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By the Research Department of the
International Monetary Fund

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The following symbols have been used throughout this paper:
. . . to indicate that data are not available;

— to indicate that the figure is zero or less than half the final digit shown, or that the item does not exist;

– between years or months (e.g., 1989–90 or January–June) to indicate the years or months covered, including the beginning and ending years or months;

/ between years (e.g., 1989/90) to indicate a crop or fiscal (financial) year.

"Billion" means a thousand million.

Minor discrepancies between constituent figures and totals are due to rounding.

Preface

The *Staff Studies for the World Economic Outlook* were prepared as background documents to the analysis and scenarios in the World Economic Outlook exercise carried out by the Fund's Research Department. They have benefited from comments by staff colleagues throughout the Fund as well as by the Fund's Executive Directors. The views expressed remain the responsibility of the individual authors.

It should by noted that the term "country" used in this report does not in all cases refer to a territorial entity that is a state as understood by international law and practice. The term also covers some territorial entities that are not states but for which statistical data are maintained and provided internationally on a separate and independent basis.

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I
The Use of Commodity Prices to Forecast Inflation

James M. Boughton and William H. Branson[1]

Changes in commodity prices have long played an important indicative role in analyses of global economic conditions, principally because of their importance for developing countries. More than 50 countries derive at least 50 percent of their export earnings from nonfuel primary commodities; another 18 derive the majority of their export earnings from fuels (see IMF (1990), pp. 117–20). Changes in the terms of trade for these countries typically arise largely from changes in world commodity prices.[2] Recently, however, attention has also been drawn to the importance of changes in commodity prices as indicators of changes in inflationary conditions affecting industrial countries. For example, the *World Economic Outlook* recently began to include an analysis comparing percentage changes in an index of 40 primary commodity prices with the aggregate inflation rate of the seven major industrial countries (the Group of Seven). (See IMF (1990), p. 13.) Two related papers, Boughton, Branson, and Muttardy (1989) and Boughton and Branson (1990b), examine the usefulness of commodity price indexes as leading indicators of inflation in each of the Group of Seven countries individually. This paper focuses on the Group of Seven as a group, in order to shed light more directly on the relationship between world commodity price movements and aggregate industrial country inflation.

An early exponent of focusing on commodity prices in relation to industrial country inflation was Robert Hall. In his 1982 book, Hall argued in favor of basing U. S. monetary policy on a commodity standard, with the commodities chosen on the basis of the closeness of their historical fit against the cost of living.[3] Bosworth and Lawrence (1982) emphasized the role of commodity prices as a contributor to the rise in inflationary pressures during the 1970s, and Beckerman and Jenkinson (1986) argued that the disinflation of the early 1980s was attributable in large measure to an exogenous drop in commodity prices. More recently, Federal Reserve Board Governor Wayne Angell (1987) noted the close qualitative link between turning points in a broad index of commodity prices and turning points in the U. S. CPI. Durand and Blöndal (1988), however, examined both short- and long-run relationships between commodity and consumer prices in the major industrial countries and concluded that the quantitative linkages were generally weak and unstable. Others, notably Klein (1986) and Roth (1990), reached more favorable conclusions when they examined the performance of commodity prices as one component of overall predictions of inflation. In addition, several recent papers have examined the question of whether a rule could be designed under which monetary policy in large industrial countries could be aimed at stabilizing commodity prices; see, for example, Baillie (1989), Furlong (1989), Hook and Walton (1989), and Webb (1988). Although much of this literature supports the usefulness of commodity prices as leading indicators, the evidence does not seem to support the stronger proposition that commodity prices could serve as a guide for monetary policy.

Chart 1 presents inflation rates for the U. S. CPI and a world export-weighted index of commodity prices; this

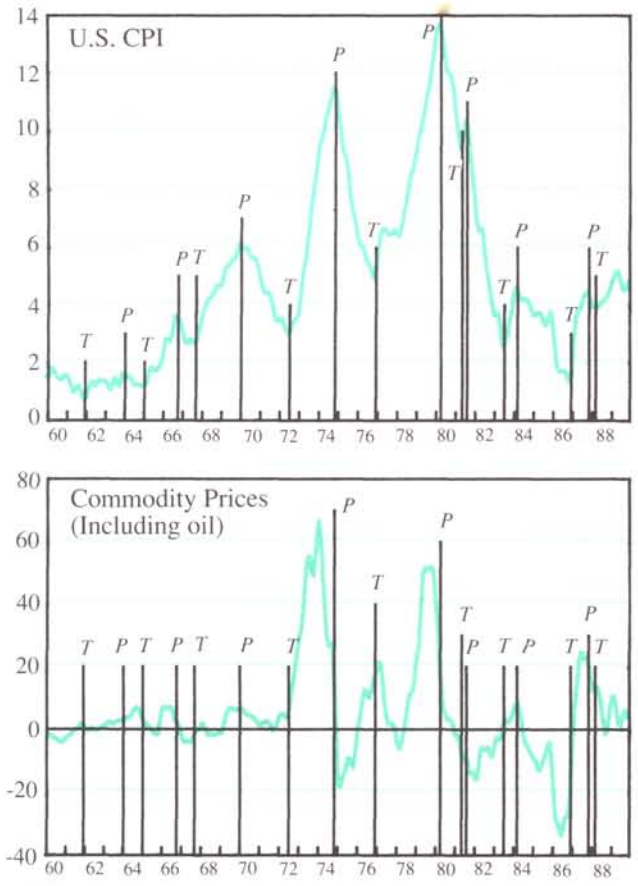
[1] Mr. Boughton is an advisor in the IMF's Research Department. Mr. Branson is Professor of Economics and International Affairs at Princeton University; his work on this paper was completed in part while he was a Visiting Scholar in the Research Department at the IMF, and in part while a Visiting Scholar at the Banca d'Italia. This paper draws in large part on Boughton and Branson (1990a), for which the authors would like to thank Kajal Lahiri and Geoffrey Moore, the editors of the volume in which that paper is to appear. The authors also are grateful to Claire Adams and Tom Walter, who carried out the empirical tests for this paper; to a number of colleagues at the Fund, especially Blaire Rourke and Alphecca Muttardy, who helped prepare and interpret the data; to Chris Gilbert, Tim Jenkinson, and Mark Watson for a number of suggestions; and to participants at seminars at the IMF, the Banks of Italy and Spain, the Centre for Economic Policy Research in London, and the Institute for International Economic Studies in Stockholm. The views expressed herein are those of the authors and should not be attributed to any institution.

[2] For an analysis of the importance of commodity price movements for developing countries, see Cuddington (1989).

[3] The index favored by Hall at that time was limited to four commodities: ammonium nitrate, copper, aluminum, and plywood (p. 112). Hall later (1987) emphasized the limitations of that index.

Chart 1. Rates of Change of Commodity Prices and U.S. Consumer Prices in U.S. Dollars, 1960–89[1]

(In percent)



[1] Three-month centered moving average of 12-month inflation rates. *T* and *P* denote troughs and peaks, respectively, in the CPI.

chart is similar to one presented by Angell. Two stylized facts emerge clearly. First, there is a similarity in the cycles for commodity and consumer prices, with the commodity-price cycles often turning ahead of those in the CPI. Second, the amplitudes of these cycles are very different (note the differences in the two scales). There is thus a presumption that the relationship is more qualitative than quantitative. Chart 2 presents the same type of information except that CPI inflation is a weighted average of inflation rates in the seven largest industrial countries, as in the *World Economic Outlook*. The qualitative relationships are generally similar in the two sets of data. These stylized facts are discussed more critically in the empirical sections that follow.

This paper begins by discussing the theoretical relationship between commodity and consumer prices and the conditions under which, in general, one would expect commodity prices to be a leading indicator of inflation. It then presents some tests of the relationships between conventional broad indexes of commodity prices and consumer prices. The following section, the question of using the data to generate the optimum weights in a commodity price index is taken up. Conclusions are summarized in the final section.

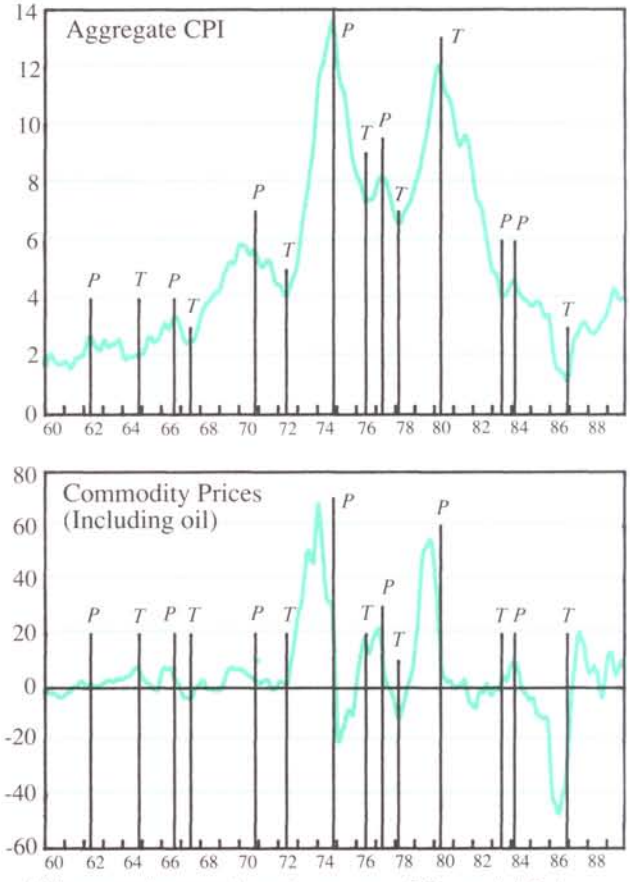
Dynamic Model of Commodity and Industrial Prices

This section presents a dynamic model of the relationship between commodity and industrial prices as a theoretical motivation for the idea of movements in commodity prices as a leading indicator of general price level fluctuations. The model treats commodities as either final goods or inputs, and emphasizes the role of expectations in determining movements of commodity prices.

An important feature of the model is that commodity

Chart 2. Rates of Change of Commodity Prices and Industrial-Country Consumer Prices in an Aggregate Currency Basket, 1960–89[1]

(In percent)



[1] Three-month centered moving average of 12-month inflation rates. *T* and *P* denote troughs and peaks, respectively, in the CPI.

prices are determined in "auction" markets, actually financial markets that trade commodity contracts, while industrial prices are set by sellers and adjusted gradually. This permits commodity prices to react immediately to "news" about future inflation, and to lead adjustment of industrial prices. The two cases of commodities as final goods or as inputs are treated separately, but the basic results are the same in both cases. With unanticipated monetary disturbances, commodity prices overshoot and lead industrial prices. With real disturbances and no monetary accommodation, commodity prices would lead industrial prices in time, but the two would move in opposite directions.

Commodities as Final Goods

This subsection discusses a basic dynamic model of the interaction of commodity and industrial prices in which the two are final goods entering the CPI, and commodity prices are determined in flexible markets with forward-looking expectations. The model can be interpreted as one country with two sectors, or as two countries, one producing commodities and the other a perishable industrial output. The model includes a monetary sector, in which expectations of commodity price movements are important, and an industrial sector, in which prices adjust gradually following excess demand. To focus attention on price dynamics, the level of real output in the industrial sector is held constant. The model is an extension of Frankel (1986), which applies the Dornbusch (1976) overshooting model to the case of commodity price dynamics. In Boughton and Branson (1990b), the model is extended to the two-country case, with the exchange rate as an additional flexible response variable.

Equilibrium in the money market is characterized by equation (1):

$$m - \alpha p_m - (1 - \alpha)p_c = \phi y - \lambda i, \tag{1}$$

where m, p_m, p_c, and y are the logarithms of the nominal money stock, the price of the manufactured good, the price of commodities, and real output; i is the nominal short-term interest rate; and α is the share of manufactures in the CPI. The interest rate is related to commodity price inflation by the arbitrage condition:

$$i = \dot{p}_c + b, \tag{2}$$

where b is the real return to holding commodities for final use, net of storage costs, and $\dot{p}_c$ is the expected rate of change of the commodity price.

Combining equations (1) and (2) yields the following dynamic equation:

$$m - \alpha p_m - (1 - \alpha)p_c = \phi y - \lambda(\dot{p}_c + b).$$

The locus of points where $\dot{p}_c = 0$ is shown in Figure 1; its slope is $-(1 - \alpha)/\alpha < 0$.

For a point above the $p_c = 0$ line to be consistent with money market equilibrium, P_c must be expected to rise. This is because above the line the CPI is higher, and real balances lower, than on it. This makes the interest rate higher than b above the $p_c = 0$ line, so commodity prices must be expected to rise. If expectations exhibit perfect foresight, P_c must actually be rising above the $p_c = 0$ line. In other words, a commodity price level above that consistent with zero expected inflation must be supported by a positive rate of commodity price inflation. Similarly, at any point below the $p_c = 0$ line, commodity prices would be falling. These dynamics of P_c are shown by the horizontal arrows in Figure 1.

The supply of the industrial good (y_m) is given exogenously in this model. Demand is an increasing function of the price of commodities relative to industrial goods, P_c/P_m, and a decreasing function of the real interest rate in terms of the industrial good. This demand function may be written as

$$d = \delta(p_c - p_m) - \sigma(i - \dot{p}_m). \tag{4}$$

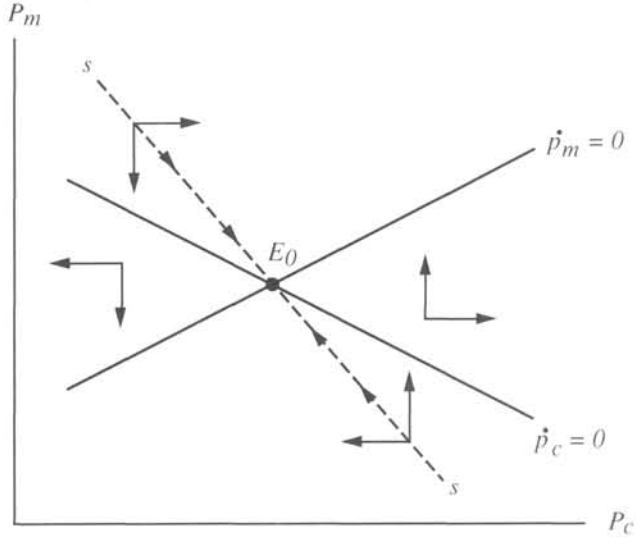
In contrast to the rapidly adjusting commodity price, the price of the industrial good is assumed to adjust slowly to eliminate excess demand:

$$\dot{p}_m = \pi[\delta(p_c - p_m) - \sigma(i - \dot{p}_m) - y_m]. \tag{5}$$

Consolidation of the terms on $\dot{p}_m$ yields a second dynamic equation:

$$\dot{p}_m = \eta[\delta(p_c - p_m) - \sigma i - y_m], \tag{6}$$

Figure 1. Commodity and Manufactures Prices: Market Equilibrium and Dynamics



where $\eta = \pi/(1 - \pi\sigma)$. If, as expected, a stimulus to excess demand is to raise the price of the industrial good, η must be positive.

The $p_m = 0$ locus in Figure 1 shows the relationship between the two prices that would maintain zero excess demand in the market for industrial goods for a given value of the money stock. The slope of the line is positive because an increase in the commodity price creates excess demand for industrial output, requiring an increase in the industrial price to eliminate it. The slope is less than unity because as prices rise, the interest rate also rises, reducing the demand for industrial goods.[4] So as the price of commodities rises, the increase in industrial goods prices needed to eliminate excess demand is less than proportional. At points above the $p_m = 0$ line, there is excess supply of industrial goods and the price is falling, assuming $\eta > 0$. Below the line, there is excess demand and the price is rising. The dynamics of adjustment of the industrial price are summarized by the vertical arrows in Figure 1.

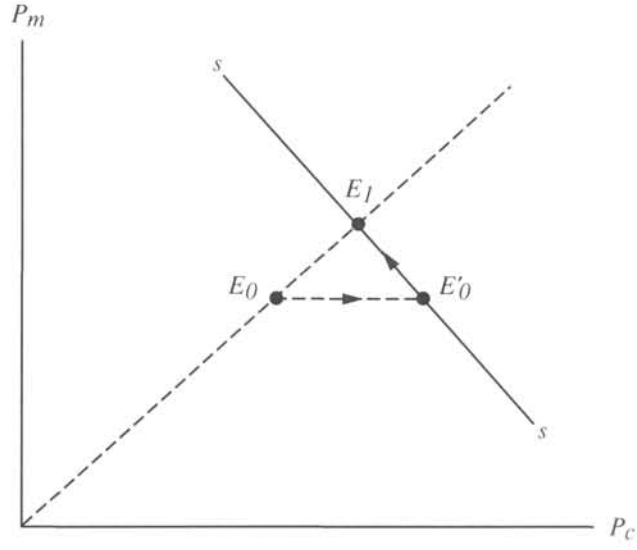
The two equilibrium lines in Figure 1 show the equilibrium pair of prices at E_0 for a given money stock and real commodity supply conditions. The dynamic adjustment to equilibrium is along the stable saddle path *ss*. This path has two essential properties. It leads to the equilibrium, and along it the expected rate of change of the commodity price is realized. All other paths explode away from the equilibrium; they are speculative bubbles. The assumption that the market seeks out the stable *ss* path is equivalent to assuming that speculative bubbles are unsustainable. Eventually they collapse, and the market moves back to the stable path.

The model of Figure 1 can be used to illustrate two properties of commodity price behavior that are important for constructing a leading indicator for inflation: following an unanticipated increase in the money supply, commodity prices overshoot, and they lead the adjustment in prices of industrial goods. In a situation in which the signals from the various monetary aggregates are unclear, the movements in commodity prices can be interpreted as distilling the information in the aggregates into a clearer signal.

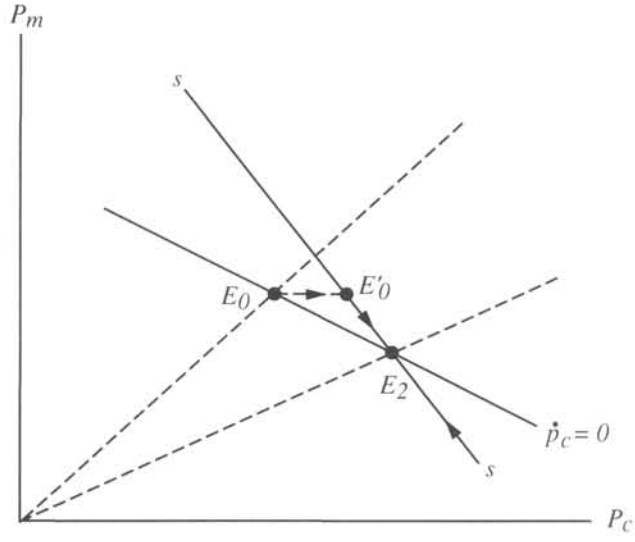
The role of commodity prices as a leading indicator of the inflationary effects of a monetary disturbance is illustrated in panel (a) of Figure 2, which shows the effects of an unanticipated increase in the money supply. If the model is interpreted as representing two countries, this would involve a proportional increase in both countries' money supplies. The original equilibrium from Figure 1 is at E_0 in Figure 2. An increase in the money supply shifts both the $p_c = 0$ and $p_m = 0$ lines, and the new long-run equilibrium moves proportionately out to E_1. In the long run, both prices rise by the same proportion as the money supply. In the short run, the gradually adjusting industrial price does not move, but the flexible commodity price jumps to the new *ss* path at E_0'. Then gradually the industrial price rises and the commodity

Figure 2. Price Adjustment with Commodities as Final Goods

(a) Monetary Disturbance (Overshooting)



(b) Real Disturbance (Undershooting)



[4] Upward movement along the $p_m = 0$ locus implies $p_c > 0$; from equation (2), this requires a rise in the interest rate.

price falls along the *ss* path to the new equilibrium at E_1. In response to an unanticipated monetary shock, commodity prices jump and overshoot, and lead the subsequent inflation in industrial prices.

The initial jump in the commodity price is consistent with an initial decline in the interest rate. In the original equilibrium at E_0, the expected rate of commodity price increase is zero, and the interest rate is equal to b. The rise in the money supply increases real balances initially, reducing the interest rate below b. This is consistent with equilibrium only if commodity prices are expected to fall. So initially the commodity price must rise by enough to create the expectation that it will fall during the adjustment period. This generates the jump onto the new *ss* path, along which the commodity price falls as expected as the economy moves toward E_1. At that point, real balances and the interest rate are back to their original levels, and the expected rate of commodity price inflation is again zero.

In response to repeated monetary shocks, jumps in the level of commodity prices would lead changes in the rate of inflation of industrial prices. This should produce a positive correlation between the *level* of world commodity prices and the subsequent *rate of inflation* of manufactures prices if repeated monetary disturbances are empirically important. Cointegration of the level of commodity prices and the rate of inflation in consumer prices is not rejected in the statistical tests in the following section.

The reaction of the model to a real disturbance that alters the equilibrium relative price of commodities is shown in panel (b) of Figure 2. As one would expect, it is substantially different from the reaction to a monetary disturbance. Suppose that a supply shock raises the equilibrium relative price of commodities. This shifts the $p_m = 0$ line down along the $p_c = 0$ line to a new long-run equilibrium at E_2, which lies on a ray from the origin that characterizes the new higher ratio of commodity prices to industrial prices. With no monetary accommodation, the $p_c = 0$ line does not move. The result is that commodity prices jump onto the new *ss* path at E_0' and then continue to rise, gradually, as industrial prices fall toward the new equilibrium E_2. As is usual in this type of model, the commodity price undershoots in response to a real disturbance. The industrial price must fall if there is no monetary accommodation. So in this case commodity prices lead, but industrial prices move in the opposite direction.

It could appear from this analysis that commodity prices would not be a useful indicator of future inflation in the presence of unaccommodated supply shocks. In fact, in this model, as long as these are not accommodated, there is no general inflation. As one price rises, the other falls to keep the weighted CPI constant. Thus a stochastic series of aggregate supply shocks would produce stochastic behavior of the commodity price with no general inflation. If in empirical implementation we use an index of a variety of commodity prices, supply shocks would come from differing sources, depending on the commodity. To the extent that these are independent, offsetting negative and positive disturbances at the individual commodity level would minimize the contribution of supply shocks to the variance of the index. Thus the path of the index would be dominated by monetary disturbances, with real disturbances producing noise around that path. The contribution of supply shocks to the variance of the index would be minimized to the extent that they are uncorrelated. This would improve the usefulness of the index as an inflation indicator.

Commodities as Inputs

The case of commodities as inputs can be discussed more briefly, since only two minor modifications need to be made to the model, and the results are essentially the same. In the money market, the deflator is now simply the price of industrial goods, so the dynamic equation (3) reduces to

$$m - p_m = \phi y - \lambda(\dot{p}_c + b). \tag{3'}$$

This change makes the $\dot{p}_c = 0$ line in the top panel of Figure 3 horizontal at the level of the industrial price that clears the money market with zero expected commodity price inflation.[5] At points above the $p_c = 0$ line, real balances are lower than on it, so the interest rate is higher than b, and commodity prices are expected to rise. Below the $p_c = 0$ line, commodity prices are falling. These dynamics are illustrated by the horizontal arrows in the top panel of Figure 3.

The market for industrial output is slightly more complicated. The demand for industrial goods is a decreasing function of the real interest rate. The supply of industrial goods is an increasing function of their price relative to commodities. Therefore, excess demand is a decreasing function of the relative price of industrial goods and the real interest rate. This gives a new equation for p_m:

$$\dot{p}_m = \eta\beta[(p_c - p_m) - \sigma i]. \tag{7}$$

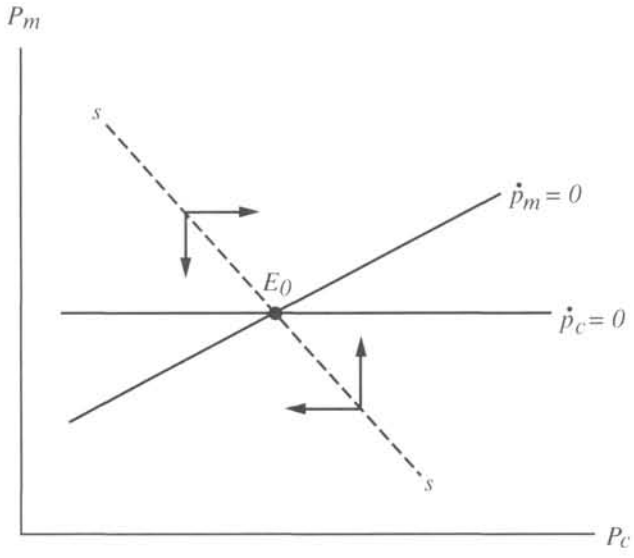
Here β represents the supply effect, and η is defined as before.

The $\dot{p}_m = 0$ locus is the positively sloped line in the top panel of Figure 3. To hold excess demand equal to zero in the market for industrial goods with a given increase in

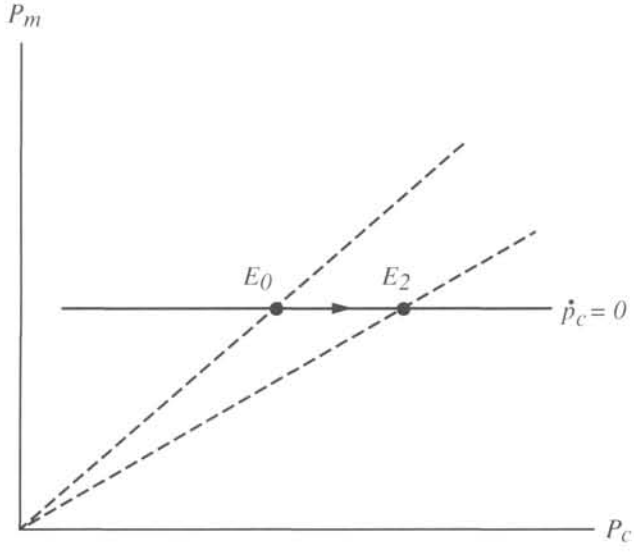
[5] Movement to the right along the $p_c = 0$ line in Figure 3 implies falling value added in the industrial sector, since input prices are rising against constant output prices. Therefore, if the vertical axis in Figure 3 measured the price of industrial-sector value added instead of the price of final output, the $p_c = 0$ line would be downward-sloping, as before.

Figure 3. Price Adjustment with Commodities as Inputs

(a) Market Equilibrium



(b) Real Disturbance



the commodity price, the industrial price would increase less than proportionately because the interest rate rises. Thus, the $p_m = 0$ line along which excess demand for the industrial good is zero has a slope less than unity in the top panel of Figure 3. Above this line, there is excess supply and P_m is falling. Below it, P_m is rising. The stable dynamic adjustment path is *ss* in Figure 3, as in the case of commodities as final goods.

The analysis following an unanticipated increase in the money supply is the same as that in panel (a) of Figure 2, discussed above. Adjustment to a supply shock that raises the equilibrium price of commodities relative to that of industrial output is illustrated in the bottom panel of Figure 3. The $p_m = 0$ line shifts out to intersect the $p_c = 0$ line at the new equilibrium price ratio. The commodity price rises, but, with no monetary accommodation, the price of industrial goods remains unchanged. The price of value added in the industrial sector or country falls. As before, it may be noted that a broad index of commodity prices might essentially average out supply shocks, leaving monetary disturbances to dominate movements of the index.

In these two models, commodity prices play the role of an inflation hedge. With gradual adjustment of industrial prices, agents can protect themselves against an anticipated inflation by buying commodities or, more generally, commodity futures contracts. The result falls naturally out of an analysis with two prices, one that adjusts gradually and one that can jump. The latter becomes the hedge against inflation in the former. A richer model would include more prices, such as foreign exchange or domestic equities, that can adjust instantaneously to inflationary expectations. In such a model, several variables can play the role of inflation hedge, with a wide variety of over-shooting and under-shooting behavior. This was shown in Frenkel and Rodriguez (1982). Then which price is the best indicator of future inflation becomes an empirical question. The conclusion to be drawn from the analysis in this section is that commodity prices are a reasonable candidate.

Empirical Tests Using Conventional Indexes

This section evaluates the empirical relationships between commodity prices and general price movements in industrial countries. In order to simplify the discussion, tests will be presented only for consumer rather than output prices as the objective variable, and only for the large industrial countries as a group.[6] These decisions are somewhat arbitrary, but there is likely to be a stronger empirical link from commodity prices to consumer prices than to output prices, especially in countries that are net importers of primary commodities. Focusing on the aggregate inflation rate for a broad group of countries may also enhance the measured importance of commodity prices as a leading indicator; changes in inflation in individual countries may be relatively more affected by policy actions and exogenous domestic events and less by international variables.

