper perspective.

TABLE 4

SIMULATED EFFECTS OF WORLD HARVEST FAILURE

(Percentage Deviation from Baseline Simulation
Trade Balance Deviation billions of U.S. dollars)

		GDP	GDP Deflator	Consumer Price Deflator	Trade Balance
AUSTRALIA	1978	−1.40	0.30	0.70	0.64
	79	−1.10	0.80	1.30	1.25
	80	0.30	0.90	1.20	2.47
AUSTRIA	1978	−3.80	−0.70	−0.30	−0.30
	79	−1.30	−0.70	−0.40	0.00
	80	2.80	0.00	−0.30	1.10
BELGIUM	1978	−1.00	0.60	0.90	−0.20
	79	−0.50	0.50	0.70	−0.10
	80	−1.50	0.10	0.30	−0.50
CANADA	1978	−1.00	1.40	1.00	−1.04
	79	−0.50	1.90	1.80	−0.12
	80	−2.10	1.80	1.50	−0.43
FINLAND	1978	0.00	0.40	0.40	−0.60
	79	0.30	4.70	0.30	0.00
	80	4.80	−1.60	−0.60	0.60
FRANCE	1978	−1.90	1.40	−0.04	1.69
	79	−0.80	1.00	0.00	3.57
	80	−1.80	0.40	−0.20	−1.06
GERMANY	1978	−0.60	−0.30		−1.32
	79	−0.60	−0.50		−1.13
	80	−1.10	−0.90		−2.14
ITALY	1978	5.10	−0.20	1.40	−1.30
	79	3.90	0.60	2.00	−0.06
	80	−7.30	1.20	1.40	4.12
JAPAN	1978	0.50	0.90	1.00	4.55
	79	0.20	1.30	1.30	4.55
	80	−1.30	0.60	0.70	−5.74
NETHERLANDS	1978	0.20	−0.70	0.40	−1.94
	79	0.20	−0.50	0.20	0.21
	80	−4.40	1.20	0.00	−2.05
SWEDEN	1978	−0.20		0.20	0.60
	79	0.20		0.20	−0.10
	80	−0.40		−0.08	1.67
U.K.	1978	0.00	−1.40	−0.10	−0.52
	79	0.40	−1.10	−0.20	0.12
	80	−1.00	−0.60	−0.10	−3.03
U.S.	1978	0.20	0.00	0.07	6.37
	79	0.30	0.10	0.00	7.06
	80	0.05	0.00	0.06	0.88

	Total Trade SITC 0–9	Real Trade SITC 0–9	Unit Value SITC 0–9	Unit Value SITC 0, 1	LINK GDP	LINK PGDP
1978	2.00	−0.80	2.90	24.90	−0.15	0.22
79	2.00	−0.10	2.10	20.70	−0.35	0.22
80	−1.10	−2.20	1.20	9.90	−0.67	−0.17

Discussion

John F. Helliwell

Prof. Klein's paper is an excellent exposition of the results from an important research project. The paper makes two very valuable contributions to the subject of this conference. On the one hand it assesses the price and output impacts of various international disturbances, and on the other hand it puts the history and models of a number of economies on a comparable basis, and thus greatly expands the information base available for our use.

The paper presents a lot of material in an admirably succinct way. At the beginning of the paper, Prof. Klein identifies nine actual or potential disturbances to the world economy. He then outlines the procedures used by Project LINK in combining econometric models of nations, regions, and commodities; and presents example results for the effects of higher export prices for developing countries (1974-76), lower oil prices (1974-76), higher oil prices (1978-79), capital transfers to the developing countries, and world harvest failure.

Before starting my detailed commentary, I would like to make a general comment on Project LINK. I have no doubt that Project LINK provides the most useful, best organized, and best documented explanations and forecasts of past and future evolution of the world economy.

The idea of linking national sources of expertise as well as national econometric models, and of doing so on a continuing basis with coordinated annual forecasts is remarkably daunting, especially to anyone who has had substantial experience in model building and use. I doubt that anyone else but Prof. Klein could have provided the necessary combination of scholarly prestige, technical skills, organizing ability, and diplomacy to make such a project work at all, let alone to continue developments and improvements over a period now approaching a decade in length.

