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Money, Inflation and Trade in the Pacific Basin

Future historians will probably write bookshelves about the striking fact that most of the economic success stories of the late 20th century have occurred in the islands and peninsulas of East Asia. Japan of course is the obvious example, but South Korea, Taiwan, Hong Kong, Singapore and Malaysia all can boast similar successes. The causes of this phenomenon are many and complex—cultural strengths, market disciplines and many other factors are surely involved. We do not attempt any broad answers here, but we are able to throw some light on the subject by investigating whether the traditional tools of monetary and fiscal policy apply differently in these fast-growing Pacific Basin countries than in the United States. The three papers in this issue apply new views on macro-economic policy and new analytical techniques in an attempt to advance the discussion.

Charles Pigott examines Japan's experience with counter-cyclical monetary policy, especially in the context of the "rational expectations" argument that a policy of this type is likely to be ineffective. As the theory goes, counter-cyclical policy has no systematic effect on real variables once private agents determine how the authorities conduct their policy. Once the policy is known, the changes in the money supply it produces are predictable, so that they then cease to influence real activity. But Pigott's results suggest, at least tentatively, that counter-cyclical policy has been used effectively, in the sense that it has not been frustrated by offsetting actions of the private sector.

Over the 1957–77 period, Pigott finds, anticipated increases in Japanese money growth stimulated real economic activity—particularly industrial production—while anticipated reductions in money growth depressed activity. But these findings for Japan are nearly opposite to those found in some recent studies of U.S. monetary policy. Taken together, these results imply that in Japan, the predictable part of money growth affects real output most heavily, while in the U.S., only unanticipated money growth influences economic activity. Institutional factors may account for some of these differences. In Japan, short-term capital markets are less developed—and close substitutes for money are thus less available—than in the United States. Moreover, Japanese corporations are strongly dependent upon the private banking sector for external funds, because of the relatively underdeveloped nature of Japanese bond and equity markets.

Pigott adds that the contrasting results might also reflect differences in U.S. and Japanese monetary policies. In Japan, M_1 grew (on average) at a stable pace, whereas in the U.S., money growth generally increased from the mid-1960's through the early 1970's. "This suggests that an unexpected acceleration of money growth in the U.S. was often followed by further above-average increases, while in Japan, on the other hand, money acceleration was generally followed within several quarters by deceleration. Consequently, an unanticipated money change in Japan, once perceived by individuals, possibly could have had a more temporary impact on real balances than would have been the case in the U.S."

The success of the East Asian economies has not encompassed price stability, according to Michael Bazdarich. He notes that a pattern of persistent inflation has occurred over the 1957–77 period in eight Pacific Basin countries—six East Asian countries plus the United States and Australia. Price levels have climbed steadily in those countries, and at average rates that are high by historical standards. "Furthermore, there is no sign of a slowdown in this phenomenon. World inflation has not been a temporary outbreak, confined to a few commodity prices, but a continuing process affecting all prices."

In this analysis, Bazdarich argues that inflation can continue only if there are continuing in-

creases in the money supply. In both the 1957–67 and 1967–77 periods, he finds statistically significant evidence of a relation between a country's rate of money-supply growth and its inflation rate. Using Granger causality techniques, he finds that the causality runs from money growth to inflation rather than the other way around. The only two exceptions have the wrong sign, indicating that a rise in the price level leads to a decline in the money supply. Pigott's analysis suggests why this has occurred in Japan's case—the Japanese authorities have acted to reduce money growth when faced with a rising inflation rate relative to abroad.

Bazdarich investigates four factors which have been said to affect money-supply growth and therefore inflation—increased wage demands, the OPEC oil-price hike of 1973, government deficit spending, and the international transmission of inflation from abroad. Given the money-price results, these sources of pressure would have to have a systematic effect on money-growth rates if they were systematically responsible for persistent inflation. But here, Granger causality tests showed little causal effect on money-supply growth from these commonly reputed "inflationary" disturbances, so that they cannot be considered sources of continued inflation. Thus he asks, "If none of these factors have been consistent causes of inflation, why have the Pacific Basin countries experienced monetary expansion and inflation? One explanation that is consistent with our results (although obviously not proven) is that monetary policy has been truly discretionary, designed to manipulate the ups and downs of the business cycle."

In a third article, Hang-Sheng Cheng contrasts the different approaches toward balance-of-payments adjustment taken by fast-growing Korea and Taiwan during the past several years. Both countries sustained unusually large current-account deficits and borrowed heavily abroad following the 1973–74 oil shock, so that the world banking community became concerned over their mounting debts. Yet barely two years later, both countries' balance of payments showed dramatic improvements and the earlier fears evaporated—indeed, international bankers began to worry instead that they would make early debt repayments or refinance on more favorable terms.

After the initial oil shock, Korea reduced its trade deficit primarily by continued export expansion, while Taiwan acted by drastically reducing its imports. This difference in adjustment paths largely reflected differences in exchange-rate policies—in particular, Korea's 18-percent devaluation in 1974 on top of Taiwan's 5-percent appreciation in 1973. In Cheng's words, "The exchange-rate changes made Korea's export expansion possible and Taiwan's import contraction inevitable. The different adjustment paths meant, for Korea, sustained output growth at the expense of domestic price stability, and for Taiwan, income stagnation coupled with a low rate of domestic inflation."

During the 1975–77 period, however, both countries' trade balances improved rapidly, primarily because of world economic recovery coupled with high world-income elasticities of demand for the two countries' exports. Indeed, Cheng notes that the world's income elasticities of demand for Korea's and Taiwan's exports are substantially larger than these countries' income elasticities of demand for imports. The differences help account for a long-run rising trend in both countries' export-import ratios.

Rational Expectations and Counter-Cyclical Monetary Policy: The Japanese Experience

Charles Pigott*

Scholars of postwar Japanese economic history generally agree that Japanese monetary policy has significantly influenced the cyclical variations in the nation's economy. According to a common view, the authorities reacted to reserve losses during the 1950's and 1960's by slowing the rate of monetary expansion, thereby reducing the growth of investment and real GNP. Monetary policy was the government's primary counter-cyclical policy tool throughout most of this period, since deficit finance was severely constrained both by law and by the relatively underdeveloped state of Japanese capital markets.

This explanation reflects a widely held view of the influence of monetary policy upon economic activity. Until recently, most economists believed that, despite the lack of any permanent relationships, variations in money growth exert a significant and systematic temporary influence on real growth and unemployment. This view, supported by statistical analyses of the various empirical relationships involved, implied that counter-cyclical monetary policy can, in principle, reduce fluctuations in real income. Because of the wide acceptance of this hypothesis, debates about counter-cyclical monetary policy have tended to focus on whether enough is known about the timing and magnitude of the effect of money-stock changes for such a policy to be effectively employed.

Recently, however, several economists have suggested that counter-cyclical monetary policy, as normally implemented, exerts no systematic impact on real economic activity in either the short run or the long run. Their argument rests on two distinct contentions.

First, they claim that private agents intelligently use all available information in forecasting economic events. This hypothesis, known as *rational expectations*, implies that policy rules relating money growth to observable variables, such as past employment or prices, will be used by private agents to forecast future money stocks. Secondly, they assert that anticipated money-stock changes do not influence real output even in the short run. Under this hypothesis, variations in prices, rather than real spending, absorb predictable fluctuations in money growth rates.

These two propositions imply that counter-cyclical monetary policy has no systematic effect on real variables once private agents determine how the authorities conduct their policy. Once the policy is known, the changes in the money supply it produces are predictable, so that they then cease to influence real activity. If this view is correct, a rule prescribing steady money growth becomes more desirable. Such a rule then is no less effective than any other in smoothing business cycles, and may possess the additional virtue of minimizing uncertainty about official policy.

This article attempts to test whether Japanese real growth in the 1957-77 period was systematically influenced by the changes in the Japanese money stock that could have been predicted by an informed economic observer. Evidence that in the U.S. predictable money growth had no influence on real activity has been presented by Barro (3, 1977) and Sargent (8, 1976). More generally, the article examines whether anticipated and unanticipated money growth had different impacts on Japanese real output.

In section I of this paper, we review several theories concerning the impact of counter-cyclical monetary policy, and examine the assumptions underlying the contention that it is ineffective. It is argued that because of "frictions" such as contractual wage and price agreements, counter-cyclical monetary policy may influence output even if expectations are fully rational.

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Section II presents an equation explaining Japanese M_1 growth over the 1957-77 period, and uses this to estimate the anticipated component of money changes. Section III tests the relationship between changes in the money stock and real economic activity. The results, although far from conclusive, suggest that anticipated money growth temporarily influenced the growth of Japanese industrial production and of real GNP. They also suggest that anticipated and unanticipated components of money growth had qualitatively different impacts upon Japanese economic activity.

I. Theories of Counter-Cyclical Monetary Policy

Developments of the last several years have raised doubts about the value of monetary and fiscal policies in combatting cyclical variations in income and employment. Traditional stimulus instruments—tax cuts, public-works expenditures, expansive monetary measures—that seemed effective during the 1960's appear now to have lost their effectiveness in many industrial countries. Public confidence in "fine-tuning" is at a low ebb.

Partly as a result of these events, theoretical views of the impact of counter-cyclical policies have changed substantially. This revision has centered around the theme of expectations: how agents form them and how they influence behavior.

These developments are illustrated by the evolution of theories about the influence of monetary policy on economic activity. During the 1960's, many economists believed that there was a stable—and in practical terms, permanent—trade-off between inflation and unemployment. The implication was that government could reduce the average unemployment level by increasing the long-run inflation rate through expansionary monetary policy. This view greatly influenced macro-economic policy in the U.S. and other industrial countries.[1]

As theoretical attempts to justify this hypothesis failed—and as the trade-off became increasingly unstable beginning in the mid-1960's—most economists came to view significant systematic associations between inflation and unemployment as temporary. The new theories developed to explain the short-run relation between these variables came to be based on the propositions that a) unemployment is influenced by *unanticipated* but not by anticipated variations in the price level; and b) in the long run, actual and anticipated inflation rates are equal. Hence an increase in the inflation rate could have only a transient influence on economic activity.

However, because such theories required only that actual and anticipated price changes coincide eventually, they generally left open the possibility that monetary policy could systematically influence real output over the business cycle. In empirical applications, expected price changes were normally assumed to depend on past inflation and (in some cases) other variables in a manner invariant to changes in government policy. This implied that the authorities could successfully conduct counter-cyclical monetary policy by relating unanticipated price and money changes to past fluctuations in activity, as we will see below.

The theory of "rational expectations," introduced by Muth (6, 1961) and developed further by Barro (2, 1976), Sargent (8, 1976), Lucas (5, 1975) and others, considerably refined the formulation of expectations in such models by making anticipations depend explicitly upon the structure of the economy and government policy. But, when combined with the assumption that predictable money changes have no influence on real activity, this view implies that counter-cyclical monetary policy is ineffective once the private sector determines how the policy is conducted.

The Phillips curve

To illustrate the implications for monetary policy of these different views, consider a simple model of the unemployment rate.

$$u(t) = a_0 + a_1 u(t\text{-}1) + a_2 u(t-2) + Z + e(t) \quad (1)$$

where $u(t)$ is the unemployment rate at time t, $e(t)$ is a random disturbance, and Z is a set of other variables influencing unemployment, including policy instruments. The unemployment rate is affected by its own past values because of delayed responses of consumption and invest-

ment to income and other lagged relations. Because of this dependence, a change in u(t) caused by the disturbance leads to further changes before unemployment returns to its long-run level. In this way, fluctuations in unemployment that resemble business cycles are produced. This process is described in detail by Larry Butler in the spring 1977 issue of this *Review*.[2]

Counter-cyclical policies are designed to reduce the severity and duration of business cycles. This is done by using the government's instruments contained in Z to offset the effects of past fluctuations in u(t). This, in effect, changes the relation between current and past unemployment and reduces business-cycle fluctuations. The controversy raised by rational expectations centers about how the government accomplishes this task.

During the 1960's it was widely believed that one element of Z was the actual change in prices $\Delta p(t)$ ($\equiv p(t) - p(t-1)$. This relation was known as the "Phillips Curve".[3] A simple version of this relation can be written as:

$$u(t) = a_0 + a_1 u(t-1) + a_2 u(t-2) - a_3 \Delta p(t) + e(t) \qquad (2)$$

where a_3 is positive. This implied that the government could, by varying money-supply growth, manipulate price changes, thereby influencing unemployment. In addition to smoothing economic cycles, the appropriate choice of money-stock growth could influence the long-run rate of inflation, and thus permanently alter the average rate of unemployment as well.[4]

Natural-rate hypothesis

This view of the relation between monetary policy and economic activity has now been largely discarded by economists. Current theories generally incorporate the "natural rate" hypothesis that trade-offs between inflation and unemployment are at best temporary, although possibly long-lived.[5]

This hypothesis says that the unemployment rate is equal in the long run to a value, known as the "natural rate of unemployment", which is determined by the cost of searching for jobs, the demographic composition of the labor force and other factors. The natural rate is assumed to be unaffected by changes in the money stock or inflation. This reflects a proposition known as the "neutrality" of money, which asserts that a change in money leads eventually to a proportional change in all prices—leaving unaffected all relative prices and all determinants of the natural rate. The proposition follows intuitively from the observation that a typical individual whose money holdings are doubled while all prices are raised in the same proportion has precisely the same real income and real money balances, and therefore the same opportunities for consumption and leisure, as he did previously; thus his behavior should not be altered.[6]

Most formulations of the natural-rate theory assume that predictable changes in money have the same effects in the short run as in the long run. Anticipated money-stock changes are often assumed to lead immediately to proportional changes in all prices, leaving unemployment and real output unaltered. This implies, in effect, that individual spending decisions depend only upon current and future relative prices and real money balances, and not upon variations in the level of prices.[7]

Natural-rate theories attribute temporary associations between unemployment and inflation to unanticipated changes in money and the price level. According to one account, an unexpected rise in the money stock raises aggregate demand. Because the increase in the total money stock is not immediately perceived (in part because reliable statistics are published with a lag), firms generally confuse the increase in aggregate demand with an improvement in the market for their own products. Firms then move up their supply curves, increasing employment, output and prices. However, once the money-stock increase becomes known, output and employment return to their normal levels. Natural-rate theories thus imply that an unanticipated money-stock increase initially stimulates activity. Furthermore, because a sustained increase in the growth rate of money must eventually become anticipated, its influence on economic activity cannot be permanent.[8]

The natural rate and counter-cyclical policy

A simple version of the unemployment relation implied by natural-rate theories is:

$$u(t) = a_0 + a_1 u(t-1) + a_2 u(t-2) - a_3(\Delta p(t) - \Delta p(t)^e) + e(t) \qquad (3)$$

where now $\Delta p(t)^e$ is the change in the level of

prices anticipated by economic agents. As explained above, a_3 is generally assumed to be positive.[9]

In contrast to the earlier unemployment relation, this implies that a sustained change in the growth of the money stock has no permanent influence on economic activity. This is because money-stock changes, and the inflation they cause, eventually become anticipated; that is $\Delta p(t) = \Delta p(t)^e$ in the long run. Hence, the unemployment rate returns to its "natural" level.

However, until recently formulations of this theory implied that counter-cyclical monetary policy could at least exert a short-run influence on economic activity. The reason is that expectations about prices and money growth were assumed to be formed in a manner that did not directly depend upon government policy. Under "adaptive" expectations, for example, expected prices changes were a function of past inflation:

$$\Delta p(t)^e = \sum_{i=1}^{n} h(i)\Delta p(t-i) \qquad (4)$$

where the h(i) were assumed to be fixed (the h's sum must also equal one if a permanent increase in inflation is eventually anticipated).

Assume, for illustrative purposes only, that prices immediately adjust to current money-stock changes $\Delta m(t)$; that is, that $\Delta m(t) = \Delta p(t)$. Then even in this simple case, a counter-cyclical policy rule of (say) the form:

$$\Delta m(t) = c_0 u(t-1) \qquad (5)$$

will influence cyclical fluctuations in unemployment. To see this, substitute from (5) into (4) to relate expected price changes to past unemployment:

$$\Delta p(t)^e = \sum_{i=1}^{n} h(i)\cdot c_0 u(t-i-1) \qquad (6)$$

Then, since actual price changes equal current money stock changes, unemployment can be written as:

$$u(t) = a_0 + a_1 u(t-1) + a_2 u(t-2) - a_3 c_0 u(t-1) + a_3 c_0 \sum_{i=1}^{n} h(i) u(t-i-1) + e(t) \qquad (7)$$

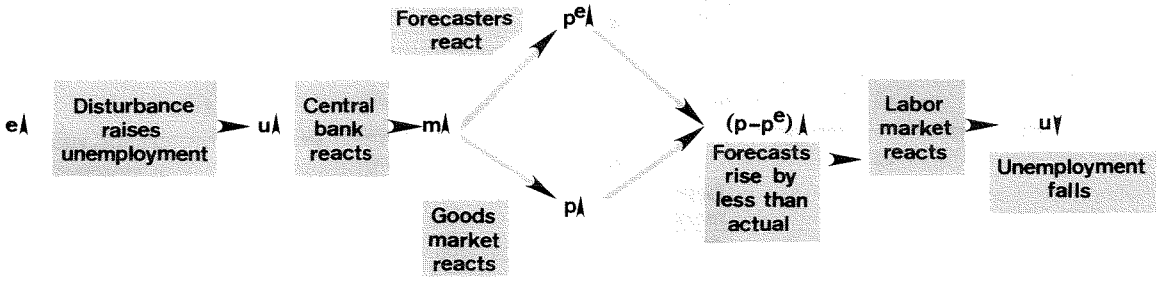
The last two terms in unemployment have been added by the counter-cyclical policy and the expectations mechanism (4). These terms change the size and duration of the fluctuations in unemployment.

More generally, a "reaction" function relating money-stock changes to past unemployment can be designed so that business-cycle fluctuations are reduced. This process is illustrated in Diagram (1). A rise in unemployment caused by the disturbance "e" leads, through the action of the monetary authorities, to an increase in the money stock, "m," and then to an increase in the price level, "p". The price level expected by individuals, "p^e", also rises, but by less than the actual increase in prices. As a result, unemployment is pushed back down toward its natural rate. As this example indicates, stabilization policy is effective because the authorities are able to make the difference between actual and anticipated inflation depend upon past unemployment. They can do this because the relation used to forecast price fluctuations does not change when policy is altered.[10]

Influence of rational expectations

Rational expectations refers to an economic theory explaining how individuals predict economic events. Because the theory has most often been applied to models incorporating the natural-rate hypothesis, the two have sometimes been

Diagram 1



confused. The concepts are actually quite distinct, and indeed rational-expectations theory is just as applicable to models in which the natural-rate hypothesis is invalid as to those in which it is correct.