[6] The countries are the United States, Japan, the Federal Republic of Germany, France, the United Kingdom, Italy, and Canada.

Construction of Data

The first empirical task is to construct a data series for the aggregate CPI for the large industrial countries. How best to do this is not obvious, because national price data are in different currencies. One approach would be to convert the time series data on price levels into a common currency (say, U. S. dollars or SDRs) and then construct an average index using GNP, consumption, or some other set of weights. One would then have a direct estimate of the aggregate price level measured in that currency. An alternative would be to average the logarithms of the price levels in local-currency terms. This procedure would give a more accurate measure of the average inflation experience in the countries concerned. Which procedure to choose depends on the intended purpose, but in the present case the choice is complicated because of the diverse international structure of the markets for primary commodities.

The problem may be illustrated as follows. If the national price indexes are averaged directly, the aggregate price level is described by

$$p_t = \sum_{i=1}^{7} w_i p_{i,t} \tag{7}$$

where p is the logarithm of the aggregate CPI, p_i is the logarithm of the CPI for country i (denominated in the currency of that country), and the w_i are the weights. Alternatively, if the aggregate CPI is to be denominated in the currency of (say) the first country, then the formula may be written as

$$p'_t = w_1 p_{1,t} + \sum_{i=2}^{7} w_i (e_{i,t} + p_{i,t}) \tag{7'}$$

where e_i is the logarithm of the exchange rate for country i, expressed as the cost of local currency in terms of the currency of country 1.

The difference between these two measures of the aggregate CPI constitutes an exchange rate between the currency of country 1 and the weighted geometric average of the other countries as a group:

$$p'_t - p_t = \sum_{i=2}^{7} w_i e_{i,t} \equiv e_t \tag{8}$$

For the tests in this paper, the aggregate CPI is constructed according to equation (7); for convenience, the implicit currency basket in which the data are thereby denominated will be referred to as the "group currency unit" or GCU.[7]

The difficulty posed by this choice is that the relationship between commodity and consumer prices is not invariant with respect to the currency in which the data are denominated.[8] In order to isolate the effects of commodity price movements on inflation from those of exchange rate changes, it is desirable not only that commodity and consumer prices be denominated in the same currency or basket, but also that that denomination correspond as closely as possible to the currency or basket that is most relevant for the various markets concerned. This last concept, however, is quite vague and difficult to judge empirically. Most commodity prices are quoted in U. S. dollars, but a number of them are quoted in other currencies, including notably pounds sterling, deutsche marks, and Japanese yen. Furthermore, the currency in which prices are quoted does not necessarily indicate the currency that is most relevant for that particular market; for a price quoted in U. S. dollars, for example, it is possible that movements in the effective exchange rate for the dollar could systematically induce corresponding changes in the dollar price.

The consequences of choosing an inappropriate denomination may be demonstrated by reference to a simple bivariate model. First, letting c denote an index of commodity prices, note that the dollar-denominated index (c') may be converted into GCUs:

$$c_t = c'_t - e_t , \tag{9}$$

corresponding to the relationship described for the aggregate CPI in equation (8). Now suppose that the "true" relationship between commodity and consumer prices, free of exchange rate effects, holds when the data are denominated in GCUs, expressed as

$$p_t = a + bc_t + \epsilon_t . \tag{10}$$

Obviously, if one were to estimate, instead of equation (10), a regression in which commodity prices were denominated in dollars (or another currency), a spurious exchange rate effect would be introduced. Perhaps less obviously, a spurious effect would be introduced even if *both* indexes were denominated in dollars. Suppose one were to estimate

$$p'_t = \alpha + \beta c'_t + \mu_t ,$$

which is equivalent to

$$p_t = \alpha + \beta c_t + (\beta - 1) e_t + \mu_t ; \tag{10'}$$

unless $\beta = 1$, the exchange rate would enter the implicit equation in GCUs, in contrast to equation (10).

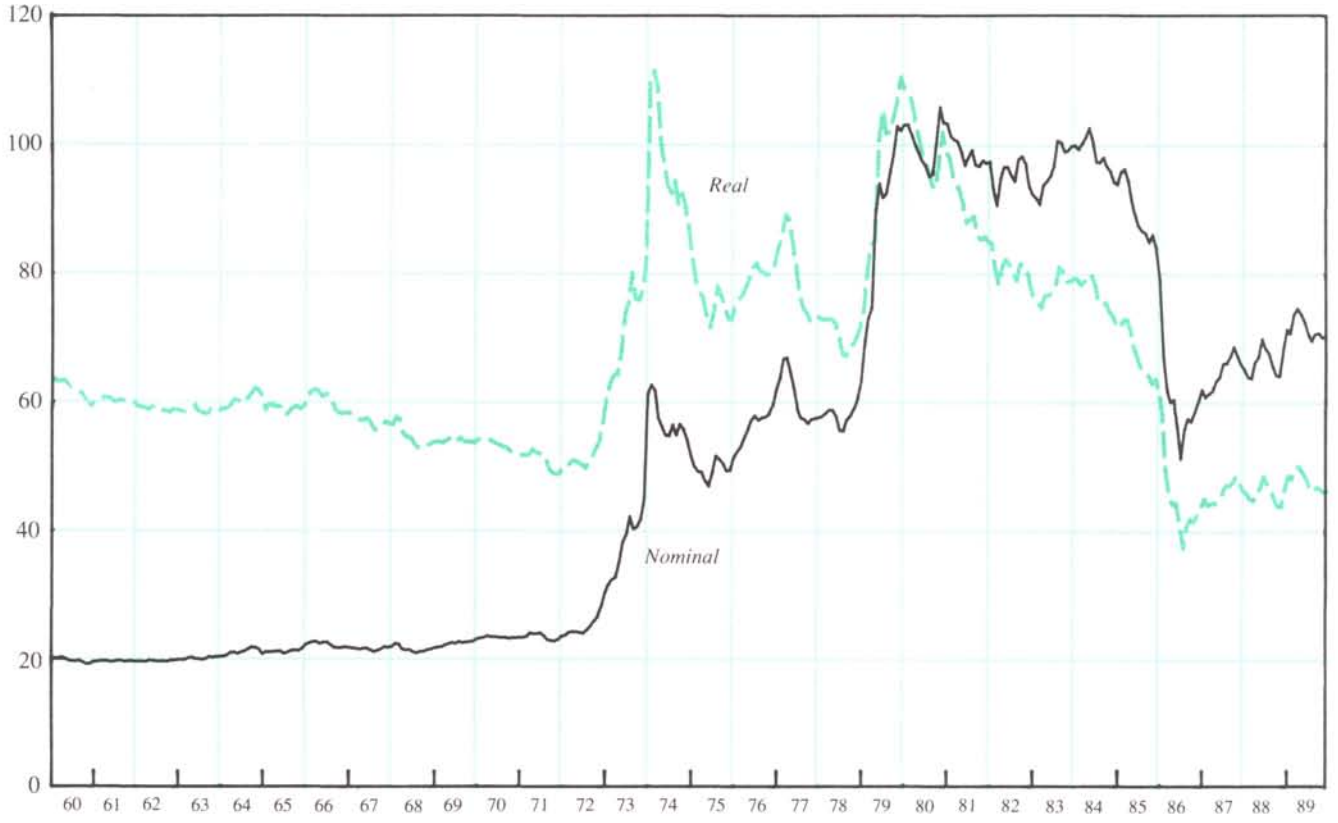
In the absence of detailed knowledge about the nature of

[7] This procedure is equivalent to the methodology used in Fund publications such as the *World Economic Outlook* for constructing aggregate inflation rates for groups of countries.

[8] For a thorough review of the theoretical and empirical issues relating commodity prices to exchange rates, see Gilbert (1990).

Chart 3. Commodity Prices: Nominal and Real, 1960–89[1]

(In GCUs; 1980 = 100)



[1] The real price is obtained by deflating by the seven-country consumer price index.

the individual markets, the best that one can do is to use a broad index of major currencies and to be sure that all data are measured commensurately. Since the aggregate CPI is constructed according to equation (7), it is appropriate to measure commodity prices in GCUs, converting dollar prices by the implicit exchange rate described in equation (8).

The commodity price index to be used for these tests uses a total of 40 prices, weighted according to 1979–81 shares in world exports.[9] This is the same weighting system that is used in the *World Economic Outlook*, as noted in the Introduction. Preliminary tests suggested that similar results (though generally not quite as favorable) would obtain using other weighting methods such as imports or consumption rather than exports. A major decision is whether to include oil prices, since in 1979–81 oil accounted for roughly 50 percent of world exports of primary commodities. The inclusion of oil did somewhat improve the statistical properties in preliminary tests, and it was therefore included in the final index used in this study.

Long-Run Relationships

The first empirical question to be analyzed is whether there exists a stable long-run relationship between the level of commodity prices and the level of consumer prices. If so, then it may be possible to make quantitative inferences about future CPI inflation from observations of commodity prices. In the absence of a long-run levels relationship, there may still be qualitative linkages between changes in inflation rates in the two data series, but one would want to avoid arguing that any given change in commodity prices would be expected to be followed (eventually) by a specified change in consumer prices.

A very simple heuristic approach to this question is to examine the stationarity of the relative price of commodities. As may be seen from Chart 3, there has been a

[9] For a description of prices, see IMF (1986), Appendix II. The export weights are listed in Table 4, below.

Table 1. Stationarity Tests for Commodity and Consumer Prices[1]

	Commodity Prices	Consumer Prices	Relative Prices[2]
Tests for zero-order stationarity			
1960–89	1.24	4.76	−0.50
1972–89	1.02	3.52	−0.16
1974–89	0.41	3.31	−0.87
Tests for first-order stationarity			
1960–89	−9.31**	−2.24	−9.69**
1972–89	−7.06**	−1.70	−7.37**
1974–89	−7.02**	−1.94	−7.12**
Tests for second-order stationarity[3]			
1960–89		−16.26**	
1972–89		−12.47**	
1974–89		−11.64**	

[1] The numbers in this table are *t*-statistics from estimates of equation (11) over the indicated sample periods using monthly data. The distribution of these statistics is not standard; the 95 percent confidence level for the rejection of nonstationarity (*) is approximately −3.78, and the 99 percent level (**) is approximately −4.35. See Engle and Yoo (1987).

[2] Commodity price index deflated by the consumer price index.

[3] These tests are relevant only where the hypothesis of first-order nonstationarity has not been rejected.

general downward trend in this relative price; the extent of the drift, however, has not been uniform, and it was starkly interrupted by a sudden and large rise in 1972–73. The hypothesis that the relative commodity price is unbounded in the long run would seem to be a reasonable one to entertain.

A preliminary examination of the long-run relationship between consumer and commodity prices can be made by testing whether each series is stationary in first differences and whether the relative price level is stationary. For this purpose, augmented Dickey-Fuller regressions have been run on first differences of each price series and on the relative price level:

$$\Delta x_t = \beta x_{t-1} + \Sigma_i \gamma_i \Delta x_{t-i} \qquad (11)$$

where x is the difference of order *j* (for a test of stationarity of order *j*) in the logarithm of the variable, and the null hypothesis (no stationarity) is that $\beta = 0$. As shown in Table 1, the tests have been conducted over three sample periods, all ending in 1989. In addition to the full-sample estimates, regressions have been run for samples beginning in 1972, when commodity prices first began to show substantial fluctuations; and beginning in 1974, after the apparently unique jump in commodity prices that occurred in 1972–73. The regressions have been run with 2 lags on Δx.[10]

[10] Since the data are monthly, without seasonal adjustment, these tests were first run using 12 lags. However, it was determined by experimentation that the addition of lags beyond the first two made no substantive difference in the results.

In the case of commodity prices, the null hypothesis is rejected, regardless of the sample period. For consumer prices, however, the hypothesis that $\beta = 0$ cannot be rejected, although the second differences appear to be stationary. The implication of these tests is that commodity prices are integrated of order 1, whereas consumer prices are integrated of order 2; that is, the first differences in commodity prices are stationary, whereas only the second differences of consumer prices are stationary. In these circumstances, the levels of the two data series cannot be cointegrated, and the standard cointegration tests are not applicable (see, for example, Granger (1986)).[11]

One interpretation of the different stationarity properties of consumer and commodity prices is that consumer prices have a more persistent tendency toward inflation, so that the real (or relative) price of commodities is nonstationary with a negative trend. Such drift is at least weakly evident in Chart 3, and nonstationarity is confirmed in the tests summarized in the final column of Table 1. Another interpretation, however, is that the relative stationarity of commodity prices may reflect their role as a jump variable, as discussed in the previous section. That is, even though the tendency for the relative commodity price to return to a fixed level is fairly weak, there does seem to be a strong relationship between high levels of commodity prices and high *inflation rates* for consumer prices, following positive monetary shocks (and conversely, following negative shocks). Indeed, standard test results are consistent with the hypothesis that the level of commodity prices is cointegrated with the average CPI inflation rate for the seven major countries.[12]

Short-Run Relationships

The next step is to evaluate the relationship between shorter-run movements in commodity and consumer prices. For this purpose, it is necessary to render the data stationary, which may be accomplished simply by taking second differences of the data. As noted above, commodity prices are reasonably stationary in first differences,

[11] The absence of cointegration in the levels of these data was documented in Durand and Blöndal (1988). In a recent paper, however, Brayton et al. (1990) have shown that the levels of commodity and consumer prices may be cointegrated when allowance is made for other structural determinants of both variables.

[12] For the full sample period, the Durbin-Watson statistic for a cointegrating regression of the CPI inflation rate on the commodity price level is 0.67, compared with a 99 percent confidence level for rejecting non-cointegration of approximately 0.5. The *t*-statistic for an augmented Dickey-Fuller regression of the residuals from that equation is −6.41, compared with a 99 percent confidence level of approximately −3.8.

Table 2. Commodity Prices and Industrial-Country Inflation: Granger Causality Tests[1]

	Non-oil Commodities		All Commodities	
	Commodity prices cause CPI	CPI causes commodity prices	Commodity prices cause CPI	CPI causes commodity prices
With data in U.S. Dollars:				
1960–89	—	**	**	—
1972–89	—	—	—	—
1974–89	—	—	—	—
With data in GCUs:				
1960–89	**	—	**	**
1972–89	—	—	**	**
1974–89	—	—	**	**

[1] For the test of whether commodity prices Granger-cause the CPI, the CPI has been regressed on 18 lagged monthly values of the commodity price index plus 18 lagged values of itself. For the test of reverse causation, the two series are switched. Industrial-country inflation is measured by the average change in consumer prices for the seven largest countries; the construction of the data is described in the text. All data have been made stationary by taking monthly changes in 12-month inflation rates. The double asterisk indicates that the null hypothesis—that the aggregate effect of the lagged values of the independent variable is zero—is rejected with 99 percent confidence.

but second differencing is required to make the full data set stationary.[13] In addition, in order to reduce the importance of seasonal fluctuations, inflation rates have been calculated as 12-month changes. Thus, the following tests relate to monthly changes in 12-month inflation rates:

$$z_t = (x_t - x_{t-12}) - (x_{t-1} - x_{t-13})$$

where x is the logarithm of the relevant index and z is the "whitened" form of the data.

Causality Tests

Table 2 summarizes the results of tests of whether commodity prices "cause," in Granger's sense, consumer prices for the large industrial countries as a group. The null hypothesis is that the lagged values of commodity prices contribute nothing to predictions of aggregate CPI inflation, given the predictions from lagged values of the CPI. In addition, tests of reverse causation are also included. In view of the ambiguities associated with the currency denomination of the data, discussed above, the tests have been conducted both with the data expressed in U. S. dollars and with the data denominated in GCUs. Finally, given the rather different behavior of both consumer and commodity prices before and after the early 1970s, the tests have been run over three overlapping samples, as in Table 1 above.

The results of the Granger causality tests are mixed. With the data measured in U. S. dollars, there is evidence of causation only when the full sample (1960–89) is used, and even then the direction of estimated causation is reversed when oil prices are excluded. With the data measured in GCUs, there is stronger evidence of causation from commodity prices to consumer prices, but reverse causation is also found for the inclusive index. Given the lack of robustness of the results, it is difficult to draw any firm conclusions from this exercise. Nonetheless, it does seem warranted to conclude that if commodity prices are to serve as a leading indicator of industrial-country inflation, it is preferable to denominate the data in terms of a broad currency basket rather than in terms of U.S. dollars.

Full-Sample Relationships

As a second fairly simple test of whether commodity prices contribute to predictions of inflation, the changes in the aggregate CPI inflation rate have been regressed on lagged changes in itself plus lagged changes in commodity-price inflation, using polynomial distributed lags (PDLs).[14] The null hypothesis for this test is that the contribution of the PDL on commodity prices does not add to the in-sample explanatory power of the regression.

The baseline regression, omitting commodity prices, is estimated (1962–89, monthly data) as

$$p_t = \underset{(3.34)}{.454} \sum_{i=1}^{36} w_i\, p_{t-i} \qquad \begin{array}{l} \bar{R}^2 = .283 \\ DW = 1.59 \\ SEE = .220 \end{array} \qquad (12)$$

[13] Boughton and Branson (1990b) present tests showing that overdifferencing of these data does not materially affect the results.

[14] The specific functional form is a 36-month, 4th-order PDL, constrained to zero at the far end of the distribution.

and the expanded regression result is

$$p_t = \underset{(1.86)}{.303} \sum_{i=1}^{36} w_i\, p_{t-i} + \underset{(2.63)}{.079} \sum_{i=1}^{36} v_i c_{t-i}. \quad \begin{array}{l} \bar{R}^2 = .356 \\ DW = 1.57 \\ SEE = .209 \end{array} \quad (13)$$

The F statistic for the additional contribution of the commodity price index (c) is 10.4, which implies rejection of the null hypothesis with more than 99 percent confidence.

An interesting comparison may be made against predictions using an aggregate measure of monetary growth in the large industrial countries.[15] The data series for money stocks has been extended back only to January 1964; using three-year lags on 12-month inflation rates, the regressions for this comparison therefore start in February 1968. For this sample, a regression using only past inflation (as in equation 12) has $\bar{R}^2 = .335$; the addition of a PDL on lagged money growth has $\bar{R}^2 = .352$. The F statistic for the significance of this improvement is 2.7 (significant with 95 percent confidence), compared with 10.4 for commodity prices. It is, of course, possible that other models—allowing for other influences or developing different lag structures—might alter these comparisons. Nonetheless, there is a prima facie case for the value of commodity prices as an inflation predictor.

Post-Sample Tests

Table 3 presents information on the out-of-sample predictive ability of commodity prices, with broad-money equations also included for comparison. For this exercise, regressions such as those in equations (12) and (13) were run over a series of six sample periods, starting with 1968–77 and then extending by two years up to 1968–87. In each case, the estimated equations were used to generate dynamic predictions for the aggregate CPI inflation rate over the 24 months following the end of the sample. During the prediction period, commodity price inflation and broad-money growth were projected on the basis of their own prior history. As shown in the table, three comparisons were made. First, did the inclusion of commodity prices reduce the standard error of the estimate within the sample period? Second, did the equations that include commodity prices reduce the forecast error for the average inflation rate over the two-year horizon? Third, did they reduce the root mean squared error (RMSE) for the 24 monthly inflation forecasts?

Perhaps the most striking feature of Table 3 is that the RMSE is reduced by the inclusion of commodity prices in only one of the seven forecast periods: 1984–85. In that period, the prior weakness in commodity prices provided useful information about how rapidly consumer prices would decelerate. In the other periods, however, the predictions are worsened somewhat in comparison with those made only on the basis of the CPI's own history. In all periods other than 1984–85, the equations using broad money do somewhat better than the equations using commodity prices.

Overall, the inclusion of neither commodity prices nor broad money could be said to have improved the post-sample inflation forecasts. In contrast, within each sample period, there is a substantial improvement in the fit when commodity prices are included, and only a small improvement when money balances are included. It thus

[15] Money stocks in each country are broadly defined (money plus quasi-money, as defined in *International Financial Statistics*). These stocks are aggregated using the same procedure as the CPIs; thus the data are implicitly denominated in GCUs.

Table 3. Inflation Predictions, 1976–89[1]

(In percent)

	1976–77	1978–79	1980–81	1982–83	1984–85	1986–87	1988–89
Actual inflation	7.5	9.5	10.3	4.9	3.7	2.1	3.7
Baseline prediction	8.2	7.7	11.0	6.6	4.9	2.8	3.2
Baseline prediction error	0.7	-1.8	0.7	1.7	1.2	0.7	-0.5
Predictions using commodity prices:							
Predicted inflation	9.0	5.4	11.2	8.0	5.0	3.6	2.6
Reduction in:							
In-sample error	18.2	16.3	10.8	11.6	11.7	11.5	11.0
Prediction error[2]	—	—	—	—	—	—	—
RMSE	—	—	—	—	1.1	—	—
Prediction using broad money balances:							
Predicted inflation	7.9	7.4	10.1	7.4	5.4	2.9	3.0
Reduction in:							
In-sample error	2.9	2.6	1.7	1.5	1.3	1.0	1.5
Prediction error[2]	0.3	—	0.5	—	—	—	—
RMSE	—	7.8	95.5	—	—	20.1	—

[1] Post-sample 24-month dynamic predictions of the aggregate CPI from equations as described in the text. The estimation sample is from February 1968 (plus prior lagged data) to December of the year preceding the listed forecast period.

[2] In percentage points.

appears that the quantitative linkages between commodity and consumer prices are significant, but are not stable enough to permit one to draw quantitative inferences about the extent to which consumer prices might respond to a given change in commodity prices.

Empirical Estimates of Weights

The tests in the preceding section took as given the weights assigned to each commodity in the price indexes. This section examines the feasibility of estimating optimum weights (optimum in the sense of generating the best predictions of the aggregate CPI) for a commodity price index through regression analysis.

Estimation of Indexes

Two basic approaches have been used to estimate commodity price indexes on the basis of their relationship with the aggregate CPI. One is to allow the data to determine the weights freely, with all commodity prices as contenders for inclusion in the index. The other involves constraining the data, by eliminating negative weights and, in the final set of estimates, by initially aggregating commodities that have small weights in industrial-country trade or consumption into somewhat broader categories. The second approach was intended to check whether the efficiency of the estimates might be improved by the constraints.

Estimation Using All Available Commodity Price Data

The objective of the first approach is to allow the maximum freedom for the data to "speak" in determining the "best" weights for commodities for the purpose of predicting CPI inflation. This approach uses the prices that are incorporated into the available IMF commodity price indexes, plus the prices of gold and petroleum, in an unconstrained regression framework. There are 32 years of monthly observations on the 40 commodity price series, extending from January 1958 through December 1989. With a forecast horizon chosen to run from 1 to 36 months, the problem is to devise a procedure that narrows quickly to the most important explanatory variables over different forecast horizons with a minimum of loss in efficiency in utilizing the information in the data.

The procedure that was employed to estimate "optimum" indexes was as follows. First, the aggregate CPI and all 40 series, expressed as logarithms of GCU-denominated indexes, were transformed by taking the first differences of their 12-month differences (i.e., changes in inflation rates). Second, the 40 principal components were extracted from the data matrix of the transformed commodity price data, to produce orthogonal regressors. Third, a multiple regression was estimated over the period February 1962 to December 1984 with the transformed CPI as the dependent variable and the 40 principal components as independent variables (with the constant suppressed) separately at each lag length from 1 to 36 months. The termination of the sample at the end of 1984 was chosen so as to leave a reasonably long post-sample period for testing the stability of the results.

These regression results were used to select significant principal components for the remaining analysis. Two selection criteria were used to narrow the set of principal components. The first was to rank them by average absolute t-ratio across lags. The second was to select principal components with coefficients that were significant at the 1 percent level at at least four different lags, of which at least one was longer than 12 months. The second criterion yielded eight principal components, of which seven coincided with those in the highest ten on the average absolute t-ratio criterion. Thus the two criteria together yielded a list of 11 candidate principal components for the next stage.

Next, a regression was estimated with the transformed CPI as the dependent variable, and fourth-order PDLs with length 36 months (constrained to zero at the far end only) on the candidate principal components as independent variables along with a similar PDL on the lagged transformed CPI. This regression (over the 1962–84 period) had an adjusted R^2 of .55, compared with .31 for a regression of the transformed CPI only on its own lags. Each of the 11 selected principal components contributed significantly to this regression. Finally, the coefficient on the weighted (and normalized) lag distribution on each principal component was taken as an estimate of the contribution of that component to the index being derived.

The lag distributions on the 11 principal components in the final regression differ in length and shape. Therefore, when the implied weights on the commodity prices are retrieved, a weighting matrix is obtained, which in principle would have a different set of weights for each lag length. Thus the distributed lag coefficients on the final principal components equation could be used to estimate a different set of weights for the commodity prices at each forecast horizon, reflecting differences in the information in the various commodity prices for explaining aggregate CPI inflation at different forecast horizons. This step was not taken at this stage. Instead, a single set of weights was calculated, reflecting the average information in the commodity price series across forecast horizons. These are the weights shown in the first column of Table 4.

The most notable feature of the weights in the uncon-

Table 4. Econometrically Estimated Weights for Commodity Price Indexes[1]

(In percent)

Commodity[2]	Unconstrained	Eliminating Negative Weights	Using Prior Aggregation	Memorandum: World Export Weights[3]
Cereals	79.6	17.6	16.8	10.6
Wheat	34.2	7.6	8.1	5.1
Maize	36.7	8.1	6.1	3.8
Rice	8.7	1.9	2.6	1.6
Vegetable oils	−36.3	10.2	0.1	5.7
Soybeans	−46.6	2.4	0.1	4.5
Other	10.4	7.9	—	1.2
Meat	80.8	17.8	—	3.3
Beef	29.7	6.6	—	2.8
Lamb	51.1	11.3	—	0.5
Sugar	18.0	5.8	—	1.6
Bananas	67.3	14.9	—	0.4
Beverages	−19.6	6.1	—	6.0
Coffee	27.7	6.1	—	3.8
Cocoa	−7.3	—	—	1.6
Tea	−39.9	—	—	0.6
Agricultural raw materials	−60.3	4.9	62.7	12.0
Timber	−9.1	—	14.7	5.4
Cotton	−36.9	—	—	2.0
Wool	−3.4	0.7	—	1.2
Rubber	19.1	4.2	11.0	1.3
Tobacco	−5.2	—	37.0	1.3
Other	−24.8	—	—	0.7
Metals	−3.4	22.7	1.9	14.9
Copper	5.1	1.1	0.4	3.0
Aluminum	16.2	3.6	0.3	2.3
Gold	−38.6	—	0.5	3.7
Iron ore	44.9	9.9	0.3	2.1
Other	−31.1	8.0	0.5	3.8
Petroleum	−26.0	—	18.5	45.5
Total	100.0	100.0	100.0	100.0

[1] Detail may not add to totals, owing to rounding.

[2] Several of the listed commodities are divided into two or more components in the full data set. When negative weights were reset to zero for the second index, the calculations were made at that disaggregated level.

[3] Based on 1979–81 data. Source: IMF, Commodities Division.

strained index is that about half of the commodities have negative weights. In particular, within most groups, some commodities have positive and some negative weights. The reason for the negative weights is not that a rise in the price of a particular commodity, by itself, would be expected to lead to a fall in consumer prices; it is rather that the regression essentially computes the weights for an optimal portfolio of commodity prices that minimizes the residual error vis-à-vis the CPI. This procedure assigns negative weights to some prices that have positive covariance with the others. Small changes in specification could easily reverse the signs on individual commodities. The individual weights therefore should not be assigned any intrinsic value.[16]

The time path of this index is shown in the upper left panel of Chart 4. It is apparent that this is a much more volatile index than the others. Nonetheless, a moving average of this index would have a time profile reasonably similar to those of the other indexes shown in the chart. A regression of the transformed aggregate CPI on its own history plus a 36-month PDL on this first index yielded an adjusted R^2 of .33. The reduction from .55 is a measure of the cost of time aggregation into a single index; in fact, it may be seen that most of the improvement over equation (12) has been lost through time aggregation. The out-of-sample performance of this index is examined in the next subsection.

[16] For Boughton and Branson (1990b), this same exercise was conducted over the 1962–82 period rather than 1962–84; more than half of the weights in this index changed signs with the addition of two years' data.