In preparing my comments, I have been able to exploit the excellent documentation of Project LINK to focus the Project LINK models and forecasting experience on the issues facing this conference. Having read all of the papers prepared for the conference, I am inclined to pose three questions that seem to be common among them:

1. Do any models that are based on pre-1974 experience serve to satisfactorily explain the size and duration of the post-1974 stagflation?

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2. If not, are there any specific changes in model structure that would enable the experience of the middle and late 1970s to be better explained?
3. Finally, if one class of model can be demonstrated to have superior logical and explanatory power, what does this class of model suggest by way of policy improvements at the national or international level?

Prof. Klein's application of the LINK models does not address these specific questions, although the general tenor of his presentation presumes the basic validity of the underlying models and emphasizes the importance of higher oil prices in contributing to the high inflation and slow growth of the mid-1970s. I shall try to address myself more closely to the economic structure of the LINK system, in the context of the first two of the questions I have presumed to underlie the papers and discussion at this conference.

The excellent documentation of the LINK system allows an independent researcher, even one situated in a cabin on the far-off shores of Lake Huron, to assess how well the component models have dealt with the mid-1970s, and to examine model structure to look for clues that might explain the pattern of results. The primary sources, in addition to Prof. Klein's current paper, are the LINK forecasts for 1975 and 1976 by Klein et al [1976] and the individual models for 13 industrial countries contained in Waelbroeck [1976][1]. The forecasts, which were prepared at the end of 1974, embody the full extent of the 1973–74 increases in oil prices. To some extent the forecasts are not pure tests of model structure, as they involve forecasts of exogenous variables for 1975 and 1976, plus some exogenous adjustments designed to capture additional depressive effects anticipated in the aftermath of the oil crisis. It would now be possible, and it would certainly be worthwhile, to go back and recreate the same forecasts on an ex post basis, using actual values of exogenous and policy variables, and eliminating any other adjustments to model structure, in an attempt to see whether the actual post-1974 history is adequately depicted by the model structure. For the time being, the comparison of the ex ante forecasts with actual results will provide a valuable first test of whether the domestic and international transmission mechanisms of Project LINK capture the essence of the mid-1970s stagflation.

In the context of this conference, the question to be asked of the LINK models is whether their implied possibilities for growth and inflation are belied by actual experience in the mid-1970s. If there is systematic error, then the subsequent task is to see whether there are specific model improvements that might have helped to explain events rather better. Alternatively, the forecast record from the Project LINK models can be used as a standard against which to

[1] These forecasts were prepared at the end of 1974, and the model descriptions relate to roughly the same structures that were used to generate the forecasts. Also helpful are the papers by Johnson and Klein [1974] and Hickman [1974] presented to Federal Reserve Bank of Boston's 12th Conference in June 1974. Table 1 in Prof. Klein's current paper is drawn from Tables 5 and 6 in Klein et al [1976].

test the forecasting ability of other models based on different data or conceptions of how national economies operate separately and together.

Table 1 shows the forecast and actual percentage changes in real GNP (or GDP in several countries), consumer prices, and wages for 1974, 1975, and 1976 for each of the 13 industrial countries that were then represented by country models within the LINK system.[2] What is apparent from the table is that real GNP in general dropped more or rose less from 1973 to 1976 than was forecast by the models at the end of 1974. If we cumulate the three-year 1973-76 growth paths of forecast and actual growth of real GNP, the 1976 forecast level exceeds the actual level for 10 of the 13 countries.[3] For six of these ten countries the cumulative error is greater than 4 percent. One hypothesis (which is easily testable by re-running the models with actual values for policy variables) to explain this is that the oil-induced balance-of-trade deficits in many countries led them to adopt deflationary policies intended to restore their own trade balances but doing so, if at all, at the cost of lower real growth for the world as a whole.

However, this hypothesis does not square with the results for consumer inflation and for wage rates, which reveal that more inflation took place than could be consistent with the structure of the models and either the actual or the forecast values for real GNP growth. Only for Japan and the Netherlands were the actual (cumulated) 1973-76 inflation rates less than the forecast rates, although for the United States, Sweden, and Germany the cumulated error was about 2 percent or less. For the other eight countries the cumulated three-year error was over 4 percent in all cases, and averaged 8.6 percent for the eight countries.