Rational-expectations theory asserts that private agents forecast economic events in much the same manner as economists. That is, agents use past data and their knowledge of behavior to estimate relations among economic variables—and thus to forecast future developments. In this respect, the rational-expectations model is little different from other forecasting models incorporated in most natural-rate formulations: all imply that agents use past data to predict economic variables.[11] However, rational expectations also implies that individuals continually update their prediction schemes on the basis of new information. This means that when economic behavior changes—in particular, when government policy is altered—individuals' forecasting relations are changed also. According to this aspect of the theory, any counter-cyclical monetary policy based *entirely* on agents' misperceptions about prices and other observable variables must eventually become ineffective.

To see this, consider again the model summarized in relations (4) through (6). Counter-cyclical policy is effective in this case because individuals underpredict actual price level changes when unemployment is above its natural rate, while they do the opposite when unemployment is below the natural rate. Rational-expectations theory asserts that individuals notice these relations. They then improve their predictions by raising their original forecasts when unemployment is high and reducing them when it is low. In this way, agents discover the policy rule used by the government to combat business cycles. But when this happens the policy becomes ineffective, because it produces only predictable variations in prices and money. This is illustrated in Diagram (2). As before, a rise in unemployment leads to an increase in the money stock. However, under rational expectations, anticipated price changes,

$$\Delta p(t)^e = c_0 u(t-1) \qquad (8)$$

are exactly equal to actual price changes. Unemployment and the business cycle are thus unaffected.[12]

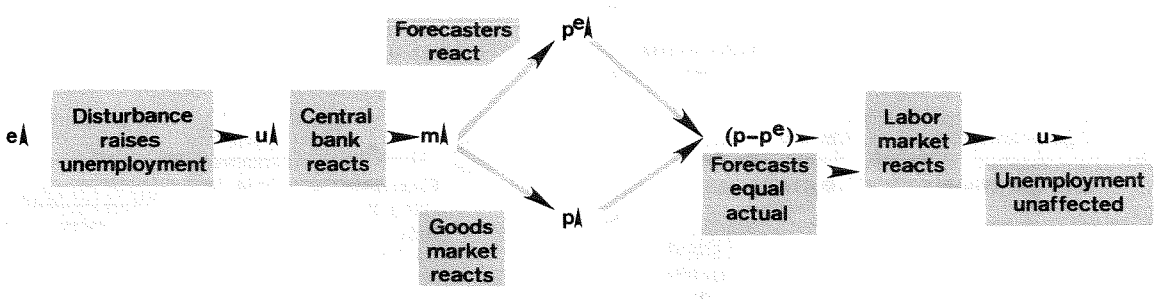
Natural-rate theories reconsidered

This view of counter-cyclical monetary policy is not widely accepted. Most economists believe that counter-cyclical monetary policy can influence unemployment and real output in the short run, but that it has no significant permanent effect. Some economists, skeptical about the policy implications of combined natural rate and rational expectations theories, have questioned the practical validity of the rational expectations hypothesis.

Rational expectations is, however, simply one aspect of the more general assumption that individuals are rational. Economists normally assume that individuals are able to maximize their satisfaction (given their income) and that firms are able to minimize costs (given available resources). But this hypothesis is tenable only if economic agents effectively use all information available to them. Rational-expectations theory merely asserts that agents do just that when predicting economic variables.

On the other hand, less plausible assumptions underlie those theories in which only unanticipated price and money-supply changes influence economic variables. Such theories generally as-

Diagram 2



sume that there are no institutional impediments to free, continuous adjustment of prices and wages. Perceived money-stock changes are often assumed to lead immediately to offsetting price-level movements, leaving unaffected such variables as agents' real money balances, real output, and the relative prices of goods and factors. Predictable attempts by the government to restrict or expand money-supply growth then only produce offsetting price-level fluctuations, with no effect on economic activity.

Prices and wages are not actually adjusted in this manner. Some product and factor prices are contractually set for fixed periods. Others that appear variable in principle are not actually so, but instead tend to respond primarily to long-run rather than cyclical fluctuations in demand. Although the reasons for such behavior are not entirely understood, the implication is that variations in money growth produce temporary fluctuations in private real-money balances.[13]

Theoretically, such transient variations in real balances can influence economic activity: individuals with temporary excess cash may choose to increase their spending, for example.[14] Economists differ, however, about their actual impact. Some believe that fluctuations in real balances have a negligible impact on real aggregate demand, while others assign a more prominent role to such changes. Indeed, in many large econometric models—including several for Japan[15]—temporary variations in liquidity caused by changes in money growth significantly affect at least some spending components.

Predictable changes in money growth thus may exert significant temporary impacts on economic activity, even when expectations are rationally formed. More generally, the impact of both unanticipated and anticipated money growth may vary with institutional factors. For example, the effect of anticipated money growth on activity may depend on the degree to which prices and wages fluctuate with variations in the money stock, as argued above. This impact may also depend upon the extent to which close substitutes for money are available to individuals and firms, as well as other factors. Consequently, the influence of anticipated and unanticipated money growth could vary among countries. Barro (3, 1977) and Sargent (8, 1976), on the basis of U.S. evidence, suggest that anticipated money growth has no influence on economic activity, but the evidence presented here would suggest otherwise for Japan.

II. Testing the Hypothesis: Estimation of Anticipated Money Growth

The hypothesis concerning the relationship between anticipated money-stock changes and Japanese economic activity is particularly significant for Japan because few other industrial countries have relied so heavily on monetary policy as a tool of stabilization policy. Indeed, the Japanese until recently have utilized fiscal policy, by and large, only to accomplish longer-term economic objectives.[16]

Various studies—such as Keran (4, 1970) and the OECD (9, 1972)—suggest that Japanese monetary policy has affected real output in a substantial and systematic way. However, these studies do not distinguish between anticipated and unanticipated components of money growth, and thus do not directly reveal the impact of predictable counter-cyclical changes in the money stock. Indeed, it is possible that such estimates reflect the impact on real activity of unanticipated money growth only. Thus the hypothesis that anticipated money changes influence real output must still be tested.

Testing this proposition is complicated by the fact that expectations are not directly observable. But following the procedure adopted by Barro (3, 1977) in his U.S. study, we can estimate the anticipated components of money growth under the assumption that agents' predictions are rational in the sense defined earlier. More exactly, we can develop a "prediction" equation relating historically observed money-stock changes to other variables; on the assumption that economic agents had at least a rough knowledge of this relation, we may use the fitted values from the equation as estimates of anticipated money growth. The unanticipated components are then defined as the actual changes minus the predicted elements.

If this procedure is to be acceptable, the estimated predicted money-growth components

must be based on commonly available data. Accordingly, the equation developed here related actual money growth during a given quarter to data from earlier quarters. Similarly, the relation should be consistent with the processes actually determining money-stock changes—especially official policies—during the period examined. For this reason, it will be useful to briefly review Japanese monetary policy over the 1957-77 period.

Japanese monetary policy

As many writers have emphasized, Japanese monetary policy is heavily influenced by institutional factors. Large-scale open-market operations have not been feasible, so that central-bank credit has provided the primary source of the banking system's reserve growth. As a result, the major commercial banks are net debtors to the Bank of Japan.[17]

Consequently, the Bank of Japan has exerted a substantial de facto influence on bank lending policies. This influence has been reinforced, particularly during the 1960's, by "window guidance", an informal device whereby the central bank fixes ceilings on individual banks' aggregate lending as well as on their credit to particular sectors. Although there is no legal basis for the ceilings, the Bank's wishes have generally been respected. Thus the Bank generally has been more successful than the central banks of other major industrial countries in implementing its objectives for money growth.[18]

Japan's money stock has grown very rapidly over time, reflecting the nation's exceptionally rapid economic growth. Money stock (M_1) growth averaged 16.5 percent annually from 1957:1 through 1977:3, compared to 4.4 percent for the U.S. over the same period. In contrast to the U.S., Japan's average rate of money growth was the same over the latter half of this period as during the first half (Table 1).

Table 1

Japanese and U.S. M_1 Growth Rates (seasonally adjusted annual rates)

Period	Japan	U.S.
1957:1–1977:3	16.5	4.4
1957:1–1967:4	16.5	3.0
1968.1–1977:3	16.5	6.0

Over shorter time periods, however, Japanese M_1 changes have fluctuated substantially (Chart 1). For example, money growth was below average, and monetary policy was relatively restrictive, from roughly 1961:2 through 1962:2 and again from 1963:3 through 1964:4. Money growth was relatively rapid over the interval 1962:4 to 1963:2, during 1971, and from mid-1972 through mid-1973.[19]

During the 1950's and 1960's, periods of monetary restriction were normally initiated by a deterioration in Japan's balance of payments, while periods of ease normally occurred when economic activity had slowed sufficiently to restore external balance. According to most accounts, a business-cycle expansion typically would lead to a trade deficit, producing a deterioration in the balance of payments and international reserve outflows. The resulting drain in private bank reserves, combined with Bank of Japan credit restrictions, would then lead to a deceleration of money growth and force a reduction in the expansion of private bank credit. The reduction in bank lending (these accounts assert) particularly affected the corporate business sector—which is heavily dependent on commercial banks for external funds—and through it private investment.

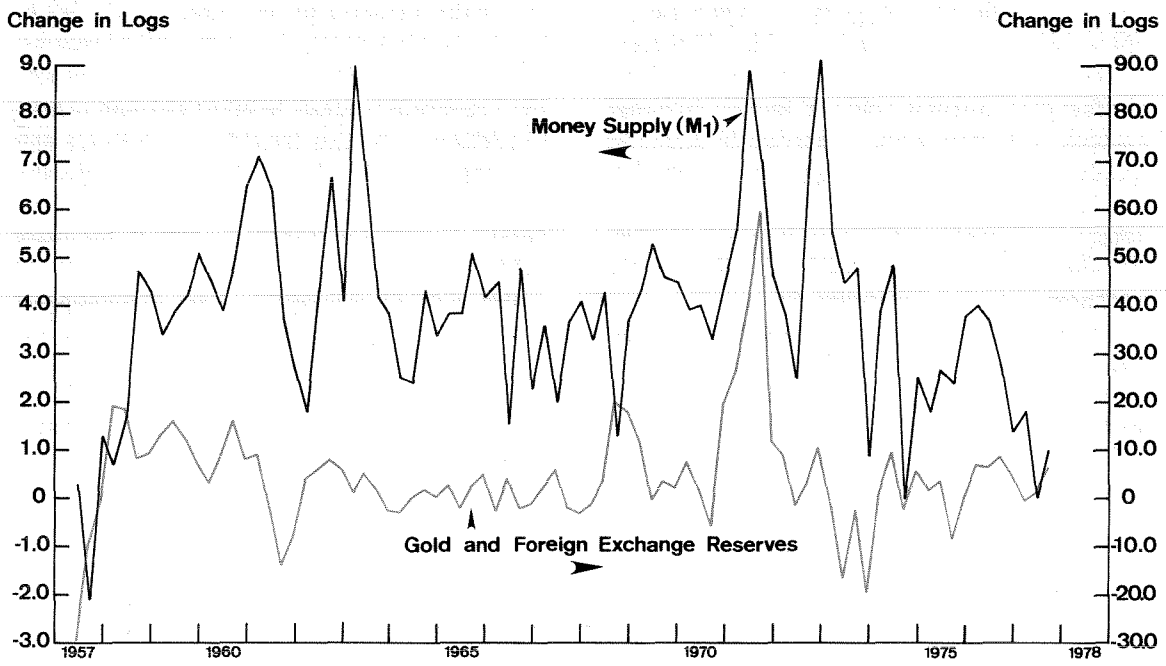
Japanese monetary policy thus was aimed more at offsetting the impact of business-cycle fluctuations on official reserves, than in reducing variations in real income.[20] For example, the decline in the M_1 growth rate from 1961:2 through 1962:2 was accompanied, indeed preceded, by a fall in the growth rate of gold and foreign-exchange reserves. The pattern was similar, although less pronounced, during the subsequent cycle in money growth from 1962:2 through 1964:4 (Chart 1).

Systematic relations between Japanese M_1 growth and reserve fluctuations diminished considerably after 1970. Japanese reserves increased dramatically in 1971 as the government initially resisted revaluation of the yen. As a result of this accumulation of reserves, the Bank of Japan had much less need to use monetary policy to offset temporary balance-of-payments fluctuations.[21]

Japan's economic environment changed even more dramatically beginning in 1973. The advent of generalized floating freed the Bank of the obligation (although not necessarily the desire)

Chart 1

Changes in Japanese Money Supply (M_1) and Gold and Foreign Exchange Reserves



of continuously defending a fixed exchange rate. This development further weakened the direct influence of reserves on domestic money. In addition, inflation accelerated sharply, leading the government eventually to reduce money growth in order to bring price increases back to historical rates. This suggests that fluctuations in Japanese money growth after 1970 may be better explained by variations in foreign and domestic inflation rates than by changes in reserves.

Prediction equation

A statistical analysis of Japanese money-supply changes supports these observations. (In choosing a measure, M_1 data was used to facilitate comparisons with other studies of the determinants of Japanese money growth.)[22] Prior to 1971, variations in M_1 growth appear to be positively and significantly related to changes in Japan's gold and foreign-exchange reserves. Subsequently the two are not significantly associated. Instead variations in M_1 growth appear to be more closely related to the difference between Japanese and U.S. consumer-price inflation. Since maintenance of a stable exchange rate requires that domestic and foreign prices of similar goods grow at the same average rate, this relation may reflect the Japanese authorities' attempt to prevent large changes in the dollar value of the yen, even under floating exchange rates.

A number of equations explaining Japanese M_1 growth fit the 1957-77 sample period about equally well. Generally the more complex the estimated relation, the greater the likelihood that variables will be included that were not actually used by individuals to forecast M_1 growth. The "predicted" M_1 changes estimated from such a relation will then include a portion of money growth that was actually unanticipated; anticipated changes may then appear to affect activity when in fact their influence reflects the impact of unpredicted M_1 changes. For this reason, a relatively simple relation explaining M_1 growth was chosen (Table 2).

To see how Japan's balance of payments af-

fected her money stock in the pre-1971 period, suppose that the growth of reserves rises for a single quarter by one percentage point. The equation implies that M_1 growth will be raised by .04 percent in the next quarter and by .05 percent in the quarter thereafter. This response reflects the fact that Japanese gold and foreign exchange reserves were only about 7 percent of Japanese M_1 during this period; the equation also implies that a decline of one dollar in reserves led to a total fall of roughly 520 yen in Japanese M_1 over the next two quarters, or nearly 1.5 dollars at the exchange rate then prevailing.[23]

The post-1970 equation suggests that the Japanese authorities manipulated money growth to keep the Japanese-U.S. inflation relationship within a range consistent with a stable exchange rate for the yen. Suppose that the ratio of Japanese to U.S. consumer prices rises for one quarter by one percentage point. The equation implies that Japanese M_1 eventually declines by 1.25 percent (Table 2). That is, Japanese money, and eventually Japanese prices, subsequently fall by nearly the same proportion as the initial increase in the relative inflation rates. Thus the authorities apparently attempt to offset changes in relative inflation rates in order to maintain a stable exchange rate. As Chart 2 indicates, the general pattern of variations in actual M_1 growth in both periods is reflected reasonably well in the fitted values.

Measures of anticipated and unanticipated money growth can be extracted from these prediction equations. Anticipated money growth is defined as the values of M_1 growth predicted from the equations in Table 2. Unanticipated money growth is simply the difference between actual and anticipated money changes. These

Table 2

Money Prediction Equations[1]

Period: 1958:1 – 1970:4

$$DMIA(t) = .02 + .044 \times DRSA(t-1) + .052 \times DRSA\ (t-2) + .209 \times DMIA(t-1) + .226 \times DMIA(t-2)$$
$$(4.43)\ (1.21) \qquad (1.35) \qquad (1.41) \qquad (1.75)$$

Period: 1971:1 –1977:3

$$DMIA(t) = .020 - .533 \times (DJCPI(t-2) - DUSCPI(t-3)) + .576 \times DMIA(t-1)$$
$$(4.43)\ (-3.00) \qquad (5.41)$$

Summary Statistics for the Entire Sample

R^2 (adjusted)= .36

Standard Error= .015

1958 : 1–1970 : 4[3] = .012

1971 : 1–1977 : 4[3] = .017

Rho= .009

Durbin-Watson= 1.97

Sample Period= 1958:1–1977:3

Number of Observations= 79

Memorandum: Sum of Coefficients of DRSA= .096

(2.88)

Notes: [1]The estimates were derived from a single equation applied to the entire sample, using multiplicative dummy variables.

[2]DMIA = Difference between the current and previous quarter's logarithm of seasonally adjusted M_1.

DRSA = Difference between the current and previous quarter's logarithm of seasonally adjusted gold and foreign-exchange reserves.

DJCPI = Difference between the current and previous quarter's logarithm of the Japanese CPI.

DUSCPI = Difference between the current and previous quarter's logarithm of the U.S. CPI.

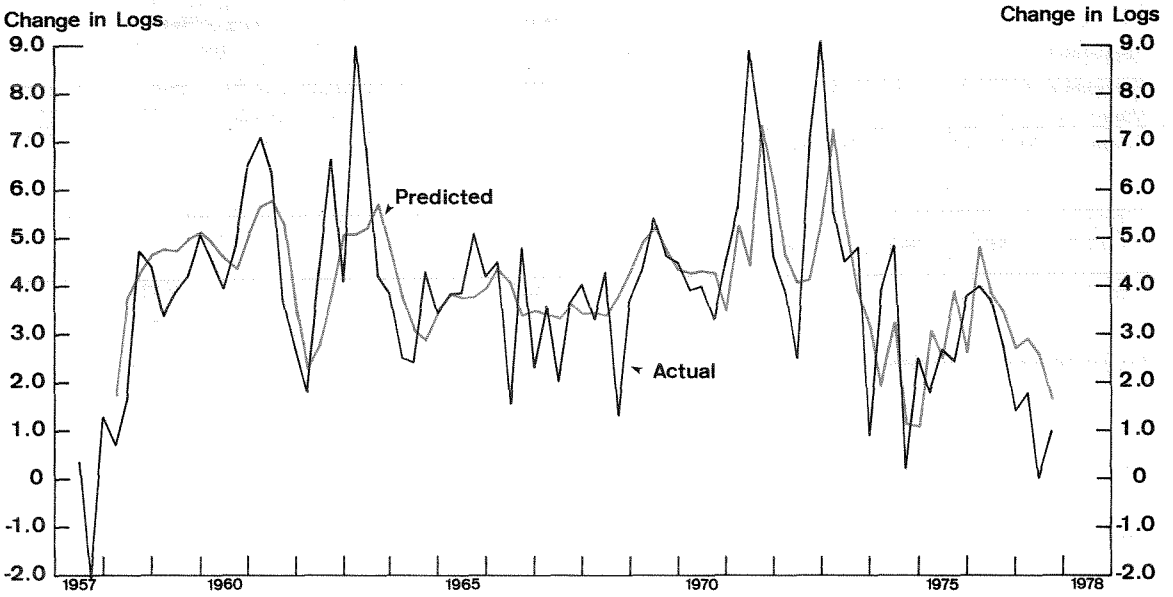
[3]This is the square root of the sum of squared residuals divided by the number of observations; these are not strictly comparable with the standard error of the entire sample.