Estimation Subject to Constraints

The second index was derived from the first by simply eliminating all of the commodities whose prices had negative coefficients in the first index. The weights for this index are shown in the second column of Table 4. As may be seen by comparing these weights with the export weights in the last column of the table, and by examining the movements in the indexes as shown in Chart 4, this index looks quite a bit more like a conventional price index than does the unconstrained version.

A regression of the transformed aggregate CPI on itself lagged, plus a PDL on the transformed version of this second index, yielded an adjusted R^2 of .35, which is slightly higher than that for the first index but still well below the performance of the conventional export-weighted index (equation (13), above).

The third index (third column of Table 4 and lower left panel of Chart 4) was derived by a procedure that differed in two major respects from that used for the first two indexes. First, most of the prices in the original set of 40 were aggregated into broader categories, in order to reduce the amount of detailed information required for the estimation process and to eliminate the possibility that a commodity with relatively little importance in trade or consumption might have a large weight in the estimated index. This aggregation procedure, using world export weights, produced six aggregates (cereals, vegetable oils, beverages, meat, metals, and fibers) and five single commodities (sugar, petroleum, rubber, tobacco, and timber).[17]

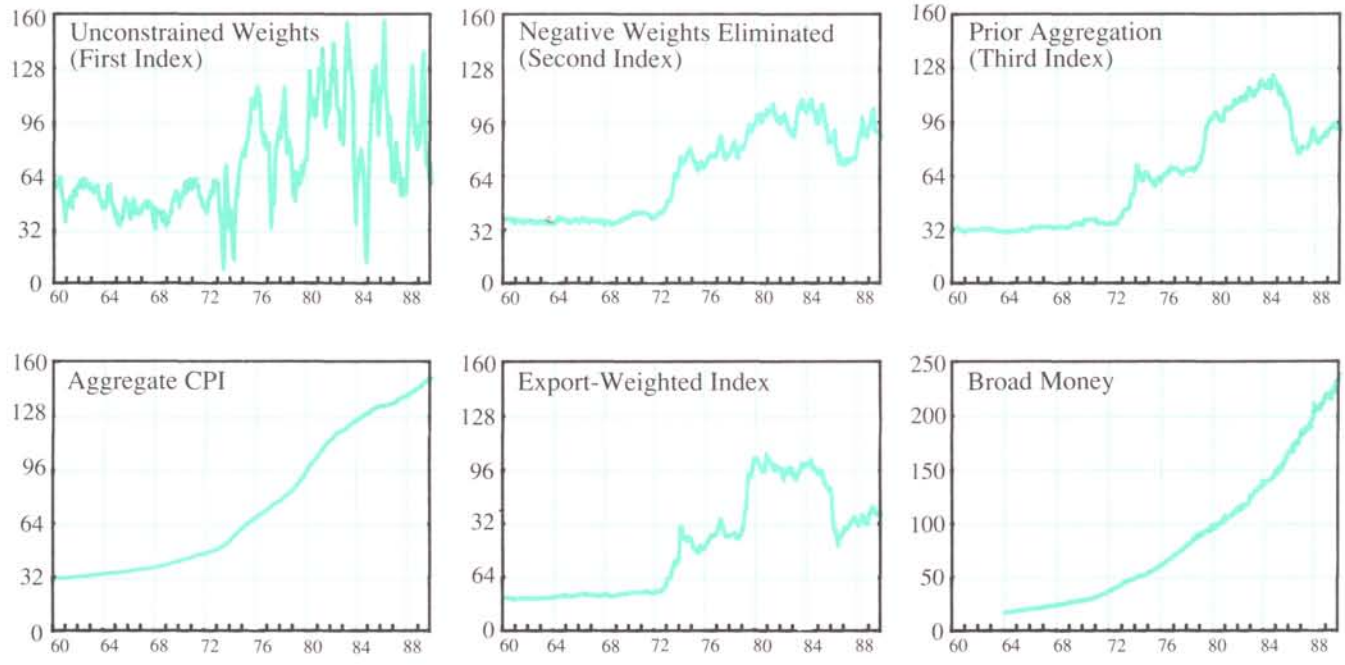
When these 11 prices were converted into stationary series by taking changes in 12-month rates of change, there was very little multi-collinearity in the data matrix. Therefore, it was decided to compute the regressions using these transformed prices rather than their principal components. Thus the second stage of the procedure was to regress the transformed aggregate CPI on PDLs of the 11 transformed price series, plus the PDL on its own lagged values.[18] That regression yielded an adjusted R^2 of .51, compared with .55 for the unconstrained estimation of the first index. As before, the coefficients on the sums of the lag distributions from this regression were normalized to sum to unity and were used as the weights for the

[17] The prices of bananas, hides, jute, and sisal, which did not fit neatly into the sub-aggregates and which had a small weight in both consumption and trade, were eliminated from this data set. The price of sugar for this exercise is a weighted average of the three prices in the full data set (a free market price and the U. S. and European Community import prices).

[18] In order to further simplify the procedure, the lag lengths in this regression were shortened to 12 months (except for petroleum, whose effect ran out to 24 months), the polynomials were constrained to third rather than fourth degree, and the end-point constraint was dropped.

Chart 4. Econometrically Estimated Indexes, Consumer Prices, Export-Weighted Index, and Broad Money, 1960–89

(In GCUs; 1980 = 100)



third index. The time profile for this index (Chart 4) is quite similar to that of the export-weighted index, although there are periods when they move independently. A regression using a PDL on this index had an adjusted R^2 of .40; this is the best in-sample result for any of the four indexes.

Evaluation of the Estimated Indexes

The properties of a leading indicator are, of course, not well defined by how well they fit within the sample period. This subsection therefore examines the post-sample properties of the estimated indexes. These properties are summarized in Table 5, which may be compared with the results presented above in Table 3.

As with the full-sample results, it may be seen that the third index does much better than the other two estimated indexes, and a little better than the export-weighted index, in terms of reducing the standard error of the estimate for in-sample CPI predictions. Post-sample, however, the unconstrained index does quite a bit better: the average prediction error is reduced in three of the seven periods, and the RMSE is reduced in four of seven cases.

The apparently poor overall quantitative performance of commodity prices as additional inflation predictors is attributable in part to the difficulty of forecasting commodity prices during the forecast period. When actual commodity prices are used in the post-sample period, the prediction errors drop sharply. The use of a 24-month dynamic forecast period is a harsh standard, and the choice is to some extent arbitrary. Given the strong in-sample performance—especially for the third estimated index as well as for the export-weighted index—it is likely that better results would be obtained for shorter horizons.

Qualitative relationships may be as important as quantitative ones if commodity prices are to serve as a leading indicator. That is, one may be at least as interested in predicting turning points in CPI inflation as in predicting the value of the future inflation rate. It was already noted (see Chart 1) that there is an observed tendency for inflation in the export-weighted commodity price index to display cyclical patterns that are similar to those of the aggregate CPI inflation (though with differing amplitudes) and that frequently lead CPI turning points. This tendency is examined more closely in Table 6.

The first three columns of Table 6 list the turning points in the aggregate CPI inflation (denominated in GCUs) since 1960. These turning points are defined by a shift in direction in the three-month moving average inflation

Table 5. Inflation Predictions Using Estimated Commodity Price Indexes, 1976–89[1]

(In percent)

	1976–77	1978–79	1980–81	1982–83	1984–85	1986–87	1988–89
Actual inflation	7.5	9.5	10.3	4.9	3.7	2.1	3.7
Baseline prediction	8.2	7.7	11.0	6.6	4.9	2.8	3.2
Baseline prediction error	0.7	−1.8	0.7	1.7	1.2	0.7	−0.5
Predictions using first (unconstrained) index:							
Predicted inflation	6.0	9.6	11.2	6.5	5.7	3.1	3.9
Reduction in:							
In-sample error	3.7	4.8	3.2	1.8	2.3	1.8	0.6
Prediction error	—	1.7	—	0.1	—	—	0.3
RMSE	—	86.5	55.2	14.4	—	—	81.3
Prediction using second (positive weight) index:							
Predicted inflation	13.0	6.4	11.8	7.6	5.3	3.5	4.5
Reduction in:							
In-sample error	7.6	8.2	8.0	7.8	6.2	5.7	4.3
Prediction error	—	—	—	—	—	—	—
RMSE	—	—	—	—	—	—	—
Prediction using third (prior-aggregation) index:							
Predicted inflation	8.5	5.5	11.1	9.1	4.6	3.7	2.7
Reduction in:							
In-sample error	21.0	19.4	15.6	16.2	13.2	13.3	12.4
Prediction error	—	—	—	—	0.4	—	—
RMSE	—	—	—	—	51.4	—	58.8

[1] Post-sample 24-month dynamic predictions of the aggregate CPI from equations as described in the text. The estimation sample is from February 1962 (plus prior lagged data) to December of the year preceding the listed forecast period.

rate that is sustained for at least three months. For a peak, it is also required that the rate exceed the previous trough by at least 75 basis points; troughs must be at least 50 basis points below the previous peak. These requirements are obviously rather arbitrary, but they do capture the major turns in CPI inflation, taking account of the general upward drift in the data.

The remaining columns of Table 6 indicate the lead times that one would have obtained from various commodity price indexes, or from monetary growth. These lead times are shorter than the actual lead times, usually by three or four months, in order to take account of the need for identifying a turning point. For example, when commodity price inflation reaches a trough, one cannot immediately identify it as such; only after it has risen for two or three months can one know that a trough has occurred. These turning points are defined as for the CPI, except that the required magnitudes are larger and are symmetric, reflecting the different patterns in the data.[19] A lead time of zero months is treated as a successful prediction, because the commodity price data are available a few weeks earlier than the CPI data.

The main conclusion to be drawn from Table 6 is that commodity prices are a reasonably successful predictor of turning points. The conventional export-weighted index predicted 6 of the 12 turning points, with just three false signals over the 30-year period. Although the estimated indexes and the aggregate money stock did about as well in terms of the number of correct predictions, they

[19] For the first estimated index, which is highly volatile, the required swing is 25 percentage points. For the other commodity price indexes, the required swing is 5 percentage points, while for broad money, the requirement is 1.5 percentage points.

Table 6. Prediction of Turning Points in Aggregate CPI Inflation

Turning Points in Aggregate CPI Inflation			Lead Time for Prediction[1] (in months)				
Date	Peak or Trough	Inflation Rate	Export Weights	First Index	Second Index	Third Index	Broad Money
September 1	P	3.3	—	1	0*x*	—	—
July 1967	T	2.5	−6	5	−19	—	0
November 1970	P	5.6	25	4*x*	1	—	—*x*
June 1972	T	4.1	—	−1	1	3	—
November 1974	P	13.5	6	2*x*(2)	5	6	14
July 1976	T	7.3	12	—*x*	5	14	12
May 1977	P	8.1	—*x*	—	—*x*	3	—
March 1978	T	6.5	—	7	—	−2	—
May 1980	P	12.0	3*x*	—*x*	0*x*	2	16
July 1983	T	4.0	13	2*x*	3	—*x*	6*x*
March 1984	P	4.6	−5	3	0	—	2
December 1986	T	1.1	2	—*x*	2*x*	−1	—*x*
Memorandum:							
December 1989		3.9	[2]	[3]	[4]	[5]	[6]
Summary:							
Number of calls							
On time			6	7	9	5	6
Late			2	1	1	2	0
Missed			4	4	2	5	6
Number of false signals			3	7	5	2	4
Lead time for correct calls (in months)							
Mean			10	3	2	6	8
Standard deviation			8.6	2.1	2.0	4.9	6.6

[1] A minus sign indicates a late call. *x* indicates that a false signal preceded the correct one; *x*(2) indicates 2 consecutive false signals. — indicates that (a) the index was pointing in the wrong direction at the time of the turning point in the CPI or (b) that the index called the turning point before the preceding turning point.

[2] False signal in December 1987; peak called in July 1989.

[3] Peak called in February 1989.

[4] False signal in April 1987.

[5] False signal in January 1988.

[6] False signal in November 1987.

mostly had more false signals and shorter lead times.[20] Although these comparisons do not suggest that one indicator is clearly superior to the others in all circumstances, they do provide support for the view that turning points in commodity price movements precede turning points in CPI inflation with sufficient regularity and with sufficient lead time to provide useful information to forecasters and policymakers.

Conclusions

This paper has argued that commodity prices might serve as a useful leading indicator of inflation, based on the relative importance of flexible auction markets for the determination of these prices. They thus may have a tendency to respond relatively quickly, especially in response to monetary disturbances. This theoretical conclusion holds regardless of whether primary commodities serve mainly as final goods or as industrial inputs.

Empirical evaluation of a conventional trade-weighted commodity price index leads to several conclusions. First, the levels of commodity and consumer prices are not cointegrated; the hypothesis that the relative price of primary commodities is bounded, or that there is a reliable long-run relationship between the level of commodity prices and the level of consumer prices, may be rejected. There may, however, be a stable relationship between the level of commodity prices and the inflation rate of consumer prices. Second, there is a tendency for changes in commodity prices to lead those in consumer prices, at least when the data are denominated in a broad index of major-country currencies and oil prices are included. When the data are denominated in U. S. dollars or when oil prices are excluded, this tendency is weakened. This conclusion underscores the importance of making appropriate allowances for exchange rate changes in analyzing these relationships. Third, although the inclusion of commodity prices significantly improves the in-sample fit of regressions of an aggregate (multicountry) consumer price index, the results may not be sufficiently stable to improve post-sample forecasts. Fourth, commodity prices have done reasonably well at foretelling turning points in the CPI inflation rate.

Estimation of alternative commodity-price indexes, in which the weights are chosen so as to minimize the residual variance in aggregate inflation regressions, was not fully successful. The derived indexes do track the behavior of the aggregate CPI reasonably well in-sample. On the other hand, the weights are not robust with respect to changes in the methodology, and the indexes work only moderately well in post-sample predictions. Overall, the estimated indexes do not appear to offer significant advantages over the conventional export-weighted index.

In conclusion, it would appear that commodity prices do have a useful role to play as an aid in predicting inflation, so long as one is careful to interpret the relationships qualitatively and in the context of more general macroeconomic developments. The ratio of consumer to commodity price movements changes over time, and the relative price of commodities undergoes long sustained swings; nonetheless, the qualitative linkages are quite evident in the data. Perhaps most importantly, turning points in commodity-price inflation frequently precede turning points in consumer-price inflation for the large industrial countries as a group.

[20] The results for the estimated indexes are hypothetical and illustrative, because the indexes were constructed using data through 1984 and so could not have been used to predict the earlier turning points.

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II
Saving, Investment, Financial Integration, and the Balance of Payments

Michael Artis and Tamim Bayoumi[1]

The last decade has witnessed a marked increase in the degree of current account imbalances among the industrial countries. At the same time, it is evident that the capital markets of these same countries have become more closely linked to each other. The coincidence of these two observations sets the agenda for this paper, which is the extent of global financial integration and its consequences. In particular, in view of the significance traditionally attached to current account balance as a policy objective and the role that current account balance has acquired in the exercise of international economic policy coordination, the paper discusses the implications of the new circumstances brought about by capital market integration for the importance of the current account position as a policy objective.

The plan for the rest of the paper is as follows. The first section looks at some definitions associated with the balance of payments. The second section discusses the determination of the external current account balance under various conditions and the role of international capital market integration in that process. The paper then examines some evidence on the question of whether capital markets have become more highly integrated; while it acknowledges that the high correlation between national saving and domestic investment seems to indicate a low degree of integration, this discussion suggests some alternative explanations that appear to be more plausible. The following section looks at this same issue from a different perspective, asking whether consumption/saving choices have become less constrained in the recent period, as would be expected if capital markets have become more efficient. The main conclusions are summarized in the final section.

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Definitions

The definition of the balance of payments in this paper, as explained below, is that given by the national income accounts as the difference between savings and investment. This can be shown by noting the following definitions of (i) the current account of the balance of payments, and (ii) the gross national product:

$$CAB \equiv X - M + NPI, \tag{1}$$

$$GNP \equiv GDP + NPI, \tag{2}$$

where X is the value of exports, M the value of imports and NPI is net property income from overseas.[2] The definition of GDP can be written in the usual way as:

$$GDP \equiv C + I + G + X - M, \tag{3}$$

where C is total consumption, I is gross investment, and G is total government spending. Disposable income of the private sector, which is given by the difference between output and taxes (T) is spent on consumption or is saved (S):

$$GNP - T \equiv C + S. \tag{4}$$

Substituting (3) into (1) yields an alternative equation for the current account as the difference between output and total domestic spending:

$$CAB \equiv GNP - (C + I + G). \tag{5}$$

Substituting (4) into (5) then yields:

$$CAB \equiv (S - I) + (T - G), \tag{6}$$

$$CAB \equiv NFAp + NFAg, \tag{6a}$$

or

$$CAB \equiv (S + T - G) - I. \tag{7}$$

In (6, 6a) the current account appears as identically equal to the sum of the net acquisition of financial assets by the private ($NFAp$) and government ($NFAg$) sectors (the CAB

[2] For the convenience of exposition transfers are omitted.

itself may be defined as the negative of the overseas sector's net acquisition of financial assets). In (7) the current account is written as the difference between overall national saving—private savings plus government saving ($T - G$)—and investment.[3]

Analysis of the Balance of Payments

Table 1 summarizes the trends in current account balances of the major industrial countries. As can be seen from the ratio of the absolute sum of these balances to GNP/GDP, the external imbalances are, in the 1980s, some three to four times the levels reached in the late 1960s and early 1970s. This increase is predominantly due to the large surpluses run by the Federal Republic of Germany and Japan, and the large deficit appearing in the U. S. accounts in the 1980s. (Current account imbalance among the industrial countries outside the seven largest countries has also increased between the 1970s and 1980s, but only by about 20 percent.) The basic evidence would thus appear to suggest that the growing integration of the world's capital markets may have facilitated the emergence of the U. S. deficit and its counterparts in Germany and Japan. In less accommodating circumstances, some adjustment might have been required at a relatively early stage.

As already described, the current account of the balance of payments is definitionally equivalent to the difference between a nation's overall saving rate and its rate of investment; it is also equal to the difference between exports and imports, adjusted for factor income flows and transfers. These two ways of writing the balance of payments identity have given rise to different theoretical approaches to explain the external account that should be regarded as offering complementary rather than competing explanations.

The approach which proceeds from the identity of the current account balance as the difference between exports and imports is the well-known "elasticities" approach; this is based on assumptions about the supply and demand conditions in the markets for exports and imports, with the role of relative prices reflected in the relevant

[3] These definitions follow convention in assuming that all of G is a "consumption good." In effect, of course, governments typically undertake a large amount of investment which should be recognized in empirical analysis of this topic (see the work reported below).

Table 1. Major Industrial Countries: Current Account Balances, 1965–1990

(In percent of GDP/GNP)

	Canada	United States	Japan	France	Federal Republic of Germany	Italy	United Kingdom	Total Absolute
1965	−1.9	0.8	1.0	−0.6	−1.1	3.4	−0.2	0.9
1966	−1.7	0.4	1.2	−1.1	0.3	3.0	0.3	0.7
1967	−0.7	0.3	−0.2	−1.0	2.3	2.1	−0.7	0.7
1968	−0.1	0.1	0.7	−0.7	2.5	3.1	−0.6	0.6
1969	−1.2	—	1.2	−1.1	1.5	2.5	1.0	0.6
1970	1.2	0.2	1.0	—	0.7	0.8	1.6	0.5
1971	0.4	−0.1	2.5	0.4	0.4	1.7	1.9	0.7
1972	−0.3	−0.5	2.2	1.1	0.5	1.5	0.3	0.7
1973	0.2	0.5	—	0.6	1.5	−1.6	−1.3	0.7
1974	−0.9	0.1	−1.0	−1.4	2.8	−4.4	−3.8	1.2
1975	−2.7	1.1	−0.1	0.8	1.0	−0.3	−1.4	1.0
1976	−2.1	0.2	0.7	−1.0	0.8	−1.3	−0.8	0.6
1977	−2.0	−0.7	1.6	−0.1	0.8	1.0	−0.1	0.9
1978	−2.0	−0.7	1.7	1.5	1.4	2.1	0.6	1.2
1979	−1.8	—	−0.9	0.9	−0.7	1.5	−0.3	0.5
1980	−0.4	0.1	−1.0	−0.6	−1.7	−2.2	1.4	0.7
1981	−1.7	0.3	0.4	−0.8	−0.5	−2.3	2.7	0.7
1982	0.8	−0.2	0.6	−2.2	0.8	−1.5	1.7	0.7
1983	0.8	−1.3	1.8	−0.9	0.8	0.4	1.3	1.2
1984	0.6	−2.8	2.8	−0.1	1.6	−0.6	0.6	2.1
1985	−0.4	−2.8	3.7	−0.1	2.6	−0.9	0.9	2.4
1986	−2.1	−3.1	4.3	0.4	4.4	0.4	—	2.9
1987	−1.7	−3.2	3.6	−0.5	4.0	−0.2	−0.7	2.7
1988	−1.7	−2.6	2.8	−0.4	4.0	−0.6	−3.2	2.5
1989[1]	−2.3	−2.6	2.7	−0.6	4.5	−1.0	−3.6	2.6
1990[1]	−2.3	−2.7	3.0	−0.5	4.4	−1.1	−3.0	2.7

Source: International Monetary Fund, *World Economic Outlook*, October 1989.
[1] Projections.

price elasticities. The focus on the elasticities connects the analysis directly to the exchange rate in that changes in the latter, through their impact on the relative prices of domestically produced and foreign goods will lead, ceteris paribus, to adjustments in the supply and demand for imports and exports. (The caveat "ceteris paribus" indicates that a *complete* account of the effects of an exchange rate change requires a broader analysis of the origin of the exchange rate change.) As noted below, the elasticities approach has an important role to play, for example, in the determination of "fundamental equilibrium exchange rates."

The complementary "absorption" approach identifies the current account as the difference between national saving and investment (Alexander (1952)). Viewed in this way it is clear that the current account improves or deteriorates as the excess of domestic saving over domestic investment rises or falls. Alternatively, as saving is the difference between income and total domestic spending (including government consumption), the current account improves or deteriorates as "absorption" (consumption plus investment) falls or rises relative to output.

Recent elaborations of balance of payments theory in the context of integrated capital markets (Sachs (1981); Frenkel and Razin (1987)) apply modern intertemporal consumption and saving theory for the behavior of the individual to the economy as a whole. The economy is assumed to be able to freely lend to, or borrow from, other economies. The paradigm for individual consumer behavior is that of "consumption smoothing." In the absence of liquidity constraints, consumers smooth their consumption path relative to their lumpy income stream. The life-cycle hypothesis, which builds on the familiar idea that people will borrow during their early working years, then begin to save for retirement during the remainder of their working lifetimes before dissaving in retirement, is an early representative of this approach. It assumes the ability and willingness of agents to look ahead so that current decisions can be said to be forward looking.[4]

This forward-looking behavior has important implications. Ceteris paribus, a rising income trajectory will lead to contemporaneous current account deficits that eventually would be followed by surpluses. Temporary shocks will have different effects from permanent shifts. A temporary decline in income will be covered by an increase in the deficit (decrease in the surplus) to support consumption, while a permanent decline in income necessitates a complete readjustment of consumption. The opening up of new investment opportunities that have higher returns than existing capital can be shown to lead to an increase in the deficit (decrease in the surplus) on current account that is somewhat larger than the investment itself (the excess reflecting the expected superior returns).

A complication is introduced in the analysis to the extent that government policy may also influence the outcome. Failing full "Ricardian equivalence" when consumers "see through" the government's financial policies, fiscal policy will affect the current account, which by definition is the residual of total investment and saving, both private and public. Nevertheless, the general thrust of the argument remains unimpaired.

Role of Financial Integration

In a financially integrated area there are no regionally differentiated barriers to the free flow of capital. In consequence, arbitrage will drive the risk-adjusted nominal rate of return into uniformity across the area as a whole. Most political unions are financially integrated areas in this sense. In particular, such areas are normally also currency unions and therefore there is no exchange risk. A movement in the direction of greater integration at the international level thus implies (i) the widespread dismantling of exchange controls and related impediments to the flow of capital between nations, and (ii) the consequent arbitraging of rates of return of assets in different currencies of denomination in different locations.

This process of financial integration began in the mid-1970s with liberalization in Germany, the United States, and Canada among the large countries, and gathered speed at the end of the decade when additional measures of liberalization were undertaken, notably by Japan and the United Kingdom. Since that time, further liberalization has occurred, notably in Europe, where Italy, France, and some other EC member countries achieved the complete elimination of exchange controls by the end of June 1990.[5]

Since the hallmark of financial integration is the arbitraged uniform risk-adjusted rate of return, its correlate at the level of the global economy is interest parity adjusted for expected exchange rate depreciation. One measurable concept is that of parity between onshore rates of return in different locations after allowing for the cost of cover in the forward market—that is, covered interest parity

[4] As saving is simply the addition to wealth, another way to think about the saving process is as an adjustment toward a desired wealth/income position (which itself may be an evolving target). This in turn indicates that current account surpluses (and deficits) are not unbounded; verification of the nature of these processes over long periods is an important objective for future research though one that is somewhat hampered by lack of data.

[5] Frankel (1989) provides a comprehensive review of the process of liberalization and computes various associated measures of financial integration.

(CIP).[6] What the removal of exchange controls does is to remove barriers to arbitrage between offshore and onshore assets in a currency, and to enable arbitrage—by removing the "country premium"—to bind the onshore rates of return in assets of different currencies located in the corresponding countries of currency issue. The dramatic effect on the onshore/offshore differential of removing exchange controls is illustrated in Figure 1 for the cases of Japan and the United Kingdom, both of which removed controls in 1979.[7] The removal of controls implies that these differentials are essentially arbitraged to zero.[8]

A more rigorous test of the extent of integration may be judged by estimates of the deviation from uncovered interest parity (UIP); this deviation is simply $i - i^* + \delta$ where i, i^* are the domestic and foreign risk-adjusted rates of return on assets of comparable maturity, and δ is the expected rate of depreciation. Measuring deviations from UIP requires estimating the expected rate of depreciation. Observed deviations ("violations" of UIP) therefore may be due to errors in estimating expectations or may reflect a risk premium. The large literature on this question[9] generally identifies the persistence of a time-

[6] Offshore CIP (i.e., covered parity of returns in Euromarkets) does not imply that arbitrage can operate freely across national boundaries: since the same institutions set both the forward rate for a currency and the Euro-interest rate in that currency by reference to CIP (Johnston 1979), observed deviations from offshore CIP are invariably due to no more than the employment of imprecise (perhaps averaged or inexactly date-matched) data.