Turning to the wage forecasts, only for Japan was the actual 1973-76 wage growth less than that forecast at the end of 1974, by an amount cumulating to 3.6 percent by 1976. For Sweden and the United States the 1974 forecasts for the 1976 wage level are almost exactly right, and for Austria, Germany, and the United Kingdom, the cumulative forecast error is about 3 percent or less.[4] For the remaining seven countries the cumulative forecast error (i.e., the excess of the actual 1976 wage rate over the forecast 1976 wage rate) averages 14.9 percent.

Figure 1 shows the pattern of forecast errors for real GNP, and Figure 2 shows the pattern for changes in wages. All of the changes, whether forecast or actual, are measured as the cumulative three-year percent change from the base year 1973 to 1976. For GNP, all of the observations are near or below the 45° line, showing the most of the LINK models overforecast real GNP growth. For

[2] The forecast changes are from Klein et al [1976, p. 9], while the actual changes are from International Financial Statistics. Especially for wage rates, the Project LINK series may not correspond exactly to that reported in IFS.

[3] The exceptions are Belgium, Italy, and the United States. For all three of these countries, as well as for Finland and Sweden, the cumulative error is less than 2 percent.

[4] For the U.K. model the wage rate is exogenous, so the U.K. result contains no information about model structure.

TABLE 1

Annual Percentage Changes, Forecast and Actual 1974–76

		Real GNP		Consumer Prices		Wage Rates	
		LINK FORECAST	ACTUAL	LINK FORECAST	ACTUAL	LINK FORECAST	ACTUAL
Australia	1974	5.4	2.5	10.3	15.1	13.6	22.3
	1975	2.6	1.7	9.6	15.1	12.1	18.5
	1976	2.7	3.5	9.5	13.5	11.4	14.5
Austria	1974	5.4	4.1	8.0	9.5	14.0	16.7
	1975	4.3	−2.0	5.4	8.5	11.7	13.4
	1976	2.6	5.2	4.7	7.3	9.9	9.0
Belgium	1974	3.5	4.9	9.9	12.7	10.9	20.9
	1975	1.6	−2.0	9.0	12.7	12.1	20.2
	1976	2.2	5.5	6.0	9.2	10.7	11.1
Canada	1974	6.2	3.7	14.5	10.9	17.5	13.5
	1975	4.9	1.1	6.1	10.7	9.2	15.7
	1976	6.1	4.9	3.5	7.5	6.8	13.8
Finland	1974	2.9	4.2	14.3	16.6	12.5	21.4
	1975	1.6	0.9	10.7	17.8	14.5	17.6
	1976	1.2	0.4	8.8	14.4	15.0	19.0
France	1974	4.9	2.3	16.7	13.7	17.1	19.2
	1975	3.9	0.1	7.0	11.7	11.0	20.3
	1976	4.4	5.2	6.6	9.2	11.1	16.5
Germany	1974	1.7	0.4	6.7	7.0	8.3	10.2
	1975	2.9	−2.5	2.9	5.9	4.8	7.9
	1976	3.0	5.6	5.6	4.5	8.2	6.4
Italy	1974	3.1	3.9	19.2	19.1	20.9	20.1
	1975	−1.6	−3.5	19.9	17.0	30.8	28.0
	1976	3.0	5.6	11.3	16.8	4.1	20.8
Japan	1974	−2.3	−1.2	25.2	24.3	27.6	24.8
	1975	5.9	2.4	13.4	11.9	19.1	16.9
	1976	7.9	6.0	8.3	9.3	12.1	12.6
Netherlands	1974	4.4	4.2	13.3	9.5	6.7	17.3
	1975	2.7	−2.3	9.1	10.3	8.2	13.6
	1976	4.1	5.2	8.0	8.8	7.1	9.0
Sweden	1974	4.0	4.0	11.0	9.9	15.2	10.8
	1975	2.4	0.9	10.5	9.8	14.1	14.9
	1976	2.0	1.7	6.6	10.3	13.9	17.5
U.K.	1974	−1.5	−0.6	16.9	16.0	17.2	17.9
	1975	2.8	−1.4	17.9	24.2	24.2	26.6
	1976	3.5	2.5	11.3	16.6	16.2	16.0
U.S.	1974	−0.8	−1.4	11.0	10.9	8.5	8.1
	1975	0.4	−1.3	7.9	9.2	8.2	9.1
	1976	2.9	6.0	5.5	5.8	7.4	7.7