[4]Figures in parentheses are "T" statistics.

Chart 2

Japanese Money Supply (M_1) Growth Rates

Actual and Predicted Values



components can be used to test the extent to which predicted M_1 growth influenced Japanese economic activity.

As we have seen, however, the relation explaining money growth apparently changed in 1971. The predicted M_1 changes are most likely to reflect expectations held by economic agents if the relation has been fairly stable over a long period of time. Under such circumstances, it is reasonable to suppose that individuals at least had an approximate knowledge of the relation and could have used it to forecast. When (as appears to have been the case) the relation changes significantly, this presumption becomes less plausible.

III. Impact of Anticipated and Unanticipated Money Changes on Japanese Economic Activity

Three separate hypotheses should be tested: 1) that neither anticipated nor unanticipated changes in the money stock influence economic activity in the *long run*; 2) that anticipated money-stock variations have no impact on real activity; and 3) that unanticipated money-growth changes stimulate real activity in the short run.

The first proposition is simply the natural-rate hypothesis; it does not preclude a *short-run* influence of money on real output. The second hypothesis—the focus of this article—suggests that counter-cyclical monetary policy will have no systematic influence on activity once agents determine how the policy is being conducted. The third proposition is frequently used to explain temporary unemployment-inflation-money growth relationships.

These propositions are tested here by regressing alternative measures of real activity on their own past values, and on current and past values of the estimated (predicted and unpredicted) components of money growth. In addition, a time trend is included to allow for secular changes in real growth. The two dependent variables examined are changes in the logarithms of Japanese industrial production and real GNP. Industrial production is included because, according to previous studies, money-growth variations particularly affect the corporate-business sector, and hence industrial activity. The reader interested primarily in the conclusions may wish to skip the unavoidably technical "Analysis of estimates".

Table 3

Summary of Regressions of the Activity Variables on the Money Growth Components

Regressors	Changes In: Log of Industrial Production		Log of Real GNP	
Constant	2.36	(3.06)	2.50	(4.07)
Time	−.02	(−2.33)	−.02	(−2.72)
Anticipated Money Changes - Lag sums:				
0 -2	1.20	(3.91)	.35	(1.27)
3 - 7	−1.20	(−3.91)	−.35	(−1.27)
Unanticipated Money Changes - Lag sums:				
0 - 2	−.23	(−.96)	.06	(.32)
3 - 7	.23	(.96)	−.06	(−.32)
Lagged Dependent Variables (sum)	.56	(4.85)	.30	(2.07)
Rho	−.03		−.58	
R^2(adjusted)	.73		.30	
Standard Error of Regression	1.38		1.34	
Number of Observations	71		71	
Period	1960:I - 1977:III		1960:I - 1977:III	

The basic equation was:

$$\Delta X(t) = a_0 + a_1 \times T + \sum_{i=0}^{7} a_2(i)DMP(t-i) + \sum_{i=0}^{7} a_3(i)DMR(t-i) + \sum_{i=1}^{4} a_4(i)\, X\,(t-i)$$

where $\Delta X(t)$ is the activity variable, T is a time trend, DMP is predicted money growth and DMR is unanticipated money growth. The ΔX, DMP, and DMR were also expressed as percentages (i.e. multiplied by 100). A Cochrane-Orcutt correction for first-order serial correlation of the disburbance was also applied.

Sources: i) Industrial Production: OECD Main Economic Indicators, Historical Statistics.
ii) Real GNP; Investment: OECD Quarterly National Income Accounts.

Notes: 1) Figures in parentheses are "T" statistics.
2) Industrial Production and Real GNP are seasonally adjusted.

Table 4

Summary of Statistics Testing the Hypotheses+

	H0	H1	H2	H3
Change in the Logarithm of Industrial Production	0.48	6.42**	3.14*	3.91**
Change in the Logarithm of Real GNP	0.03	2.35*	0.55	1.36

HO: F test of the hypothesis that the sum of the coefficients of anticipated and unanticipated money growth are zero. The hypothesis is rejected at the 5-percent level (with 50 degrees of freedom) if the statistic exceeds 3.18.

H1: F test of the hypothesis that all the coefficients of anticipated money growth are zero, against the alternative that some of the coefficients of both components may not be zero. The hypothesis is rejected at the 5-percent level (with 50 degrees of freedom and seven restrictions) if the statistic exceeds 2.20.

H2: F test of the hypothesis that the coefficients of unanticipated money growth are all zero, against the same alternative as in H1. The critical 5-percent value is also the same.

H3: F test of the hypothesis that all the coefficients of both money components are zero. The hypothesis is rejected (with 50 degrees of freedom and 14 restrictions) if the statistic exceeds 1.90.

\+ Since a Cochrane-Orcutt procedure was applied, these statistics are only asymptotically distributed as "F".

* Significant at the 5-percent level.

** Significant at the 1-percent level.

Analysis of estimates

The estimates were obtained by allowing lags of seven quarters for the money-growth components and four quarters for the lagged dependent variables.[24] The results are summarized in Tables 3 and 4. To simplify the presentation, only the sums of the coefficients over the indicated lags are listed in Table 3, while the individual coefficients are listed in Appendix A.

The results support the natural-rate hypothesis that money-stock changes exert no permanent influence on economic activity. This hypothesis implies that the sums of the coefficients of anticipated and unanticipated money growth both equal zero. In other words, an acceleration in economic activity following an increase in money must be fully offset by a later deceleration in production if the *level* of activity is to be unaffected in the long run.[25] As shown in the first column of Table IV, the long-run natural-rate hypothesis could not be rejected at the 5 percent confidence level for either of the relations. Variations in M_1 growth thus showed no long-run impact on either Japanese industrial production or real GNP. Consequently, the natural-rate hypothesis is imposed on the estimates presented in Table 3, and this relationship holds for the remainder of this discussion.[26]

Anticipated money growth apparently had a substantial and significant short-run impact on Japanese industrial production and a smaller but still significant effect on real GNP. As shown in the second column of Table 4, the hypothesis that all the predicted money growth coefficients are zero is easily rejected (at well above the 1 percent confidence level) for industrial production, and can also be rejected for real GNP: at least some of these coefficients then differ significantly from zero. Thus, contrary to most formulations of the natural-rate hypothesis, anticipated money growth has had an effect on Japanese economic activity.

Finally, unanticipated money growth apparently shows a much different impact than anticipated money expansion. The hypothesis of zero influence on activity—that is, all zero coefficients—can be rejected for industrial production but not for real GNP, as seen in the third column of Table 4. An unanticipated rise in M_1 initially raises real-output growth; however, this effect is relatively small and statistically insignificant (Appendix A and Table 3). But in the following two quarters, the growth of real output is actually depressed by the unpredicted money increase. Thus the natural-rate hypothesis—that unanticipated money growth stimulates real activity—is not supported by these results. Any stimulus from unanticipated money growth apparently was both small and temporary—at least in Japan, if not the U.S.

Assume that M_1 increases for one quarter by

Table 5
Impact of a One Percent Rise in the Money Growth Rate Sustained Over One Quarter

Quarter	Percentage Rise in Quarterly Money Growth	Percentage Rise in Growth of Industrial Production if:		Percentage Rise in Level of Industrial Production if:	
		Anticipated	Unanticipated	Anticipated	Unanticipated
1	1.0	.52	.03	.52	.03
2	0	.78	−.07	1.30	−.04
3	0	.61	−.20	1.91	−.24
4	0	−.79	−.53	1.12	−.77
5	0	.51	.13	1.63	−.64
6	0	.12	.09	1.75	−.55
7	0	−1.37	−.18	.38	−.73
8	0	−.07	.34	.31	−.39
9	0	−.16	.17	.15	−.22
10	0	−.19	.09.	−.04	−.12
11	0	.00	.09	−.04	−.02
12	0	−.01	.04	−.05	.00

one percentage point. If the increase is anticipated, the growth of industrial production is immediately raised by one-half percent (Table 5). Industrial production continues to rise above its normal level, and by the third quarter it is nearly two percent above the level it would otherwise have reached. But subsequently, production declines back toward its long-run level, and after three years it is virtually unaffected by the anticipated M_1 increase.

If the M_1 increase is unanticipated, the impact on industrial production is both qualitatively different and more modest in size, with an 0.8 percent *decline* below its normal level by the fourth quarter. But again, the impact of the M_1 increase is again largely dissipated after the end of three years.

Implications of results

What do these results imply about Japanese monetary policy over the 1957-77 period? First of all, anticipated increases in money growth stimulated real economic activity—particularly industrial production—while anticipated reductions in money growth depressed activity. Countercylical monetary policy was thus at least potentially effective in reducing Japanese business-cycle fluctuations.[27] The results are consistent in this respect with previous studies of Japanese monetary policy. At the same time, they are incompatible with those rational-expectations formulations of the natural-rate hypothesis that deny any systematic relationship between counter-cyclical monetary policy and real economic activity.

Indeed, the findings for Japan are nearly the opposite of those obtained by Barro for the U.S. Using annual data, he found that anticipated money growth had no impact on the U.S. unemployment rate, whereas unanticipated money growth led to a reduction in unemployment lasting for nearly three years. The results for Japan imply that any stimulus generated by unanticipated money growth is, at best, small and quite short-lived. Thus in Japan, the predictable part of money growth affected real output most heavily, while in the U.S., only unanticipated money growth influenced economic activity.

Institutional features possibly may account for some of these differences in national behavior. In Japan, short-term capital markets are less developed—and close substitutes for money are thus less available—than in the U.S. Moreover, Japanese corporations are strongly dependent upon the private banking sector for external funds, because of the relatively underdeveloped nature of the bond and equity markets. This suggests that Japanese corporations' expenditures may depend more heavily on their real money balances than do the expenditures of their U.S. counterparts, and thus may respond more to anticipated money-growth fluctuations.

It is also conceivable that the contrasting results reflect differences in U.S. and Japanese monetary policies during the period examined. In Japan, M_1 grew (on average) at a stable pace, whereas in the U.S. money growth generally increased from the mid-1960's through the early 1970's.[28] This suggests that an unexpected acceleration of money in the U.S. was often followed by further above-average increases; in Japan, on the other hand, money acceleration was generally followed within several quarters by deceleration. Consequently, an unanticipated money change in Japan, once perceived by individuals, possibly could have had a more temporary impact on real balances than would have been the case in the U.S. If true, this factor may help explain the apparently different impact of unanticipated money growth on real output in the two countries.[29]

The results must, in any case, be regarded as tentative—particularly regarding the findings for unanticipated money growth.[30] Nonetheless, they suggest that, in Japan at least, counter-cyclical monetary policy can be used effectively to reduce fluctuations in real activity.

IV. Summary and Conclusions

The apparent failure in recent years of macroeconomic policy to alleviate conditions of simultaneous inflation and unemployment has disappointed many advocates of counter-cyclical economic policies. During the late 1960's, many economists believed that it would soon be possible to "fine tune" variations in economic activity—that the objectives of price stability and

continuous full employment could be reconciled. Recent proposals for the adoption of incomes policies are, in part, an indicator of the current disillusionment with the traditional macro-economic tools that were supposed to accomplish these policy goals. Some economists have come to question whether counter-cyclical policies have (or indeed ever had) any consistent impact on economic activity, even in the short run.

The results presented in this article suggest that this view of the impotency of policy is not applicable to Japan. If this conclusion is correct, counter-cyclical policies can theoretically be used to reduce business-cycle fluctuations. Officials who design and implement Japanese monetary policy are thus not irrelevant, as some economists have in effect suggested. But the task confronting them today is almost surely more complicated than was generally believed during much of the 1960's.

A decade ago, economists tended to believe in the stability of the relationships among inflation, employment, and real economic activity. In the U.S., for example, the increase in inflation associated with a given reduction in the unemployment rate apparently remained constant for many years. Many economists thus came to believe that economic theory, aided by the sophisticated econometric models then being developed, could exploit such relations to ameliorate the effects of business-cycle fluctuations.

It now seems clear that such relations, which shifted distressingly often as inflation accelerated over the past decade, were actually more complex than had originally been thought. Many economists now believe that changes in prices, money, and other variables that are anticipated by private individuals have different effects than those changes that are unanticipated. This view helps explain why "stable" relations between inflation and unemployment fluctuated as monetary policy changed and as inflation accelerated in the U.S. and other industrial countries. According to this view, the amount of inflation associated with a given level of unemployment in the U.S. is higher now than a decade ago, in large part because actual and expected average money growth has been higher than during the 1960's.

The results for Japan are quite consistent with this approach. Apparently, anticipated money growth substantially, although temporarily, stimulates real economic activity. Unanticipated money growth apparently has a significantly different impact; it may raise activity for one quarter, but then seems to depress activity for some time thereafter.

Thus, it appears that Japanese policy-makers cannot mechanically manipulate private real activity in the manner suggested by the theories of the 1960's. An official interested in determining the impact of a given M_1 increase on real output, for example, must first ask his staff how much of the planned change is expected by the market. And while policy-makers study the market's behavior, they must also know that the market is studying their own reactions. If it were true that predictable policy-generated changes in money do not affect real economic activity, the task facing Japanese officials would be not only difficult, but ultimately futile. Fluctuations in real income could then be offset by monetary policy only to the extent that the authorities were able to confuse the market about actual official intentions. A policy of this type could hardly enhance officials' credibility. But the results derived in this article suggest that Japanese policy-makers may be both predictable and effective in using counter-cyclical monetary policy.

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9. Organization for Economic Cooperation and Development, **Monetary Policy in Japan,** OECD, Monetary Studies Series, December 1972.

APPENDIX A

Individual Coefficient Estimates

Regressors	Changes In: Log of Industrial Production		Log of Real GNP	
Constant	2.36	(3.06)	2.50	(4.07)
Time	−0.02	(−2.33)	−0.02	(−2.72)
Anticipated Money Changes:				
Lag – 0	0.52	(1.99)	0.47	(1.73)
1	0.51	(1.52)	−0.23	(−0.50)
2	0.16	(0.46)	0.11	(0.24)
3	−1.20	(−3.52)	−0.39	(−0.87)
4	0.89	(2.40)	0.56	(1.28)
5	−0.08	(−0.21)	−0.29	(−0.65)
6	−1.35	(−3.78)	0.19	(0.45)
7	0.54	(1.87)	−0.42	(−1.72)
Unanticipated Money Changes:				
Lag – 0	0.03	(0.24)	0.12	(1.02)
1	−0.09	(−0.61)	−0.10	(−0.63)
2	−0.16	(−1.10)	0.04	(0.20)
3	−0.42	(−2.82)	−0.03	(−0.19)
4	0.43	(2.67)	0.23	(1.31)
5	0.06	(0.34)	−0.28	(−1.56)
6	−0.22	(−1.27)	0.01	(0.00)
7	0.38	(2.26)	0.02	(0.13)
Lagged Dependent Variable:				
Lag – 1	0.53	(4.15)	0.43	(3.51)
2	0.06	(0.46)	0.06	(0.41)
3	0.07	(0.55)	0.02	(0.18)
4	−0.10	(−0.90)	−0.20	(−1.69)

Notes: 1 Figures in parentheses are "T" statistics

2 Changes expressed as percentages (i.e. multiplied times 100)

FOOTNOTES

1. For a brief description of the influence on U.S. policy, see Robert J. Gordon, "Recent Developments in the Theory of Inflation and Unemployment," **Journal of Monetary Economics,** (2). 1976, p. 190. David Laidler and Michael Parkin, "Inflation, a Survey", **Economic Journal,** December 1975, pp. 741-809 and Rutledge (1975) provide more detailed surveys of the evolution of theories about the Phillips Curve and about monetary policy and economic activity.

2. In the model in the text, a_1 and a_2 must be chosen so that unemployment is stationary. In general the greater the response of current unemployment to its past, the greater the severity and the longer the duration of business cycles.

3. The "Phillips Curve" became a significant influence on economic policy with the publication of A. W. Phillips, "The Relation Between Unemployment and the Rate of Change of Money Wages, 1862-1957," **Economica,** November 1958, pp. 283-299. This describes an apparently stable relation between money wage changes and unemployment in the United Kingdom over the period 1862-1957.

4. Policy prescriptions to exploit the Phillips Curve were generally described in somewhat different terms. Price changes were assumed to be positively related to excess demand, proxied by the unemployment rate. The implication was that by raising aggregate demand, through either fiscal or monetary policy, unemployment could be reduced while inflation would be raised.

5. Strictly speaking, the neutrality proposition refers only to unsustained changes in the level of money, not to changes in the rate of inflation. Variations in the inflation rate alter the real return to money balances and may, as a result, affect the demand for capital; if so, the natural rate of unemployment will **not** be invariant to the long-run rate of money growth. The proposition that the natural rate is unaffected by the rate of inflation is sometimes referred to as "super-neutrality." Natural-rate theorists assert that this is a valid approximation of actual behavior.

6. The first complete description of the elements of the natural-rate hypothesis was given by Milton Friedman ("The Role of Monetary Policy," **American Economic Review,** May 1968). Friedman defined the natural rate as that which would be determined in a general-equilibrium system of excess-demand relations for commodities and factors; these relations were assumed to be functions of relative prices and invariant to movements in the general price level. Variations in unemployment about the natural rate were assumed to result (in part) from unanticipated movements in the price level. Strictly speaking, his account implied only that a permanent rise in inflation would have no long-run impact on unemployment; it did not rule out the possibility that an accelerating rate might have an impact.

7. This was one of the elements of Friedman's original statement of the natural-rate hypothesis. It was also central to attempts by Phelps and others to develop a micro-economic theory of the temporary Phillips Curve based on incomplete information and costly search in the labor market. See E. Phelps (ed.), **The Microeconomic Foundations of Employment and Inflation Theory.** The reader will have noticed that the natural-rate hypothesis and formulations of the natural-rate theory are distinguished in the text. The reason is that many economists who accept the proposition that the Phillips Curve is vertical in the long run do not accept all elements of what are commonly known as natural-rate theories. In this sense Friedman stated both the natural-rate hypothesis and a theory of the natural rate, the latter being more restrictive.

8. This is essentially the account given by Robert Barro in "Rational Expectations and the Role of Monetary Policy", **Journal of Monetary Economics,** (2), 1976, pp. 1-33.

9. Actually the theory implies that the unemployment rate is a function of the difference between the actual and expected price level. Assuming that agents know last period's price level, however, $\Delta p(t) - \Delta p(t)^e = (p(t) - p(t-1)) - (p^e(t)) - p(t-1)) = p(t) - p^e(t)$, so (3) is consistent with the theory.