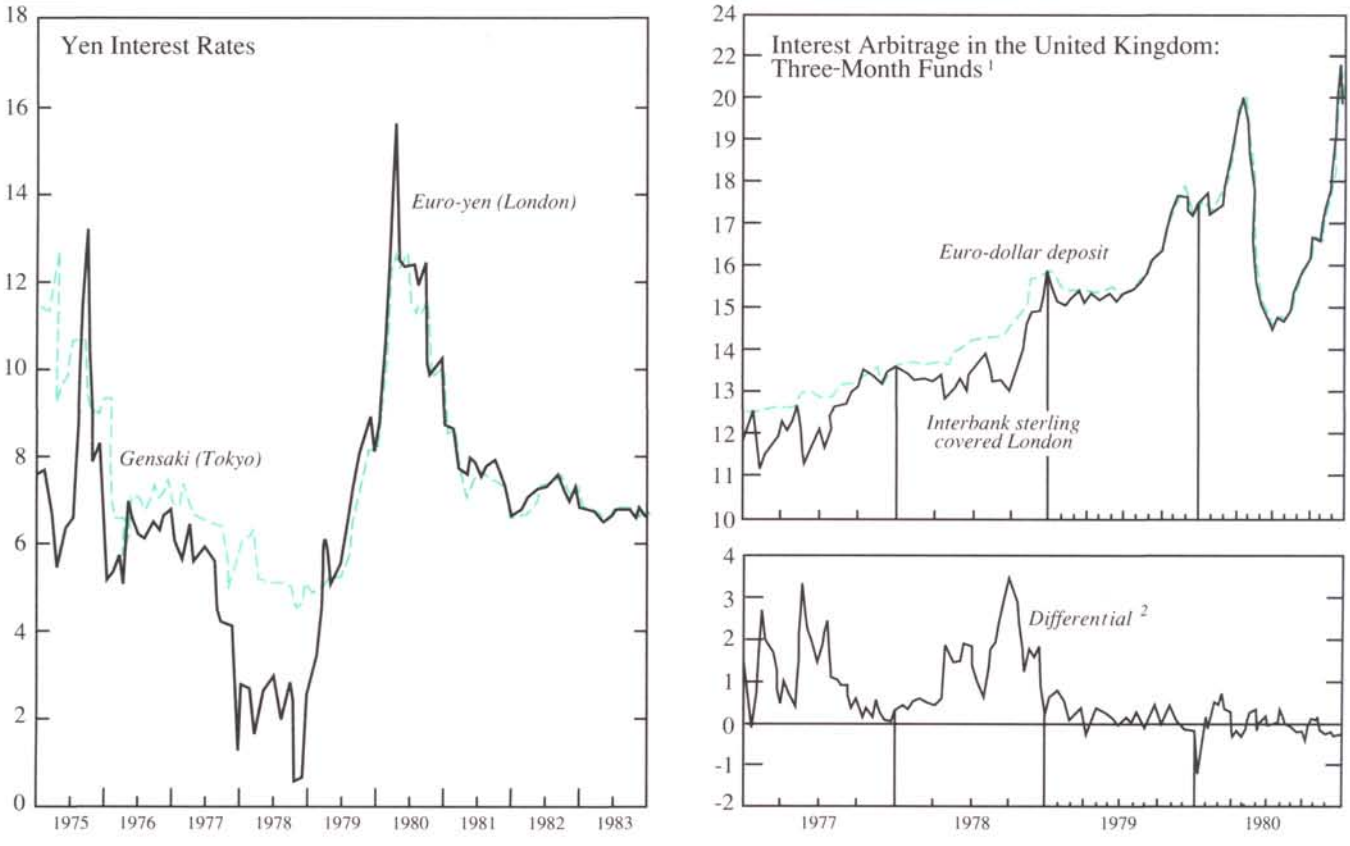
[7] We are grateful to Jeff Frankel for permission to reproduce this diagram.

[8] Frankel (1989), Table 6 shows that prior to 1986, violations of offshore/onshore parity were much more marked for France and Italy than for the United States, Germany, the United Kingdom, and Japan, in the 1980s.

[9] A representative recent paper is Hodrick and Srivastava (1986).

Figure 1. Financial Liberalization in Japan and the United Kingdom: the Impact on the Offshore/Onshore Differential

(Annual percentage)



Source: Frenkel (1989), based on *Economic Report of the President* (1984)

[1]Averages for week ending Wednesday.

[2]Plus (+) favors dollar assets.

varying risk premium, though one related recent study (Frankel and Froot (1989)) using direct expectations data suggested that the variation was all in the expectations error rather than reflecting a risk premium.[10]

To summarize, the ex ante rate of return approach to the measurement of financial integration identifies major shifts, for short-horizon assets, in the direction of integration in the mid-1970s and early 1980s. In fact, Frankel's (1989) conclusion from a review of this process is that "the barriers to cross-border flows are sufficiently low that, by 1989, financial markets can be said to be virtually completely integrated among the large industrial countries (and among some smaller countries as well)." However, exchange risk remains a problem, particularly for assets with longer maturities. It is possible that increased volatility in the foreign exchange markets has made exchange rates harder to predict and has thereby limited the degree of financial integration.

To illustrate the implications of capital market integration for the balance of payments, it may be useful to start from the polar extreme of a world of complete capital immobility, or "financial autarky." In such a world the current account would be required to be in balance continuously up to the limit allowed by the availability of official foreign exchange reserves. Given the appropriate stability conditions, a freely flexible exchange rate could be expected to perform this task with the saving-investment balance cleared domestically by the rate of interest. If the level of output were not fixed, then the task of clearing the external and internal balance could be shared by the level of income. There would be no reason for the rate of interest in different countries to be connected. In such a model there is a binding liquidity constraint on the size of current account deficits and the "sustainability" question is correspondingly easy to answer: no deficit or surplus is sustainable.

Now consider an intermediate regime of relatively, but not completely, immobile capital. It may be appropriate to think of this in stock rather than flow terms; as a country's stock of international borrowing rises, so does the cost of such borrowing, ultimately very steeply. A liquidity constraint is still binding in that there are limits to borrowing, but the question of sustainability now has some content. To answer this question requires computing whether a country's present and likely future policies will push its accumulated net foreign debt into the constrained region. Deficits that are matched by investments in profitable projects will be rated differently from deficits which correspond to excess consumption because the former may promise a reversal of the cumulative deficit. It is convenient to characterize this intermediate regime as one in which the liquidity constraint, though less tight, is likely to bind prior to a solvency constraint.

In the case of a fully integrated capital market (in the sense of a market without exchange risk), a borrower—private or public sector agent— needs to meet a solvency constraint, but there is no binding liquidity constraint prior to this. Governments, of course, have more scope to meet their solvency constraints than private sector agents; they have taxing powers, for example. Sustainability now becomes a question of solvency; and there will usually be a variety of policy and current account trajectories which are sustainable in the sense of obeying this constraint, and the concept of sustainability thereby inevitably loses some of its apparent precision. This taxonomy illustrates how the significance of the concept of sustainability is diminished as the relevance of liquidity constraints decreases and ultimately converges toward that of solvency.

Under the Bretton Woods regime, in which capital mobility was restricted, the fixed but adjustable exchange rate and demand management policy had to be set in such a way as to clear the current account up to the limit given by any long-term net capital inflow. Thus the connection between the current account and the exchange rate was relatively direct. In the liberalized system prevailing today, this link has essentially disappeared.

Following Williamson (1985), a country's fundamental equilibrium exchange rate (FEER) may be defined as the real effective exchange rate that is compatible with the current account balance existing under the "normal" (i.e., cyclically adjusted) functioning of an economy. To be more concrete, an economy operating at normal capacity levels in the medium run will generate, *conditional on the policy setting*, rates of saving and investment which imply a particular current account balance. The equations determining the current account can then be inverted, for given levels of domestic and world activity, and a given level of debt service (property income) so as to yield (via the trade elasticities) the corresponding real exchange rate, the FEER. Calculations of FEERs are intended as a policy guide rather than as a positive estimate of the medium-run exchange rate. However, if the fiscal policy assumption is "realistic," these two ways of regarding the FEER would essentially be identical. In principle, a FEER calculation will yield a trajectory rather than a single figure, if only because of debt-service dynamics.

Three difficulties arise with FEER calculations. First, in the absence of full "Ricardian equivalence," the assumption about fiscal policy is critical, and necessarily normative. Second, the debt-service assumption may

[10] Note however that there is no incentive to arbitrage *real* rates of return. Real return equalization is predicted only where expected depreciation is (correctly) given by relative expected inflation, that is, where PPP governs the determination of exchange rates.

generate a kind of hysteresis effect. If the course of the actual exchange rate is different from that of the FEER, then the dynamics of debt accumulation and debt-service obligations will deviate from those involved in the FEER trajectory, which may require that it be continually recalculated. Third, in circumstances of fully integrated capital markets, the calculation of FEERs is largely arbitrary because governments and countries have liberty to borrow or lend (net) subject only to a solvency constraint. This constraint can generally be met by a variety of policy and associated current account trajectories, with correspondingly different FEERs.

Policy Toward the Current Account

The discussion above raises the issue of the extent to which a country should conduct its macroeconomic policy on the basis of targets for its current account. Traditionally, there is little doubt that for most countries the balance of payments on current account has been a principal objective of (or constraint upon) economic policy. It is easy to see why this would be the case in a regime of limited capital mobility such as the Bretton Woods regime. Under the arrangements underlying the international monetary system in that period, an incipient current account deficit required an exchange rate devaluation or deflation. In the Bretton Woods system, however, a policy of devaluation became associated with negative connotations, and in practice an exchange rate adjustment was used only sparingly. Accordingly, current account balance, or an imbalance up to the limits given by the inflow or outflow of long-term capital (as in the notion of the "basic balance"), often became a target for policymakers such that an actual or prospective deficit (surplus) prompted deflation (reflation). Therefore under conditions of a low degree of capital mobility, the current account is likely to continue to be a target of policy even if the exchange rate arrangement has been transformed from a fixed-but-adjustable regime to a flexible system. While there has been a reduction in the political sensitivity that attaches to exchange rate adjustments, in many cases governments are still quite sensitive to the economic and other consequences of exchange rate changes and so will continue to treat their current account position as a legitimate target for, or constraint upon, economic policy.

The rationale for current account targets when capital markets are highly integrated is less compelling. When there are no barriers to financial flows and capital is highly mobile, the current account simply reflects the net effect of decisions taken by agents within a framework of constrained optimization. The value of the current account is of little importance, being simply a residual outcome of private actions. Cooper (1981) makes the point in this way: "In the context of overall saving-investment analysis countries should not take any particular view of their current account positions at all. Some will draw savings from the rest of the world, others will invest in the rest of the world. Nothing is wrong with this, it is as it should be."[11] While the degree of capital mobility and the adoption of the current account as a target or constraint governing generalized fiscal and monetary policies are conceptually separate items, the former would indeed appear to have implications for the latter.

Even in a world of highly integrated capital markets, however, there may be reasons for the government to target the current account. One set of arguments focuses on the inverse of the current account, the capital account, and identifies the possibility of a departure of social from private benefit in decisions about net foreign investment. Private decisions to invest at home or overseas will be taken on the basis of expected after-tax returns; from the point of view of the social benefit of the potential capital exporting country, however, the relevant comparison is between the foreign after-tax rate of return and the domestic *pre-tax* rate of return since the domestic tax proceeds are retained. This suggests that a measure of restraint over capital outflow might be an appropriate response. In a similar vein, where the private investor will compare expected rates of return adjusted for the probability of losses owing to fraud or confiscation, the government of the potential capital exporter could argue that this does not fully take account of the social interest. If confiscation or fraud occurs at home, the losses of one domestic private investor become the gains of another, whereas if the loss occurs overseas, it is an overseas resident (or government) who benefits. These considerations also could justify limiting capital outflow. By contrast, concern about the influence of foreign capital on the domestic economy may motivate restrictions on capital inflows. Explicit restrictions reduce the mobility of capital and will tend to elevate the current account as a policy goal; even in the absence of such restrictions—and their progressive dismantling is a feature of post-war history—it can be argued (e.g., Summers (1988)) that the state of the current account—which is after all just the *inverse* of the capital account—will not be a matter of indifference to governments.

There are also policy considerations which, though not aimed at the current account per se, nevertheless imply

[11] The fact that markets react to current account announcements does not necessarily indicate that capital mobility is low. If markets look to governments as a source of information and governments act as if financial constraints require current account balance, then the market will continue to react to deviations from balance since they imply changes in policy stance, and governments will feel justified in continuing to target the current account.

predictable outcomes for a country's external accounts such that even though it is not itself an explicit target, it will nonetheless be limited in some way. For example, current account deficits may be a symptom of excess demand and inflationary pressure; this is the interpretation customarily associated with the "absorption approach." To the extent this is true, it would not be surprising to find that the conduct of counterinflationary policy would look rather like a policy of targeting the current account. But it is by no means the case that the reduction of inflation and the reduction of current account deficits are synonymous; for example, a combination of lax fiscal and tight monetary policy, which promises the reduction of inflation through the appreciation of the exchange rate, has the opposite implication for the current account. Indeed, it is interesting to note that the targeting of national wealth has been advocated recently by writers in the Keynesian tradition (Weale and others (1989)) precisely on the grounds that it is necessary to correct for a bias toward a tight money/lax fiscal policy combination to achieve full employment with low inflation. For given values of capital investment, such a target would again imply, residually, a current account target. In contrast to this approach, policies designed to secure an "over"-devaluation of a currency with a view to promoting the growth of tradables production may result in a current account surplus and thus look like a latter-day mercantilism, thereby elevating a trade surplus to a policy goal.[12]

Saving-Investment Correlations

The ex ante rate of return approach to the measurement of financial integration described above may be contrasted with the ex post approach of examining whether flows of saving and investment have exhibited behavior indicative of integration. Such an alternative test, based upon the behavior of saving and investment between countries, was proposed by Feldstein and Horioka (1980). They argued that in a world characterized by high capital mobility there is no a priori reason to expect saving and investment to be correlated across countries. Savers in different countries face the same interest rate; hence the relative level of saving in one country compared with another is determined by structural factors in the different economies. Similarly, investors also face the same interest rate, so investment decisions simply depend upon relative investment opportunities. Assuming that structural factors affecting saving and investment are not correlated, domestic saving and investment rates will also be uncorrelated. If, on the other hand, capital mobility is restricted then domestic investors will face a wedge between the cost of domestic and foreign saving, and hence domestic saving and investment will be correlated. Indeed, in the extreme case of zero capital mobility, saving and investment would be perfectly correlated.

In order to test this hypothesis, Feldstein and Horioka ran the following cross-section regression:

$$(I/Y)_i = \alpha + \beta\,(S/Y)_i + \epsilon_i\,, \tag{8}$$

where I represents domestic investment, S national saving, Y output, subscript i represents different countries, and ϵ is an error term. They interpreted the coefficient β as measuring the amount of domestic saving required to finance an extra dollar of investment. These regressions revealed that saving and investment rates were highly correlated, in terms both of levels and medium-term changes over time. The estimated coefficients were generally significantly different from zero, but not from one, using both ordinary least squares and instrumental variable techniques, and showed no signs of declining over time. Subsequent work has confirmed that these coefficients are large and significantly different from zero, although recent data indicate that the coefficients may have fallen somewhat in the 1980s.[13]

The results from regressions using equation (8) on data for 23 industrial countries over various time periods are presented in Table 2. The regressions show large and significant coefficients; for the full 1960–86 period the estimated coefficient using gross saving and investment is 0.79.[14] There is also some evidence that the coefficient has been falling over time. The coefficient estimate for the period 1960–73 is 0.91, and insignificantly different from unity; for the 1974–86 period the estimated coefficient falls to 0.67, and for the period 1980–86 it falls further to 0.61.[15] When net saving and investment data are used, however, the coefficient shows almost no decline over time.

In addition to these cross-section results, various authors have found a close correlation between saving and investment over time. Bayoumi (1990), for example, estimated the following equation using annual time series data for ten industrial countries.

[12] This case was elaborated by Schmitt (1979); the subsequent findings of Krugman and others in regard to the nature of international trade underline the relevance of this model (see Vines and Stephenson (1989)).

[13] Both gross and net saving and investment have been used in the literature. The data are generally averaged over several years in order to avoid bias caused by the correlation of saving and investment over the business cycle.

[14] Similar regressions for developing countries also show a significant correlation over time, although the coefficients are somewhat lower than that for industrial countries (Dooley, Frankel, and Mathieson (1987)).

[15] These estimates use ordinary least squares. Typically researchers have found instrumental variables results to be similar to OLS.

$$\Delta(I/Y)_t = \alpha + \beta\, \Delta(S/Y)_t + \epsilon_t . \qquad (9)$$

This equation is found to yield a positive correlation between saving and investment in all cases except Norway. Moreover, the estimated coefficient is insignificantly different from unity and significantly different from zero for seven of the ten countries.[16]

Table 2. Results from Regressions of National Saving on Investment

Sample Period	1960–86	1960–73	1974–86	1980–86
Gross Saving and Investment	0.79(0.09)	0.91(0.07)	0.67(0.15)	0.61(0.13)
Net Saving and Investment	0.87(0.11)	0.89(0.08)	0.88(0.15)	0.79(0.14)

Source: Feldstein and Bacchetta (1989).
Note: The table reports estimates of the coefficient β in equation (8). Standard errors are indicated in parentheses.

Three broad sets of explanations for these high correlations have been identified in the literature:

Low international capital mobility. Despite other evidence, international capital mobility may in fact be low, owing to factors such as information constraints, lack of enforceability of contracts, exchange rate risk and, in earlier periods, exchange controls. This is the original interpretation proposed by Feldstein and Horioka and later reaffirmed by Feldstein and Bacchetta (1989).

Private sector behavior. Several authors have built models in which there is perfect capital mobility, but saving and investment are correlated because of factors such as productivity shocks, population growth, or low integration of international goods markets. In this interpretation saving and investment are correlated because they both react to a common set of conditions (Tesar (1988)).

Government targeting of the current account. Governments may use fiscal and monetary policies to target the current account (Summers (1988)).

These explanations have substantially different policy implications. Low international capital mobility implies that policies to promote domestic saving should also raise domestic investment. In contrast, if the correlations reflect private sector behavior in a world of high capital mobility, policy-induced increases in domestic saving will tend to flow abroad unless accommodated by measures to promote investment. Finally, the possibility that governments have been targeting the current account raises the question of the appropriateness of such a policy, as discussed above.

In order to differentiate among these hypotheses, it is necessary to go beyond the simple regressions outlined in Table 2. One avenue of investigation involves calculating the behavior implied by theoretical models. Obstfeld (1986) found that the correlations implied by a simple model of saving-investment behavior were of the same order of magnitude as the observed ones; Frankel (1989) and Tesar (1988) report similar results for somewhat different theoretical models. Although these results show that the correlations can be explained by private sector behavior, they do not demonstrate that they are caused by such behavior.[17] Furthermore, these models are usually directed at the time series behavior of saving and investment, and hence are less useful for explaining the cross-section correlations.

A second line of inquiry has involved disaggregating total saving and investment. Feldstein and Horioka examine data for several sectors and conclude that there is little evidence of different sectoral behavior. Summers (1988) regresses the private sector saving investment balance on the government deficit, and finds a strong negative correlation, a result which he attributes to government targeting of the current account. Roubini (1988) proposes a model where government policies to smooth taxation produce time series correlations between total saving and investment, and presents regressions supporting this model. However, in both these cases the results also appear compatible with the hypothesis of low international capital mobility.[18] Bayoumi (1990) looks at the correlation between private sector saving and investment, and finds lower correlations for private sector data than for total data. He argues that this is evidence against explanations based on private sector behavior. He also finds that the time series correlations between saving and investment are reduced when fixed investment is substituted for total investment.

Studies have also been made of saving and investment correlations for alternative data sets. Murphy (1984) reports the results of running saving-investment regressions using data for the top 150 U. S. corporations. He finds high correlations and argues this shows evidence that the observed correlations are caused by private sector behavior. Another approach has been to consider data derived from regimes which are known to exemplify a high degree of capital market integration. In this spirit, Bayoumi (1990) runs saving-investment regressions on international data from the classical gold standard period (1880–1913), while Bayoumi and Rose (1989) use post-

[16] Frankel (1989) reports that for regressions using data for the United States, the inclusion of the period 1984–87 significantly reduces the estimated correlations. However, Bayoumi (1990) does not find such an effect.

[17] Feldstein and Bacchetta (1989) argue that Obstfeld's model cannot explain the correlations when "realistic" parameter values are used.

[18] Feldstein and Bacchetta (1989) disaggregate the data in the Summers study further and argue that they support the hypothesis that capital mobility is low.

war data on regional saving and investment for the British Isles; in neither case do the correlations reveal any significant relationship between saving and investment.[19] These results argue against the private sector behavior hypothesis, since one would not expect different behavior across regimes. At the same time, however, they do not help distinguish between the government policy and low mobility hypotheses. Unlike the currency union of the United Kingdom and the stable exchange rate of the gold standard period, today's capital markets have to cope with exchange risk; and whereas it can be assumed that government intervention in the gold standard period or between the regions of the United Kingdom was minimal or zero, no such confidence can be expressed about the absence of current account targeting in the postwar period. A direct approach to this last question is possible, however.

A third approach is to estimate government reaction functions to establish whether the current account has been a major policy objective and, if so, whether there is any evidence of change in this regard. Generally, policy reaction functions are estimated as reduced-form equations with the government policy variable as the dependent variable, and lagged values of policy targets as the independent variables. Black (1983), in a wide-ranging study of monetary policy in the major industrial countries, concludes that external variables (which in his case do not include the current account) are relatively unimportant for the United States, but generally have greater weight for other major countries. Joyce (1986), in a summary of the reaction function literature, comes to similar conclusions about monetary policy; she also surveys the rather smaller literature on fiscal reaction functions and concludes that the evidence of systematic fiscal policy "is weaker" than for monetary policy.

The appendix reports some new work on government reaction functions. Reasonably stable monetary policy reaction functions are identified for several countries; these functions suggest that the current account was a policy target in the 1970s, and that its importance declined in the 1980s. Interestingly, these results appear as strong for the United States as for other countries. While attempts to estimate stable fiscal policy reaction functions based on lagged variables were not successful, this work did identify a strong negative contemporaneous correlation between the saving-investment balances of the government and private sectors. These results indicate that the two balances almost completely offset each other in the 1970s, although the correlations have fallen somewhat in the 1980s. If this reflects a policy response, it must be admitted that the degree of policy success is rather surprising; the correlation is of course not incompatible with the alternative hypothesis of low capital mobility.

[19] Issues of data reliability suggest that cross-section correlations are more reliable for the gold standard period than correlations performed on the time series. However, it should be noted that Obstfeld (1986), using a different data source to Bayoumi's, reports quite a high coefficient for a gold standard time series equation for the United Kingdom.

Consumption Paths and Financial Integration

The fundamental advantage of closer financial integration between countries is that it allows countries to choose paths for consumption and investment which are independent from each other (subject to a long-run budget constraint). In a situation of financial autarky, consumption and investment are constrained to add up to the output of the economy, and therefore cannot be considered to be independently determined. On the other hand, if international financial markets are open, then the sum of consumption and investment can diverge from national product as foreign saving can be used to bridge the gap between domestic saving and investment. This section looks at evidence relating to whether national consumption paths have become more "optimal" over time, as international financial markets have become increasingly integrated.

Modern work on consumption usually starts from the Euler equations implied by maximizing behavior. These models assume that the consumer can borrow and lend freely at a given real interest rate; together with more technical assumptions, this implies that the intertemporal path of consumption can be characterized by the following relationship:

$$U'(c_t) = \beta E_t[(1+r_t) U'(c_{t+1})], \qquad (10)$$

where c_t is the level of consumption in period t, $U(.)$ is the utility function of the consumer, β is the consumer's discount factor, r_t is the real interest rate faced by the consumer and E_t is the expectations operator conditional on information known at time t.

This equation states that the marginal utility of consumption today is equal to the expected marginal utility tomorrow, adjusted by the real interest rate and discount factor. Combined with the assumption of rational expectations, this model predicts that the current change in consumption should not depend upon any lagged information, except the first lag of the real interest rate. The intuition behind this result is that consumption simply depends upon permanent income and the real interest rate. In any given period, the estimate of permanent income includes all information up to that point, hence no other information should be pertinent to the decision. This characteristic can be used to test whether consumption paths deviate significantly from the "optimal" path implied by equation (10).[20]

The international implications of equation (10) have been explored by Obstfeld (1986). He noted that, in a world of perfect capital mobility, consumers have access to both home and foreign capital markets. As a result, while home consumers have access to a real return of $(1+i_t)(P_t/P_{t+1})$, the foreign consumer has access to a real return of $(1+i_t)(P^*_t X_t/P^*_{t+1}X_{t+1})$, where asterisks represent foreign variables and X_t is the current exchange rate measured in home currency. Using a particular functional form for the utility functions, and equating the terms in interest rates for home and foreign consumers, produces the following equation:

$$E_t[(C_t/C_{t+1})^{\alpha}(P_t/P_{t+1}) - (C^*_t/C^*_{t+1})^{\alpha *} (P^*_t X_t/P^*_{t+1}X_{t+1})] = 0. \quad (11)$$

A similar expression can be derived using the foreign interest rate.

Obstfeld estimated equation (11) using data for the United States, Japan and the Federal Republic of Germany. He rejected the model for the period up to the break-up of the Bretton Woods system, but not for the period afterwards. While these results are suggestive of an improvement in the path of consumption, considerable caution should be exercised. The reason for this is the inclusion of a term in the change in the exchange rate in equation (11). The floating rate period has been characterized by considerable volatility in exchange rates. This adds noise to the realizations of the term within the expectations operator, making it more difficult to reject the hypothesis.

This framework was also used by Bayoumi and Koujianou (1989), using data for six countries from the floating exchange rate period, to examine two hypotheses: whether the model holds for the entire period, and whether it holds better for the more deregulated 1980s than for the 1970s. Their results indicate that for the entire time period the model can be rejected. There is, however, some evidence that the path of consumption has become "more optimal" as a result of international financial market deregulation in the 1980s.

Conclusions

While the interpretation of the evidence presented above is not entirely unambiguous, certain facts seem fairly clear. First, considerable liberalization has continued from earlier decades through the 1980s, which has resulted in a closer integration of world capital markets. At least for low-risk, short-horizon instruments, capital is now very highly mobile. Second, there has been a marked increase in current account imbalances in the 1980s compared with earlier decades. Third, however, the evidence shows that overall net flows of saving and investment are still markedly insular compared with the paradigms implied by fully integrated capital markets and the evidence from the gold standard period. The research reported in this paper suggests that the principal explanation for this is probably that macroeconomic policies have in part been concerned with the current account position and have aimed at offsetting to a large extent the fluctuations in private sector saving-investment balances, thereby reducing countries' net involvement in the world capital market. Another part of the explanation no doubt has to do with exchange risk. Exchange risk raises the cost of forward cover and may exert a strong deterrent force for those maturities for which forward facilities are nonexistent.

If it is accepted as a basic finding that there has been a genuine increase in the integration of the world's capital markets—a movement more likely to be continued than reversed—an issue to be addressed concerns the implications of this trend for economic policy. Current account imbalances have long been a leading target of economic policy and are one of the indicators closely monitored by the Fund in the context of its surveillance activities, both in consultation with member countries and in the *World Economic Outlook*. A movement toward more integrated capital markets implies that the current account is more of a residual factor that reflects the net effect of agents' decisions, and inevitably weakens its role as a policy objective; indeed, it is possible to view events in the 1980s as already confirming this.

Finally, the interpretation of a given balance of payments position from a policy perspective depends not so much on the magnitude of the imbalance, but on an assessment of factors underlying the investment (both private and public) and saving decisions that give rise to the imbalance. To the extent that inappropriate fiscal policies are reflected in recourse to foreign savings, policy action should aim at addressing the government's budgetary position. If private saving and investment decisions are subject to microeconomic distortions, then the proper policy response would be to remove these distortions. If a current account deficit is a source of concern because it generates pressure to adapt trade restriction to close the payments gap, then the preferred course of action for policy makers is to resist this pressure rather than allow macroeconomic policies to be influenced by protectionist sentiment. Thus the "first-best" approach is to correct those policies that may be generating the external imbalance, rather than to interpret the imbalance itself as necessarily a cause for concern.

[20] This model has been tested extensively on data for the United States. The overall conclusion is that the model works reasonably well as a first approximation, but that a significant proportion of consumption emanates from households that are liquidity constrained. These households consume out of current, rather than permanent, income. Tests for other countries have tended to reject the model more readily than for the United States (Hall (1988)).

Appendix

Policy Reaction Functions

This appendix reports the results obtained from policy reaction functions estimated across a number of different countries. The main focus of this work is to examine the degree to which government policy has reacted to the current account, in order to investigate the hypothesis of Summers (1988), among others, that the observed cross-country correlations between saving and investment are due to government policy. As the observed correlation between domestic savings and investment has declined between the 1970s and the 1980s, this work also investigates whether there has been a fall in the importance of the current account as a policy target over the last twenty years. Monetary and fiscal policy reaction functions are estimated directly, using reduced form equations with a policy instrument as the dependent variable and (lagged) targets as the independent variables. While there are other, more structural, methods of estimating reactions functions (Pissarides, 1972), the reduced form approach has been widely used in the literature (Joyce, 1986).

Monetary Policy Reaction Functions

The monetary policy reaction functions are based on estimated equations of the following form:

$$\Delta(i_t) = \underset{?}{\alpha_1} + \underset{+}{\alpha_2}\,\Delta(y_{t-j}) + \underset{+}{\alpha_3}\,\Delta(p_{t-j}) + \underset{-}{\alpha_4}\,(CA/Y)_{t-j}\,, \qquad \text{(A1)}$$

where i is an interest rate, y is the logarithm of real output, p is the logarithm of the price level, (CA/Y) is the ratio of the current account surplus to output and Δ is the first difference operator. This equation states that the authorities raise or lower interest rates depending upon the recent behavior of three target variables, namely growth of output, inflation, and the size of the current account. The expected signs of the coefficients of these target variables are given below the coefficients. Growth and inflation represent the basic internal targets of monetary policy, while the current account variable represents the external target.