Figure 1

1973-1976 CHANGE IN REAL GNP

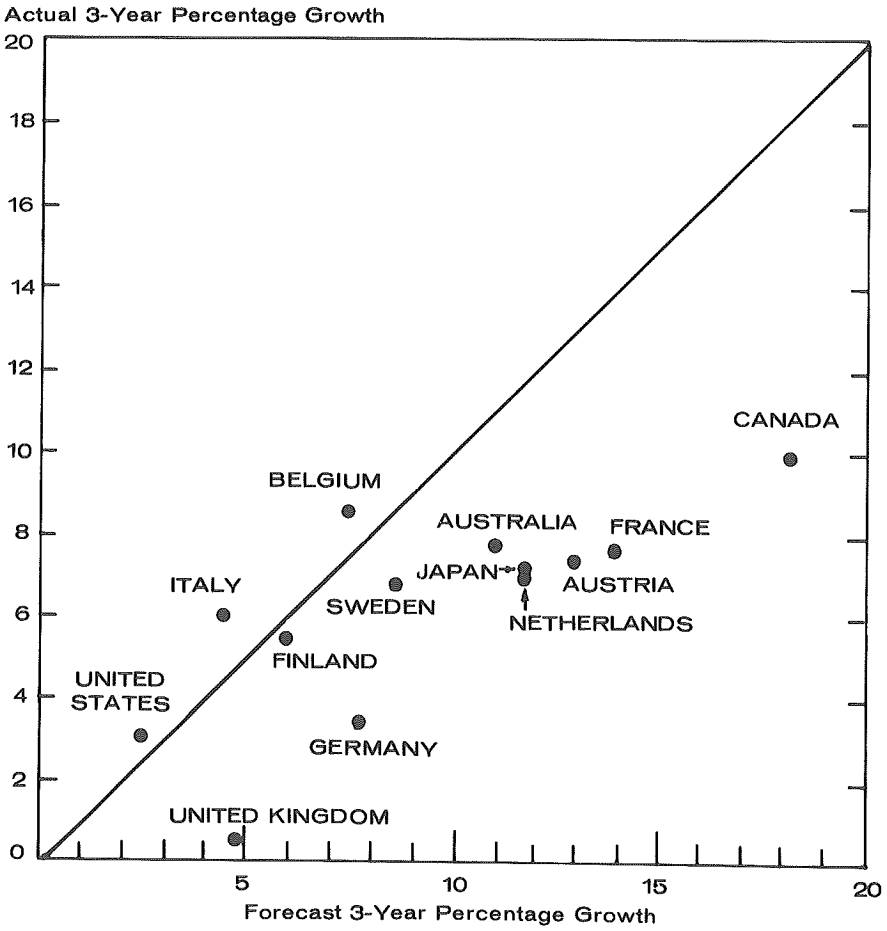
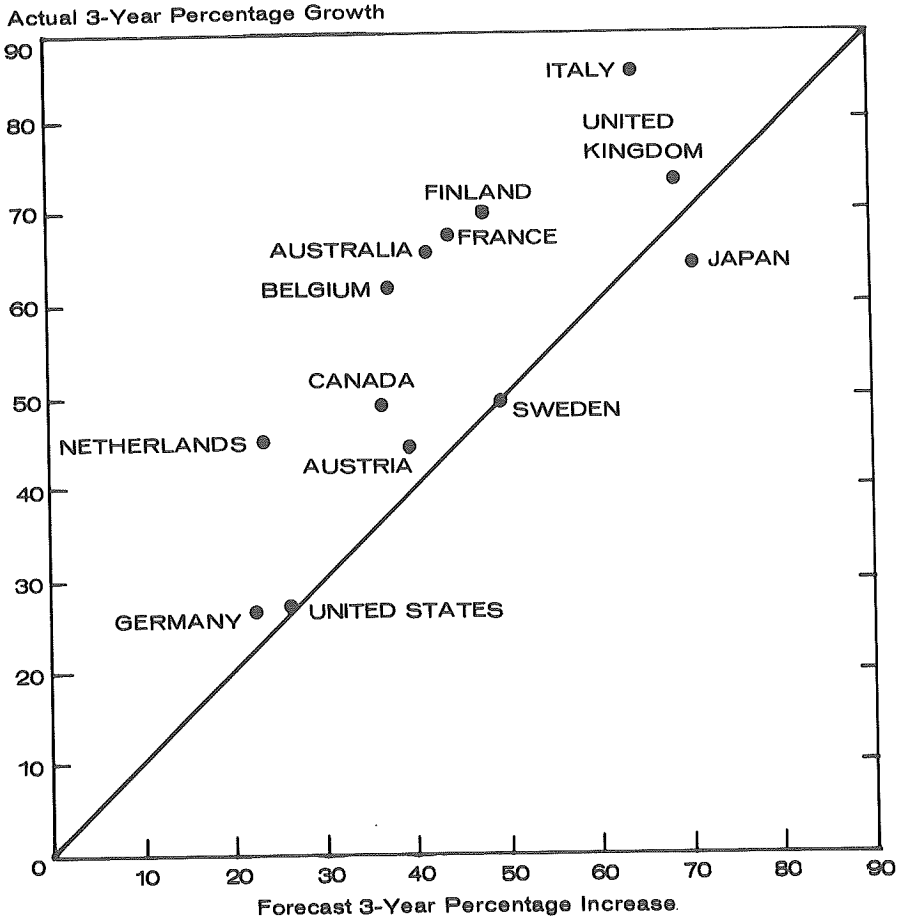