10. This assumption was often implicit. That is, in simulations of econometric models, the h(i) were assumed invariant to the policy assumptions. This methodology had been forcefully criticized by Thomas Sargent and Neal Wallace ("Rational Expectations and the Theory of Economic Policy", **Journal of Monetary Economics,** (2), 1976, pp. 168-184).

11. Indeed, the theory is really a further development of earlier notions about how expectations were formed. Adaptive-expectations schemes were originally introduced because they seemed to provide a common-sense method for forecasting economic variables. Rational expectations provides a more precise definition of what it means to forecast "sensibly".

12. Several qualifications of this view are worth noting. First, a basis for counter-cyclical policy exists if the government possesses superior information, that is, information not available to the market. For example, suppose that the government could withhold aggregate unemployment statistics from the market. Then it could successfully carry out the counter-cyclical policy summarized in equation (4) because individuals would not possess the data needed to forecast money growth. Proponents of the combined rational-expectations and natural-rate theories generally argue that the government should publish its information and allow individuals to decide how to respond to it. See Robert Barro, **op. cit.,** p. 2. Second, the rational-expectations and natural-rate theories do not imply that government policy has no impact on variations in unemployment, only that it has no systematic impact. If the government policy is prone to error—that is, if the policy produces unanticipated money-stock changes—it will generally raise the variability of unemployment. This is not usually regarded as a desirable objective.

13. Indeed, if commodity markets were efficient in the sense often used in stock-market literature, price-level changes would be random so long as the long-run inflation rate were constant. Under these circumstances, cyclical variations in nominal money would lead to cyclical variations in real balances. For a review of theories of contract pricing and other "rigidities", see Robert J. Gordon, **op. cit.,** pp. 185-219. Richard J. Sweeney, "Efficient Information Processing in Output Markets: Tests & Implications," **Economic Inquiry,** July 1978 provides theoretical and empirical arguments for commodity-market efficiency.

14. The reason is that changes in real balances affect the utility yield of existing holdings. For example, in William Brock's perfect-foresight model, ("Money and Growth: the Case of Long Run Perfect Foresight", **International Economic Review,** October 1974, pp. 750-777), a pre-announced increase in future money growth leads to an immediate increase in prices **and** will generally alter consumption if goods can be stored.

15. For example, in the reconstructed Bank of Japan macromodel, the availability of credit to the corporate sector is an explanatory variable in relations determining inventory and private fixed investment; real liquid deposits of the private household sector are used in the equations for consumption as well. See H. Eguchi and S. Tanigawa, "The Bank of Japan Econometric Model—A Progress Report on its Reconstruction" in **Proceedings of the Second Pacific Basin Central Bank Conference on Econometric Modeling,** June 1976.

16. Deficit finance became legally permitted in 1965. Ackley and Ishi (1976) have argued that even after this date, fiscal policy was primarily directed at objectives other than counter-cycli-

cal policy (p. 231).

17. See, for example, Keran (1970) pp. 174-175. In addition, the OECD (1972), pp. 1-32 and Ackley and Ishi (1970), pp. 196-205, provide detailed descriptions of the institutional setting of Japanese monetary policy.

18. According to the OECD, for example, "The Bank of Japan influenced the banks' lending attitude, buttressed by its ability to control (ration the volume and raise the cost of) its own credit, the predominant source of reserve money in Japan. The restraint on the availability of domestic bank credit was subsequently consolidated by direct quantitative controls on the major banks' lending. . . A deceleration of bank-credit expansion always set in immediately after the first restrictive action of the central bank: In each case, the degree of this slowdown seems to have been generally in line with that aimed at by the authorities" (p. 9). See also Ackley and Ishi, pp. 204-205. Keran (176-177) views "window guidance" as primarily a device designed to share business among banks, rather than as a device to control the aggregate level of credit.

19. The precise periods in the text refer to money-growth rates. The periods of "severe restraint" identified by the OECD (pp. 87-90) are quite similar although, because reserve losses themselves tended to reduce money expansion, they tended to lag the slowdown by about a quarter.

20. The relation between reserve losses and M_1 growth has been extensively documented by Keran, Ackley and Ishi, and the OECD. Keran develops a compact model of the relation between economic activity and reserve changes on the one hand and between activity and monetary policy on the other. The OECD study, pp. 51-58 and Appendix III, discusses the impact of monetary policy on investment; see also Ackley and Ishi, pp. 193-195.

21. Total Japanese reserves more than tripled over 1971, from $4.8 billion at the end of 1970 to $15.4 billion at the end of 1971. Largely as a result, Japanese M_1 rose by nearly 30 percent during 1971. Keran (p. 189) describes the severe reserve constraint faced by Japan during the 1960's.

22. See Keran; the OECD; Robert Gordon, "World Inflation and Monetary Accommodation in Eight Countries", **Brookings Papers on Economic Activity,** 1977:2; and Leroy D. Laney and Thomas Willett, "The Causes of Global Monetary Expansion", unpublished, August 1977. The first three use M_1 data in analyzing the determinants of money growth and the latter analyze both M_1 and M_2. The Bank of Japan ("Role of the Money Supply in the Japanese Economy", Special Paper #60, October 1975) argues that from 1965 on, M_2 changes were somewhat more closely related to variations in prices and real income, but that prior to 1965, M_1 changes were generally slightly more correlated with these variables. For reasons explained later, the effects of money growth on activity are evaluated using seasonally adjusted data. Therefore, the M_1 and reserve series used in the money prediction equation were also seasonally adjusted; the procedure used was the multiplicative version of the Commerce Department's X-11 applied to the level of each series.

23. The calculation in the text was made using 1965 year-end values of gold and foreign-exchange reserves and the 1965 yen value of the dollar (360.8). As Keran (p. 192) has shown, the response of M_1 to reserve changes tended to vary with the composition of the Japanese government.

24. A correction for first-order serial correlation of the disturbance was also applied. Two other features of this procedure should be noted. First, seasonally-adjusted data are used for the activity variables and for money growth. Standard seasonal-adjustment procedures may distort the temporal relations among economic variables. Seasonally adjusted data were used because no unadjusted figures for real GNP were available. Nonetheless, results using such data must be interpreted with caution. However, it was possible to estimate a relation similar to that in Table II using unadjusted money data (with seasonal dummies) and to use this to evaluate the impact of money growth on unadjusted industrial production. The results obtained are, if anything, stronger than those reported in the text. Second, the procedure used is strictly valid only if current changes in activity are assumed to have no impact on current changes in M_1. This does not seem implausible in view of the relatively close control normally maintained by the authorities over domestic money. However, if it is not true, the estimates of the impact of current money growth on activity will be biased. Again, however, the results are not substantially altered if the current money growth terms are omitted.

25. This will also be true if all the coefficients of the money-growth components are zero. The argument in the text indicates why the estimated coefficients must change sign at least once if the natural-rate hypothesis is to hold.

26. When the natural-rate hypothesis is not imposed on the estimates, the hypotheses that anticipated and unanticipated money-growth components do not influence industrial production can each be rejected. The hypothesis that predicted money has no impact on real GNP cannot be rejected; however, the "F" statistic is close to the critical 5-percent value and is significant at the 10-percent level.

27. This does not, of course, mean that policy actually stabilized Japan's real output. To establish this, the changes in output that would have occurred had the policy not been followed would have to be compared with the actual path of output, a task beyond the scope of this paper. Ackley and Ishi argue that the authorities may have increased fluctuations in activity in an attempt to avoid large reserve losses (pp. 170-171).

28. Kurt Dew has pointed out the contrasting structure of U.S. and Japanese monetary policy. His article "Practical Monetarism and the Stock Market" in the Spring 1978 issue of this **Review** describes the shift in U.S. monetary policy beginning, roughly, after 1970. He finds that after 1970, unanticipated money increases in the U.S. tended to depress stock-market prices.

29. However, this argument is admittedly plausible only when (if then) anticipated money growth influences real output. Suppose, for example, that individuals' planned levels of spending depended upon their anticipated present **and future** levels of real money balances. Imagine that money increases unexpectedly and that prices respond to this increase very slowly. Then individuals' real balances may be expected to be above normal for some time. In Japan, however, the impact on real balances may have been more temporary than in the U.S., so that real output was affected for a shorter time. Obviously the validity of this argument depends upon the response of prices to money increases and on other factors. It also does not provide a satisfactory explanation of why the level of real output falls below normal in the quarters following an unanticipated rise in M_1, nor does it explain why anticipated money had a stronger and more persistent impact than in the U.S.

30. Several other relations were estimated which are not reported here. First, similar equations were tried for changes in the ratio of private non-residential fixed investment to GNP, and in the ratio of inventory investment to GNP (both seasonally adjusted). The results were very mixed; in general, when the long-run natural-rate hypothesis is imposed, the hypothesis that anticipated money has no impact cannot be rejected. As noted in a previous footnote, the hypothesis was also tested using seasonally unadjusted M_1, reserve data, and industrial production. These results—which are quite consistent with those reported—and the investment relations will be supplied upon request to the author.

Inflation and Monetary Accommodation in the Pacific Basin

Michael Bazdarich*

This paper examines the inflation experience of eight Pacific Basin countries—the United States, Japan, Australia, South Korea, the Philippines, Malaysia, Taiwan, and Singapore—over the 1957–77 period. We will attempt to identify the causes of persistent inflation in each of these countries.

Note that we concentrate on explaining persistent inflation rather than simply short-term movements in particular prices. Over the last twelve years in the United States, and for a good deal longer in many other countries, price levels have climbed steadily, and at average rates that are high by historical standards. Furthermore, there is no sign of a slowdown in this phenomenon. World inflation has not been a temporary outbreak, confined to a few commodity prices, but a continuing process affecting all prices.

In the next section, we will argue that inflation can continue only if there are continuing increases in the money supply. Non-monetary factors can cause temporary movements in the price level, but if these are responsible for prolonged inflation, they must in some sense cause shifts in the rate of monetary expansion. According to our line of reasoning, then, identifying the reasons for accelerated money growth means identifying the reasons for increased inflation.

This approach is vital in formulating an anti-inflation policy. For if monetary expansion, and so inflation, has been an autonomous policy decision, then only tighter monetary policy will be able to stop inflation. If this were the case, price and wage hikes would moderate once monetary policy moderated. Another possibility, however, might be that monetary policy has been forced to accommodate large price or wage increases, or other disturbances. In this case, monetary tightening would subject the economy to the effects of these disruptions, with little near-term effect on inflation. A more effective policy in this case would be direct government action to slow price increases. The choice of policy therefore depends on whether monetary expansion is seen as the cause or effect of price changes.

This paper will investigate four factors which are said to affect money-supply growth: increasing wage demands, the OPEC oil price hike of 1973, government deficit spending, and the international transmission of inflation from abroad. We will consider whether these factors have indeed systematically caused money growth and inflation. The next section briefly discusses an economic theory of inflation which links the money supply and the price level. Section II presents Pacific Basin evidence for this link. Section III investigates the effects of the above four factors on money-supply growth, and Section IV provides a brief summary and discussion of these results.

I. Money and Inflation in Theory

Inflation is an increase in the money price of virtually all goods. Still, in any inflationary situation the prices of some goods will rise faster than others, and the prices of still others may even decline. These varying rates of change reflect the impact of such factors as changes in tastes, shifts of labor and capital among industries, and introduction of new productive techniques. While these phenomena can explain movements in some prices relative to others during an inflation, they cannot explain the inflation itself, the upward tendency in all prices.

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Economic theory distinguishes between factors such as these which affect relative prices, and those which affect the general price level. We can outline the reasoning behind this distinction, and give some flavor of the effect of money on prices, by discussing price determination in a very simple economy.

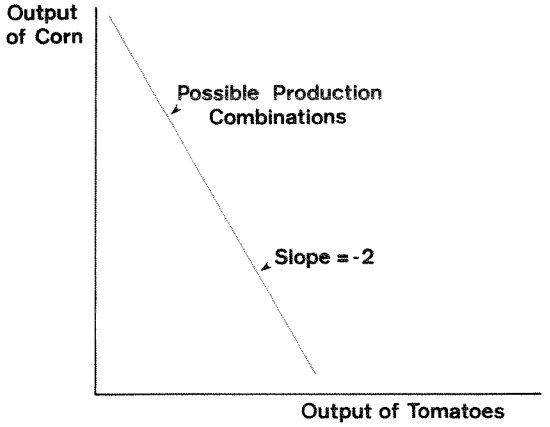
Consider an economy consisting of two commodities, corn and tomatoes, and a fixed amount of cash. Assume that land and water are plentiful enough so that labor is the only scarce factor in producing these commodities. Also, assume that one-hour of labor will produce two pounds of corn but only one pound of tomatoes.

In such an economy, possible outputs of the two commodities can be detailed by a production possibility curve as shown in Figure 1. This curve shows the maximum amount of corn that can be produced if tomato production is at a given level, and vice versa. The negative slope of this curve reflects the fact that tomato output can be increased only by drawing labor away from corn production, and so reducing corn output. Also, the slope of this curve is -2, which reflects the fact that one man-hour produces twice as many pounds of corn as of tomatoes.

Prices and outputs in the economy will reflect consumer tastes as well as these production conditions, with the end result that tomato prices will tend to be twice those of corn. Farmers know that they can increase tomato output by one pound only by decreasing corn output by two pounds, and they will be satisfied with this trade-off only if tomatoes yield twice the revenue of corn. Similarly, at this price consumers know that for every extra pound of tomatoes they purchase, they can purchase two less pounds of corn, and so they will adjust their consumption habits until they are satisfied with this trade-off.

Chart 1

Production Possibility Curve



At the same time, economic agents hold money because of the various conveniences it allows. They cannot increase consumption of both goods without decreasing their holdings of cash, and so decreasing their enjoyment of these conveniences, nor can they increase holdings of money without decreasing their consumption of goods. The money price of goods, then, indicates the purchasing power of money and so will tend to equal the value to agents of holding cash balances.

As we have said, outputs of corn and tomatoes will reflect consumers' desired consumption mix given the 2-to-1 trade between commodities. If the supply of tomatoes is increased above the usual level, the price of tomatoes will have to fall before consumers will be willing to purchase the increased amount. Furthermore, the output of tomatoes can be so increased only if that of corn falls. Though tomatoes are more plentiful than before, corn is more scarce, and consumers will be willing to pay higher prices to obtain these smaller amounts of corn. As the price of tomatoes falls, that of corn rises. Therefore the average price level, and so the purchasing power of money, need not change.

If production conditions and consumer tastes have not changed, prices and outputs will eventually move back to their old levels. However, even in the short run, when outputs are varying, the price level need not change since decreased tomato prices are offset by increased corn prices. Again, this is because output of one good can be changed only by changing output of the other good in the opposite direction.

This is not true of the money supply. For example, it takes no diversion of resources to change the denominations of currency.[1] Yet such redesignation will permanently change the supply of dollars. With an increased supply of dollars, money is less scarce at old prices, and consumers will attempt to spend some of their increased

holdings by increasing purchases of commodities. This increased demand will bid up the prices of both goods, and so the price level will rise. Dollars are more plentiful, and thus the value or purchasing power of each dollar has fallen.

In the first example, corn becomes more scarce relative to tomatoes, but goods do not become more scarce relative to money, since labor shifts from producing one good to producing the other. Therefore the price level, which is the average money price of all goods, need not change. In the second example, demand and supply do not shift from one good to the other. Rather, the larger money supply increases the demand for both goods. This makes both more scarce relative to money, and the price level rises accordingly.

We have developed this analysis in a simple two-good economy, but the same basic points hold in the real world for any type of disturbance. Changes in tastes, techniques, and wages switch resources and expenditures from one good to another, ultimately causing some money prices to rise and others to fall. Only increases in total asset holdings can augment spending on all goods. Furthermore, only increases in the money supply can permanently augment spending without augmenting productive capacity.

Certain restrictive assumptions are made in our model. For example, it ignores changes in the capital stock and the supply of labor, or technological advances, which could change the "output" line in Figure 1. Also, changes in money demand and government policy are abstracted from. Such factors can cause short-term disturbances in the money-price relationship. However, as suggested in the model, continuing inflation must be accompanied by continuing growth of the money supply. Furthermore, changes in the money-supply growth rate will lead to changes in the rate of inflation.

II. Money and Inflation in Fact

The Pacific Basin countries have experienced prolonged inflation over the last two decades. Therefore, their experiences should provide some evidence of the link between money growth and inflation.

The correlation between the average rates of inflation and money growth across countries is .841 in the 1957–67 period (Table 1A) and .654 in the 1967–77 period (Table 1B)[2]. The former statistic is significant at the 1 percent level, while the latter is significant at the 5 percent level. In both sub-periods, then, there is statistically significant evidence of a relation between a country's rate of money supply growth and its inflation rate. Yet while the data show a strong relationship between inflation and money growth across countries, they do not indicate the strength of this relation within any given country. Nor do they determine whether money growth caused prices to rise, or vice versa.

Granger causality tests provide one way of testing for the direction of such causal effects between two variables.[3] This technique is used in most of the empirical analysis in this paper. It involves regressing one variable on its own past values and the past values of the other variable. The lagged values of "dependent" variable are included in order to detrend the series, and so reduce the probability of finding a relation between two variables which are not truly causally related, but which merely move up or down together over time.[4] (See the Appendix for further details on the Granger technique).

In the present context, the Granger causality technique specifies estimating the following equations:

$$(CPI)_t = \alpha + \sum_{j=1}^{8} \beta_j (MS)_{t-j} + \sum_{j=1}^{8} \gamma_j (CPI)_{t-j} + \epsilon_t , \quad (1)$$

and

$$(MS)_t = \alpha + \sum_{j=1}^{8} \beta_j (CPI)_{t-j} + \sum_{j=1}^{8} \gamma_j (MS)_{t-j} + \epsilon_t , \quad (2)$$

where $(CPI)_t$ is the CPI inflation rate in quarter t, $(MS)_t$ is the money supply growth rate at quarter t, ϵ_t is a random disturbance term, and the α's, β's, and γ's are coefficients to be estimated. Money growth can then be said to "cause" inflation if the β-coefficients in equation (1) are significantly different from zero and generally

Table 1

Inflation and Money Supply Growth

TABLE 1A
1958.I–1967.IV

	(1) Average CPI Inflation Rate (%)[1]	(2) Average Money Supply Growth Rate (%)[2]
Korea	12.03	23.01
Taiwan	4.62	19.25
Japan	4.34	16.82
Philippines	4.17	8.57
Australia	2.32	2.77
United States	1.75	3.44
Malaysia	0.55	2.19
Correlations between columns (1) and (2)		.841***

TABLE 1B
1968.I–1977.IV

	(1) Average CPI Inflation Rate (%)[1]	(2) Average Money Supply Growth Rate (%)[2]
Korea	13.29	33.26
Philippines	10.78	16.71
Japan	9.28	16.35
Australia	8.81	9.11
Taiwan	8.62	22.72
United States	6.22	5.96
Singapore	5.34	16.01
Malaysia	4.52	14.89
Correlations between columns (1) and (2)		.654**

** Significant at 5 percent level.

***Significant at 1 percent level.

(1) Geometric average rate of change in consumer price index.