Before estimating an equation such as (A1) above, several issues require discussion. The first is the possible endogeneity of the policy variable; if the chosen interest rate is not fully under the control of the authorities, the estimated coefficients may in fact represent endogenous behavior rather than policy decisions. To avoid this problem the interest rates chosen were official discount rates, as these are fully under the control of the authorities, and are generally adjusted in discrete steps.

A second issue involves the treatment of expectations. It seems reasonable to assume that the authorities adjust policy instruments to expected future changes in the economy, not those which have occurred; hence, ideally, rather than using lagged values of the targets, it would be preferable to use expected future values. However, it is not the actual outcome of the target which should be used, but the outcome in the absence of any policy intervention. As changes in the policy variable affects the future outcome of the targets, it would be necessary to specify a model of the effects of policy instruments on the economy before the correct expected values of the targets could be derived, and any results for the reaction function would involve a joint test of the rest of the model. To avoid these problems, lagged targets were used in the regressions. This procedure is justified if future expected outcomes are based upon past behavior.[21]

Finally, there is an econometric issue which should be considered. As was noted above, the dependent variable in these regressions moves in discrete steps, while standard regression analysis assumes that the dependent variable is continuous. If it is assumed that there exists an underlying continuous reaction function, but that the actual outcomes are then rounded to the nearest (say) half a percentage point, the rounding introduces a new source of error into the regression. As a result, while the estimated coefficients are still unbiased, estimated standard errors will be upward biased. The reported results have been adjusted to take this into account.

Table 3 reports these regressions for the United States, Japan, the Federal Republic of Germany, and Italy.[22] The results are reasonably encouraging; in every case the sum of the coefficients on the targets has the correct sign. The coefficient associated with growth is significant at conventional levels in three of the equations, although somewhat surprisingly inflation is only significant for the United States. Using a one-tailed test the coefficient on the current account is significantly different from zero for both Japan and Germany, is totally insignificant for the

[21] For example, if a variable is projected using a first order autoregressive process, the first lag will contain all the information needed to project its future values.

[22] Full data sets were not available for other countries. The interest rates are end-quarter data, while the other variables are quarterly averages. For each country the change in the interest rate was regressed on the current value and first lag of growth, inflation, and the current account ratio. Since the interest rate data are end-period, the use of current period data for targets is justified, although it does assume a short lag between changes in targets and changes in instruments.

Table 3. Regression of Change in Interest Rate on Lagged Targets[1]

	United States	Japan	Federal Republic of Germany	Italy
Growth	32.4 (8.5)	0.8 (8.8)	6.4 (5.7)	1.7 (4.0)
Growth (−1)	7.0 (7.9)	6.1 (9.4)	21.8 (5.7)	11.0 (4.1)
Inflation	43.4 (14.5)	3.1 (7.2)	8.4 (11.6)	50.5 (17.5)
Inflation (−1)	−9.1 (16.2)	0.9 (7.2)	2.5 (12.9)	−40.4 (17.6)
CA/Y	11.8 (14.1)	−12.8 (8.5)	−6.6 (4.5)	−3.4 (9.4)
CA/Y (−1)	−13.0 (13.8)	3.7 (8.5)	0.4 (4.2)	−2.7 (9.4)
DW	2.19	1.24	1.37	2.34
R^2	0.36	0.11	0.24	0.29
Se	0.62	0.64	0.51	1.11

[1] The data period is 1971:3–1988:2. Adjusted standard errors are indicated in parentheses.

United States, and has a *t*-value of 0.9 in the case of Italy. These results confirm the conventional view that external factors have been a relatively unimportant influence on U. S. monetary policy, but have played a larger role in other countries.

If government policy is a major cause of the observed correlations between saving and investment, the reduction in the magnitude of these correlations between the 1970s and the 1980s should show up in terms of a decline in the importance of the current account as a policy target. Table 4 reports the results of regressions designed to investigate this hypothesis. In addition to the targets, these regressions include dummy variables that represent the values of the targets in the 1980s. The coefficients on the target variables represent the importance of these targets in the 1970s, while the coefficients on the associated dummy variable show the change in the value of the targets between the 1970s and the 1980s. (The coefficient on the targets for the 1980s can be calculated from the sum of the coefficient on the target and its associated dummy variable). In order to simplify the presentation only current values of the targets are included in the regressions; results using lagged values are broadly similar.

These results are also encouraging. The most striking results pertain to the current account variable; all the coefficients relating to the current account in the 1970s have the expected sign and have *t*-ratios well above unity. Furthermore, all the regressions show a fall in the size of the current account coefficient between the 1970s and the 1980s.[23] This decline reduces the coefficient to near zero for the United States and Germany, halves the coefficient for Italy while leaving it relatively unchanged in the case of Japan. Turning to the domestic targets, in the 1970s inflation has a larger and more significant coefficient than growth in all the regressions, and is significant at conventional levels in three of the four countries.[24] The results for the 1980s show less uniformity, with growth becoming more important than inflation in the United States and Japan, but not in the Federal Republic of Germany or Italy.

Overall, these results appear to provide some support for the view that the current account was a significant policy target for monetary policy in the 1970s, but that its importance diminished somewhat in the 1980s. This behavior appears to correspond to a reduction in the correlation between saving and investment among OECD countries. Since the major effect of monetary policy is probably on private sector saving and investment, rather than on the government balance, these data do not provide support for the hypothesis of Summers (1988) that it is fiscal policy which has been used to target the current account, but rather that governments have sought to influence private sector behavior in response to current account imbalances.

One last issue which should be addressed is whether the estimated reaction functions are stable over time. The data in Table 2 indicate that there are significant changes in the estimated coefficients between the 1970s and the 1980s; the question is whether this instability is important for shorter time periods. One way of testing this proposition is to estimate rolling regressions. These involve choosing a fixed time period, in this case 24 quarters,[25] and regressing a given equation over this time interval starting in successive time periods; hence the first regression runs from 1972:1 to 1977:4, the next from 1972:2 to 1978:1, and so forth. The estimated coefficients, plus

[23] Using a simple sign test, the probability of four coefficients all turning up negative is 6.25 percent, close to conventional significance levels.

[24] However, these results are not robust to the inclusion of lags.

[25] This length of time was chosen because it is long enough to produce reasonable coefficient estimates, but short enough to allow genuine changes in coefficients to become apparent.

Table 4. Differences in Target Coefficients Between 1970s and 1980s[1]

	United States	Japan	Federal Republic of Germany	Italy
Growth	21.9 (9.4)	0.0 (10.0)	2.7 (8.5)	6.3 (5.6)
DUM x Growth	27.1 (13.9)	18.4 (15.8)	−1.5 (12.1)	−10.8 (8.7)
Inflation	39.5 (10.5)	6.0 (6.7)	21.7 (14.4)	23.4 (12.4)
DUM x Inflation	−17.9 (9.0)	−2.1 (13.0)	−13.2 (14.7)	−10.7 (11.1)
CA/Y	−26.5 (14.6)	−11.4 (8.7)	−12.6 (7.8)	−12.9 (8.8)
DUM x *CA/Y*	30.7 (16.3)	1.5 (9.8)	9.0 (8.9)	6.5 (16.4)
DW	2.16	1.17	1.24	2.19
R^2	0.42	0.13	0.09	0.18
Se	0.59	0.63	0.56	1.19

[1] The estimation period is 1971:3–1988:2. Adjusted standard errors are indicated in parentheses. *DUM* equals 0 in 1970s and 1 in 1980s.

their standard errors, can be plotted in order to give a visual impression of the stability of the regression coefficients. This exercise has been carried out using a regression with only current target variables. The results (not reported here) are somewhat mixed. For the United States and Germany the data indicate fairly gradual movements in the coefficients, the Italian data show severe instability while the Japanese data show some instability at the beginning and end of the period. Overall, these results do not appear to invalidate the results for the longer periods, in that the estimated policy reaction functions are not excessively unstable.

Fiscal Policy Reaction Functions

In theory, fiscal policy reaction functions can be estimated in exactly the same manner as monetary functions. However, in practice several factors make estimation more difficult. The first, and most important, has to do with the exogeneity of policy. Fiscal systems are extremely complex, and the policy instruments which are under the direct control of the government, such as tax rates or allowance provisions, are numerous. Summary measures of policy, such as the deficit or average tax rate, are not entirely under the control of the government given that they are likely to be affected by growth and other factors.[26] The empirical work in this section uses the budget deficit as the basic definition of policy, but allows for some endogenous effects. (This work could be extended to other summary statistics, such as average tax rates.)

A second issue concerns the time scale over which fiscal policy is planned. While some adjustments often take place during the year, most fiscal policy changes are announced in the budget. Hence, while monetary policy can be analyzed on a quarterly or monthly basis, fiscal policy is probably best approached using annual data. This reduces the number of data points available, and lowers the precision of the estimates.

Two reaction functions were estimated for 12 industrial countries. The first regressed the ratio of the budget deficit[27] to GDP (the policy variable) against its own lagged value and lagged values of the three targets, growth, inflation and the current account; in the second, contemporaneous values for growth and inflation were included as proxies for possible endogeneity effects. The expected signs for the targets are the same as in the monetary regressions; growth and inflation should be associated with rises in the government surplus (reductions in the deficit) in order to stabilize demand, while changes in the current account should be negatively correlated with the government surplus if the current account is a target.

Table 5 shows the results from estimating the first equation; those from the second equation were broadly similar and are not reported. The coefficients are generally positive, but not significant. More worrying is the fact that all the coefficients on inflation fail to produce the expected sign; it appears that governments reacted to inflation by allowing their budget positions to deteriorate. This may be a result of the fact that inflation raises interest payments on government debt. The current account coefficients have no consistent sign, and are generally insignificant. The last column of the table shows the

[26] Concepts such as the full employment deficit, which aim to take out these endogenous factors, depend upon the model used; furthermore, using such concepts in a reaction function assumes that governments disregard endogenous effects when choosing their fiscal stance.

[27] General government data were used because central government data were only available for a few countries.

results when the six major industrial country equations were estimated as a system, with all the coefficients except the constant constrained to be equal across countries. The system results, which can be seen as a summary of the individual country regressions, indicate that growth has a positive effect on the government surplus, inflation has an insignificant coefficient, while the current account has a significantly positive effect, the opposite to the sign that would be expected if governments target the current account.[28] Attempts to find differences in the importance of the current account between the 1970s and the 1980s also produced unsatisfactory results. Overall, this evidence suggests that fiscal policy, as measured by the general government deficit, was not influenced by developments in the current account.

Contemporaneous Saving-Investment Correlation

The above results from estimating policy reaction functions are mixed. Monetary policy appears to have reacted to the current account, but there is little evidence that fiscal policy did. This section explores the existence of a contemporaneous correlation between the government and private saving investment balances.

The following regressions were estimated using a first-order autocorrelation adjustment:

$$\text{Private}[(S-I)/Y] = \alpha + \beta\ \text{Government}[(S-I)/Y], \quad \text{(A2)}$$

where Private means private sector, Government is general government, and S, I, and Y represent nominal saving, investment, and GDP respectively. The coefficient β can be regarded as the degree to which changes in the government balance offset changes in private sector balance; a coefficient of -1 indicates that changes are fully offset. It should be emphasized, however, that the direction of causation is not clear.

The results from these regressions are presented in Table 6. In 8 of the 12 regressions the estimate of β is insignificantly different from -1, with estimated values ranging from -0.8 to -1.1. Of the other four regressions, two have sizable negative estimates of β, while the two regressions with positive estimates of β, for the United Kingdom and Norway, also have the highest standard errors.[29]

To test how robust these findings are two further sets of regressions were estimated. Contemporaneous values of growth and inflation were included to test whether the correlations were caused by automatic stabilizers; the results were similar to the initial regressions. Finally, the possibility that these correlations reflect the treatment of all nominal interest payments as income in the national accounts was also examined. In times of inflation this artificially boosts the income, and hence saving, of net creditors, such as the private sector, while lowering the income and saving of net debtors, such as the government. A crude adjustment for this can be made by increasing government saving by the product of net out-

[28] When contemporaneous growth and inflation are included in the regression, the coefficient on lagged growth falls to near zero, while the coefficient on inflation becomes significantly negative.

[29] These results are not simply a product of Ricardian effects. Using similar data, Bayoumi (1990) finds a negative correlation between government and private saving, but the effect is not as powerful as the one documented here.

Table 5. Regressions of General Government Deficit on Lagged Target Variables[1]

$$DEF/Y = \alpha + \beta_1 DEF/Y(-1) + \beta_2 GROWTH(-1) + \beta_3 INFL(-1) + \beta_4 CA/Y(-1)$$

	$DEF/Y(-1)$	$GROWTH(-1)$	$INFL(-1)$	$CA/Y(-1)$	R^2
United States	0.49 (0.30)	0.29 (0.20)	−0.22 (0.23)	0.90 (0.41)	0.64
Japan	0.92 (0.13)	0.18 (0.10)	−0.18 (0.07)	−0.15 (0.20)	0.89
Germany, Fed. Rep. of	0.34 (0.34)	0.21 (0.27)	−0.27 (0.29)	−0.19 (0.37)	0.40
France	0.63 (0.30)	−0.04 (0.31)	−0.11 (0.14)	0.69 (0.38)	0.67
United Kingdom	0.21 (0.12)	−0.03 (0.08)	−0.04 (0.05)	0.21 (0.11)	0.70
Canada	0.88 (0.23)	−0.18 (0.30)	−0.47 (0.30)	−0.36 (0.50)	0.69
Belgium	0.59 (0.15)	−0.11 (0.17)	0.00 (0.15)	0.64 (0.18)	0.91
Finland	0.77 (0.14)	0.24 (0.13)	−0.19 (0.13)	−0.48 (0.18)	0.84
Norway	0.04 (0.20)	0.33 (0.36)	−0.25 (0.27)	0.39 (0.10)	0.81
Sweden	0.79 (0.18)	0.04 (0.38)	−0.21 (0.34)	−0.01 (0.44)	0.81
Austria	0.39 (0.20)	0.50 (0.15)	−0.30 (0.15)	0.60 (0.23)	0.90
Australia	0.33 (0.19)	0.15 (0.15)	−0.10 (0.09)	−0.17 (0.12)	0.60
System[2]	0.44 (0.09)	0.15 (0.04)	0.02 (0.04)	0.28 (0.05)	

[1] The estimation period is 1972–86. Standard errors are indicated in parentheses.
[2] Uses data on first six countries.

Table 6. Regressions of Private Sector and Government Saving-Investment Balances[1]

$$\text{Private}(S-I)/Y = \alpha + \beta\ \text{Government}(S-I)/Y + e_t$$
$$e_t = \rho\, e_{t-1} + \epsilon_t$$

	β	ρ	R^2
United States	−1.07 (0.13)	0.91 (0.09)	0.84
Japan	−1.05 (0.28)	0.77 (0.16)	0.52
Germany, Fed. Rep. of	−0.83 (0.21)	0.68 (0.23)	0.47
France	−0.98 (0.21)	0.03 (0.29)	0.62
United Kingdom	0.43 (0.52)	0.69 (0.18)	0.05
Canada	−0.99 (0.15)	0.29 (0.27)	0.77
Belgium	−0.93 (0.24)	0.85 (0.12)	0.59
Finland	−1.00 (0.32)	0.33 (0.25)	0.44
Norway	0.11 (0.47)	0.65 (0.20)	0.01
Sweden	−0.66 (0.16)	0.35 (0.26)	0.57
Austria	−0.56 (0.11)	−0.29 (0.28)	0.65
Australia	−0.80 (0.37)	0.70 (0.17)	0.29

[1] The estimation period is 1972–86. Standard errors are indicated in parentheses.

standing government debt and inflation and reducing saving by the private sector by an equal amount. These calculations were made for the six major industrial countries in the sample, starting in 1977; the resulting regressions were similar to those without the inflation adjustment.

There is also evidence that the importance of these correlations has fallen over time. Table 7 reports the results when a dummy variable representing the change in the coefficient β in the 1980s is included in the regressions. The results support the thesis that the coefficient has fallen between the 1970s and the 1980s. Although rarely significant at conventional levels, the results show a fall in the implied correlation over the 1980s in 8 of the 12 equations.[30] This fall in the observed correlations parallels the observed decline in the correlation of national saving and investment rates.

Overall, there is significant evidence of a negative correlation between the saving and investment balances of the private and government sectors. The cause of this correlation suggests two explanations, which are not necessarily exclusive. The first is that international capital mobility is low, although it has risen somewhat over time; hence any imbalance between saving and investment in one area of the economy requires an offsetting imbalance in another sector due to crowding out. An alternative explanation is that the government targets the current account. Fiscal policy adjustments could be made during the year, producing the contemporaneous correlation, or monetary policy could be directed to the current account, causing movements in both the private and government balances.

[30] Using a simple one-tailed sign test this result is significant at the 10 percent level, but not at the 5 percent level.

Table 7. Differences in Saving Investment Correlations Between the 1970s and 1980s[1]

$$\text{Private}(S-I)/Y = \alpha + \beta\text{Government}(S-I)/Y + \gamma\{DUM^*\text{Government}(S-I)/Y\} + e_t$$
$$e_t = \rho e_{t-1} + \epsilon_t$$

	β	γ	ρ	R^2
United States	−1.17 (0.18)	0.28 (0.26)	0.83 (0.14)	0.83
Japan	−1.10 (0.29)	0.31 (0.37)	0.78 (0.17)	0.55
Germany, Fed. Rep. of	0.88 (0.24)	0.69 (0.63)	0.53 (0.29)	0.51
France	−1.68 (0.34)	0.87 (0.48)	0.40 (0.31)	0.72
United Kingdom	0.59 (0.50)	−0.92 (0.44)	0.47 (0.24)	0.30
Canada	−0.43 (0.18)	−0.62 (0.18)	−0.01 (0.35)	0.92
Belgium	−1.17 (0.36)	0.20 (0.24)	0.87 (0.11)	0.61
Finland	−1.03 (0.32)	0.54 (0.89)	0.31 (0.27)	0.47
Norway	−0.24 (0.94)	0.39 (0.43)	0.62 (0.23)	0.03
Sweden	−0.84 (0.28)	0.40 (0.46)	0.41 (0.25)	0.56
Austria	−0.53 (0.13)	−0.21 (0.42)	−0.32 (0.29)	0.67
Australia	−0.54 (0.45)	−0.63 (0.58)	0.63 (0.20)	0.35

[1] The estimation period is 1972–1986. Standard errors are indicated in parentheses. *DUM* is a variable equal to 0 for the 1970s and 1 for the 1980s.

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III

National Savings and Targets for the Federal Budget Balance in the United States

Owen Evans[1]

The national saving rate declined in many industrial countries in the 1980s, and this tendency toward decline has became a subject of discussion and analysis.[2] In particular, the national saving rate in the United States has dropped markedly in the 1980s, with both the public and private components exhibiting declines. This paper discusses reasons for the decline and reviews possible responses by policymakers. In a recent speech, the Managing Director of the Fund observed that "a strong argument could. . . be made for the Federal Government to run a significant surplus to offset the low level of private saving."[3] This paper develops an analytical basis for such an argument and makes some preliminary attempts at quantifying what magnitude of surplus might be desirable. The general approach and methodology that are taken could be applied more widely than in the U.S. context. To provide background for the policy issues analyzed later in the paper, the first two sections review the magnitude of the decline in savings rates relative to historical averages, address questions related to measurement, and discuss the factors underlying the recent decline in the national saving rate.

The next section examines whether there are reasons for seeking to reverse that decline by policy changes and concludes that there is a strong case for policy changes aimed at raising national saving. Moreover, to the extent that the factors behind the decline in private saving do not appear easy to reverse (and assuming an absence of Ricardian equivalence effects), increases in public saving may provide the most effective means of bolstering the national saving rate.[4]

The first principal strand of the argument is that the national saving rate is a variable that public policy should seek to influence. The second main strand is that changes in the federal fiscal balance may provide the most effective means for policy to influence the national saving rate. It would be quite possible, of course, to accept the first element of the argument—that public policy should seek to influence the national saving rate—while maintaining that structural measures directed at private saving provide the most effective tools for the task.

Public policy should only be concerned about the national saving rate if there are reasons for believing that the rate generated by market outcomes should be viewed as suboptimal or inappropriate. The approach taken here on this central issue is twofold. First, a variety of government policies may tend to diminish private saving below a pure market outcome. If it is either not desirable or not feasible to eliminate such impediments, a second-best alternative may be for the government to aim for a surplus in its own accounts to offset the induced loss of private saving. Second, it should be recalled that the fundamental welfare theorems yield a presumption that market outcomes are optimal only in the absence of market failures. In an economy characterized by the assumptions of the life-cycle model—there being a lack of effective intergenerational linking of preferences—there is a fundamental market failure in the sense that unborn economic agents are not represented in capital formation decisions. Consequently, there may be a role for policy intervention in an effort to offset this market failure. The nature and magnitude of such intervention of course involve difficult questions of intergenerational equity.

Following the discussion of the rationale for policy intervention, two alternative frameworks aimed at quantifying an appropriate medium-term objective for the

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[2] For a review covering the global economy, see Aghevli and others (1990).

[3] Camdessus (1989).

[4] The U. S. Budget for FY 1991 (released in January 1990 after this paper was first prepared) set as an objective achievement of a Federal surplus of 1½ percent of GNP by FY 1995.

national saving rate are then presented. The first is based on an explicit optimality criterion—namely the neoclassical steady-state path on which per capita consumption is maximized, with a possible adjustment for a positive rate of social time preference. Illustrative calculations based on this framework indicate that a net national saving rate close to 10 percent of net national product (NNP) might be called for. While tax policy measures to boost private saving could play some role, the approach indicates that the associated target for the federal fiscal balance would nonetheless be a substantial surplus—perhaps in the neighborhood of 3 percent of NNP.

The second framework aims to calculate the net national saving rate and associated federal budget balance consistent with a target growth rate of output and assuming no reliance on foreign saving. On this basis, the calculations indicate that achievement of output growth consistent with the postwar average and the U. S. Administration's medium-term economic projections might also require a net national saving rate close to 10 percent of NNP, and thus a substantial federal budget surplus.

Decline of U.S. National Saving

The allocation of resources between present consumption and future consumption is among the most fundamental of economic choices. The magnitude of saving will help to determine the living standards of the current generation later in life and of future generations. Either by augmenting a country's stock of productive capital or by adding to its income-earning external assets (reducing its external liabilities), saving raises a nation's future consumption possibilities. Concern about future living standards is at the core of widespread recent discussion of the low national savings rate in the United States.

Review of Data[5]

Gross national saving in the United States averaged 16½ percent of GNP from 1950–79, and then fell by almost 4 percentage points to 12¾ percent of GNP in the latest three years (1987–89). The fall in the U. S. national saving rate and the role of the public and private components are illustrated in Table 1 below and Chart 1. In an accounting sense, the shift in the public sector balance—reflecting larger federal deficits—was responsible for a little more than half the fall in the national saving rate, with the remainder reflecting the drop in gross private saving from an average 16¾ percent of GNP during 1950–79 to 15 percent of GNP during 1987–89.

Net national saving (which subtracts capital consumption allowances from the gross figures) has exhibited an even more pronounced decline; it fell from an average of 8¼ percent of net national product (NNP) during 1950–79 to 2½ percent of NNP in the period 1987–89, with net private saving dropping from 8¾ percent of NNP in the earlier period to 5 percent in the last three years, while public sector dissaving widened by 2½ percent of NNP (Chart 2).

[5] The U.S. national accounts data referred to in this paper were current data from Data Resources Incorporated data banks, as of June 1990, unless stated otherwise. The data revisions released in late July 1990 covering 1987–89 are not incorporated.

Table 1. U.S. Saving Rates, 1950–89

	1950s	1960s	1970s	1980s	1987	1988	1989
			(In percent of GNP)				
Gross national saving	16.1	16.3	16.7	14.9	12.2	13.2	13.4
Private	16.2	16.6	17.6	16.6	14.7	15.1	15.4
Public	−0.1	−0.3	−1.0	−2.5	−2.4	−2.0	−2.0
Of which: Federal	0.1	−0.3	−1.7	−3.8	−3.0	−3.0	−2.8
			(In percent of net national product)				
Net national saving[1]	8.1	8.6	7.9	3.3	1.7	2.9	3.2
Private	8.2	8.9	8.9	6.2	4.4	5.2	5.4
Public	−0.2	−0.3	−1.0	−2.9	−2.7	−2.2	−2.2
Of which: Federal	0.1	−0.3	−1.9	−4.3	−4.0	−3.3	−3.2
			(In percent of GNP)				
Memorandum items:							
Current account balance[2]	0.1	0.5	—	−1.8	−3.2	−2.6	−2.0
Absorption[3]	99.1	98.9	99.2	100.1	102.5	101.5	100.9

[1] Gross saving less capital consumption allowances.
[2] Current account data do not fully reflect the revisions released in early 1990, as comparable historical data were not yet available at the time of writing.
[3] The sum of consumption, gross investment, and government spending on goods and services in nominal terms.

Chart 1. United States: Gross Saving Rates

(In percent of GNP)

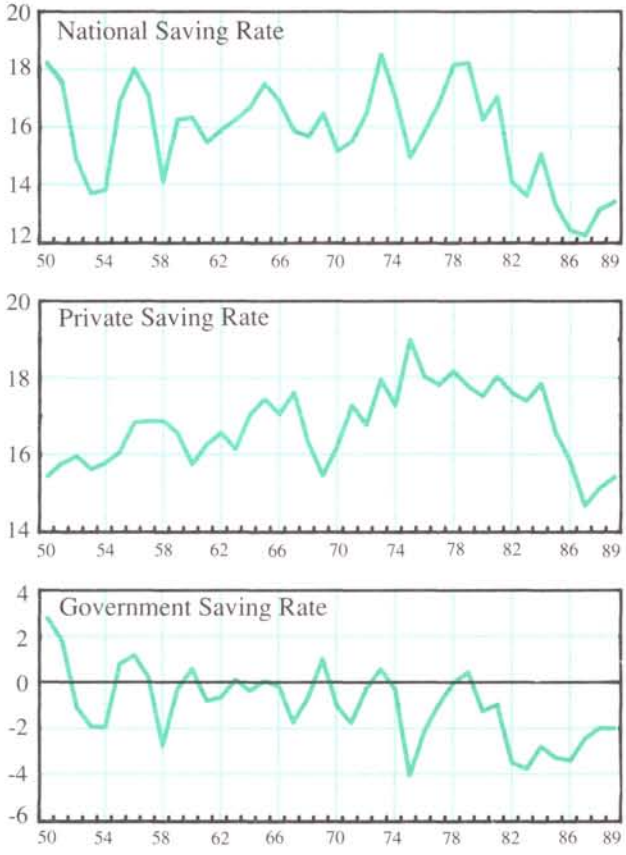
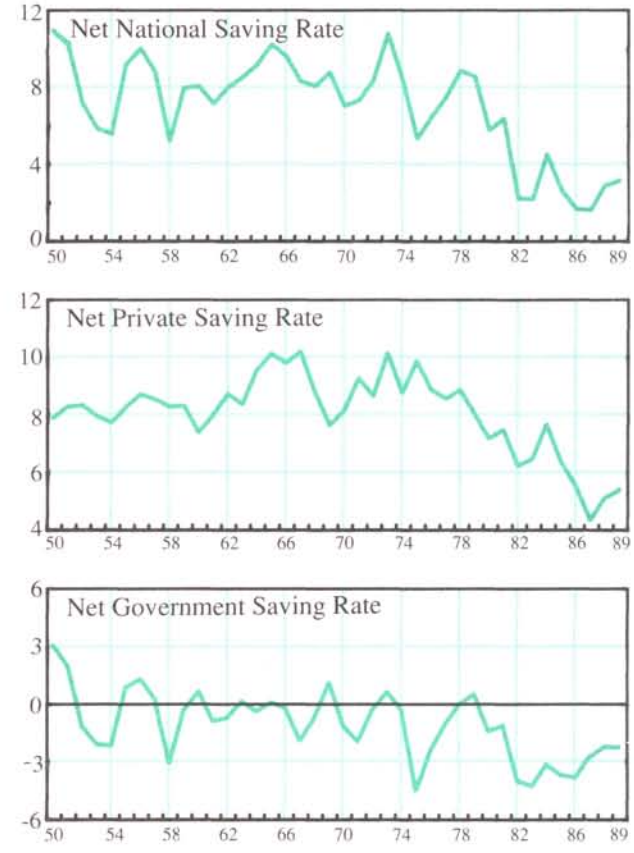


Chart 2. United States: Net Saving Rates

(In percent of net national product)



The outcome of such a falling away in the economy's propensity to save is a decline in the system's future capacity to generate income. Either the stock of external assets is reduced (liabilities increased), or else net additions to the domestic capital stock are being accumulated less rapidly than otherwise. The data indicate that both effects have been evident in the 1980s; the external current account shifted from small surpluses to large deficits, leading to a rising stock of external liabilities while at the same time net investment declined by 2½ percent of NNP (Table 2).