Figure 2

1973-1976 CHANGE IN WAGES



wage increases, all of the observations are near or above the 45° line, indicating that wage increases tended to be underforecast.

Figure 3 brings the wage and GNP forecasts and actuals together in an all purpose graph. Three-year wage changes are measured on the vertical axis, with 0 at the origin. Three-year growth of real GNP or GDP is measured on the horizontal axis, with 20 percent at the origin and going down as one moves to the right. Conventionally defined virtue is attained as one approaches the origin along either axis. The small circles represent the Project LINK 1974–76 forecasts for each of the 13 countries, while the asterisks represent the actual outcomes. The light lines with arrows connect the forecast and actual values for each country. Good wage forecasts are represented by arrows that are short in the vertical direction; good GNP forecasts by arrows that are short in the horizontal direction.

If there is any meaning to be attached to a cross-sectional definition of a Phillips-type relationship linking output growth and wage growth, then it can be defined in two ways: The circles define the cross-sectional frontier according to the Project LINK models with their assumed pattern of policies and external events, while the asterisks represent the observations based on what actually happened.

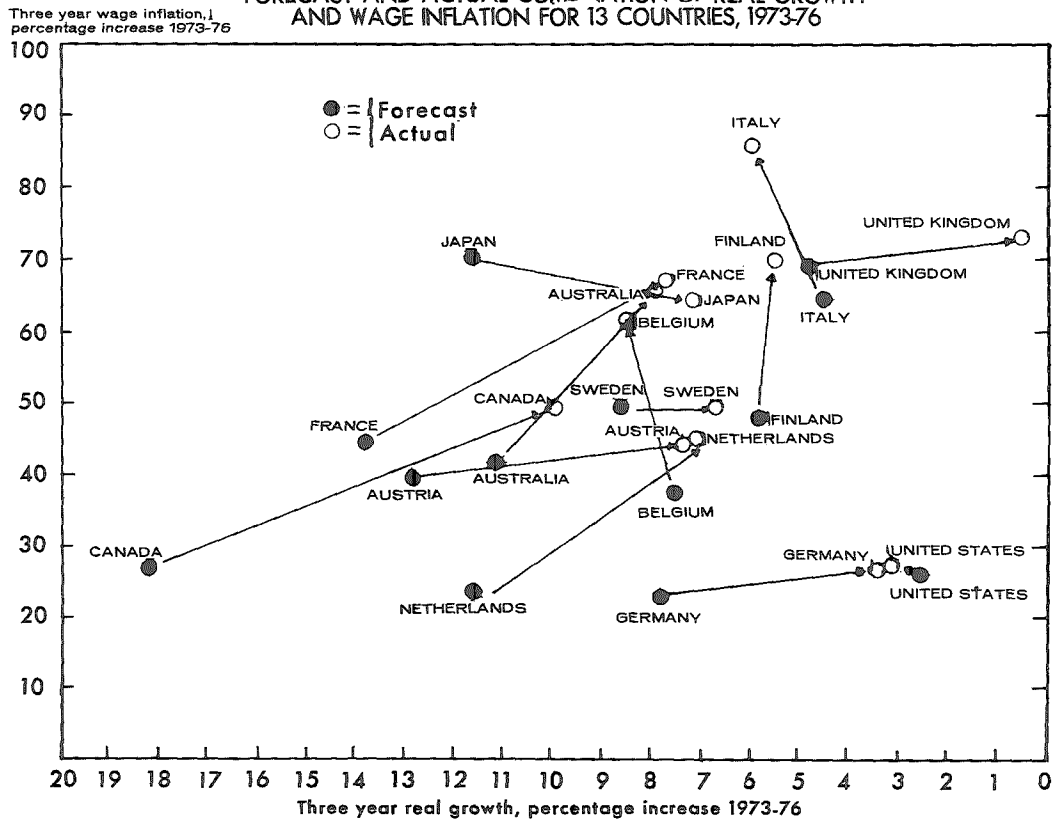
Neither the circles nor the asterisks represent a clearly defined frontier, although it is apparent that any curve that could be fitted would be further from the origin if fitted to the actual observations than if fitted to the model forecasts. Another way of putting this is that 8 of the 13 arrows point North-East, indicating that there was less GNP growth and more wage inflation than was forecast. Of the other arrows, that for the United States is so short as to represent almost perfect forecasting from 1974 to 1976: those for Sweden and Japan point South-East, with less growth of GNP and of wages; and those for Italy and Belgium involve more growth of GNP and of wages. None of the arrows point South-West towards the origin.