(2) Geometric average rate of change in money supply.

Source: *International Financial Statistics,* International Monetary Fund.

positive. Such a result would concur with our conclusions in the preceding analytical section.

On the other hand, if disturbances in the real economy caused prices to rise, and eventually forced the money supply to increase, money growth would be "caused" by short-term inflation. In this case, the β-coefficients in equation (2) should be generally positive, so that inflation would "cause" money growth. Since equation (2) measures the response of the money supply to price-level disturbances, its estimation provides our first evidence on monetary accommodation of disturbances in the real economy.[5]

Equations (1) and (2) were estimated using unadjusted quarterly data with seasonal dummies for the period 1959:I to 1977:IV[6] (Tables 2 and 3). The hypothesis that $\beta_1 = \ldots = \beta_8 = 0$ in equations (1) and (2) can be tested by use of an F-statistic[7] (Column 8 of those tables). Significant F-values of these statistics indicate the respective coefficients are significantly different from zero.

These results generally suggest causality running from money growth to inflation. That is, the β vectors in equation (1) are generally positive and significantly different from zero at a much higher confidence level than the β vectors in equation (2). Furthermore, the long-run effects of money on prices are generally insignificantly different from one, as the quantity theory of money would suggest.[8] (Column 4 of Table 2) For most countries, then, money-supply growth apparently has had a systematic effect on inflation, with little or no reverse effect.

Two exceptions to these results are Japan and Korea. For Japan, the F-test for equation (1) is barely significant at the 10 percent level, while that for equation (2) is significant at the 5 percent level, and remains so under reformulations of this equation.[9] In other words, there is two-way "feedback" between money and prices. However, the values in equation (2) are generally negative. In this context, the results suggest that monetary policy in Japan reacted strongly to *counter* the effects of temporary price movements, rather than to *accommodate* them.[10]

For Korea, the F-statistic for equation (1) is significant at the 5 percent level, yet the cumulative effect of a change in money growth on the

Table 2

Effect of Lagged Money Supply Growth on Inflation

Estimates of $CPI_t = \alpha + \sum_{1}^{8}\beta_j (MS)_{t-j} + \sum_{1}^{8}\gamma_j (CPI)_{t-j} + \epsilon_t$[1]

	(1) α[3]	(2) $\Sigma\beta_j$	(3) $\Sigma\gamma_j$	(4) Long Run Effect of MS on CPI[4]	(5) R^2	(6) Durbin-Watson Statistic	(7) Standard Error of Equation[3]	(8) F Statistic for $\beta_1=\ldots=\beta_8=0$
Australia	−0.17%	0.36	0.63	0.98 (−0.09)	0.68	1.97	3.09%	3.52***
Japan	−0.41%	0.20	0.60	0.50 (−0.84)	0.35	1.91	5.03%	1.77*
Korea	7.69%	0.04	0.33	0.07 (−1.80)*	0.20	1.99	12.10%	2.29**
Malaysia	−0.01%	0.14	0.59	0.34 (−2.28)**	0.66	1.90	3.48%	3.42***
Philippines	−1.39%	0.70	0.10	0.79 (−1.06)	0.51	2.01	7.61%	2.57**
Singapore[2]	−7.95%	0.70	0.62	1.81 (1.24)	0.71	2.28	6.40%	2.71**
Taiwan	−8.48%	0.66	0.37	1.04 (0.07)	0.22	1.98	13.82%	1.94*
United States	−0.15%	0.40	0.68	1.27 (1.05)	0.81	1.97	1.30%	2.93***

* Indicates significance at 10% level

** Indicates significance at 5% level

*** Indicates significance at 1% level

[1]Equation estimated with seasonal dummies, except in the case of Taiwan, for which the seasonal dummies increased the standard error of the equation. Period covered is 1959:I to 1977:IV.

[2]Period covered is 1966:I to 1977:IV. Because of the lower number of observations, the data were "mined" by taking the four most significant β and four most significant γ coefficients and re-estimating.

[3]Statistics are in annual rate-of-change terms.

[4]Defined as Column 2 divided by one minus Column 3. (See Appendix for an explanation). Figures in parentheses are the t-statistics for the hypothesis that this long-run effect equals one.

inflation rate is very small. This is surprising for a country which has averaged 12 percent inflation and 27 percent money growth annually over the past twenty years. Meanwhile, the effect of inflation on money growth is positive and marginally significant, indicating some monetary accommodation of price increase.

Even in these cases, there is some evidence of the effects discussed previously, and there are several possible explanations for the lack of stronger results.[11] Still, the effect of money growth on inflation appears surprisingly weak in Japan and Korea.

With these two exceptions, the results support our hypothesis that money-supply growth rates determine the underlying or continuing rate of inflation. The question then in explaining inflation becomes what caused monetary policy to act the way it did.

III. Evidence on Monetary Accommodation

What factors might stimulate money-supply growth and therefore lead to more rapid inflation? Certain disruptive shocks to the economy could perhaps have this effect, such as large com-

Table 3

Effect of Lagged Inflation on Money Growth

Estimates of

$$(MS)_t = \alpha + \sum_{1}^{8}\beta_j (CPI)_{t-j} + \sum_{1}^{8}\gamma_j (MS)_{t-j} + \epsilon_t$$[1]

	(1) α[3]	(2) $\Sigma\beta_j$	(3) $\Sigma\gamma_j$	(4) Long Run Effect of MS on CPI[4]	(5) $\bar{R}^2$	(6) Durbin–Watson Statistic	(7) Standard Error of Equation[3]	(8) F Statistic for $\beta_1=\ldots=\beta_8=0$
Australia	2.75%	0.28	0.37	0.45	0.79	1.93	8.69%	0.59
Japan	14.67%	−0.66	0.48	−1.29	0.91	1.93	8.67%	2.47**
Korea	37.64%	0.53	0.04	0.55	0.37	1.76	25.85%	2.05*
Malaysia	5.20%	0.34	0.32	0.51	0.26	2.00	15.94%	1.22
Philippines	7.05%	0.56	0.07	0.60	0.53	1.89	12.59%	1.77*
Singapore[2]	29.00%	−0.14	−0.68	−0.08	0.55	1.98	12.19%	1.01
Taiwan	27.65%	−0.11	−0.22	−0.09	0.59	1.95	19.22%	1.16
United States	2.03%	0.22	0.51	0.44	0.95	2.03	4.81%	1.17

* Indicates significance at 10 percent level.

**Indicates significance at 5 percent level.

[1]Equation estimated with seasonal dummies over the data period 1959:I to 1977:IV.

[2]Period covered is 1966:I to 1977:IV. (See footnote 2, Table 2.)

[3]Statistics expressed in annual rate-of-change terms.

[4]See Footnote 4, Table 2.

modity-price or wage increases. These increases act primarily on relative prices and the distribution of resources across industries, with little long-run effect on the price level. However, in the short run, resources can be slow to move among industries, and prices can be slow to adjust to reductions in demand. Therefore, the disruptive effects can cause temporary—but nevertheless painful—reductions in employment and output. To counter these effects, monetary authorities might seek a more expansionary monetary policy. In the long run this would lead to inflation, but the short-run gains could well make such moves desirable.[12]

Large commodity price increases, such as OPEC's quadrupling of oil prices in 1973, can also seriously strain an economy and so pressure monetary policy to provide accommodation. Similarly, large government deficits might be partially funded through money creation, in order to avoid disruptive changes in interest rates due to government borrowing needs.

Imported inflation could generate still another form of pressure. An expansionary monetary policy abroad, while causing foreign inflation, would also tend to stimulate domestic exports, and thus push the domestic-payments account into surplus. In the absence of complete exchange-rate adjustment, inflows of foreign assets due to the surplus might cause international reserves, and eventually the money supply, to increase domestically. Capital inflows and inflation would then continue until domestic prices were back in balance with prices of the country initially responsible for the inflation. Proponents of this view have attributed the world inflation and monetary expansion of the late 60's and early 70's to expansionary U.S. government policy during the Vietnam War era.

These four possible sources of pressure—wage push, commodity price increases, deficit spending, and foreign inflation—should have had a systematic effect on money growth rates if they were responsible for continued inflation. As be-

fore, we can use Granger causality tests to determine the effect these factors have had on money-supply growth.

A. Wage-push

If increasing wage settlements have consistently contributed to persistent inflation by forcing faster growth, then the rate of change of wages should statistically "cause" money growth, in much the same way that money growth was seen to cause inflation in the preceding section. On the other hand, if wage settlements have been merely a reaction to already existing inflation, then money growth should statistically "cause" wage increases.

To resolve this question, we can estimate the following models:

$$W_t = \alpha + \sum_{1}^{8} \beta_j (MS)_{t-j} + \sum_{1}^{8} \gamma_j (W)_{t-j} + \epsilon_t, \quad (3)$$

and

$$MS_t = \alpha + \sum_{1}^{8} \beta_j (W)_{t-j} + \sum_{1}^{8} \gamma_j (MS)_{t-j} + \epsilon_t \quad (4)$$

where W_t is the percentage rate of changes in wages at time t, MS_t is the percentage rate of change of the money supply, and other variables are the parameters ot the equation. If wage increases have "pushed" the money supply, then the β coefficients in equation (4) should be significantly different from zero and generally positive. If wage increases have been a response to monetary inflation, then the β coefficients in equation (3) should be significant and generally positive.

Equations (3) and (4) were estimated using quarterly data and seasonal dummies for the five countries for which data were available: Australia, Japan, Korea, the Philippines, and the U.S. The results of these estimations are summarized in Table 4 by the long-run effects of the independent variable, as defined in the Appendix, and the F-statistic for the hypothesis that $\beta_1 = \beta_2 = \ldots = \beta_8 = 0$ in either equation. Since available data covered different periods, critical F-values vary across countries. The 5 percent critical values of the F-statistic for each country are shown in parentheses following the name of each country.

Only in the case of Japan is there significant causality at the 5 percent level for equation (4). In that country, prior wage changes exert a strong but negative effect on money growth.

Table 4

Relation Between Money Growth and Wage Increases

	(1) 5% Critical F-Statistic	(2) Long-run Effect of W on MS in Equation (4)[1]	(3) F-Statistic for Hypothesis that $\beta_1=\beta_2=\ldots=\beta_j=0$ in Equation (4)	(4) Long-run Effect of (MS) on (W) in Equation (3)[1]	(5) F-Statistic for Hypothesis that $\beta_1=\beta_2=\ldots\beta_1=0$ in Equation (3)
Australia	(2.19)	0.50	1.12	0.79	1.33
Japan	(2.11)	−12.03	2.64**	2.31	2.12**
Korea	(2.95)	−0.19	2.35	−6.38	1.86
Philippines	(2.19)	−0.10	.34	−0.02	.75
United States	(2.11)	.50	1.46	1.27	1.91*

* Significant at 10 percent level.

** Significant at 5 percent level.

[1] This statistic is defined as $\Sigma\beta_j/(1-\Sigma\gamma_j)$ for the appropriate regression equation. See Appendix for derivation.

Note: Periods covered are 1961:III to 1977:IV for Australia, 1957:I to 1977:IV for Japan, 1968:I to 1977:IV for Korea, 1961:IV to 1977:IV for the Philippines, and 1957:I to 1977:IV for the United States. Wage data are weekly earnings for Australia, monthly earnings for Japan and Korea, daily wage rate for the Philippines, and hourly earnings for the United States.

Again, it appears that policy reacts strongly in Japan to counter inflationary disturbances, rather than to accommodate them, as was suggested in the preceding section. In terms of the wage equation (3), the effect of lagged money growth on wages is significant, indicating mutual interdependence between Japanese money growth and wages.

For the other countries, none of the results are statistically significant. The F-statistic for the United States for equation (3) is nearly significant at the 5 percent level, and is larger than that for equation (4). There is no U.S. evidence of a positive causal effect from wages to money. Elsewhere, the smaller number of observations tends to preclude a powerful test of the hypotheses.

In order to correct for this, the data were "mined" by taking the four most significant lags for each set of variables in equations (3) and (4) and reestimating the equations. When this was done for Australia and Korea, the β values for equation (4) remained insignificant and negative, while those for equation (3) were significant at the 5 percent level and nearly so at the 1 percent level.[13] For the Philippines, the coefficients in both equations (3) and (4) became "significant" and positive, so that only this Philippines case provides any evidence of a systematic positive effect from wages to money. In general, no hard evidence was found of a systematic accommodation of wage-push factors—of a positive one-way effect from wage growth to money.

B. Oil price hike

The OPEC oil price increase provides a prominent example of the disruptive effects of commodity price changes on an economy. It is widely recognized that this factor exacerbated world inflation in the 1974-75 period—yet once again, the oil shock can be said to have caused continuing inflation only if money-supply growth accelerated to accommodate these effects. Furthermore, the United States and most other Pacific Basin countries experienced an acceleration in money-supply growth that peaked some four quarters before the oil price increase. It remains to be seen, then, whether the oil price hike contributed to subsequent inflation, or was itself (at least partly) a response to previous inflationary money-growth.

Because of its nature as a one-time shock, this phenomenon was examined with somewhat different techniques than those used elsewhere. Equations (1) and (2) were re-estimated including a dummy variable for the eight quarters following the oil price increase.[14] The "oil dummy" inserted in equation (1) shows the amount of *inflation* that is over and above that which could be predicted from the past behavior of money and prices. Similarly, the dummy in equation (2) shows the amount of *money growth* in excess of that predictable from the past behavior of money and prices.

For most countries, inflation was significantly higher following the oil shock than previous monetary growth could explain. (Table 5, Column 1) While the "inflation-effect" dummies are generally positive and significant, this is not true of the "money growth" dummies (Column 2). For no country is this dummy variable positive and significant; thus, the oil price hike apparently was not a source of significant monetary accommodation. Rather, the results are consistent with the view that the oil price hike was primarily a relative price change with only temporary effects on inflation.

C. Deficit financing—inflation tax

Deficit spending is frequently seen as one way in which the government causes inflation. Governments in underdeveloped countries are typically said to finance their expenditures by printing money, and so taxing through inflation, rather than by raising taxes directly. In developed countries, there is also political pressure to avoid tax hikes, but, as discussed earlier, deficits are most often blamed for inflation because the money supply is increased to prevent rising interest rates. If either of these descriptions are accurate, large government deficits should cause accelerations in money growth. Furthermore, there need be no causal effect running from money to deficits.

On the other hand, one might argue that deficits and money growth are inversely related. This could occur if monetary policy balanced or countered government deficits in a "fiscal-monetary mix". This could seem to imply two-way causality or feedback between money and deficits. Al-

Table 5

Effects of Oil Price Hike on Inflation and Money Growth

	On Inflation[1]	On Money Growth[1]
Australia	6.0%	6.8%
	(3.2)***	(1.2)
Japan	10.5%	6.2%
	(2.8)***	(0.9)
Korea	16.6%	11.4%
	(3.2)***	(1.0)
Malaysia	−3.3%	−23.1%
	(−1.2)	(−2.1)**
Philippines	−0.4%	−1.0%
	(−0.1)	(−0.1)
Singapore	10.7%	−6.7%
	(0.3)	(−0.2)
Taiwan	13.1%	12.9%
	(1.0)	(0.9)
United States	2.1%	−7.2%
	(2.3)**	(−2.2)**

** Significant at 5 percent level.

***Significant at 1 percent level.

Note: Column 1 represents "oil dummy" in equation (1) and column 2 represents "oil dummy" in equation (2).

[1]t-statistic in parentheses.

ternatively, if the money supply were exogenous, but increased subsequent tax receipts by stimulating income growth, money growth would have a negative effect (i.e., it would reduce the deficit) with no reverse effect from deficits to money.

Once more, we can formalize these hypotheses in terms of a simple causality model:

$$(DR)_t = \alpha + \sum_1^8 \beta_j (MS)_{t-j} + \sum_1^8 \gamma_j (DR)_{t-j} + \epsilon_t, \quad (5)$$

$$(MS)_t = \alpha + \sum_1^8 \beta_j (DR)_{t-j} + \sum_1^8 \gamma_j (MS)_{t-n} + \epsilon_t \quad (6)$$

where $(DR)_t$ is the deficit-to-GNP ratio in quarter t, and other variables are as defined before.[15] Thus, the inflation-tax hypothesis would specify that the β coefficients in (6) are positive and significant without specifying much about the β coefficient in (5). A fiscal-monetary mix argument would suggest the β coefficients in both (5) and (6) are predominantly negative and significant. Finally, the argument about exogenous monetary policy affecting taxes and thus the deficit would specify that β is negative and significant in (5) while probably zero in (6).

Government-deficit data were available for Australia, Japan, Korea, Philippines and the United States. As Table 6 makes clear, only for the U.S. is there any sign of a positive effect of deficit spending on money growth. However, the F-statistics for the U.S. are insignificant for both equations (5) and (6). Allowing for shorter lags from deficits to money improves the U.S. F-statistic somewhat, but it is still not significant.

Where the F-statistics are significant, they indicate a negative effect of the deficit on money growth, which is apparently consistent with a policy-mix argument. This is the case with Aus-

tralia, Japan, and Korea. For the Philippines, the signs of the coefficients and the magnitude of the F-statistics are most consistent with the exogenous-money argument, although the small number of observations precludes any definite conclusions. In summary, then, there is little evidence from these five countries of a positive impact of deficit financing on money growth, which means that the inflation tax has not been consistently important in explaining inflation.

D. Imported inflation

Even if a country is not affected by domestic wage increases or government deficits, developments of this type abroad can lead to inflows of funds and domestic monetary expansion. Several observers have cited this scenario in blaming world inflation on the effects of American deficit spending, transmitted abroad under a fixed exchange-rate system.[16] Once again, if such arguments are correct, foreign inflation or monetary-expansion rates should affect domestic money growth.

Rather than attempt to construct a relevant "world inflation" or "world money supply" series,[17] we tested these hypotheses using U.S. money-supply growth and inflation rates as explanatory variables. That is, the following equations were estimated:

$$(MS)_t = \alpha + \sum_1^8 \beta_j (MSU)_{t-j} + \sum_1^8 \gamma_j (MS)_{t-j} + \epsilon_t \quad (7)$$

$$(MS)_t = \alpha + \sum_1^8 \beta_j (CPIU)_{t-j} + \sum_1^8 \gamma_j (MS)_{t-j} + \epsilon_t \quad (8)$$

where $(MS)_t$ is domestic money-supply growth at t, $(MSU)_t$ is U.S. money-supply growth at t, and $(CPIU)_t$ is U.S. inflation at t.