Measurement Issues

The decline in U. S. *public saving* in the 1980s relative to historical averages noted above reflects a deteriorating federal fiscal position, somewhat mitigated by an increase in the combined surpluses of state and local governments (Chart 3). An important measurement issue concerning U. S. public saving relates to social insurance funds. The measured federal fiscal position would recently have been much worse but for the accumulation of substantial social insurance fund surpluses in the last few years that resulted largely from the reform of the social security system in 1983. Since social security cash flow surpluses are intended to provide a reserve against the substantial demographic changes expected next century, their use to finance deficits elsewhere in the government budget may not be appropriate.[6] In a related vein, the bulk of the state and local government surpluses that have accumulated in the 1980s also consists of pension fund reserves, associated with future pension liabilities. When the social insurance fund surpluses of federal and state and local governments are separated out, the general and federal government fiscal situations appear even more serious (Table 3) and the recent improvements are much less pronounced.

Turning to *private saving*, some have argued that the economically appropriate categories of saving and investment may not be adequately captured by standard national accounts measures and that when various adjust-

[6] See Aaron and others (1989) and Ebrill (1990). A counter-argument—that forthcoming demographic changes do not by themselves imply the need for higher national saving is made in Cutler and others (1990).

Table 2. Net Saving and Investment, 1950–89

(In percent of net national product)

	1950s	1960s	1970s	1980s	1987	1988	1989
Net national saving	8.1	8.6	7.9	3.3	1.7	2.9	3.2
Net foreign saving[1]	−0.1	−0.7	−0.3	1.8	3.7	2.7	2.1
Net domestic investment	8.2	7.7	7.6	5.1	5.3	5.4	4.7
Business fixed investment	3.4	3.7	3.7	. . .	1.6	2.0	. . .

[1] Broadly equivalent to the external current account deficit.

Table 3. Public Saving, 1950–89

(In percent of GNP)

	1950s	1960s	1970s	1980s	1987	1988	1989
General government saving	−0.1	−0.3	−1.0	−2.5	−2.4	−2.0	−2.0
Federal	0.1	−0.3	−1.7	−3.8	−3.6	−3.0	−2.8
Excluding social insurance	−0.4	−0.7	−1.7	−3.8	−4.2	−4.1	−4.1
Social insurance	0.4	0.4	—	0.1	0.6	1.1	1.2
State and local	−0.2	—	0.8	1.2	1.1	1.0	0.8
Excluding social insurance	−0.6	−0.5	—	—	−0.3	−0.4	−0.6
Social insurance	0.3	0.5	0.8	1.2	1.4	1.5	1.5

Table 4. Personal and Private Saving Rates, 1960–88

(In percent of GNP)

	1960s	1970s	1980–1985	1986	1987	1988
Personal saving	4.6	5.6	4.4	3.0	2.3	3.0
Adjusted personal saving[1]	4.8	5.8	3.6	3.1	2.1	2.7
Private saving	16.6	17.6	17.5	15.8	14.7	15.1
Adjusted private saving[1]	16.7	17.8	16.7	16.3	14.5	14.8

[1] National accounts personal (private) saving plus actual spending on consumer durables less imputed depreciation on and the service flow from the stock of durables.

ments are made, the problem may look less severe. However, when suggested corrections are made to measured savings and investment data, the broad conclusion that rates of saving and capital formation have declined in the recent past emerges unaltered.[7]

For example, treating spending on *consumer durables* in a consistent way reduces year-to-year fluctuations in the saving series but the recent downward trend remains. Moreover, the saving/investment balance is unaffected since such spending needs to be added to the investment side of the ledger as well. In Table 4, movements over time in conventionally measured personal and private savings relative to GNP are compared with movements in adjusted series which regard consumer durable spending as savings and correspondingly treat depreciation on the stock of consumer durables as consumption.[8] The not-too-surprising result that the calculated savings rates are very similar across the alternative definitions stems from the fact that the depreciation series added back to pure consumption is very similar in magnitude to the series for spending on durable goods taken out of consumption and added to saving.

Treating *changes in household wealth* as the appropriate measure of saving—as advocated by Shoven (1984)—is an alternative approach that, however, produces highly volatile series for saving whose interpretation is difficult. Moreover, other analysts have suggested that saving in the form of unrealized capital gains should be viewed somewhat differently from saving out of current income, so that such an overall saving measure may not be appropriate. Such capital gains or losses would also need to be added to investment, so that the saving/investment balance would be affected only to the extent that there were effects on the net value of foreign holdings of U.S. assets.

A recent paper by Bradford[9] argued that a measure of

[7] Bovenberg and Evans (1990). The logical structure of this subsection dealing with measurement issues draws on the paper just cited.

[8] The calculations of pure consumption and corresponding savings concepts derive from the framework employed in the Federal Reserve MPS model of the U. S. economy. See Brayton and Mauskopf (1985).

[9] Bradford (1989).

Table 5. Aggregate Saving Measured by Changes in Wealth, 1950–87[1]

(In percent of GNP)

1950s	1960s	1970s	1980–85	1986	1987
11.6	9.7	7.4	5.9	10.5	5.9

[1] The figure for each year was computed as the ratio of the change in the sum of household and government net worth to GNP. Decade averages were computed as the average of the ratios for individual years. Data were reported in Bradford (1989).

saving based on changes in wealth corresponds more closely to the relevant theoretical concepts, noting that the basic notion of wealth is the market value of household claims on future goods and services. Despite the well-known measurement problems in the Federal Reserve balance sheet data,[10] Bradford argued that this approach was preferable. As with Shoven's earlier work, the resulting savings series were highly volatile. Nevertheless, the trend decline in the aggregate saving rate was also evident in the wealth based measure (Table 5) so that the overall picture of a declining national savings rate was unaffected.

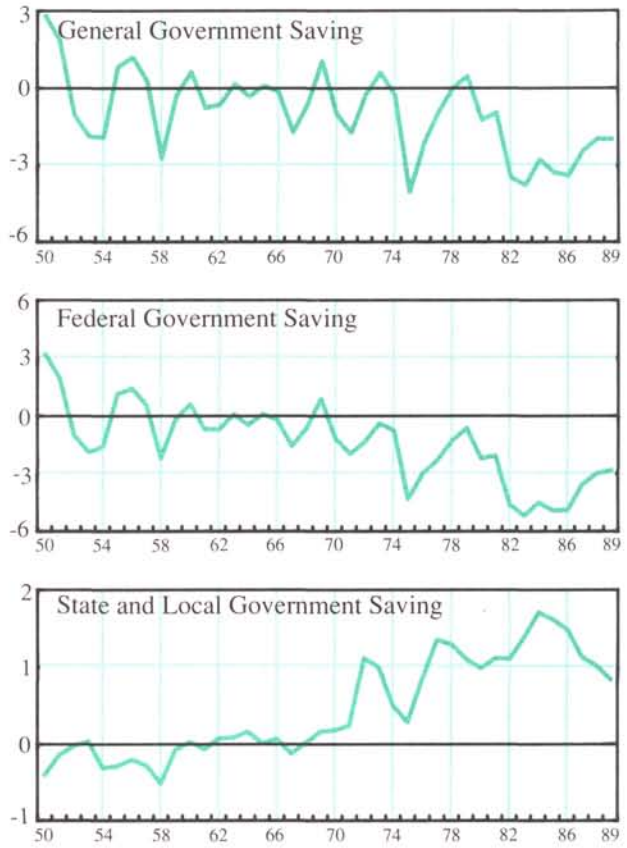
Another proposed correction to measured saving rates concerns *inflation*. Inflation potentially distorts the measured saving rate of a sector, with the direction of its impact depending on whether the sector is a net creditor or net debtor in fixed nominal value financial securities. The net result of adjusting the saving data for inflation is that the decline in the national saving rate remains evident as before, but its attribution across sectors is somewhat altered. In particular, an even larger proportion is attributed to shifts in the public sector balance.[11]

A further measurement issue concerns whether gross or net savings and investment data should be employed. From the perspective of economic theory, net savings and investment appear to be the relevant concepts since economic decisions are typically considered to be made in net terms. From a more pragmatic vantage point, however, gross saving and investment may also be seen as relevant constructs. First, accurate measurement of economic depreciation is difficult and national accounts measures may be subject to a considerable margin of error. Second, the more rapid recent decline in net savings relative to NNP than in gross savings relative to GNP reflects a rise in capital consumption allowances, associated with a shift over time to investment in shorter-lived capital goods, especially information processing equipment.[12]

As a result of this shortening of average service lives, an increasing proportion of gross investment has been devoted to replacement of the depreciating part of the capital stock rather than to making net additions. The fact that the capital stock is on average younger than before suggests that it may on average be more technologically up to date. The implications of the shift to capital goods with shorter economic service lives for the quantity and quality of capital services to be derived from a given addition to the capital stock are thus ambiguous. The conclusion would appear to be that both gross and net saving concepts contain relevant information and that neither should be the exclusive focus of attention.

Chart 3. United States: Government Saving Rates

(In percent of GNP)



Factors Behind Lower U.S. National Saving

This section discusses some of the reasons that may underlie the declines in gross and net national saving in

[10] Including the fact that the household sector is the residual sector in the calculations, so that the effects of errors elsewhere feed into the household sector and the fact that the balance sheet accounts may not adequately separate out assets owned by nonresidents. See the discussion in Bovenberg (1989).

[11] For a discussion of issues related to inflation adjustment see Jump (1980) and Bovenberg (1989).

[12] For a more detailed discussion, see Corker and others (1989), de Leeuw (1989), and Evans (1989).

recent years outlined in the previous section. With regard to *public saving*, the fact of a deterioration in saving performance is clear. This outcome should probably be viewed as reflecting the political process and as not easily amenable to analysis in economic terms.[13]

The decline in gross and net *private saving* rates has been attributed to a variety of factors. The approach adopted here assumes that there are several motivations for saving, including precautionary, life cycle (that is, saving for retirement), inheritance, and target saving for purchase of housing or large durable goods. In analyzing the behavior of private saving, the issue of whether to view household and corporate saving as jointly or separately determined needs to be addressed. If households see through the so-called *corporate veil*, then they may reduce their own saving when saving at the corporate level increases. And indeed, the private saving rate exhibits a greater degree of stability over time than either of the personal or corporate components taken individually. Even if households only partially see through the corporate veil—and there are plausible reasons why this might be the case[14]—an increase in corporate savings is likely to induce a revaluation of corporate equity, which through a wealth effect on consumption, would lead to a decline in household saving. Available empirical studies appear to indicate that while dollar-for-dollar offset does not exist, there is some degree of substitutability between household and corporate saving, with the offset coefficient in the neighborhood of 0.25 to 0.5. The upshot is that while there may be a degree of substitutability between corporate and household saving, the extent of the offset appears to be far from complete. Accordingly, the following discussion treats the two elements as separate, but related.

The recent decline in the *gross private saving rate* has been associated both with a large reduction in gross personal saving relative to GNP and also a drop in gross business saving in 1987 and 1988 from an unusually high level in the first half of the 1980s (Chart 4). The decline in net private saving relative to net national product from previous decades to 1987 and 1988 amounted to about 4 percent of net national product, with the personal and business components playing roughly equal roles (Table 6). The greater importance of business saving in explaining the behavior of private saving when the data are viewed on a net basis reflects the increase over time in the importance of capital consumption allowances—the wedge between gross and net business saving.

With regard to reasons for the decline in the *household saving rate*,[15] the increase in the value of household wealth in the 1980s prompted by substantial revaluations of assets such as holdings of equities and the housing stock, is one factor that has tended to diminish saving out of current income. According to the estimates presented in Bovenberg and Evans (1990), the rise in the wealth/income ratio may have subtracted ½ to ⅔ of 1 percent from the household saving rate in the 1980s.

Another factor that may have contributed importantly to the decline in household saving is the increased proportion of income going to *older groups in the popula-*

[13] There is, however, a segment of the public choice literature which argues that the shift to large U. S. federal deficits reflects changes in the nature of political incentives and constraints eroding the political need for fiscal discipline. See Buchanan, Rowley, and Tollison (1986).

[14] First, piercing the corporate veil assumes a very high level of skill in analyzing and processing information on the part of households. Second, differences in tax policy between the household and corporate sectors may cause households to value a dollar of corporate retained earnings substantially less than a dollar of their own saving. Third, the separation of corporate control from ownership may also result in households viewing corporate savings differently from saving on their own account, even though households are the ultimate owners of the corporate sector.

[15] An empirical analysis of household saving behavior is provided in Bovenberg and Evans (1990), with the largest weight placed on demographic developments in explaining the decline in the household saving rate. Kotlikoff (1989) provides a comprehensive review of alternative models and reasons for the decline in the savings rate.

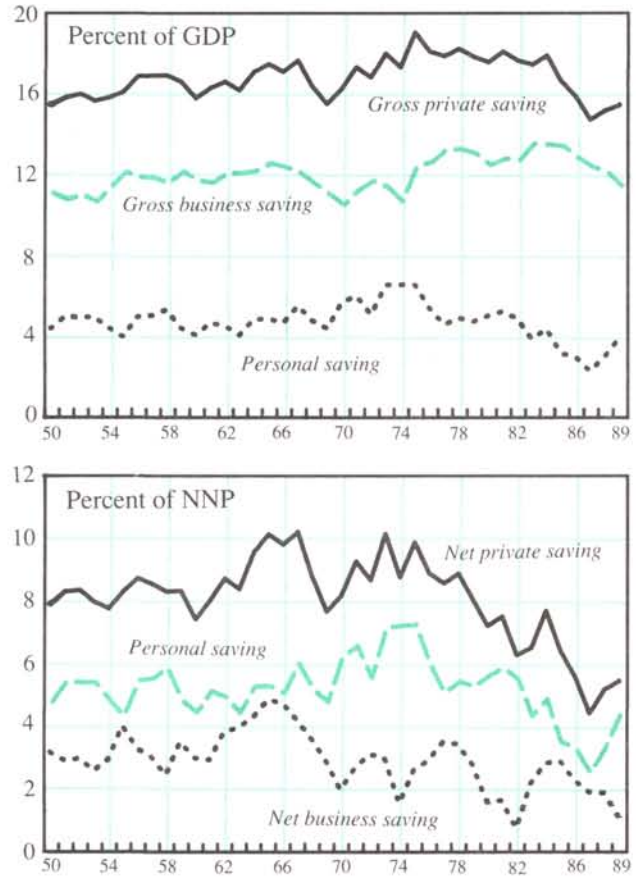
Table 6. Private Saving, 1950–89

	1950s	1960s	1970s	1980s	1987	1988	1989
			(In percent of GNP)				
Gross private saving	16.2	16.6	17.6	16.6	14.7	15.1	15.4
Household	4.7	4.6	5.6	3.8	2.3	3.0	3.9
Business[1]	11.4	11.9	12.0	12.8	12.4	12.2	11.5
			(In percent of net national product)				
Net private saving	8.2	8.9	8.9	6.2	4.4	5.2	5.4
Household	5.2	5.1	6.2	4.3	2.5	3.3	4.4
Business[2]	3.1	3.8	2.7	1.9	1.9	1.8	1.1

[1] Undistributed corporate profits with inventory valuation and capital consumption allowances plus total capital consumption allowances (including those of unincorporated business). The inclusion of total capital consumption allowances in what is defined here as gross business saving contains an element of arbitrariness.

[2] Gross business saving less total capital consumption allowances.

Chart 4. United States: Private Saving Rates



tion, attributable both to the increasing proportion of older people and to changes in the social security system. An increasing proportion of older people could by itself contribute to a decline in the household saving rate. Moreover, the social security system influences saving behavior in several ways. One is by redistributing income to the elderly who are likely to have higher marginal propensities to consume according to the life-cycle model.[16] A second is by reducing the need to save for retirement by those currently working,[17] and a third is by curbing the need for precautionary saving to cover the contingency of living longer than expected.[18]

A third factor which may have contributed to the fall in the household saving rate in the 1980s relates to *private pension plans*. U.S. national accounts data treat contributions to pension plans and income earned in such plans as personal income. Most private pension plans are on a defined benefit basis, which means that when returns in the bond and stock markets surged in the early 1980s, such plans reduced required contributions since benefit levels were already mandated. Because these contributions account for a considerable proportion of household saving, the result was a drop in the household saving rate.[19] In effect, pension funds act like pure target savers so that when the rate of return increases there is a negative income effect with no offsetting positive substitution effect.

Another important factor may have been the increased availability of various kinds of insurance (such as health insurance, life insurance, disability insurance, and unemployment insurance) that has provided households with a greater ability to *guard against uncertainty*, thus gradually reducing the need for precautionary saving. Much of this increased insurance has been provided through the public sector. Under certain (not very restrictive) theoretical conditions, a reduction in the degree of uncertainty about the future income stream can be shown to lead to a decline in saving, with other factors equal.[20] Kotlikoff (1989) discusses ways that improved access to various kinds of insurance—particularly health insurance—may substantially reduce the need for precautionary saving.

Financial innovation and increased efficiency of financial markets also may be contributing to a decline in household saving. In earlier decades, purchase of large durable goods—such as houses and cars—required substantial saving to accumulate a downpayment. More recently, it has become possible to make large durable purchases with smaller downpayments, implying a reduced need for target saving.[21] Recent financial innovations also have made it easier for households to draw on their accumulated equity in the housing stock to support consumption, by means of home equity loans.[22] Bayoumi and Koujianou (1989) provide empirical evidence in a cross-country setting consistent with the view that financial innovation may have contributed to lower saving rates. In addition, the pace of corporate restructuring activities quickened markedly in the 1980s partly as a result of financial market innovation which, by producing large windfall gains for households, may have contributed to a fall in the saving rate.[23]

[16] This mechanism was emphasized in Evans (1983).

[17] The mechanism emphasized in the literature spawned by Feldstein (1974).

[18] An excellent survey of the time series evidence on the effect of social security on private saving is provided in Aaron (1982). A more recent review is provided in Bernheim and Levin (1989).

[19] Bernheim and Shoven (1985) estimate this effect at about 2 percent of disposable income from 1982 to 1984.

[20] Drèze and Modigliani (1972) and Sandmo (1970).

[21] High real estate prices in Japan together with the need for a large downpayment have often been cited as a reason for the very high Japanese household saving rate. There is also a growing literature which argues that the recent decline in household and private saving rates in several European countries may be attributable in part to financial innovation, in combination with some aspects of tax policy. See for example Andersson (1988).

[22] See the discussion in Skinner (1989).

[23] See the discussions in Fries (1989) and Hatsopoulos and others (1989).

A final feature of the recent literature on household consumption and saving is the research by Boskin and Lau.[24] This research analyzes panel data for individual households and finds strong statistical support for the proposition that households headed by individuals born after 1939—with economic and financial factors held constant—save substantially less than do those headed by individuals born before 1939. Thus there appears to be a *vintage effect in saving*, that is, as time passes and the proportion of households headed by people born before 1939 diminishes, the private saving rate would decline substantially over time, even if its macroeconomic determinants are unchanged. While Boskin and Lau are cautious in explaining these results, one interpretation could be that heads of U.S. households with a recollection of the depression of the 1930s and the second world war might feel a greater need to build a stock of wealth as a buffer against risk. By contrast, younger households may be conditioned to the public sector providing insurance against various risks and thus find less need for precautionary saving.

With regard to *business saving*, recent developments are less easy to characterize than those of household saving. As an earlier tabulation indicated, gross business saving is now at about the same level relative to GNP as in earlier decades, albeit somewhat lower than in the early 1980s. Net business saving, however, has fallen sharply relative to net national product, reflecting the proportionate rise in the capital consumption allowance. If households are believed to see fully through the corporate veil, then movements in business saving can be viewed as essentially stemming from household decisions. If the veil is only partially pierced—as argued earlier—then a separate role exists for factors affecting corporate profitability, such as for example trend wage and productivity developments, supply shocks, and the like.

Moreover, if personal and corporate saving are only partial substitutes, changes in the distribution of the tax burden between the household and business sectors could significantly influence the overall private saving rate. For example, the Tax Reform Act of 1986 sought to be revenue neutral in an overall sense, while raising the corporate tax burden and correspondingly reducing it for households. Some recent studies have suggested that this tax change may have had the unintended consequence of lowering the gross private saving rate substantially,[25] perhaps by as much as 1 percent of GNP.

[24] Boskin and Lau (1988).

[25] See for example Evans and Kenward (1988) and Poterba (1987).

Government Policy and National Saving

The question addressed in this section is what approach government should adopt concerning national saving.[26] One polar viewpoint argues that government should balance its own budget and accept whatever private saving rate emerges as a result of market decisions. A related view recognizes the existence of various distortions to private saving decisions, proposes that those distortions should be eliminated, and argues that the Government should then balance its budget. A second approach suggests that not all of the existing impediments to private saving decisions can or should be eliminated and that as a result, the government should aim for a surplus to offset the loss of private saving caused by these impediments—a second-best approach. A third view notes in addition that market decisions regarding saving may not produce a desirable overall result since the interests of future generations may not be adequately taken into account. The view taken here is a combination of the second and third approaches, for reasons outlined below. The nature of the possible policy response is then discussed.

Role of Impediments to Private Saving

The first qualification mentioned above was the existence of various government interventions which may cumulatively work to reduce private saving. The U.S. tax system for example, treats owner-occupied housing favorably in several ways, including the absence of a tax on imputed rental values, the generous exemptions on capital gains, and the deductibility of mortgage interest.[27] These tax preferences have boosted the market value of housing and through a wealth effect on consumption may have lowered the household and private financial saving rates. The optimal response would perhaps be to adopt tax policies to eliminate the distortions, presumably in a phased way, to minimize distributional effects and short-run disruptions. However, to the extent that eliminating the source of the distortion is not viewed as feasible, a second-best alternative could be for the government to raise the level of public savings.

A second distorting feature of the tax system which may influence the overall private saving rate is the fact that corporations may deduct interest but not dividends when computing profit for tax purposes. Combined with the effects of financial innovation discussed above, this feature has facilitated the restructuring of the U.S. corpo-

[26] The discussion relates only to the Federal Government. State and local governments are assumed to make independent fiscal decisions, unrelated to national saving considerations.

[27] Andersson (1989).

rate sector (and the associated increase in leverage) and may have contributed to a decline in the private saving rate. The optimal response would be to reform the distorting features of the tax code contributing to this process. To the extent that this is not viewed as feasible, a second-best alternative could be to compensate by raising public saving. While other distorting features of the tax system could be examined,[28] the general point has been made with these two examples—that if first-best changes to eliminate distortions are not feasible, a second-best approach may be to augment public saving to offset the effects on private saving.

Turning to *social security*, there is a body of evidence indicating that the U.S. social security system may lead to a decline in the private saving rate, as noted earlier. Thus a case can be made for larger public saving to offset reduced private saving, particularly in light of the forthcoming demographic transition toward an aging of the U.S. population.[29]

Provision of *insurance against risk*, as noted earlier, is another feature of government policy that may well reduce private saving. One interpretation of the Boskin and Lau finding of a vintage effect in consumption and saving behavior cited above is to link it to the observation that the present generation in the United States may have been conditioned to expect the public sector to provide such insurance. The appropriate policy response might not be to eliminate this provision of insurance in various spheres by the public sector.[30] However, recognizing that these public sector activities may lead to an otherwise unintended reduction in private saving, an offsetting adjustment in the public saving rate may be called for.

According to the *Ricardian equivalence* proposition, however, changes in public sector saving will not influence the national saving rate because offsetting shifts in private saving will be induced. If this argument were true, and augmenting national saving were the objective, then adjustments in public saving as advocated above would be fruitless. However, the available empirical studies show little evidence in favor of a significant degree of Ricardian equivalence in the United States, so that the problem does not seem to arise.[31] If the desirability of using the fiscal balance to target national saving is accepted and if partial Ricardian equivalence characterizes the U.S. economy, then the case for raising public saving would—perhaps surprisingly—be strengthened, not weakened.[32]

Interests of Future Generations

A final and crucial argument for the public sector to play a role in the national saving decision concerns the *interests of future generations*. The neoclassical growth model suggests that competitive economies may tend to approach steady-state balanced growth paths, characterized by a constant growth rate of output, a constant capital-output ratio, and a constant rate of return to capital.[33] In such a model, the long-run growth rate of output is determined by the rate of growth of the labor force and the rate of technical progress, both generally assumed to be determined outside the economic system. While the long-run growth rate is independent of the saving rate, the capital/labor ratio and the level of consumption per capita both depend on the saving rate.

The central question to be posed is how much saving is sufficient. If a neoclassical steady-state growth path is a reasonable approximation of the long-run tendency of the U.S. economy, can some steady states be viewed as preferable to others? One possibility is the steady-state growth path which maximizes per capita consumption. This path can be shown to be one on which the net rate of return on capital equals the sum of population growth and the rate of technological progress—the so-called golden rule.[34] If the rate of return on capital exceeds the growth rate, then by saving more and sacrificing consumption in a transition period, steady-state consumption per capita can be raised for all future generations.[35]

The golden rule analysis makes no allowance for time preference. If one assumes a constant rate of social time preference, then a modified golden rule proposition emerges in which the welfare superior steady-state path is that in which the rate of return on capital minus the rate of

[28] The interaction between the tax system, corporate leverage, and saving behavior was discussed in Fries (1989). The impact of the U. S. tax system on private saving more generally was reviewed in Bovenberg (1989).

[29] See the discussion in Aaron and others (1989) and Ebrill (1990). Cutler and others (1990) provide an argument to the contrary.

[30] This is of course not to argue against well-designed reforms in these areas.

[31] See Ebrill and Evans (1988) and Bernheim (1987).

[32] The following example makes the point. Imagine that the national saving rate is 1 percent of GNP below a desired level, and zero Ricardian equivalence applies. Then, an increase in public saving by 1 percent of GNP achieves the target. However, if 50 percent Ricardian equivalence applies—that is, a dollar increase in public saving leads to a 50 cent decline in private saving—then a 2 percent of GNP increase in public saving is required to achieve the desired 1 percent of GNP rise in the national saving rate.

[33] Useful expositions are available in Solow (1970) and Enzler and others (1981).

[34] That is, $r = n + g$ in an obvious notation. See for example Robinson (1964) and Solow (1962). If the rate of return is lower than this sum, then the system in a sense is dynamically inefficient—that is, a portion of the capital stock could be consumed and consumption per capita would then be higher in the new (golden rule) steady state.

[35] Note that this is not a Pareto optimal shift since the initial generation sacrifices consumption possibilities for the benefit of future generations.

pure time preference equals the sum of the population growth rate and the rate of technological progress.[36]

In an economy characterized by effective intergenerational altruism, as under Ricardian equivalence, and given various other subsidiary assumptions, utility maximization by the current generation will take into account the interests of future generations, and the economy will be driven to a modified golden rule position.[37] However, if reality is better approximated by the assumptions of the life-cycle model—there being a lack of effective intergenerational linking of preferences—then there is no guarantee that the steady state toward which the system might move would satisfy any particular welfare requirements.[38] Consequently, it is possible—even in the absence of government induced distortions—that there might be insufficient provision for the future and too low a national saving rate in this sense.

While a strong qualitative case can be made for the public sector to play a role, decisions concerning that role inevitably involve difficult judgements of *intergenerational equity*. Lack of action by the public sector entails an implicit equity judgement just as much as intervention would. One argument has been that since future generations may be likely in any event to be better off than the current generation, there is no reason for the current generation to make sacrifices for the sake of its descendants. An alternative argument has been that there is a kind of implicit contract between generations, and that just as the parents of the present generation made sacrifices to build a better future, so in turn the present generation should do the same for its children. The recent sharp decline in U.S. national saving is—from this perspective—viewed as a renunciation of this implicit contract. Thus, Penner (1989) wrote:

> . . . the budget deficit is primarily a moral issue. Combined with our low net private savings rate, it implies that per capita wealth in the United States is growing slowly. The basic moral question is whether we should increase national saving by reducing Government dissaving and do as much for our descendants as our ancestors did for us. They believed in the Golden Rule, but we do not seem to.[39]

Although disagreement is likely on issues of intergenerational equity, the golden rule may have some merits as a benchmark. If the current generation fully internalized the welfare of future generations in its own decisions, then absent other distortions, a golden rule solution would emerge without government intervention. The golden rule case can thus be viewed as the benchmark in which the interests of all generations are viewed as equally important.[40] Such an approach to issues of intergenerational equity can inter alia be defended on the basis of the considerations underlying the Rawlsian theory of justice.[41]

What Kind of Policy Response?