Hence we must conclude that most of the Project LINK national models, whose fitting periods generally ended between 1969 and 1971, had structures that were too optimistic about the possibilities for the 1974–76 period. If the forecasts had been made in 1973, then the over-optimism might have been due to the failure to consider the effects of the oil price increase, and not to the structures of the models themselves. As Prof. Klein's Table 1 shows, the Project LINK models would have shown markedly more growth in real GNP and less growth in wages and prices without the"excise tax" effects of the oil price increases of 1973 and 1974. However, the forecasts I have been examining were made after the oil price increases, and take them fully into account.

My next task is to examine briefly the structural characteristics of the models to see if there are important respects in which they might have understated the stagflationary effects of the oil price increases. If so, then it is possible that the oil price increases, when combined with the government and private sector behaviour as depicted in the models, could give a reasonably accurate

Figure 3

FORECAST AND ACTUAL COMBINATION OF REAL GROWTH AND WAGE INFLATION FOR 13 COUNTRIES, 1973-76



picture of the evolution of the major industrial economies through the middle and late 1970s.[5]

Before I proceed with that task, however, it is worth noting that the Project LINK forecasts did manage to capture the 1974–76 industrial recession and recovery, at least in their broad terms. Although the LINK models did in general overestimate growth and underestimate inflation between 1974 and 1976, their forecasts were far better than could have been obtained, for example, by simple extrapolation of previous trends. This is true whether one is interested in explaining world trends or intercountry differences. Looking first at the average experience of the industrial countries, the average 70–73 GNP growth was 16.2 percent (over the three years), the average LINK forecast for the 1973–76 was 9.3 percent and the average actual was 6.2 percent. For consumer prices, the LINK forecasts were even better, averaging 34.4 percent, compared to the 73–76 actual of 36.5 percent and the 70–73 actual of 21.4 percent. For wages, the average LINK forecast of 45.0 percent for 73–76 was less than one-third of the way from the 70–73 actual of 40.8 percent to the 73–76 actual of 56.1 percent.