Under the imported-inflation hypothesis, if U.S. money-supply growth exerts immediate effects on domestic money, then the β values in equation (7) should be positive and significantly different from zero. However, because of the lags from U.S. money to U.S. prices, and from U.S. prices to domestic money, eight-quarter lags may be insufficient to capture these effects. In this case, the β values in equation (8) would be more

Table 6

Relation Between Deficits and Money Growth
Estimates of Equations (5) & (6)

	(1) 5% Critical F-Stat.	(2) Long-run Effect of $(DR)_t$ on $(MS)_t$[1]	(3) F-Statistic for Hypothesis that $\beta_1=\beta_2=\ldots\beta_8=0$ in Equation (6)	(4) Long run-Effect of $(MS)_t$ on $(DR)_t$[1]	(5) F-Statistic for Hypothesis that $\beta_1=\beta_2=\ldots\beta_8=0$ in Equation (5)
Australia	(2.36)	−0.05	1.99*	−1.68	2.08*
Japan	(2.11)	−0.74	2.33**	−1.85	1.95*
Korea	(2.18)	−0.11	3.02***	3.64	0.64
Philippines	(3.44)	−0.44	0.54	−1.55	1.83
United States	(2.11)	0.43	1.61	0.01	1.63

* Significant at 10 percent level.

** Significant at 5 percent level.

***Significant at 1 percent level.

Note: Periods covered are 1965:I to 1977:IV for Australia, 1957:I to 1977:III for Japan, 1960:I to 1976:IV for Korea, 1969:I to 1977:IV for the Philippines, and 1957:I to 1977:IV for the United States.

[1]See footnote 1, Table 4.

likely to capture the effect, since they have dropped one source of lag in the process.

Equations (7) and (8) were estimated with unadjusted quarterly data and seasonal dummies over the period 1957:I to 1977:IV for the seven countries other than the U.S. in our study.[18] F-statistics were then computed for the hypotheses that $\beta_1 = \beta_2 = \ldots = \beta_8 = 0$ in these equations.

Table 7 suggests that U.S. price and money developments are not very helpful in explaining money-supply growth in Pacific Basin countries. While the β values are generally positive, for the most part they are not statistically significant. Therefore, they provide little indication of a causal effect of U.S. inflation on domestic money growth.

When longer lags were tried in equation (7), they did not change the results. Also, when Japanese money growth was substituted for U.S. money growth, no causal effects emerged. American inflation did show an effect on Malaysian money growth, but it is not clear how much meaning we can attach to this isolated case.

In summarizing, we have found little evidence in this section of systematic monetary accommodation. It might be objected that the techniques employed were biased toward finding no causality, since the tests involved the significance of a whole vector of coefficients. Yet it's not clear how meaningful are one or two significant lagged coefficients, since the theories do not suggest, say, that wages affect money growth at the third- and sixth-quarter lag. Rather, the monetary-accomodation hypotheses suggest that certain factors have some effect on money growth. The F-tests employed here showed the general explanatory power of past values of changes in the "independent" variables, which seems to be the proper way to test the accommodation hypotheses. Furthermore, mining the data by re-estimating the equations with only the most significant lags did not change our conclusions in most cases.[19]

Finally, any objections that would be made to the estimation procedure used here would apply equally to the procedure used in the preceding section. Yet that section generally supported our analysis of the effect of money-supply growth on inflation, while the present section showed very few systematic effects of commonly discussed "inflationary" disturbances on money growth.

IV. Summary and Conclusions

This study has found the existence of a fairly strong "causal" relation between the money supply and prices, but little causal effect on money-supply growth from the factors most commonly ascribed as underlying causes of inflation. The evidence presented here suggests that such factors as wage demands, deficit spending, and imported inflation did not, individually, sys-

Table 7

Effects of U.S. Money and Prices on Domestic Money

	F-Statistics for Hypothesis that $\beta_1=\beta_2=\ldots=\beta_8=0$ in	
	Equation (7)	Equation (8)
Australia	1.46	1.23
Japan	0.32	0.80
Korea	1.04	1.40
Malaysia	1.14	2.29**
Philippines	1.40	0.43
Singapore	0.83	0.37
Taiwan	1.67	0.82

** Significant at 5 percent level.

tematically affect the money supply in the countries studied, and therefore cannot be considered sources of continued inflation.

If none of these factors have been consistent causes of inflation, why have the Pacific Basin countries experienced monetary expansion and inflation? One explanation that is consistent with our results (although obviously not proven) is that monetary policy has been truly discretionary, designed to manipulate the ups and downs of the business cycle. Unfortunately, a meaningful test of this hypothesis would involve an analysis of policy objectives that is far outside the scope of this paper. For now, we have found no evidence that the money supply has been led to expand in response to certain commonly-mentioned sources of inflationary pressure.

Appendix[20]

This Appendix explains the methodology of Granger causality used in most of the empirical results in the text. A general model that can be written for two time series x_t and y_t is

$$x_t = \alpha + \sum_{o}^{\infty} \beta_j y_{t-j} + \sum_{1}^{\infty} \gamma_j x_{t-j} + \epsilon_t \quad (A.1)$$

$$y_t = \quad + \sum_{o}^{\infty} \mu_j x_{t-j} + \sum_{1}^{8} \eta_j y_{t-j} + u_t, \quad (A.2)$$

where ϵ_t and u_t are white-noise processes. In this model, y_t can be said to cause x_t if the β vector is non-zero, since in this case the y series will affect the determination of the x_t. Similarly, x_t causes y_t if the μ vector is non-zero.

However, consistent estimates of (A.1) and (A.2) cannot be obtained since if β_o and μ_o are non-zero, estimation will be subject to simultaneous-equation bias. In order to correct for this problem, we can substitute (A.1) for x_t in (A.2), and solve for y_t, and substitute (A.2) for y_t in (A.1), and then solve for x_t. This yields:

$$x_t = \frac{\alpha}{(1-\beta_o\mu_o)} + \sum_{1}^{\infty} \frac{\beta_j + \beta_o\eta_j}{(1-\beta_o\mu_o)} y_{t-j} + \sum_{1}^{\infty} \frac{\gamma_j+\beta_o\mu_j}{1-\beta_o\mu_o} x_{t-j} + \frac{\epsilon_t+\beta_o\mu_t}{1-\beta_o\mu_o}$$

$$\equiv a + \sum_{1}^{\infty} b_j y_{t-j} + \sum_{1}^{\infty} c_j x_{t-j} + e_t, \quad (A.1')$$

and

$$y_t = \frac{\delta}{1-\beta_o\mu_o} + \sum_{1}^{\infty} \frac{\mu_j + \mu_o\gamma_j}{1-\beta_o\mu_o} x_{t-j} + \sum_{1}^{\infty} \frac{\eta_j + \mu_o\beta_j}{1-\beta_o\mu_o} y_{t-j} + \frac{\mu_t + \mu_o\epsilon_t}{1-\beta_o\mu_o}$$

$$\equiv d + \sum_{1}^{\infty} n_j y_{t-j} + f_t, \quad (A.2')$$

where e_t, f_t are white-noise random processes. In this formulation all right-hand side variables are independent of e_t, f_t and so these equations can be consistently estimated.

Furthermore, if the β vector in (A.1) is zero, then the b vector in (A.1′) is zero, while if $\mu = 0$ in (A.2), m = 0 in (A.2′). Thus, causality can be tested by running equations (A.1′) and (A.2′) with suitably truncated lags. This is the procedure taken in the text.

The text estimates such equations in the form

$$x_t = a + \sum_{1}^{8} b_j y_{t-j} + \sum_{1}^{8} c_j x_{t-j} + e_t \quad (A.1'')$$

$$y_t = d + \sum_{1}^{8} m_j x_{t-j} + \sum_{1}^{n} n_j y_{t-j} + f_t. \quad (A.2'')$$

Now suppose $b_1 = b_2 = \ldots = b_8 = 0$ in (A.1″). Then this equation becomes

$$x_t = a + \sum_{1}^{8} c_j x_{t-j} + g_t. \quad (A.3)$$

It can then be shown that under this hypothesis, if SSR_u is the sum of squared residuals from the estimation of (A.1″), and if SSR_c is that from (A.3), then

$$\mathcal{F}. = \frac{(SSR_c - SSR_u)/8}{(SSR_u)/(n-17)} \quad (A.4)$$

is distributed F with 8 and n-17 degrees of freedom, where n is the number of observations. 8 is the number of constraints placed on the b vector ($b_1 = b_2 = \ldots = b_8 = 0$), and 17 is the number of

coefficients estimated in (A.1″). If three seasonal dummies were included, the 17 would change to 20.

The statistic defined in (A.4) can thus be used to test the hypothesis that $b_1 = b_2 = \ldots = b_8 = 0$. An equivalent test holds for $m_1 = m_2 = \ldots = m_8 = 0$ in (A.2″).

In the equations in Section 3, for example, the data run from 1957:I to 1977:IV, 84 quarters. One observation is lost in computing percentage changes, and 8 more are lost in lagging the right-hand side variables. Thus, the equation is fitted over the period 1959:II to 1977:IV, a 75-quarter period. Subtracting 17 coefficients and 3 seasonal dummies leaves 55 degrees of freedom in equations (1) and (2). The F-statistics in Section 3, then, have 8 and 55 degrees of freedom. The degrees of freedom for the other tests follow similarly.

The long-run effect of x_t on y_t (or vice versa) can be defined as the change in the "steady-state" value of $y_t(x_t)$ due to a change in the "steady state" value of $x_t(y_t)$. In (A.2″), if x_t is held at a value $\bar{x}$ indefinitely, then y_t will tend to a value $\bar{y}$ such that

$$\bar{y} = d + \sum_1^8 m_j\bar{x} + \sum_1^8 n_j\bar{y}$$

or

$$\bar{y} = \frac{d}{1-\sum_1^8 n_j} + \frac{\sum_1^8 m_j}{1-\sum_1^8 n_j}\bar{x}$$

In other words, $\sum_1^8 m_j/(1-\sum_1^8 n_j)$ is the change in the long-run value of y_t due to a sustained change in x_t. A similar formula gives the long-run effect of y_t on x_t. These formulae are used in computing the long-run values used in the text.

Finally, applying seasonal filters to seasonally adjust the data before estimating equations (A.1″) and (A.2″) can be shown to introduce spurious causality. However, adding seasonal dummies to these equations using unadjusted data can be shown to subtract seasonal means from the data without filtering it, and so without distorting the causality relationships. The latter procedure is therefore taken in the text.

FOOTNOTES

1. Obviously, money creation does divert some resources temporarily, but it does so in small amounts compared to the value of the currency printed. Furthermore, a permanent increase in the money supply can be accomplished by only a temporary use of the printing presses.

Alternatively, continually increasing supplies of one good would require continual drains of more and more resources away from the other goods. However, the money supply can be continually increased using the same amounts of resources.

2. The money supply series used in these and the other tables is that given in **International Financial Statistics**, as published by the International Monetary Fund. This series differs very slightly from the Federal Reserve's M_1 definition, but corresponds to Japanese M_1 as published by the Bank of Japan. Singapore came into existence in 1966 and so is excluded from Table 1.

3. For a full exposition of this technique, see Christopher Sims, "Money, Income, and Causality," **American Economic Review**, September, 1972.

4. For example, there is no economic reason to suppose that, say, the population and the price level should be causally related. Yet because both have increased over time, a regression of the price level on population alone would almost surely show significantly positive coefficients. These would reflect the spurious correlation in the trends of the two series. However, including lagged values of the price level in the regression would capture the trend in the price level and therefore tend to eliminate the significance of the population coefficients.

If one variable truly causes another, then the former should be able to explain changes in the latter's trend. The Granger technique seeks to determine whether this is the case.

5. Notice that the β vector in (2) need not show a central bank's reaction function to inflation. If the inflation were originally caused by monetary expansion, and the central bank thus reacts to the effects of its own prior actions, such behavior will show up in the γ coefficients in equation (2). The β coefficients in (2) are more likely to show the monetary response to temporary price disturbances.

6. For Taiwan, the seasonal dummies did not improve the fit of equation (1). They were therefore not used in the result shown for Taiwan in Table 3.

7. For an explanation of this test, see Franklin Fisher, "Test of Equality between Sets of Coefficients in Linear Regressions," Section 3.1, **Econometrica**, March 1970.

8. This long-run effect is derived in the Appendix.

The Quantity Theory is the traditional theory of the effect of the money supply on prices. For a review of it, see Milton Friedman, "The Quantity Theory of Money: A Restatement," in his **Studies in the Quantity Theory of Money.**

9. When the four most significant lags of each set of variables are retained in Equations (1) and (2), and these equations are re-estimated, the vectors in both equations become significant, with the β's in equation (2) still having negative sum.

When such reformulations were done for other countries, however, the one-way causality from money to prices became more prominent. Japan appears to be the exception here.

Also, running equation (1) over subperiods of the 1957-77 period tends to improve the fit of inflation regressed on money,

suggesting that changes in coefficients over time were more important for Japan than other countries.

10. These results are in accord with other studies which have found a strong counter-inflationary bias in Japanese monetary policy in order to maintain external balance. On this subject, see Charles Pigott's article in this **Review,** as well as R. Komiya and S. Suzuki, "Inflation in Japan," in **World Inflation,** L. Krause and W. Salant (eds.), Brookings Institution, 1977.

11. One such explanation is that money growth rates and inflation did not vary much over the sample period for these countries, so that equation (1) had little variation to measure. A measure of the variation of a variable is the ratio of its standard deviation to its average value. This ratio gives the variation in the variable **relative to trend.** When this "detrended variation" variable was computed for each country and compared to the size of the F-statistic in Table 3 for that country, the resulting Spearman rank correlation coefficient was 0.95, which is significant at the 1 percent level. In other words, countries with significant variation in money-supply growth rates tended to show stronger effects of money growth on inflation.

We can rationalize this in terms of our theory as follows. Changes in the money growth rate alter the underlying rate of inflation. If a country's money growth rate does not vary much, then its underlying rate of inflation will not vary much. The variations in the inflation rate that do occur will then be more likely the temporary effects of relative price changes, or random factors, which are less likely to be affected by the money supply. The effect of money-supply growth on inflation will then naturally be statistically weaker in these cases, since money growth rates are useful in explaining movements in inflation trends, and few of these have occurred. It is instructive to note that the two countries with the weakest effect in Table 2, Japan and Taiwan, also show the least variation in money-supply growth relative to trend.

12. For another discussion of monetary accommodation, and for references to the various expanations of inflation, see Robert J. Gordon, "World Inflation and Monetary Accommodation in Eight Countries," **Brookings Papers on Economic Activity,** 1977:2.

13. More precisely, these values would be significant at this level if we had run the equation without use of prior information. The fact that we used results from a previous estimate for this sample reduces the significance of the results somewhat.

14. The oil embargo and quadrupling of prices occurred in the 4th quarter of 1973. The dummy period used was 1974:I to 1975:IV.

15. The ratio of deficit to GNP—rather than the deficit itself—was used in order to induce stationerity in (i.e., to detrend) the government deficit series. The deficit series is in nominal terms and so will be non-stationary during a period of rising prices. Dividing by nominal GNP will produce a variable which need not automatically increase over time when prices do.

16. For references on this argument, see Robert J. Gordon, **op. cit.**

17. This is not to minimize the relevance of such series. However, there is reason to believe that different countries are more affected by some trading partners than others. However, a world money-supply series gives a fixed weight to each country that may be disproportionate to its effect on a particular Pacific Basin country.

While the U.S. money series does the same, by giving 100 percent to the U.S., it nevertheless helps us concentrate on the hypothesis that U.S. money growth spawned world inflation, as postulated in what Gordon calls the "international monetarist" hypothesis.

18. The sample period for Singapore runs from 1966:I to 1977:IV.

19. Nor do the causality conclusions change when inflation rates are substituted for money-growth rates in equations (3)-(8). The author will supply results of these other tests on request.

20. Larry Butler has developed this derivation of the causality technique.

Alternative Balance-of-Payments Adjustment Experiences: Korea and Taiwan, 1973-77

Hang-Sheng Cheng*

In 1974 and 1975, both Korea and Taiwan sustained unusually large current-account deficits and borrowed heavily abroad. As their debts mounted, the world banking community became concerned over the risk of continued heavy lending to those countries. Yet by 1977, barely two years later, both countries' balance of payments showed dramatic improvements and the earlier fears evaporated—indeed, international bankers began to worry instead that these countries would make early debt prepayments or refinance on more favorable terms. This study examines the factors accounting for Korea and Taiwan's success in achieving such rapid adjustments in their balance of payments.

During the two crucial years, 1974 and 1975, the two countries apparently followed different approaches toward balance-of-payments adjustment. Taiwan, on the one hand, pursued what may be characterized as a classical "gold standard" approach. It maintained a fixed exchange rate of its currency against the U.S. dollar, and adjusted primarily through domestic deflation and restrained growth of imports. Korea, on the other hand, did not deflate; indeed, it achieved a remarkably high economic growth rate in the midst of a severe world-wide economic recession. It devalued its currency in the face of domestic price increases, and reduced its payments deficit mainly through export expansion. Both countries achieved payments adjustment, but the paths were different.

These alternative paths of adjustment represent alternative policy responses to external disturbances. During recent years, the oil shock and the world stagflation have brought about very large trade deficits for many oil-importing countries. External borrowings have provided deficit countries with the needed time to adjust their production and consumption patterns, and thereby reduce their trade deficits. But each deficit country that failed to make the necessary adjustment has had to face mounting external debts, eroding international credit standing, and an impending financial crisis. Therefore, Korea's and Taiwan's different experiences in achieving payments adjustment can provide valuable insights for other countries in responding to future external shocks.

In Section I, we briefly survey the developments in the two countries' balance of payments from 1973 to 1977. For both countries, the fluctuations can be attributed almost entirely to changes in merchandise-trade balances; the latter, therefore, constitute the focus of this study. In this analysis, the year-to-year change in each country's trade balance is divided into a part due to *price* changes and another due to changes in the *volume* of exports and imports. By making this distinction, we are able to isolate the "price shock"—including the oil shock—and further narrow the focus of this study to concentrate on changes in export and import volumes.

Section II presents a simple framework for analyzing trade-volume fluctuations in terms of changes in income and relative prices. It calls attention to the similarities between the two countries' growth experiences during the 1963-73 decade. The two countries, as close competitors in international trade, both depended on rapid export expansion for sustaining their high economic growth. Under these circumstances, relative price changes—including exchange-rate adjustments—can be expected to significantly affect each country's export demand and thereby its income-growth rate. Changes in income will, in turn, affect the country's import demand in the adjustment process.

Section III presents the results of regressions

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for testing these relationships. The results indicate remarkably stable relationships over the 1952-76 period between export and import volumes on the one hand, and income and relative-price changes on the other hand. This stability was maintained despite the rapid growth and economic transformation of the Korean and Taiwanese domestic economies, and despite unusually large disturbances in the world economy. Preliminary data indicate that the relationships continued to hold in 1977.