If it is accepted that policy should seek to augment the national saving rate, the question arises as to how that objective should be pursued. One alternative would be to adopt measures of tax policy aimed at stimulating private saving, while a second would be tax and spending measures designed to achieve a public sector balance consistent with the objective for national saving.

Whether tax policy measures could be used to stimulate private saving to a significant extent depends in part on the responsiveness of private consumption and saving to changes in real after-tax interest rates—long a matter of debate. Some empirical studies (for example, Boskin (1978)) have suggested a significant positive effect of real after-tax interest rates on household saving while others (for example, Friend and Hasbrouck (1983)) find an effect close to zero. On balance, the evidence from empirical consumption studies appears to favor only a small positive interest responsiveness of household and private saving (see, for example, Bovenberg and Evans (1990)), although the subject remains a matter of controversy. Thus the evidence from macroeconomic consumption studies suggests that tax policy can perhaps play only a limited role in boosting private saving. However, studies of the impact of structural tax changes specifically designed to encourage household saving—for example, individual retirement accounts (IRAs)—indicate that a significant proportion of IRA saving in the early 1980s was new, and did not stem from a reshuffling of portfolios.[42] Consequently, such measures can contribute to a strategy to raise national saving. While tax policy measures thus have some role to play, it appears that if large increases in the national saving rate are called for—as will be argued subsequently—then increases in public

[36] That is, $r - p = n + g$, in an obvious notation.

[37] See Foley and others (1969), Foley and Sidrauski (1971), and Blanchard and Fischer (1989), especially chapters 2–4.

[38] The so-called market failure from which this result stems is simply that unborn agents are not represented and consequently the full set of Arrow/Debreu markets is not operative.

[39] In a similar vein, Petersen (1989) observed that, "with our pathetically small savings and investment for the future, we have already decided whose living standard should suffer: our children's."

[40] Equivalent to a zero rate of social time preference.

[41] In this approach to equity questions, social arrangements are deemed just if they would be accepted by hypothetical individuals who did not know in advance what their position in society would be, what generation they would be born into, and so on.

[42] A review of the literature in this area is provided in Evans (1990). See also Venti and Wise (1986 and 1988) and Feenberg and Skinner (1989).

saving are nevertheless likely to be central to the approach.

Some caveats to this view should be mentioned. If public saving can be enhanced only through increases in distortionary taxation, then the efficiency costs of such increases would need to be taken into account. However, it should be recalled that very large amounts of revenue could be raised by curbing tax preferences, which could at the same time enhance efficiency.[43] Another concern is that if national saving were boosted by means of a significant government surplus, the political temptation to interfere in the efficient allocation of this surplus would be substantial. In this view, a large government surplus is less helpful than increased private saving because the latter should in reality reap a higher rate of return. In response to this concern, it can perhaps be argued that if the political system is sufficiently disciplined to generate a substantial surplus—a large supposition in itself—then the additional discipline required to avoid interference in the disposition of that surplus might well be forthcoming.

Some Illustrative Calculations Based on the Golden Rule

In considering where the U.S. economy may stand relative to the benchmark provided by the modified golden rule, only the rate of time preference is not amenable to measurement. There is, however, an extensive literature on the choice of an appropriate social time preference rate to be used by governments when making decisions with intertemporal ramifications. For example, Sen (1967) notes that provision for future generations has a public good aspect, and suggests that this provides a rationale for a lower social time preference rate than that evident in private behavior. Arrow and Lind (1970) argue that to the extent that private time preference rates represent risk premia, they should not be incorporated into public decisions, as the public sector may be able to pool risks more effectively. A related argument suggests that to the extent that private time preference rates represent an allowance for individual mortality probabilities, they should not be incorporated into government intertemporal decisions. In sum, there is a case to be made that the social rate of time preference used by the public sector in intertemporal calculations should be less than private sector time preference rates and could even be close to zero.

If a particular social time preference rate is taken for purposes of illustration, then some implications can quickly be sketched, again using the modified golden rule as a benchmark.[44] According to some calculations, the rates of population growth and technological progress for the U.S. sum to about 3 percent a year.[45] Combined with an assumed social time preference rate of 1 percent, this would imply that, on an optimal balanced-growth path, the real net rate of return to capital should be close to 4 percent. If the technology of production is Cobb-Douglas, and a labor share of about 0.7 and a depreciation rate of 5 percent are both assumed, then the optimal capital-output ratio is about 3.3. Given this capital-output ratio, the implied gross saving rate that is required is about 26 percent of gross output while the corresponding net saving rate would be about 12 percent of net output.[46]

If the assumed rate of technological progress is 1 percent instead of 2 percent, and other assumptions as before, the modified golden rule capital-output ratio would be 3.75 and the associated net saving rate 9¼ percent. The results from other parameter combinations are presented in Table 7. The optimal saving rate is an increasing function of the rate of technological progress and a decreasing function of the assumed rate of social time preference. Using a framework similar to that employed here, Boskin (1986) addressed the issue of the optimal national saving rate for the United States and found a range clustering from 11 percent to 14 percent. He concluded that by this criterion, the U.S. national saving rate in the 1980s has been well below the desirable range.

The calculations just laid out are of course only illustrative. However, the parameters were chosen to be broadly consistent with the stylized facts of the U.S. economy, and further sensitivity tests indicated that the broad thrust of the results was robust. For example, a higher assumed depreciation rate (reflecting the shift to shorter-lived capital goods) would lower the optimal net national saving rate, but not by so much as to alter the qualitative direction of the results.[47] It is noteworthy that

[43] See Ebrill (1989).

[44] A helpful exposition along related lines can be found in Johnson (1981).

[45] The rate of population growth has averaged in the neighborhood of 1 percent in recent years. The rate of multifactor productivity growth in the nonfarm business sector averaged about 2 percent annually in the 1950s and 1960s, but only 1 percent over the period 1950–87. For the present exercise the rate of multifactor productivity growth in the nonfarm business sector is taken as representative of the rate of technical progress for the economy as a whole.

[46] The algebra and the assumptions are laid out formally in the appendix.

[47] In the case highlighted in the text, with a 70 percent labor share, 2 percent technical progress, 1 percent labor force growth, a 1 percent rate of social time preference, and a 5 percent depreciation rate, the optimal net national saving rate was 12 percent. With other assumptions unchanged and a 10 percent depreciation rate—well above a reasonable range—the optimal net national saving rate would be 8¼ percent. Over the period 1950–88, the depreciation rate on the gross business sector capital stock average 4.9 percent using national accounts data; from 1980–87 it averaged 5.4 percent.

Table 7. Optimal Net National Saving Rates Under Alternative Parameter Values[1]

(In percent of net national product)

Labor Share[2]	Rate of Technical Progress[2]	Rate of Social Time Preference[2] 0	1	2	3	4
70	0.5	9.0	7.5	6.4	5.6	5.0
	1.0	10.9	9.2	8.0	7.1	6.3
	2.0	13.8	12.0	10.6	9.5	8.6
75	0.5	7.1	6.0	5.2	4.5	4.1
	1.0	8.7	7.4	6.5	5.7	5.1
	2.0	11.1	9.7	8.6	7.7	7.0

[1] The calculations assume a depreciation rate of 5 percent annually, and labor force growth of 1 percent annually. The algebra is presented in the appendix.

[2] In percent.

the current U.S. net national saving rate—2 percent to 3 percent of NNP—is below the entire range presented, even with an assumed social rate of time preference of 4 percent a year. If the appropriate social rate of time preference is lower—perhaps zero—and a modified golden rule provides an approximate benchmark, then the results indicate that a sustained increase in the U.S. net national saving rate from its current level of 2 to 3 percent of net national product could substantially improve living standards for future generations, and possibly for the current generation after a transition period.[48]

There are several respects in which the framework presented above may be overly simplified. For example, technological progress is taken to be exogenous and constant. If instead, technological progress is positively related to the processes of saving, investment, and production then increasing the saving rate would yield an additional potentially large benefit not captured here. There is a growing literature in which the rate of technical progress is treated as endogenous, and potentially amenable to influence by economic policy. In these models, shifts in saving or investment can contribute to sustained shifts in the rate of output growth, so that (as noted) increasing the saving rate has a more powerful effect on future living standards.[49]

A second limitation to the analysis is the assumption of a closed economy. However, such an assumption may not be too large a limitation given the apparent robustness of the Feldstein/Horioka result that domestic saving appears to constrain domestic investment in industrial countries.[50] If open economy considerations were incorporated, then additional saving could be invested either domestically or abroad, depending on relative rates of return. As a result, the pace at which the rate of return would be driven down by extra saving would be more gradual than in the closed economy case, and the optimal U.S. saving rate might be higher still.[51]

To conclude this section, the simple algebra of the golden rule together with an assumed social time preference rate of zero implies an optimal net national saving rate in the United States of close to 10 percent. If such an objective were to be achieved entirely by increased public sector saving and if Ricardian effects were absent, then federal government saving would need over time to shift from a deficit of 3 percent of net national product to a surplus in the order of 3 percent of NNP or more.[52] To the extent that tax policy measures could boost private saving, the required fiscal adjustment would be smaller.

While the precise magnitude of the needed shift of course depends on the other assumptions, it nevertheless appears that most calculations based on welfare-theoretic grounds of this kind would be likely to conclude that the U.S. national saving rate is well below a desirable level and consequently that a substantial federal budget surplus could be an appropriate medium-term objective for U.S. federal fiscal policy.

Alternative Approach to Medium-Term Fiscal Targets

This section presents an alternative approach to the quantification of medium-term objectives for U.S. federal fiscal policy. The framework is based on assessment of current savings and growth performance relative to historical averages. Unlike the discussions in the pre-

[48] Whether living standards would be enhanced for the current generation by a shift to a higher national saving rate depends on the magnitude of the sacrifice to current consumption and the sacrifice time—the length of time over which current consumption is lower than it would have been under the initial saving rate. A recent paper suggests that the sacrifice time may be as low as half a decade. See Lewis and Seidman (1988).

[49] See for example Lucas (1988); Romer (1986 and 1987).

[50] Feldstein and Horioka (1980). A recent paper suggests that this constraint has remained important in the 1980s, albeit somewhat less than before. See Frankel (1989).

[51] Given that the United States is not a small economy, the rate of return would still be influenced by changes in U. S. saving behavior.

[52] Assuming that the net private saving rate remained close to 5 percent of NNP, and that the state and local surplus was close to 1 percent of NNP.

vious section, there is no optimality criterion underlying the analysis.[53] Rather, the approach aims to find the national saving rate—and the associated federal fiscal position—needed to support the path for the capital stock that is judged to be consistent with a target growth rate of output.

In order to develop the framework, some simple equations need to be presented. First, the net national saving rate may be viewed in terms of the uses of saving from a flow-of-funds vantage point.

$$\frac{NS}{NY} = \frac{IF}{NY} + \frac{IV}{NY} - \frac{NFS}{NY}, \tag{1}$$

where:

NS = net national saving
IF = net fixed investment
IV = inventory investment
NFS = net foreign saving[54]
NY = net national product

and all variables are in nominal terms.

The identity (1) states that net national saving plus any inflow of foreign saving equals domestic investment (fixed plus inventories). At the same time, the share of net fixed investment equals the product of the growth in the net capital stock, the capital-output-ratio, and the relative price of capital goods. That is,

$$\frac{IF}{NY} = (\dot{K})\cdot(K/Y)\cdot(Pk/Py), \tag{2}$$

where:

$\dot{K}$ = growth of the real net capital stock
K = level of the net capital stock
Y = real net national product
Pk = deflator for net fixed investment
Py = deflator for net national product.

A third useful identity is that the growth in the capital stock is the sum of growth in employment and growth in the amount of capital per worker. That is,

$$\dot{K} = \dot{E} + \dot{(K/E)}, \tag{3}$$

where:

$\dot{E}$ = total employment, with other notation as before.

The fourth equation in the system is a production function, assumed to be of Cobb-Douglas form.

$$Y = A\cdot K^{\alpha} L^{1-\alpha}. \tag{4}$$

From the production function, one can derive that the rate of growth of productive potential equals the sum of multifactor productivity growth plus the growth of the labor force weighted by its share of output $(1-\alpha)$ and the growth rate of capital weighted by its share (α). That is,

$$\dot{Y} = \dot{A} + (1-\alpha)\dot{L} + \alpha\dot{K}. \tag{5}$$

Given these equations and some other assumptions, it is possible to solve for the path of the capital stock, net investment, and net national savings over a projection period. The important assumptions relate to the following variables:

- projected growth of employment
- the behavior of total factor productivity
- the behavior of the relative price of investment and output
- the share of inventory investment
- the behavior of net foreign saving (the current account balance)
- the growth of output with which the projections are to be made consistent.

A broad consensus exists that labor force growth in the period ahead is likely to be in the neighborhood of 1¼ percent.[55] If, as is generally believed, the U.S. economy is currently close to full capacity, employment should grow at a similar rate to the labor force. Because the appropriate assumption regarding total factor productivity is a subject of much more controversy,[56] in the experiments reported a range of alternative assumptions was employed.

The appropriate assumption concerning the relative price of investment to output is also problematic, as this price has declined in the 1980s, reflecting the drop in the price of high technology equipment.[57] The deflator for net fixed investment relative to NNP dropped by 10 percent from 1982 to 1987, or by about 2 percent annually; a similar trend decline is assumed in the calculations to be presented here.

Inventory investment averaged 1 percent of NNP from 1959 to 1979, but only 0.5 percent from 1980 to 1988, with the decline perhaps reflecting the introduction of improved inventory management practices. A figure of ½ percent of NNP is assumed in the calculations. As regards *net foreign saving*, any specific numerical assumption has an undoubted element of arbitrariness. In the calculations presented here, it is assumed that there is no

[53] The framework employed is similar to that employed in a recent paper by Schultze (1988). A related methodology was employed in earlier unpublished IMF staff analysis.

[54] If *NFI* is positive, there is an inflow of foreign saving into the United States.

[55] In its medium-term projections (see Chapter 3 of *Budget of the U.S. Government: FY 1990*), the Administration assumes growth of labor input of 1 to 1½ percent; the Congressional Budget Office appears to be using a figure of 1.2 percent in its projections (see Congressional Budget Office (1989)); the U. S. Department of Labor projects labor force growth of 1.2 percent annually over the rest of this century (see Saunders (1987)). See the discussion in Adams and Coe (1990).

[56] The behavior of productive potential and productivity was studied in Adams and Coe (1990).

[57] See the discussion in Evans (1989).

reliance on net foreign saving and that domestic investment is fully financed by domestic saving. The view underlying this assumption that it would be desirable for the U.S. current account deficit to be brought down over time is generally accepted.

Schultze (1988) uses a similar framework to that just presented to find the net national saving rate needed to support medium-term growth of 2¼ percent, in line with the projections of the Congressional Budget Office. His principal assumptions were zero reliance on foreign saving and multifactor productivity growth of 0.7 percent annually, with other assumptions similar to those outlined above. The result was a required net national saving rate of 5 percent on average which in turn would permit an average federal budget deficit equivalent to 1¼ percent of NNP.[58]

This framework can also be used to evaluate the medium-term projections presented by the Administration in January 1989[59] in the context of its own target of budgetary balance over the medium term. These projections envisaged growth averaging 3¼ percent annually with the labor force increasing by about 1¼ percent.[60] If other assumptions are taken as above, and in addition a net private saving rate of 5½ percent of NNP and a state and local surplus equivalent to 1 percent of NNP are assumed, then the system can be solved for the national saving rate and the required federal budgetary balance (see tabulation below).

Assumed Multifactor Productivity Growth	National Saving Rate	Federal Budget Balance
(In percent)	(In percent of NNP)	
1.4	7.3	0.8
1.1	9.4	2.9
0.7	12.2	5.7

For growth of 3¼ percent annually to be achieved without reliance on foreign saving and assuming multifactor productivity growth of 1.4 percent annually—well above its average in the 1970s and 1980s—the appropriate net national saving rate would be about 7 percent of NNP, requiring a federal budgetary surplus of almost 1 percent of NNP.[61] Thus, even with an extremely optimistic multifactor productivity assumption, a federal surplus would appear to be necessary to provide sufficient domestic saving to support the desired growth path from the Administration's January 1989 medium-term projections —equivalent to growth in line with the postwar average in the United States—without resort to foreign saving. A more realistic multifactor productivity assumption would be growth of 1.1 percent annually, which would imply that a net national saving rate of 9½ percent of NNP and a federal surplus of almost 3 percent of NNP would be required. A pessimistic multifactor productivity growth assumption—0.7 percent annually—would suggest the need for net national saving equivalent to 12 percent of NNP and a federal surplus of almost 6 percent of NNP.

If the various other assumptions are held unchanged and the target output growth rate is set at 3 percent a year—in line with the revised medium-term projections presented in the mid-session budget review in July 1989 and the budget for FY 1991 (released in January 1990)—then the implied net national savings rates and federal budget balance decline somewhat. Multifactor productivity growth of 1.1 percent annually would indicate the need for a federal budget surplus averaging 2 percent of NNP, while a more pessimistic productivity assumption (0.7 percent annually) would suggest that a federal surplus of 4½ percent of NNP could be required to support output growth at an average annual rate of 3 percent.

To conclude this section, the approach developed provides a way of calculating the national saving rate and federal budgetary balance consistent with a target growth rate of output over the medium term, given a host of other assumptions. If output growth of 3¼ percent annually is viewed as desirable—as in the Administration's January 1989 medium-term projections and in line with the U.S. postwar average—then even a very optimistic assumption regarding multifactor productivity growth would indicate the need for a small federal surplus as the medium-term fiscal objective. If multifactor productivity growth is assumed to rebound somewhat from its performance in the 1970s and 1980s, but to remain below the levels of the 1950s and 1960s, then a federal budgetary surplus of significant proportions—3 percent of NNP—would seem to be needed to support output growth of 3¼ percent annually, without reliance on foreign saving. A more pessimistic assumption on multifactor productivity growth would imply the need for an even higher federal budgetary surplus. If the target output growth is reduced to 3 percent—in line with the assumption made in Administration projections released in early 1990, and revised in mid-year—then the calculations indicate that a significant federal budget surplus would still be needed. The calculations of course assume, among other things, an unchanged private saving rate. To the extent that tax policy changes could boost private saving, the required

[58] This would be a medium-term budget target, and thus should be thought of in cyclically adjusted terms.

[59] The Administration's medium-term economic projections were revised in the mid-session review of the budget for FY 1990, released in July 1989. In that document, projected medium-term output growth was reduced to about 3 percent. An assumption of potential output growth of about 3 percent per annum was maintained in the projections issued in January 1990 and subsequently revised in July 1990.

[60] The average annual growth of U. S. real GNP from 1950–88 was also 3¼ percent.

[61] As noted earlier, multifactor productivity growth in the U. S. nonfarm business sector averaged about 2 percent annually in the 1950s and 1960s, but only about 1 percent annually from 1980–87.

fiscal adjustment—though still substantial—would be smaller.

Conclusion

The national saving rate declined in many industrial countries in the 1980s and this tendency toward decline has become a subject of discussion and analysis. In particular, the U.S. national saving rate dropped markedly in the 1980s reflecting declines in both the public and private components. Many of the factors that may be behind the decline in the U.S. private saving rate appear difficult to reverse in a major way through public policy. While carefully selected tax policies could play some role in boosting private saving, the magnitude of their likely contribution may be limited. An alternative strategy would be for the federal government to aim for the achievement of budgetary surpluses to offset reduced private saving. Such an approach would be justified by the fact that some part of the decline in private saving may reflect unintended consequences of public sector interventions into private market decisions—such as the provision of social security and various aspects of tax policy—and more fundamentally because private sector decisions may not adequately take account of the interests of future generations.

Two alternative frameworks aimed at quantifying medium-term objectives for the federal fiscal balance were then developed. Although used only in a U.S. context in the present paper, the approaches could be applied to other countries. The first framework was based on an explicit optimality criterion—namely finding the neoclassical steady-state path on which per capita consumption was maximized. Illustrative calculations indicated that the current U.S. national saving rate appeared to be well below the optimal level by this criterion and suggested that a net national saving rate of close to 10 percent of NNP might be called for. The associated target for the federal fiscal balance might be in the neighborhood of 3 percent of NNP surplus.

The second approach calculated the net national saving rate consistent with a target output growth rate, assuming no reliance on foreign saving (and a host of other assumptions). A key parameter in this framework is that related to multifactor productivity growth; one way to proceed is to assume that the latter rebounds in the projection period above its performance in the 1970s and 1980s, while remaining below the rapid growth rates of the 1950s and 1960s. On this basis, output growth of 3¼ percent annually—in line with average growth from 1950 to 1988—without reliance on foreign saving would require a net national saving rate of almost 10 percent of NNP and a federal budgetary surplus of close to 3 percent of NNP. If the target growth rate for output is reduced to 3 percent, then a federal surplus equivalent to 2 percent of NNP would still be indicated.

Thus two alternative frameworks of calculation yield the result that a net national saving rate equivalent to 10 percent of NNP and a federal budgetary surplus in the neighborhood of 3 percent of NNP may provide appropriate medium-term objectives. The precise numerical results of course depend on the specific frameworks presented and the assumptions that are made. In particular, if tax policy measures could boost private saving, the needed fiscal adjustment would be correspondingly reduced, though it would remain very substantive. In sum, a strong case exists for a large federal budget surplus to be an objective of U.S. fiscal policy.

Appendix

Modified Golden Rule Calculations

Simple Heuristics of the Golden Rule[62]

Assume a one-sector closed economy in a steady-state growth path, with a population growth rate of n and an exogenous technological progress rate of g. The steady state growth rate of the system is $n + g$. The net rate of return on capital is r. Compare this steady state to one with slightly more capital. The gain in output is given by $r\,\Delta K$ compared with the previous steady state. However, in this second steady state additional output must be devoted to investment to keep the (larger) capital stock growing at the steady-state growth rate. The additional investment requirement is given by $(n + g)\Delta K$.

If in the initial steady state, r exceeds $n + g$ then a shift to a more capital intensive steady state raises consumption possibilities since the output gain exceeds what needs to be reinvested. If in the initial steady state r is less than $n + g$, then additional investment yields an output gain that is less than the amount needed for reinvestment and consumption possibilities are lowered. However, in this situation, a shift to a less capital-intensive steady

[62] A similar exposition is provided in Solow (1962).

state releases resources for consumption equal to $n + g$ which exceed the output loss from lower capital intensity of $r\ \Delta K$. Consequently, the steady-state path on which consumption possibilities (defined as per capita consumption with no allowance for time preference) is that on which the net rate of return on capital equals the sum of the growth rates of population and technological progress. That is,

$$r = n + g. \tag{A1}$$

When a pure time preference rate of p is incorporated into the structure, the steady-state growth path along which consumption possibilities are maximized (adjusted for time preference) satisfies a modified golden rule condition, namely that

$$r - p = n + g. \tag{A2}$$

Some Simple Algebra Behind the Calculations in the Text

The economy is assumed to be one-sector, closed, and characterized by a Cobb-Douglas production function:

$$Y = AK^{\alpha}L^{1-\alpha}, \tag{A3}$$

where

Y = gross output
K = gross capital stock
L = the labor force.

Then the marginal product of capital is given by

$$R = \alpha\ Y/K \tag{A4}$$

and equals the sum of the net rate of return on capital r and the rate of depreciation d. That is,

$$r + d = \alpha\ Y/K. \tag{A5}$$

From equation (2), at the modified golden rule position, r is given by the sum of g, p, and n. Consequently, the capital output ratio consistent with the modified golden rule is

$$K/Y = \alpha/\ (d + p + g + n). \tag{A6}$$

Now since the increase in capital equals gross saving less depreciation, we can say

$$\Delta K = S - d\,K, \tag{A7}$$

which on rearrangement leads to

$$S/Y = (\frac{\Delta K}{K} + d)\frac{K}{Y}. \tag{A8}$$

In the steady state, capital grows by $n + g$, and thus

$$S/Y = (n + g + d)\frac{K}{Y}. \tag{A9}$$

Equations (A6) and (A9) permit the gross saving rate in a modified golden rule path to be calculated. The net saving rate is given by the identity:

$$\frac{NS}{NY} = \frac{S - dK}{Y - dK}, \tag{A10}$$

where NS is net saving and NY is net output.

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IV
Agricultural Policies in Japan and Their Economic Consequences

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The Japanese economy's impressive postwar performance has been led by rapid growth in manufacturing productivity and accompanied by a substantial loss in comparative advantage in agriculture. However, government policies—prompted by concerns about farm income as well as food security—have acted to inhibit the reallocation of resources corresponding to this shift in comparative advantage. Thus, although Japanese imports of agricultural products during the postwar era have increased in relation to domestic production, almost three fourths of food consumption is still produced domestically at prices substantially higher than those on the international market.

In recent years, pressure for agricultural policy reform has increased. Much of the pressure has been associated with Japan's substantial trade surplus, as well as with the large imbalances in world agricultural markets that have made agricultural reform and trade liberalization a major priority in the Uruguay Round of multilateral trade negotiations. Within Japan, public awareness of the costs of agricultural policies seems to be increasing, and the need for reform has been recognized in the Mayekawa reports and the latest Five-Year Plan.[2] Thus, certain steps have been taken, such as the liberalization of beef and citrus imports and small reductions in administrative prices for a number of commodities. However, full-fledged reform remains a major unresolved issue.

This paper reviews the main policies that have been used to support Japanese agriculture and provides an indication of the costs of these policies and of the benefits that would accrue from their elimination. It presents a brief background on developments in the agricultural sector in Japan and discusses policies that have affected agriculture; given the importance of rice in Japan, it also outlines separately policies related to that commodity. The paper then examines the effects of government intervention and the impact of policy reform and provides concluding comments.

Postwar Developments in Japanese Agriculture

The importance of agriculture to the Japanese economy has declined markedly since the mid-1950s. Over 1955–88, real GDP in agriculture rose at an average annual rate of only ½ of 1 percent, and its share in total GDP shrank from about 20 percent in 1955 to 2½ percent in 1988. Employment in agriculture, which accounted for almost 40 percent of total employment at the beginning of the period, fell by over two thirds and now amounts to less than 7 percent of the total.

At the same time, Japan's agricultural imports have risen rapidly, both in relation to world trade in agriculture and to domestic production. Accordingly, Japan's self-sufficiency in food has declined (see Table 1). Nevertheless, 70 percent of food consumption continued to be produced domestically in 1986, with self-sufficiency rates particularly high for rice and certain other highly protected commodities. The growth in imports has largely reflected the expansion of domestic livestock industries, which are heavily dependent on freely imported feedgrains.[3]

In the postwar period, Japan's comparative advantage in agriculture has declined sharply. From 1960 to 1980, the annual growth of labor productivity in agriculture fell short of that in manufacturing by about 1½ percentage points; for the United States, the United Kingdom, France, and the Federal Republic of Germany, annual productivity growth in agriculture exceeded that in manufacturing by an average of 3 percentage points over the same period.[4] The loss in comparative advantage in large part reflects the rapid growth of productivity in Japanese manufacturing. In addition, however, agricultural pro-

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[2] For the details of the Five-Year Plan, see Economic Planning Agency, *Economic Management Within a Global Context*, May 1988.

[3] See Fitchett (1988) and the Australian Bureau of Agricultural and Resource Economics (ABARE) (1988).

[4] These industrial countries gained comparative advantage in agriculture vis-à-vis a number of developing countries as well. See Hayami (1988).

Table 1. Japan: Self-Sufficiency Rates of Major Agricultural Products, 1960–86[1]

(In percent)

	1960	1970	1980	1986
Rice	102	106	87	108
Wheat	39	9	10	14
Barley	107	34	15	15
Pulses	44	13	7	8
Soybeans	28	4	4	5
Vegetables	100	99	97	95
Fruits	100	84	81	73
Eggs	101	97	98	97
Milk and milk products	89	89	86	86
Meats	91	89	81	78
Beef	96	90	72	69
Pork	96	98	87	82
Poultry	100	98	94	89
Sugar	18	23	29	33
Fats and oils	42	22	29	32
Food total	90	78	72	70
Grains total	82	45	33	31

Source: Ministry of Agriculture, Forestry, and Fisheries, *Food Balance Sheet*, 1983 and 1986.