Looking at intercountry variation, cross-sectional regressions of the actual three-year growth (of real GNP, wages, and prices) from 1973–76 were run alternatively on the LINK forecasts and the 1970–73 actual growth rates. In all cases the LINK forecasts explained more of the actual cross-sectional differences that did previous experience. The LINK forecasts were relatively strongest for real GNP and consumer prices. The LINK forecasts explained 56 percent of actual intercountry variance in actual 1973–76 growth rates of real GNP. By contrast, the 1970–73 actual figures explained only 22 percent of the 1973–76 intercountry variation. For consumer prices, the LINK forecasts explained 78 percent and the 1970–73 actual 51 percent of the intercountry variance for 1976 over 1973. For wages, the LINK forecasts explained 62 percent of the actual variance, while the earlier experience explained 49 percent. In addition, there was less average bias in the LINK forecasts as predictors, as their slope coefficient was in all cases closer to 1.0 than was the slope coefficient for the regressions based on previous experience.

I turn now to my second question, which asks whether there are specific changes in model structure that might have made the Project LINK models better able to handle the 1974–76 period. Following Prof. Klein's emphasis on international disturbances, I shall concentrate on the ability of the models to depict the consequences of the oil price increases.

The first and most obvious thing to note is that capital flows and exchange rates are not determined within the Project LINK system; and monetary policies, to the extent that they are modeled at all, are in general defined with interest rates or the money supply treated as exogenous. As a consequence, the

[5] Even here, there is the possibility that the 1974 forecasts already involved such heavy adjustments to the wage-price mechanisms of the national models that the correctness of the aggregate forecasts for wages, prices, and output would not provide any test of the aptness of the underlying model specifications. To check this possibility would require more information than is available to me.

models are incapable of showing the distribution or monetary consequences of the OPEC-related capital flows. With no modeling of capital flows, it is not possible to realistically model exchange rates; indeed, the asset approach to flexible exchange rates emphasizes how important it is to model capital flows and exchange rate expectations in a consistent manner. Although I would be surprised if the multilateral determination of capital flows and exchange rates were not fairly high on the Project LINK research agenda, the monetary repercussions of oil price increases and the resulting trade imbalances are for now handled in an ad hoc manner, with exchange rates set exogenously and then reassessed in the light of the trade imbalance implied by the Project LINK solutions for trade prices and trade flows. In general, one would have to conclude that the domestic and international determinants and consequences of monetary policy, including private sector expectations about future policies, are not adequately handled within the Project LINK national models.

Within the present structure of linkages, what are the various features of an oil price increase that might have important macroeconomic consequences for the oil-consuming countries?

1) A rise in the oil price implies worse terms of trade and lower real incomes and real money balances for the consuming countries. To model this correctly, it is necessary that the absorption price rather than the output price be used to deflate income and wealth in spending equations. In most of the Project LINK models this requirement is partially met by deflating disposable income by some measure of consumer prices.

   The treatment of real balances is less satisfactory; five of the models had no monetary sector at all, and six used the output price to define real balances. Only the U.S. and U.K. models used the consumer price to determine real balances and the real value of bank lending.

2) Even if the absorption price is correctly used to define real incomes, it is also necessary that the price of traded goods should influence the absorption price in some appropriate manner. Of the 13 models presented in Waelbroeck [1976], four do not contain any direct channel for import prices to influence the absorption price. These models, and several others in the Project LINK system, have absorption prices responding to current unit labor costs (rather than permitting current and normal unit labor costs to have separately estimated effects), and thus show temporary price increases in response to demand reduction.

3) If oil price increases lead to trade deficits that are financed by capital account inflows, then the accumulation of foreign indebtedness requires a continuing increase in foreign interest payments with a corresponding drop in GNP. Unless these increasing interest payments are appropriately modeled, the rate of growth of GNP for borrowing countries is likely to be seriously overstated. Of all the 13 models, only that for Japan depicts foreign interest payments in such a way as to show them rising with the size of foreign indebtedness. In all of the other models, foreign debt service

payments are either exogenous or modeled without proper feedback from the stock of debt to the flow of interest payments.