The regression results confirm the important role of relative prices in determining the two countries' export and import volumes. They suggest that the different adjustment paths followed by the two countries largely reflected the difference in their exchange-rate policies. Taiwan experienced plummeting exports and stagnating output in 1974, when it maintained a stable exchange rate in the face of large domestic price increases and Korea's sharp exchange devaluation. Until 1976, when economic recovery from the world recession became widespread, it managed to reduce its payments deficit only by sharply curtailing its imports. Korea, in contrast, through the exchange devaluation, was able to maintain a steady export expansion and output growth in 1975 in spite of the severe world recession. Thus, different exchange-rate policies made Korea's export expansion possible and Taiwan's import contraction inevitable.

The regression results also suggest that the income elasticities of world demand for Korea's and Taiwan's exports are substantially higher than the elasticities of the two countries' demand for imports. These differentials help explain the rapid improvement in their trade balances from 1975 to 1977, as well as their long-run trend of steadily disappearing trade deficits. But as a corollary, our finding implies that as world income continues to expand, both Korea and Taiwan will find it increasingly difficult to reconcile domestic economic-stabilization objectives with policies of fixed exchange rates and restrictive exchange and trade controls.

The high income elasticities of world demand for Korea's and Taiwan's exports reflect the degree to which the two countries have successfully adapted their output to world demand. Given a steady growth in world income, both countries' balance-of-payments prospects are reasonably assured. This finding has significant implications for the growth strategies of other developing nations, but has rather limited relevance for other LDC's *short-run* balance-of-payments adjustment policies.

As for short-run lessons, Korea's and Taiwan's experiences during the 1974-1975 period suggest the critical role of a nation's exchange-rate policy. Exchange-rate flexibility enabled Korea to achieve adjustment through export expansion; exchange-rate rigidity compelled Taiwan to undergo income stagnation and import reduction. However, exchange depreciation aggravated Korea's domestc inflation, while income deflation helped Taiwan maintain domestic price stability. Thus, the two adjustment paths reflected alternative choices with a short-run trade-off between income growth and price stability.

I. Balance of Payments Developments, 1952-77

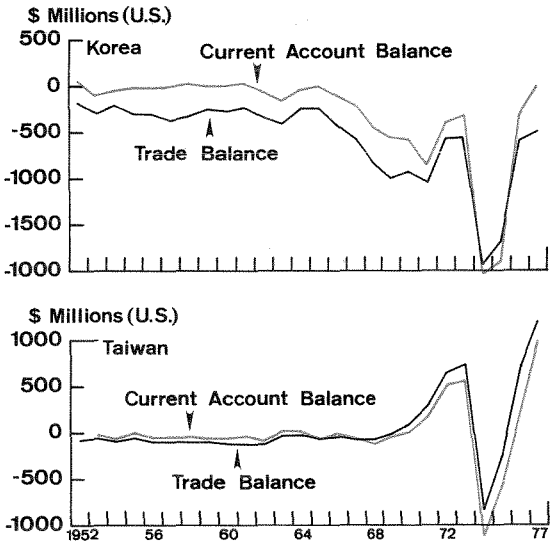
For both Korea and Taiwan, the current-account deficits in 1974 and 1975 were large by historical standards (Chart 1).[1] Equally dramatic were the subsequent improvements, so that by 1976 both countries had regained the average current-account balances that prevailed in 1972-73. This V-shaped pattern in their current accounts was repeated in their trade balances, and in fact was dominated by the latter. The rest of this article, therefore, will focus on the trade balance alone.[2]

During the adjustment period of 1974-75, both countries' foreign borrowings rose substantially (Table 1). Korea continued to borrow heavily in 1976 and 1977, but was not a large net borrower because its increase in official reserves largely offset its net capital inflows. Taiwan meanwhile reduced its borrowings, and in 1977 was a net lender of more than $1 billion. For the 1974-77 period as a whole, both countries recorded substantial increases in external public debt outstanding, including liabilities to U.S. banks.

The large trade deficits of 1974 and 1975 have been generally attributed to the "oil shock", i.e.,

Chart 1

Current Account Balance and Trade Balance
Taiwan and Korea, 1952-1977



the quadrupling of oil prices in December 1973. However, the oil shock was a part of a worldwide price inflation, with wide fluctuations occurring in individual countries' terms of trade. For analytical purposes, it would be desirable to find a way to isolate the external shocks various countries received from the large price fluctuations in the world economy.

A simple formula is used here for that purpose. Since value equals price times quantity, a change in the value of exports or imports from one year to another can be split into two parts: one due to *price change* at the base-year quantity, and the other due to *quantity change* valued at the current-year price. Algebraically, the formula is derived as follows:

$$V = PQ \qquad (1)$$

$$\text{Hence, } \Delta V = Q_0\Delta P + P_0\Delta Q + \Delta P\Delta Q$$

$$= Q_0\Delta P + P_1\Delta Q, \qquad (2)$$

where V, P, and Q designate value, price, and quantity respectively; the subscripts o designate the base year and 1 the current year; and Δ preceding a symbol designates the year-to-year change in that variable.

Consider the case of an oil-price increase. For a small importing country, the supply of imported oil may be assumed to be perfectly elastic with respect to price; hence, in Chart 2, the supply curve S is horizontal. The oil-exporting countries' decision to raise the oil price from OP_0 to OP_1 is depicted as a rise of the supply curve from S to S'. Equation (2) shows the resultant change in the value of the country's oil imports as a sum of two terms. The first term, $Q_0\Delta P$, shows the change in import value when the elasticity of demand for imported oil is zero (D_0 in Chart 2), so that the country imports the same quantity of oil, OQ_0, as before the price increase. The resultant rise in the value of imported oil is shown by the rectangle $AP_1P_0E_0$. The second term, $P_1\Delta Q$, introduces the decline in the value of imported oil when the country's demand for oil is price-elastic (D in Chart 2). At the new price OP_1, the resultant reduction in oil-import quantity, Q_0Q_1, implies a decline in oil-import value, depicted by the rectangle $AE_0Q_0Q_1$, from what the import value would be if the demand were zero-elastic. The first term, $Q_0\Delta P$, measures the extent of the "oil shock" to the country, which is proportional to the quantity of its imported oil in the base year Q_0. The second term, $P_1\Delta Q$, measures the effect on import value of the quantity change ΔQ valued at current-year prices P_1.

From 1973 to 1975, both Korea's and Taiwan's trade balances deteriorated by about $1 billion in nominal terms (Table 2, Part A).[3] In both cases, the deterioration was attributable to a much

Chart 2

Price and Quantity Changes

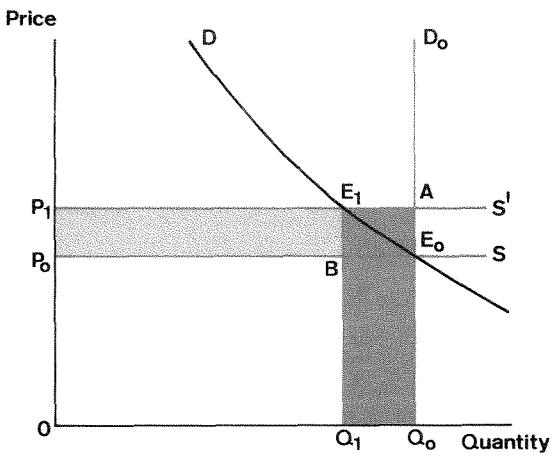


Table 1

Net External Borrowings, Reserve Changes and External Debts, 1971–77
(Millions of U.S. Dollars)

	Average 1971–73	1974	1975	1976	1977[1]
Korea					
Net External Borrowings (Private and public)	570	1,603	2,267	1,691	1,449
Changes in Official Reserves (Increase: +)	160	−172	368	1,314	1,468
External Public Debt Outstanding (end of period)	4,556	6,178	6,912	10,210	n.a.
U.S. banks	n.a.	n.a.	2,604	3,252	3,948
Taiwan					
Net External Borrowings (Private and public)	−226	1,018	528	108	−1,088
Changes in Official Reserves (Increase: +)	178	42	12	410	−236
External Public Debt Outstanding (end of period)	1,820	2,612	3,103	3,158	n.a.
U.S. Banks	n.a.	n.a.	1,810	2,578	3,458

[1]Data are for the first three quarters at annual rates for net capital inflows and changes in reserves, and end of year for debts to U.S. banks.

Sources: International Monetary Fund, *International Financial Statistics,* April 1978; World Bank, *World Debt Tables,* Vol. 1, September, 1977; U.S. Treasury, *Treasury Bulletin,* February 1978; Federal Reserve Board, *Statistical Release* E. 11, various dates.

Table 2

Changes in Trade Balance
1973–75 and 1975–77[1]
(Millions of U.S. Dollars)

	1973–75			1975–77		
	Exports	Imports	Trade Balance	Exports	Imports	Trade Balance
A. Value						
Korea	+1,719	+2,825	−1,106	+5,039	+3,812	+1,227
Taiwan	+ 825	+1,816	− 991	+4,440	+2,875	+1,565
B. Prices						
Korea	+ 547	+2,323	−1,776	+1,148	+ 44	+1,104
(Oil Shock)		(+739)			(+205)	
Taiwan	+1,093	+1,523	− 430	+ 775	+ 647	+ 128
(Oil Shock)		(+269)			(+131)	
C. Volumes						
Korea	+1,172	+ 502	+ 670	+3,891	+3,768	+ 123
Taiwan	− 268	+ 293	− 561	+3,665	+2,228	+1,437

[1]The data are cumulative year-to-year changes during the respective periods derived by using Equation (2) in the text.

Sources: Based on data in International Monetary Fund, *International Financial Statistics,* April 1978; except for "oil shock" data on the price of crude petroleum (Arabian Light, 34 gravity) which are from American Petroleum Institute, *Basic Petroleum Data Book,* April 1978, updated by data supplied by the API.

larger rise in imports ($2.8 billion and $1.8 billion, respectively) than in exports ($1.7 billion and $0.8 billion). By applying Equation (2), we can break down these nominal-value changes into two parts -- one due to price changes (Table 2, Part B) and the other due to volume changes (Table 2, Part C).

For both countries, nearly all the import increases during 1973-1975 were due to steep rises in import prices (Part B). In terms of U.S. dollars, import prices rose 59 percent for Korea and 41 percent for Taiwan.[4] These price increases accounted for 82 percent of Korea's 1973-75 import increase and for 84 percent of Taiwan's increase. The oil shock accounted for 26 percent of Korea's, and 15 percent of Taiwan's total import increase.

Abstracting from price changes, changes in import volume (Part C) accounted for 18 percent of Korea's $2.8-billion rise in imports, and for 16 percent of Taiwan's $1.8-billion rise in imports. In real terms, the rise in import volume was 8 percent and 10 percent, respectively. For Taiwan, the cumulative change in import volume over the two-year period masks wide annual fluctuations, as will be discussed below.

During the 1975-77 period, both countries' trade balances improved dramatically -- $1.2 billion for Korea and $1.6 billion for Taiwan, compared to the actual deterioration both suffered in the preceding two-year period. Price changes accounted for 23 percent of Korea's export increase and for 17 percent of Taiwan's increase (Table 2). Import-price increases accounted for 23 percent of Taiwan's import growth but for hardly any of Korea's increase.

In real terms, Korea's exports increased 56 percent and Taiwan's 64 percent, while their imports rose 43 percent and 32 percent, respectively. In other words, Taiwan was much more successful than Korea in holding its import-growth rate below its export-growth rate. Thus, Taiwan's $1.6-billion trade-balance improvement resulted mainly from its trade-volume-adjustment, while Korea's $1.2-billion improvement resulted mainly from improved terms of trade. Put differently, Korea benefitted substantially more than Taiwan did from terms-of-trade improvements during the 1975-77 recovery phase.

A number of questions emerge from this analysis. First, what might account for Korea's much stronger real-export growth in the 1973-75 period? Second, why did the two countries, with supposedly similar production and trade patterns, react so differently in their trade adjustment during that period (stronger export growth for Korea, and stronger import restraints for Taiwan)? Third, how did the two countries achieve such spectacular real export growth during the 1975-77 recovery? Lastly, why did exports grow considerably faster than imports for both countries between 1973 and 1977?

II. Analysis of Trade-Volume Fluctuations

In seeking answers to these questions, we assume changes in prices and income as given, and examine how Korea and Taiwan's export and import volumes reacted to these changes (see the above description of Chart 2). Our basic premise is that certain stable systematic relationships existed during the 1973-77 period, between the changes in the two countries' trade volume on the one hand, and income and price changes on the other.

More specifically, we assume that the demand for each country's exports depends on world real income, and on the price competitiveness of each country's exports relative to competing goods in importing countries and to exports of close competitor countries. We further assume that Korea and Taiwan are each other's closest export competitors, and that their exports are sufficiently differentiated from each other and from goods in the importing countries as to allow different price movements, adjusted for exchange-rate changes. Similarly, we assume that each country's demand for imports depends on its real income, and on the price competitiveness of imported goods relative to its domestic products, again adjusted for exchange-rate changes.

The two countries exhibited different patterns of real output and prices during the 1973-77 period. Korea maintained a surprisingly high output-growth rate of 8.8 percent in both 1974 and

1975 -- close to the 10.3-percent average rate of the preceding decade. However, this was attained only at the cost of a high domestic consumer-inflation rate, averaging 25 percent a year. Taiwan took a somewhat different course. Its output-growth rate dropped precipitously from an annual average of 10.4 percent during the 1963-73 decade to 0.6 percent in 1974 and 2.4 percent in 1975. Meanwhile, its domestic inflation rate jumped abruptly by 48 percent in 1974 and then dropped to an average rate of only 3.8 percent in 1975-76 -- about the same as in the 1963-73 decade.

Contrasts also showed up in the two countries' exchange-rate policies. Taiwan abandoned a system of multiple exchange rates in 1963, and thereafter maintained a fixed exchange-rate policy except for one revaluation in February 1973. At that time, it revalued by 5.3 percent, from 40 to 38 New Taiwan dollars (NT) per U.S. dollar, in order to curb domestic inflationary pressures arising from mounting trade surpluses. Subsequently, it kept the exchange rate unchanged despite large domestic price increases in 1974 and trade deficits in 1974 and 1975. Korea, on the other hand, devalued by 67 percent between 1963 and 1973 -- from 130 to 398 won (W) per U.S. dollar, and then devalued another 18 percent to W484 in December 1974. Since then, it too has maintained a fixed exchange rate against the dollar.

Although Korea's domestic inflation rate was considerably higher than Taiwan's for most years, the inflation-rate differentials were largely offset by exchange-rate adjustments. Thus, between 1963 and 1973, consumer prices increased at a 12.4-percent average rate for Korea and at only a 3.5-percent average rate for Taiwan, but Korea's cost of living (in terms of U.S. dollars) fell at a 3.4-percent average rate against Taiwan's. In 1974, this cost-of-living ratio fell another 18.2 percent because of Taiwan's sharp price rise in that year, but the ratio rose steadily thereafter as Korea's exchange devaluation failed to offset that nation's higher rise in consumer prices.

III. Regression Results

The regression equations derived in this study postulate the following relationships:

$$X_i = f(Y_w, P_{xi}/P_w, P_{xi}/P_{xj}) \qquad (3)$$

$$M_i = f(Y_i, P_{mi}/P_i, X_{i,-1}) \qquad (4)$$

Equation (3) states that the demand for country i's real exports (X_i) is positively related to world real income (Y_w), and negatively related to the ratio of its own export price to the world price level (P_{xi}/P_w) and to the ratio of its own export price relative to the export price of its close-competitor country j (P_{xi}/P_{xj}). Equation (4) states that the demand for country i's real imports (M_i) is positively related to its real income (Y_i) and to its volume of exports during the preceding year ($X_{i,-1}$), and negatively dependent on the ratio of its import price to the domestic price (P_{mi}/P_i).

The lagged export volume is included in the import equation as a proxy for the market's expectation of the current year's volume of exports. It is based on the fact that both Korea and Taiwan import large amounts of materials, parts and components for processing and assembling for exports. Because of the time lag between placement of import orders and import arrivals, importers when anticipating future export demand must rely upon such indicators as the current level of exports. Thus, the higher the current level of exports, the larger will be the import orders for future import arrivals. For simplicity, we postulate that the average lag is one year.[5]

Because the regressions are designed to explain the year-to-year percent changes in the two countries' export and import volumes, rather than their absolute levels, the demand functions (3) and (4) are assumed to be of a constant-elasticity type:

$$D = a_0 Z_1^{a_1} Z_2^{a_2} \qquad (5)$$

where D designates the dependent variable X_i or M_i, Z_1 and Z_2 are the explanatory variables, and the a's are parameters. Equation (5) can be rewritten in percent-change terms:

$$\Delta D/D = a_1 \Delta Z_1/Z_1 + a_2 \Delta Z_2/Z_2 \qquad (6)$$

or alternatively, in logarithms:

$$\log D = \log a_0 + a_1 \log Z_1 + a_2 \log Z_2 \quad (7)$$

In either case, the parameters a_1 and a_2 designate demand elasticities with respect to Z_1 and Z_2, respectively.

Regression equations of the percent-change form (Equation 6) and the logarithmic form (Equation 7) are estimated on the basis of annual data for the years 1952-76. In the export equations, OECD real output is used to stand for world real income (Y_W), and a weighted average OECD consumer-price index for world price level (P_W).[6] In the import equations, each country's consumer price index is used for P_i. In all the regression equations, consumer prices rather than wholesale prices are used, as the latter are more likely to be influenced by changes in the prices of internationally traded goods, and thus are more reflective of world-market conditions than domestic-inflation conditions.

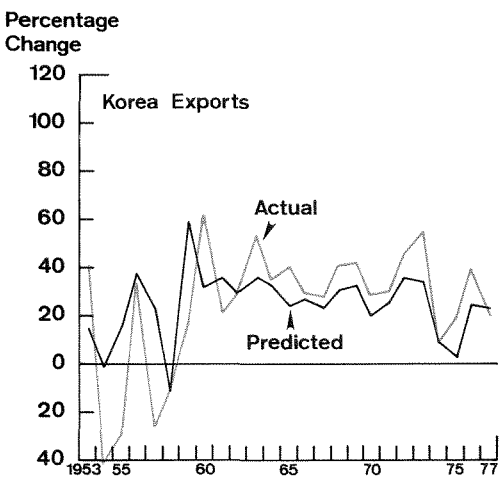
The regression results, presented in Table 4, show that the best export equations for both countries were of the percent-change form and the best import equations of the logarithmic form. Because of problems of multicollinearity with P_{xi}/P_{xj}, the relative-price term P_{xi}/P_W had to be dropped from the export equations. The squared simple-correlation coefficient between the two relative-price terms was 0.90. The regression coefficients of all the other variables were of the correct signs and statistically significant. The regression equations accounted for varying portions of the variances of the dependent variables, with little or no evidence of significant serial correlation in the error terms.[7]

The regression results suggest stable relationships over the 1952–76 period (Charts 3–4)—a period in which both countries became transformed from slow-growing agricultural economies to fast-growing manufacturing economies. Moreover, the relationships continued to hold for the 1973–76 period and for (projected) 1977, with the unexplained variations falling well within one standard error of the respective regression equations. Thus, the two countries' trade adjustments to the oil shock and the severe world inflation and recession of the 1973–77 period differed from their experiences of the preceding twenty years only in magnitude, not in kind.