4) If net foreign interest and dividends are properly modeled, then it is also important to make endogenous the distinction between GNP and GDP. Gross national product is the income of residents, while gross domestic product is income produced by labor and capital employed within the national boundaries. Where net foreign indebtedness is changing fast, as in the aftermath of the oil price increases, then GNP and GDP can move rather differently, because net debt service payments to foreigners must be added back to GNP in the derivation of GDP. If this were not done, then the derived demands for domestic factors of production, which should be based on expected growth of GDP rather than GNP, would be falsely reduced. Only the Canadian model has the appropriate endogenous distinction between GNP and GDP, but it does not serve the intended purpose because the net interest payments are not properly based on the stock of foreign indebtedness.

5) Finally, there is the important question of how domestic wage rates respond to changes in the terms of trade. In the Scandinavian model of inflation (for a survey, see,e.g., Jorgen Gelting [1974]), the wage rate is set by productivity in the traded goods sector. In the present context of a terms of trade shift, and with emphasis on a rise in the price of an import with few domestic substitutes, the wage rate would remain relatively fixed in the face of the oil price increase. Most of the Project LINK models do not focus on the output price but on the consumer price as a key determinant of money wages. This procedure, relative to the alternative of using the output price or some similar measure of the marginal revenue product of labor, means that the domestic economy will incur more wage inflation and more unemployment. The reason is fairly obvious. If a deterioration in the terms of trade leads to an offsetting increase in the money wage, then the real wage will be above its equilibrium level and the levels of employment and output will be correspondingly reduced.

   It is not easy to decide whether the output or the consumer price ought to be the key determinant of money wages; in principle, especially at the industry level, both ought to have some importance. If, at the aggregate level, a choice has to be made, then the consumer price seems a better bet, if only because it produces more stagflation in response to an oil price increase, and the existing model structures have tended to underestimate the resulting degree of stagflation.

   The recent variability of the relative prices of traded goods, and hence in national terms of trade, gives rise to another hypothesis about the effects of international price disturbances on domestic wages and prices. It is at least possible that sequential favorable and unfavorable changes in the terms of trade have an upward ratcheting effect on domestic wages and prices. When the terms of trade improve, then domestic wages would rise to claim a share of the higher national income, as they are supposed to have done in

Australia during the mineral boom of the early 1970s. But when the terms of trade deteriorate, then emphasis may shift to achieving real wage protection, with consumer price increases used to define minimum increases in money wages. Such a ratcheting mechanism has no place in any aggregate model of wage determination, and its theoretical rationale is as weak as that of most ratchet models, but it may nevertheless have something to contribute to explanations of the continuing high rates of inflation and slow growth.

That is enough by way of discussion of the structural features of the Project LINK models. Although I have made a number of suggestions for improving the ability of the models to capture the repercussions of oil price increases, the suggestions I make are not such as to threaten Prof. Klein's main conclusion that the oil price increases have been an important source of the mid-1970s stagflation in the industrial economies. There are two reasons for my confidence that his basic conclusion is correct. First, my comments are based on the versions of the models used for the results reported by Prof. Klein in his Table 1. Several of the models have since been updated; and in several cases have built in more appropriate treatment of oil price increases. The results in Prof. Klein's Table 2, which are broadly consistent with those in his Table 1, are based on the updated versions of the models. Thus the changes made so far to the LINK system have been such as to strengthen the basis for Prof. Klein's conclusion. Second, almost all of the suggestions I have made are such as to increase the estimated stagflationary effects of an oil price increase, and hence would be likely, if implemented, to strengthen rather than weaken his main conclusion that oil price increases have been a key source of the post-1974 stagflation in the international economy.

Thus, my brief review of the LINK models and results tends to support the view that major increases in import prices, however they may be caused, tend to have stagflationary consequences for the importing countries. This does not, however, provide any direct evidence about, for example, the relative importance of monetary and nonmonetary causes of the world inflation of the 1970s, or about the origins of the increases in the prices of oil and other major commodities. The models of Project LINK could be used to provide one interpretation of these other issues, and the high standards of LINK documentation will permit the LINK view to be methodically tested and compared with explanations from models with different structure and emphasis. I must conclude by repeating my note of congratulation to Prof. Klein and his collaborators for their continuing focus on issues of great importance, and for their continual high standards of care and clarity in the documentation of models and forecasts.

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