What light can these regression results throw on the central questions raised earlier? First, there is the question of Korea's much stronger export performance during the 1973–75 period. Over that period, Korea's export volume rose by 33 percent, while Taiwan's fell by 6 percent. Our regression equations relate changes in export volumes to changes in world real income and in the two countries' relative export prices. Since both countries' exports faced the same changes in world real income, any explanation based on the regression equations must come from the relative price term.

Chart 3

Korea and Taiwan Exports, Actual and Predicted Values



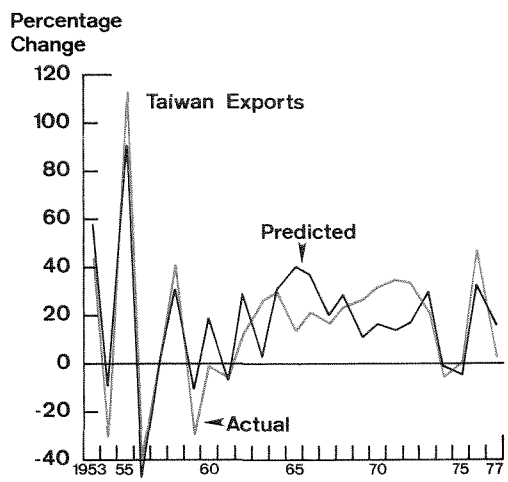


Table 3

Economic Profiles of Korea and Taiwan, 1963–73 and 1973–77 (Percent Changes)

	Average 1963–73	1973–74	1974–75	1975–76	1976–1977
Real-Output Growth					
Korea	10.3	8.8	8.8	15.0	9.8
Taiwan	10.4	0.6	2.4	11.8	8.1
Consumer-Price Inflation					
Korea	12.4	23.7	26.3	15.3	10.3
Taiwan	3.5	47.5	5.2	2.5	6.2
Export Prices in National Currency					
Korea	16.9	29.0	10.5	11.7	7.1
Taiwan	2.9	30.8	−5.7	2.4	8.1
Exchange-Rate Adjustment[1]					
Korea	−67.4[2]	−1.8	−16.2	- 0 -	- 0 -
Taiwan	4.6[2]	0.8	- 0 -	- 0 -	- 0 -
Relative Consumer Prices in U.S. Dollars[3]					
Korea/Taiwan	−3.4	−18.2	0.7	12.5	3.9
Relative Export Prices in U.S. Dollars[3]					
Korea/Taiwan	1.2	−3.9	−1.4	8.9	−0.9

[1]Percent change in the value of the national currency against the U.S. dollar.
[2]Total change from 1963 to 1973, not average annual rate of change.
[3]Ratio of consumer-inflation rates or export prices in national currencies adjusted for exchange-rate changes.
Source: International Monetary Fund, *International Financial Statistics,* May 1978.

Table 4

Regression Results, Export and Import Functions (Annual Data: 1952–76)

1. Exports, Korea

$$\Delta X_k = 6.74 + 4.63\Delta Y_w - 0.507\Delta(P_{xk}/P_{xt}),$$
$$(0.75) \quad (2.50) \quad (2.14)$$
$$R^2 = 0.231, S = 23.5, DW = 1.90, N = 24.$$

2. Exports, Taiwan

$$\Delta X_t = 3.29 + 4.13\Delta Y_w - 1.18\Delta(P_{xt}/P_{xk}),$$
$$(0.003) \quad (3.35) \quad (6.89)$$
$$R^2 = 0.730, S = 16.0, DW = 1.52, N = 24.$$

3. Imports, Korea

$$\ln M_k = -3.80 + 1.19 \ln Y_k - 0.987 \ln(P_{mk}/P_k) + 0.311 \ln(X_k)_{-1},$$
$$(1.46) \quad (2.57) \quad (3.12) \quad (2.16)$$
$$R^2 = 0.962, S = 0.235, DW = 1.97, N = 24.$$

4. Imports, Taiwan

$$\ln M_t = 0.323 + 0.550 \ln Y_t - 0.970 \ln(P_{mt}/P_t) + 0.567 \ln(X_t)_{-1},$$
$$(1.33) \quad (5.06) \quad (4.56) \quad (8.95)$$
$$R^2 = 0.982, S = 0.110, DW = 2.27, N = 24.$$

Notes: (a) For explanations, see the text.
(b) The t-statistics are shown in parentheses under the regression coefficients.

From 1973 to 1975, the ratio of Korea to Taiwan's export prices in U.S. dollars declined by 5.3 percent (Table 3); alternatively stated, the ratio of Taiwan to Korea's export prices rose by 5.6 percent. When these relative price changes are multiplied by the price elasticities obtained from the respective export equations—0.507 for Korea and 1.180 for Taiwan (Table 4)—the results indicate that relative price changes accounted for less than 10 percent of the rise in Korea's export volume,[8] but for more than the total decline in Taiwan's export volume.

In terms of national currencies, Korea's export prices actually increased by 15.6 percent more than Taiwan's export prices during the 1973–75 period (Table 3). Yet, Korea was able to more than offset the higher price rise by an 18-percent currency devaluation in 1974 on top of Taiwan's 5.3-percent currency appreciation in 1973. Thus, different exchange-rate policies helped account for much of the difference in the two countries' export performance in this period.

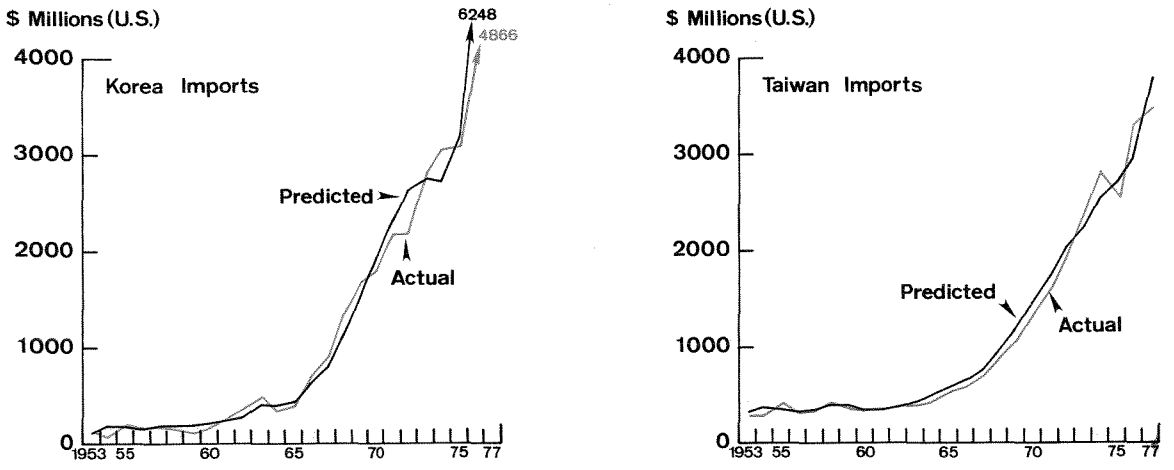
The second question refers to the apparently different adjustment paths followed by Korea and Taiwan for reducing payment deficits. On the export side, the difference could be attributed largely to different exchange-rate policies, as we have just seen. On the import side, most of the change in import volume could be attributed to income, relative prices, and to lagged exports (Table 4). A notable exception, however, was the sharp 12-percent decline in Taiwan's import volume in 1975, which was opposite to what would be expected on the basis of our regression equation (Chart 4). A detailed examination of this episode may help explain the paradox.

Taiwan's economic growth during the last fifteen years has been featured by an increasing dependence on export demand. The export share of total output jumped from 13 percent in 1963 to 46 percent in 1973, partly on the basis of a 62-percent export increase in 1971-73 alone. But then exports actually declined 6 percent over the ensuing two-year period, representing a severe setback to Taiwan's economy. In 1974, Taiwan recorded a 0.6-percent increase in real output, but only because of a sixfold increase in inventory accumulation.[10] Then, in 1975, while exports remained weak, real output rose by 2.4 percent, primarily on account of an unprecedented 12.1-percent increase in real government consumption expenditures and a 52.2-percent increase in fixed capital formation by public corporations and government enterprises.[11] But for the extra spending, on inventories in 1974 and on government projects in 1975, real output would have declined about 6 percent in both years.

Under these circumstances, Taiwan still managed to reduce its volume of imports. First, in order to maximize the intended output-expansion impact, the government allocated its extra purchases mostly to domestic products rather than

Chart 4

Korea and Taiwan Imports, Actual and Predicted Values



imports. Second, as exports declined, it imposed additional import restrictions (including surcharges and cutbacks in permits), partly as a trade-adjustment measure and partly as a means of diverting demand to domestic products. Neither of these two developments would have been reflected in our import equation.

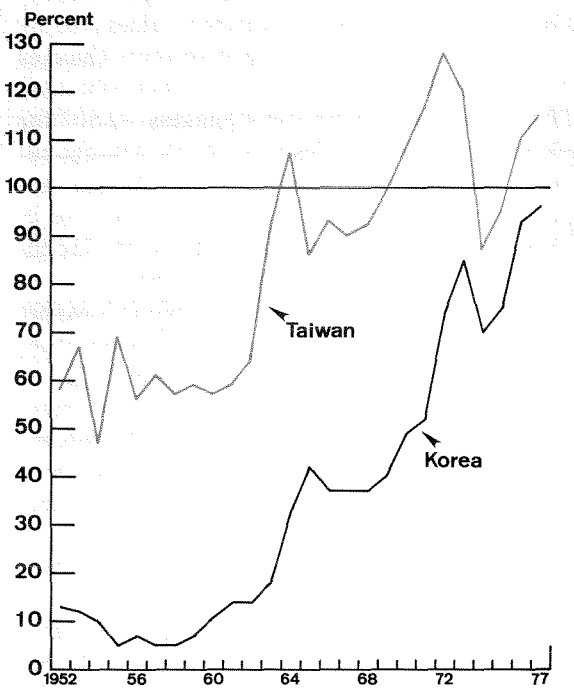
In short, Taiwan's adjustment through income deflation was not a result of deliberate economic policy, but rather was imposed on the economy by the unexpected export decline, which in turn was caused by Taiwan's 1973 currency appreciation and Korea's 1974 currency devaluation. Thus, underlying the difference in balance-of-payments adjustment was a different approach to exchange-rate adjustment: Korea's readiness to adjust its exchange rate when needed, and Taiwan's strict adherence to a fixed exchange rate in the face of sharp domestic price increases and a sharp currency devaluation by its close trade competitor.

The third question to be examined has to do with the spectacular export growth of the 1975–77 period, amounting to 56 percent for Korea and 64 percent for Taiwan, in real terms. During that period, world real income rose by 8.5 percent, while Korea's export prices in U.S. dollars rose by 7.9 percent relative to Taiwan's. When these changes are multiplied by the respective elasticities derived from the two export equations, the results indicate that world income growth accounted for 40 percentage points of Korea's export growth and 35 percentage points of Taiwan's; and that the change in relative export prices reduced Korea's export growth by 4 percentage points and increased Taiwan's by 9 percentage points. Thus, our regression results indicate that the two countries' remarkably strong export growth was largely due to world economic recovery, combined with the world's high income elasticities of demand for the two countries' exports. Relative export prices played a minor, though not insignificant, role during that period.[9]

Finally, there is the question of why both countries have experienced faster growth of exports than of imports over time. Export-import ratios for both countries showed an unmistakable upward trend after 1960, except for a flattening-off

Chart 5

Export-Import Ratios, 1952-1977



in the second half of the 1960's and a sharp dip in 1974. Both ratios resumed their rise after 1974 (Chart 5). The upward trends imply that both countries were paying for an increasing portion of their imports through exporting. In Taiwan's case, exports have exceeded imports almost every year since 1969.

Our regression results suggest that the world's income elasticities of demand for Korea's and Taiwan's exports (larger than four) were much higher than these countries' income elasticities of demand for imports (roughly one). Unless offset by higher economic growth rates, the differences in income elasticities would lead Korea and Taiwan to show faster export growth than import growth. From 1960 to 1973, OECD real output grew at a 4.9-percent annual average rate, while Korea's and Taiwan's output grew by 9.2 and 9.7 percent a year, respectively. In neither case was the growth-rate differential sufficient to offset completely the income-elasticity differential.

The income elasticities have been derived on the basis of stable relationships extending over a

quarter-century. Thus, the upward trend in Korea's and Taiwan's export-import ratios is likely to continue, in the absence of basic structural or policy changes which reduce the world's income elasticity of demand for their exports or increase their own elasticity of demand for imports. For international bankers, this suggests that both countries will remain good credit risks. But at the same time, the upward trends could portend difficult policy choices for these countries.

Given the limited scope of monetary-policy instruments in Korea and Taiwan, the authorities might encounter difficulty reconciling domestic stabilization objectives with policies of fixed exchange rates and restrictive exchange and trade controls. In order to relieve the increasing inflation pressures arising from growing trade surpluses and mounting foreign reserves, the two countries might be forced to revalue their currencies and/or liberalize the exchange and trade controls which were imposed during an earlier era of foreign-exchange shortage. The policy choice might be complicated by their traditional reliance on export expansion for economic growth, as well as the strength of the domestic interests arrayed against trade liberalization.

IV. Summary and Conclusions

Like other oil-importing developing countries, Korea and Taiwan sustained unprecedentedly large payments deficits in 1974 and 1975. Yet, barely two years later, both had succeeded in eliminating the deficits. The two appear to have followed different adjustment paths—Korea through export expansion and output growth, at the cost of severe domestic inflation, and Taiwan through import contraction and relative price stability, at the cost of temporarily reduced output growth. Each country was successful in its own way, but the approaches to success were different.

This study has sought to develop some explanation for these contrasting success stories. By isolating the impact of price changes, we were able to concentrate on trade-volume changes. On the basis of regression equations, we found that the wide and divergent fluctuations in trade volumes largely reflected several key explanatory factors.

1. During the 1973–75 period, Korea sustained a much more severe oil shock and terms-of-trade deterioration than Taiwan. Yet, Korea was able to reduce the resultant trade deficit through export expansion and restrained import growth. In contrast, Taiwan's imports increased and exports decreased, worsening its trade balance.

2. After the initial shock in 1974, both countries reduced their trade deficit in 1975: Korea primarily by continued export expansion, and Taiwan by drastic reduction in imports. The difference in their adjustment paths largely reflected their exchange-rate policies: in particular, Korea's 18-percent devaluation in 1974 on top of Taiwan's 5.3-percent appreciation in 1973. The exchange-rate changes made Korea's export expansion possible and Taiwan's import contraction inevitable. The different adjustment paths meant, for Korea, sustained output growth at the expense of domestic price stability, and for Taiwan, income stagnation coupled with a low rate of domestic inflation. The former reflected a deliberate demand-management policy aimed at rapid income growth, and the latter reflected an adherence to fixed exchange rates and a policy focused on the maintenance of domestic price stability.

3. During the 1975–77 period, both countries' trade balances improved rapidly, primarily because of world economic recovery coupled with high world-income elasticities of demand for the two countries' exports. In addition, Korea was particularly helped by improved terms of trade.

4. The world's income elasticities of demand for Korea's and Taiwan's exports are substantially larger than these countries' income elasticities of demand for imports. The differences help account for a long-run rising trend in both countries' export-import ratios. This suggests small credit risks for these countries, but it could also portend difficult policy choices—between domestic stabilization on the one hand, and continued restrictive foreign-exchange and foreign-trade policies on the other. How the two countries resolve this policy dilemma will be fascinating to watch.

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FOOTNOTES

1. The current account balance is defined here as the sum of the balance on the goods-and-services account and the net private and government unrequited transfers (i.e., remittances, donations and grants) in a country's international balance of payments.

2. However, a few remarks on the service transactions, unrequited transfers, and foreign borrowings are in order. For most years, Korea had large net receipts from U.S. Government grants, services provided by Korea to U.S. military forces stationed there, and remittances from overseas Koreans. Taiwan did not have such receipts to any significant extent. Its service-account balance ran a steadily increasing deficit since 1967, reflecting mainly rising shipping and transportation costs for Taiwan's growing volume of foreign trade—a development which was also evident in Korea's service transactions. Moreover, in recent years, especially since 1974, both countries have been making large and increasing amounts of interest and dividend payments to foreigners.

3. In actual calculation, ΔP in Equation (2) is converted to percent-change terms by rewriting the formula as

$$\Delta V = V_0 \Delta P / P_0 + P_1 \Delta Q$$

where ΔV, V_0, and $\Delta P / P_0$ are all readily obtainable from published data, and $P_1 \Delta Q$ is derived as a residual.

4. Data cited in this and the following paragraphs, but not shown in Table 2, are from IMF, **International Financial Statistics**, April, 1978.

5. Some statistical complications may be introduced by the use of a lagged variable. The relationship between the export volume and the import volume may in fact be contemporaneous, so that the lagged exports may be a proxy for lagged imports, rather than for export expectation. In that case, certain statistical tests, such as the t-test and the Durbin-Watson test, would not be applicable.

6. Both sets of data are published in OECD, **Main Economic Indicators,** various issues, for 1960-76 only. For the years 1952-59 the U.S. real GNP series was spliced to the OECD output series, and the U.S. consumer-price series to the OECD price series, through simple regressions. In both cases, the squared correlation coefficient was about 0.90.

7. The only exception is the Taiwan export equation, which has a Durbin-Watson statistic within the critical range at the 5 percent significance level, indicating a probable positive serial correlation of a fairly low magnitude (about 0.24).

8. That the relative-price term accounts for so small a portion of Korea's export growth is disappointing. It reflects the relatively poor fit of the Korea export equation, as shown in Chart 3, indicating the presence of some powerful factors—e.g. technology and marketing improvements, export-promotion measures—that are not captured by our regression equation. Nevertheless, the Durbin-Watson statistic (1.90) is so close to 2 that there appears to be little **systematic** error in the specification.

9. Why the world's income elasticities of demand for the two countries' exports are so high is an interesting question not pursued in this article. It would be useful to compare these with the world's income elasticities of demand for other countries' exports, to see whether those for Korea's and Taiwan's product are indeed significantly higher; and if so, why.

10. The data cited in this paragraph are based on Directorate-General of Budget, Accounting and Statistics, Executive Yuan, **National Income of the Republic of China.** December 1976, especially pp. 83 and 123.

11. All capital-formation data are in nominal values, as data on capital formation according to purchasers are not available in real terms.