[1] Data relate to fiscal years.

ductivity has been adversely affected by the small scale of farming operations in Japan, which has limited the scope for substituting capital for labor and the realization of scale economies, particularly for land-extensive industries. In the case of rice, for example, the average cost of production on large farms (i.e., larger than 3 hectares) was 50 percent less than on small farms (i.e., smaller than 0.3 hectare) in 1985; moreover, this discrepancy was only about 10 percent in the period 1955–65. In 1985, average farm size amounted to 1.2 hectares, with only 4 percent of all farms operating on land of more than 3 hectares; this scale of holdings has been broadly unchanged over the last 30 years and compares extremely unfavorably with other industrial countries.[5]

During the 1950s, the relative decline in agricultural productivity growth and broadly constant domestic terms of trade in agriculture led to a widening disparity between rural and urban family incomes, which, in turn, became a major consideration in the development of agricultural policies over the subsequent two decades. The objective of rural-urban income parity certainly has been achieved —in the mid-1980s, the average per capita income of farm households was about 10 percent higher than that of wage-earning households in other sectors. Government policies have contributed to growth in farm incomes through the provision of subsidies as well as by causing a sharp rise in the agricultural terms of trade.[6] However, off-farm earnings appear to have been the main factor in the increase in farm household incomes. Part-time farming increasingly has become the norm, and by the mid-1980s, off-farm earnings accounted for 85 percent of farm household income, up from 50 percent in 1960. It may be noted further that the proportion of off-farm earnings in total farm household income is higher the smaller the scale of operation. Thus, the Japanese farm sector is dominated by a large number of small-scale, part-time, and high-cost producers for whom agricultural income is relatively unimportant. This suggests substantial scope for greater efficiency through structural reforms and a lowering of trade barriers.

Policies Affecting Japanese Agriculture

The key objectives of Japanese agricultural policy from the early 1960s to the mid-1980s were (i) the equalization of incomes and living standards of farm and nonfarm workers and (ii) the achievement of food security. The Agricultural Basic Law of 1961 specified that the income parity objective should be achieved by raising productivity through increases in operational farm size and improvements in land infrastructure and agricultural technology, as well as by shifting production toward products whose demand was expected to increase. Food security became a prime concern following the world grain crisis and the soybean export embargo imposed by the United States in 1973, and later the establishment of the 200 nautical mile exclusive economic zones in view of the Japanese fishing industry's heavy dependence on coastal waters.

In pursuit of these objectives, the Government has intervened heavily in the agricultural sector. Measures that have attempted to encourage structural adjustment include supply management and deregulation of controls on land use. Progress in achieving structural adjustment, however, has been limited. Although certain subsectors (such as poultry and pigs) have expanded and have done so with relatively little protection, the policies have failed to transform Japan's farm sector into one dominated by "viable farm units."[7] As noted earlier, there has been little change in the operational scale of farms, and rural-urban income parity has been achieved mainly through the increased importance of off-farm earnings.

Analysts[8] cite a number of factors that have contributed to the prevalence of small-scale, part-time farming: the

[5] ABARE (1988).

[6] During 1960–80, the price of agricultural products relative to manufactures doubled in Japan, despite a 10 percent decline on world markets.

[7] Viable farm units were defined in the Agricultural Basic Law as "farms sufficiently large in operational scale so that family members engaged in farming are able to work in their full capacity and earn high enough income to enjoy the level of living equivalent to that of nonfarm workers." (Hayami, 1988.)

[8] Including Hayami, a leading expert on Japanese agriculture. See Hayami (1988).

rapid growth in nonfarm employment opportunities and in their accessibility; the diffusion of small-scale machinery; regulations governing land use; and expectations of land price increases combined with the widespread fear that land, once leased, is lost forever. This agricultural structure, however, has been heavily supported by policies that directly affect agriculture: border measures, direct price and income support to producers, input subsidies, and tax preferences. The discussion that follows briefly describes the main features of such policies.

Border Measures

The border measures that have perhaps generated the most attention recently among Japan's major trading partners have been the *quantitative restrictions* on agricultural imports. The number of agricultural and marine product groups considered under GATT rules to be subject to import quota restrictions was reduced from 102 in 1962 to 22 by 1974. Subsequently, there was no change in the number of agricultural product groups covered by quotas until 1988, although quotas were removed on some minor individual items within the groups and loosened on certain other commodities. In addition to these quotas, state trading by governmental monopolies controls the imports of four other agricultural product groups. The most important of these is rice, which has not been imported since 1970 except for small quantities intended for particular forms of processing. All in all, the commodity groups subject to quantitative restrictions have been estimated to have accounted for almost half of gross agricultural output in the mid-1980s.[9]

Japan took several steps to liberalize quotas during 1988–90. In response to a GATT panel ruling on a complaint lodged by the United States that restrictions on 10 of 12 agricultural products (which account for a relatively small share of trade) were inconsistent with the GATT, the Government undertook to phase out quotas on eight of the product groups by April 1990 and agreed to improve market access for all the other four groups.[10] More important, following negotiations with the United States and Australia, it was announced that quota protection for beef and fresh oranges would be eliminated in April 1991, and for orange juice by April 1992. For beef, new tariffs would replace the quotas, while citrus imports would continue to face existing tariffs.[11]

A number of other *nontariff barriers* also have served to protect Japanese agriculture, including health and quality standards and the limited capacity of quarantine facilities (e.g., for live cattle imports). As part of the 1988 citrus agreement, however, one notable nontariff barrier, a regulation requiring imported orange juice to be blended with domestic citrus juice, is being phased out.

While quantitative restrictions have been important, *tariff* protection has been relatively modest. Substantial tariff cuts were made under the Kennedy and Tokyo rounds of multilateral trade negotiations. The average post-Tokyo Round tariff rate on agricultural commodities was 8.6 percent for Japan, substantially higher than the 2.9 percent for the United States but lower than the 12.3 percent for the European Community (Yoshioka, 1988).[12] In addition, certain agricultural commodities are protected by *tariff quotas*,[13] whereby primary tariff rates (sometimes zero) are applied up to a certain quantity of imports and higher rates levied thereafter.

Price and Income Support

Direct support through price and incomes policies has come to play a key role in Japanese agricultural policy. Prior to the enactment of the Agricultural Basic Law in 1961, pricing policies were limited to rice, wheat, raw silk, feed, and potatoes for industrial use. Subsequently, pricing policies also have been applied to livestock and dairy products, soybeans, rapeseed, sugar beet, sugar cane, vegetables, and fruit. It has been estimated that in 1982 as much as 80 percent of agricultural output was covered by price policies.[14]

A noteworthy feature of agricultural price policy in Japan is its product specific nature, with no general system covering the agricultural sector as a whole. The extent of government control also varies widely. Government regulation has been most pervasive for rice, wheat, barley, beef, dairy products, and sugar, with state trading organizations administering price support schemes. The largest and most expensive price support program is that for rice (see below).

Producer prices for most commodities are set on the basis of estimated production costs and, in pursuit of the Government's policy, to ensure income parity between farm and nonfarm employment. However, for a number

[9] OECD (1987).

[10] By April 1990, quotas were being removed for processed cheese, prepared and preserved beef, other sugars and syrups, fruit puree and paste, fruit otherwise prepared and preserved, fruit juices (noncitrus), tomato juice, ketchup, and paste, and other food preparations, mainly of sugar. GATT-inconsistent quotas were liberalized for certain dairy products (including condensed and evaporated milk), and starch and inulin; and GATT-consistent quotas for dried leguminous vegetables and groundnuts.

[11] The tariff rate on beef is to be set at 70 percent for 1991/92, 60 percent for 1992/93, and 50 percent for 1993/94.

[12] The variable import levy, a form of tariff, however, is a principal means of agricultural protection in the EC.

[13] These commodities include natural cheese, oats, maize for corn starch and industrial uses, feeder cattle, and leather.

[14] ABARE (1988).

of commodities, in particular rice, the annual price-setting process has been heavily influenced by political considerations. Since 1960, domestic sales prices generally have been lower than the guaranteed purchase prices for producers, resulting in large government expenditures, either directly or through statutory agencies.

Price stabilization schemes have been developed for a number of products, including beef, pork, dairy products, and cane and beet sugar. These programs involve buffer stock operations to maintain domestic wholesale prices within certain price bands. Deficits, generated by consumer prices normally being lower than prices within the band, are financed by import levies and budgetary transfers. In the case of beef, for example, the Livestock Industry Promotion Council (LIPC), which administers the price control and import quota system, intervenes in order to stabilize prices by adjusting domestic stocks as well as the flow of imports into the Japanese market. The price stabilization arrangements for beef are likely to change as the role of the LIPC is reduced markedly with the liberalization of beef imports.[15]

Deficiency payments are used to support incomes of producers for a limited number of products, including soybeans, rapeseed, and milk for processing. In these cases, the Government makes payments to producers for the difference between target prices and market prices. For calves, vegetables, and fruit for processing, similar support is provided under "price stabilization" funds, which make deficiency payments when market prices fall below certain target levels. Payments by these funds are financed jointly by contributions from the Government and producer associations.

As the price support mechanisms were instituted from 1960 onward, administrative prices of agricultural products in Japan rose (Table 2). The government purchase price of rice, for example, increased fourfold from 1960 to 1977, more than twice the rate of increase in world market prices. The rise in administrative prices came to a halt in the 1980s. Indeed, during 1986–88, support prices of major agricultural products were reduced across the board, reflecting the lower cost of imported inputs as well as the recognition of the need to raise efficiency and reduce discrepancies relative to world market prices. Accordingly, the government purchase price of rice was lowered by 6 percent in 1987 and by a further 4½ percent in 1988, the first such reductions since 1956. In addition, it was announced in mid-1988 that effective 1989, the calculation of the purchase price for rice would be on the basis of production costs of farms with a minimum of 1.5 hectares, rather than the average for all farms as in the past. Calculating producer prices on the basis of costs on more efficient farms was introduced for several other products in 1987–88 as well.

Progress in increasing the market orientation of administered prices was much more limited in 1989. The purchase price of rice was not reduced, and implementation of the new method for calculating production costs was delayed. In addition, support prices for manufacturing milk and beef also remained at their 1988 levels. In 1990, however, some renewed progress has been evident; in July the purchase price for rice was lowered by 1½ percent and the revised cost-calculation scheme was instituted.

[15] The Government has announced that once the beef quotas are eliminated, the LIPC will not be involved in the pricing, purchase, or sale of imported beef.

Table 2. Japan: Administrative Prices of Major Agricultural Products, 1970–89

(In yen per kilogram, unless otherwise noted)

	1970	1980	1985	1987	1988	1989
Rice (husked)						
Government purchase price	138	295	311	293	279	279
Wheat						
Government purchase price	57	178	185	174	166	160
Sugar beet						
Minimum producer price[1]	7,760	20,480	21,020	19,660	18,720	18,450
Soybeans						
Standard price	84	280	287	266	251	251
Manufacturing milk						
Guarantee price	44	89	90	83	80	80
Butter						
Stabilization indicative price	647	1,253	1,276	1,100	1,080	1,092
Skimmed milk						
Stabilization indicative price	388	501	541	527	521	527
Steer beef						
Standard stabilization price	. . .	1,105	1,120	1,020	995	995
Pork						
Standard stabilization price	345	588	600	455	410	400

Source: Ministry of Agriculture, Forestry, and Fisheries.

[1] Yen per metric ton; years refer to beginning of crop year running October to September; from 1975, includes production subsidy.

Other Policies

Japanese agricultural policy relies on a number of other *subsidy programs* in addition to direct price and income support. These include subsidized production diversification programs (most notably in the rice sector), the financing of buffer stock operations, the financing of marketing activities for products subject to state trading, the subsidizing of several land and other infrastructure improvement programs, the subsidizing of loans at preferential rates of interest, and the public funding of research and development activities.[16]

Given the large number of such programs and the various institutional channels through which the assistance is provided, quantifying the extent of such support is difficult. With regard to budgetary expenditure of the central government, however, program payments excluding those related to price policies amounted to an estimated ¥ 1.8 billion or 15 percent of gross agricultural output in 1985, up from only 4 percent of gross agricultural output in 1960.[17] Furthermore, the farm sector came to depend heavily on such assistance to finance investment—government subsidies funded 60 percent of capital formation in agriculture in 1984, up from 26 percent in 1960.[18]

Certain features of Japan's *tax system* also have served to discriminate in favor of agriculture. Hayami (1988) cites studies that suggest that first, the effective tax rate on agricultural income is markedly lower than that on other income, reflecting a lower ratio of reported to actual taxable income on self-assessed agricultural income. Second, property taxes on farmland in urban areas are negligible compared to other uses, reflecting land price assessments that are only a fraction of market value. In 1982, an attempt was made to raise property taxes on agricultural land in urban areas to a level equal to those on residential land, but loopholes were introduced that have exempted 85 percent of the targeted farmland. And third, the inheritance tax includes an exemption for agricultural land with respect to the difference between the market value of the land and the present value of the agricultural income from the land, provided the heir declares the intention to continue farming the land for 20 years. With a widening margin between the present value calculation and market value, this exemption increasingly acts to discourage the liquidation of inherited farmland. These problems have attracted increasing attention, and the Government is now in the process of conducting a comprehensive review of the land tax system to address them as well as other issues. Legislation regarding a comprehensive land tax reform is scheduled to be presented to the Diet by the end of FY 1990.

Finally, Japanese agricultural policies are intimately linked with the activities of agricultural cooperatives (*Nokyo*). Organized at the village, prefectural, and national levels, the cooperatives have links to all agricultural sectors with almost all farm households as members.[19] The cooperatives provide farmers with a comprehensive range of services, including marketing, finance, insurance, management guidance, and provision of fertilizer and other inputs. The increase in part-time farming has led to a greater dependence of farmers on these services. Furthermore, they perform important roles in the implementation of government policies, particularly in the marketing and distribution of rice, for which they receive commissions and budgetary subsidies. The cooperatives have also been accorded a quasi-official role in various aspects of the policy formulation process, and are generally consulted on all major legislative changes that may affect them.

Policies for the Rice Sector

Rice has traditionally been the most important agricultural product in Japan, and government intervention in the rice industry has been long-standing. At present, rice continues to account for one third of total agricultural output and is subject to the highest protection among agricultural products.

Since the passage of the Food Control Law in 1942, the rice industry has been under the direct control of the Government.[20] The Food Agency of the Ministry of Agriculture, Forestry, and Fisheries initially regulated the distribution of rice from the producer to the consumer, and set prices from the farm gate to the retail level. In 1972, controls over rice distribution beyond the wholesale level were removed, and retail prices were freed.

At present, most of the rice crop is marketed through either the government rice (*seifu mai*) channel or the voluntary rice (*jishu ryutsu mai*) channel. Under the former, the Food Agency purchases rice from producers through agricultural cooperatives and sells it to wholesalers,[21] whereas under the latter cooperatives sell di-

[16] For a detailed discussion of these programs, see OECD (1987) and ABARE (1988).

[17] Estimated from Ministry of Agriculture, Forestry, and Fisheries sources.

[18] Hayami (1988).

[19] The *Nokyo* have a membership of about 8 million individuals, including other local residents in addition to farmers who utilize their services.

[20] In the face of severe shortages and high prices during the Second World War, this law was passed to ration all staple foods. Since 1952, rice has been the only commodity whose distribution is under the Government's direct control.

[21] The actual purchasing and selling of government rice is done by designated collection agencies; about three fourths of these are cooperatives, with the rest made up of registered dealers.

rectly to wholesalers. Under supply management programs introduced since 1971, the total quantity of rice a producer can sell through these two channels has been subject to regional quotas.

A substantial portion of the rice crop—estimated from 15–25 percent—is said to be marketed through illegal private channels rather than through either of the two official channels. The Government has made strong efforts to contain such private marketing, as these practices serve to undermine other policies, such as the production quotas.

In 1988, a number of measures were taken to liberalize trade between wholesalers and retailers. Scale requirements for obtaining licenses to trade were relaxed;[22] wholesalers were allowed to sell in neighboring rather than only in one prefecture; retailers were permitted to sell prefecture-wide rather than only in one locality; and it was decided that new entrants would gradually be permitted into the wholesale network.

With regard to the mechanism of price support, *purchase prices* of government rice are set annually by the Food Agency. Since 1960, the government purchase price has been based, in principle, on a formula that takes account of both production costs and the objective of income parity with urban workers.[23] To take account of the latter, nonfarm wage rates have been used to impute the value of family farm labor in the calculation of production costs. Furthermore, average production costs have been calculated to ensure that costs of marginal producers are covered,[24] although as noted earlier, beginning in 1990, average production costs are to be based on those prevailing on larger and more efficient farms.

In practice, the government purchase price has not been set purely on the basis of strict adherence to this formula. After increasing rapidly during 1960–68 with the introduction of the formula and the rise in industrial wages, the purchase price was frozen during 1968–70 to counter a situation of excess supply that had developed (Table 3). In the mid-1970s, the price was pushed up again in response to food security concerns; most recently, lower production costs associated with the appreciation of the yen have not been fully passed through to prices.

With regard to the government *selling price* to wholesalers, a fixed formula has not been used as a basis for its determination. Rather, it has been set according to a variety of considerations such as changes in the cost of living, general economic conditions, and the fiscal situation. As may be seen in Table 3, the selling price was kept below the purchase price from 1961 until 1987; this, combined with administrative costs, has resulted in considerable losses for the Government. During the 1980s, increases in the selling price relative to the purchase price have substantially reduced budgetary expenditures and transferred to consumers a substantial portion of the cost of support.

The voluntary rice marketing channel was initiated in 1969 mainly in an attempt to lower the fiscal cost of the price support mechanism, but also as a means to better

[22] Both wholesalers and retailers need to be licensed to trade by their respective prefectural governments.

[23] Prior to the adoption of this "Production Cost and Income Compensation" formula, purchase prices had been based on maintaining the purchasing power of farm income from year to year.

[24] The average cost has been based on the average for farms where the yield per hectare is lower than the national average by one standard deviation. See Hayami (1975).

Table 3. Japan: Purchase and Selling Prices of Government Marketed Rice, 1960–89

	Government purchase price (Yen per kilogram)	Government wholesale price (Yen per kilogram)	Government administrative cost (Yen per kilogram)	Government profit on trading (In billions of yen)
1960	69	73	7	15
1965	109	102	10	−67
1970	138	124	23	−196
1975	260	203	40	−388
1980	295	265	69	−96
1981	296	273	61	−66
1982	299	284	57	−82
1983	304	284	48	−100
1984	311	295	52	−105
1985	311	305	57	−70
1986	311	310	55	−78
1987	293	310	52	−85
1988	279	302	45	−7
1989	279	307	. . .	. . .

Source: Ministry of Agriculture, Forestry, and Fisheries.

reflect consumer preferences. Prices of voluntary rice are free from government intervention, and determined through negotiations between agricultural cooperatives and rice wholesalers. Most of this rice has been of higher quality, and prices have been roughly 25 percent higher at the wholesale level and roughly 35 percent higher at the retail level.[25] To encourage this marketing channel, the Government provides various subsidies including those related to marketing and storage costs. Since its introduction, the share of voluntary rice has risen to about one half of the total rice sold through the two legal channels.

During the 1960s, the Government accumulated a large stock of surplus rice, as consumption moderated and production increased in response to the sharp rise in the purchase price. As one way to address oversupply, a number of *supply management* programs have been introduced since 1971.[26] While the emphasis of the programs has shifted over time, all of the programs have involved subsidies designed to reduce rice output and increase that of other priority crops such as wheat, barley, and soybeans. During the 1980s, the focus increasingly has been on encouraging productivity improvements such as the use of bonus payments when the rice land diversion also involves the consolidation of land holdings. Reflecting budgetary concerns, however, subsidy levels have been cut back sharply in recent years.

Effects of Government Policies

With the increased attention that has been paid worldwide to agricultural support policies, various approaches have been applied in attempting to quantify their effects. One transparent measure is the nominal rate of protection (NRP)—defined as the percentage difference between the domestic price and the international price. The calculation of NRPs is subject to a number of problems, such as quality differences, the unavailability of price data at equivalent points in the distribution process, and the exclusion of nonprice agricultural support, that may bias the results in either direction. Nevertheless, NRPs calculated by Hayami (1988) clearly suggest that the level of agricultural protection in Japan has risen from 18 percent in 1955, a level that was below that of most other major industrial countries, to 102 percent in 1984, substantially higher than any other (Table 4). According to these data, the level of protection in Japan is particularly high for feedgrains.

Moreover, the substantial appreciation of the yen since early 1985, accompanied by only modest cuts in support prices, appears to have resulted in a further large increase in the level of protection. While comprehensive data for the most recent period are not available, the NRP for rice, for example, rose from 420 percent in 1984 to 622 percent in 1988, and the NRP for wheat rose from 412 percent in 1984 to 791 percent in 1988.[27]

As noted above, the NRP does not take account of nonprice income support. One measure that does is the producer subsidy equivalent (PSE), defined as the subsidy that would be necessary to compensate producers for removing government support under existing programs and expressed in percentage terms as a ratio of transfers to producers to total producer income.

In the context of providing a quantitative measure of support policies for the Uruguay Round, the OECD has calculated PSEs for a range of commodities and countries for the period 1979–89. The results indicate that, accord-

[25] OECD (1987).

[26] There have been four rice land diversion programs since 1971: The Rice Production Control and Diversion Program (1971–75), The Comprehensive Paddy Field Utilization Program (1976–78), The Paddy Field Utilization Program (1978–86), and The Paddy Field Farming Establishment Program (1987–92).

[27] Staff calculations on the basis of Japanese government purchase prices; Thai milled rice, 5 percent broken, f.o.b. Bangkok; U.S. No. 1 hard red winter wheat, f.o.b. Gulf ports.

Table 4. Average Nominal Rates of Protection in Industrial Countries, 1955–84[1]

	1955	1960	1965	1970	1975	1980	1984
Japan	18	41	69	74	76	85	102
European Community	35	37	45	52	29	38	22
France	33	26	30	47	29	30	25
Germany, Fed. Rep. of	35	48	55	50	39	44	49
Italy	47	50	66	69	38	57	20
United Kingdom	40	37	20	27	6	35	15
Australia	5	7	5	7	−5	−2	. . .
Canada	—	4	2	5	7	−3	−3
United States	2	1	9	11	4	—	6

Source: Hayami (1988).

[1] Defined as the percentage by which the producer price exceeds the border price. Weighted averages for 12 commodities (rice, wheat, barley, corn, oats, rye, beef, pork, chicken, eggs, milk, and sugar).

Table 5. Net Percentage Producer Subsidy Equivalents, 1979–89
(In percent)

	1979–85	1986	1987	Est. 1988	Prov. 1989
Japan	64	75	76	75	72
Australia	11	16	11	10	10
Austria	29	49	51	49	44
Canada	30	49	48	43	35
European Community[1]	35	50	48	43	38
New Zealand	23	33	14	7	5
United States	26	42	40	35	27
Average, all OECD countries	35	51	49	45	39

Source: OECD (1990).
[1]EC-10 for 1979–85; EC-12 for 1986–89.

ing to this measure, the Japanese agricultural sector has received the highest level of government support among major industrial countries (Table 5). Furthermore, the PSE for Japan tended to rise over the course of the 1980s, largely reflecting the rise in the value of the yen. As in the case of the NRPs, the PSEs indicate that the grain products receive the heaviest protection. Indeed, in 1989 the transfer to producers is estimated to have been the equivalent of over 92 percent of producer income for wheat, and 86 percent for rice.

The OECD has also estimated that the direct cost for consumers and taxpayers of Japan's agricultural support policies averaged $62 billion a year in the period 1987–89, up from $32 billion in 1979–81.[28] Moreover, with the decline in budgetary expenditures on agriculture over this decade, as well as the rise in the value of the yen, an increasing proportion of the total cost—over 90 percent in 1987–89—has been borne by consumers in terms of high domestic relative to foreign prices. Finally, it may be noted that the average annual transfer to producers, as measured by the nominal PSE, amounted to $35 billion in 1987–89, or about 60 percent of the average cost. The remainder represents a deadweight welfare loss of 1 percent of GNP, and suggests substantial welfare gains from liberalization.

Measures such as the NRP and the PSE are indicators of the direct effects of agricultural policies. Various studies also have analyzed the impact of Japan's agricultural policies on domestic and international economic variables by performing counterfactual simulations of a liberalization of these policies. One major study (Tyers and Anderson, 1986) simulated various trade liberalization scenarios using a world food model that covered 7 commodity groups involving grains, livestock products, and sugar, and 30 countries or country groups. According to these simulations, the unilateral liberalization by Japan of its support policies in the grains, livestock, and sugar markets would result in a welfare gain to Japan equivalent to 2 ¼ percent of GNP. This gain reflects the estimated favorable impact of lower prices on consumer welfare being substantially greater than the estimated loss to producers. There would be a large increase in imports for rice, ruminant meat (beef and mutton), and dairy products, resulting in large reductions in self-sufficiency in these products (see Table 6). For the latter two groups, consumption more than doubles, while in the case of rice (for which demand is price inelastic) the increase in consumption is modest, despite a sharp fall in prices. There is a notable decline in imports of coarse grains, owing to the impact of the cut in ruminant meat production on feedgrain imports.

The results suggest that the boost in imports of rice, ruminant meat, and dairy products would imply a sharp rise in world trade and lead to higher world prices. While net exporters of these commodities thus would benefit on both counts, net importers could suffer losses associated with a fall in their terms of trade.

The Tyers and Anderson model, while rich in detail with respect to world food markets, is a partial equilibrium framework that does not capture the response of various aspects of the overall macroeconomic environment, other sectors of the economy, and factor markets, to agricultural policy changes. A number of recent studies have assessed the economy-wide consequences of agricultural support policies in Japan, as well as in other countries, by building applied general equilibrium models that incorporate the spillover effects of agricultural policies on the rest of the economy.

The results of one such study are reported in a paper by Vincent (1988). Two main alternative scenarios are presented that examine the implications of a unilateral liberalization of agricultural support policies in Japan.[29] The

[28] The cost to consumers is defined as the cost of higher domestic prices owing to border measures less consumer subsidies, and the cost to taxpayers is defined as public expenditures on support policies less tariff receipts (OECD, 1988).

[29] The liberalization assumes (i) the elimination of domestic subsidies on current agricultural inputs estimated to have amounted to about 9 percent of agricultural GDP in the early 1980s, and (ii) the removal of tariffs and other border measures so as to eliminate differentials between domestic and international prices, as given by estimates of average nominal rates of protection of 420 percent for agricultural crops and 116 percent for livestock products in 1986.

Table 6. Tyers and Anderson Model: Simulated Effects of Unilateral Liberalization of Japanese Support Policies
(Percentage changes)

	Wheat	Grain	Rice	Ruminant Meat	Non-ruminant Meat	Dairy Products	Sugar
Domestic effects							
Producer prices	−74	−77	−68	−74	−33	−64	−67
Consumer prices	−20	−23	−64	−74	−33	−61	−64
Production	−30	−29	−44	−60	−10	−41	−42
Consumption	−18	−30	20	128	−13	128	4
Self-sufficiency rate	−1	—	−49	−79	3	−61	−13
Net imports (thousands of metric tons)	−960	−6,090	6,280	2,960	−120	14,300	470
Global effects							
World trade volume	—	3	30	57	−8	28	1
International prices	0.4	—	4.1	4.2	0.6	3.3	0.5

Source: Tyers and Anderson (1986).

scenarios differ in their treatment of how equilibrium is established (i) in the labor market, and (ii) between aggregate expenditure and supply. One scenario assumes constant nominal wages and changes in employment to clear the labor market, as well as constant real domestic spending so that any changes in national income are reflected in the external balance. In a second scenario, these assumptions are reversed, namely, wages are assumed to adjust to keep employment constant and domestic spending to adjust to keep the external balance unchanged. Both scenarios assume that capital is fixed in each industry,[30] and thus the simulation results apply to a short- to medium-term adjustment period.

The two scenarios are summarized in Table 7. While the differences in assumptions do lead to certain differences in the simulation results, several broad conclusions emerge. First, the results suggest that support for agriculture has served to reduce significantly the real incomes of Japanese wage earners, by raising prices of agricultural imports and import-competing products and the overall level of consumer prices. Agricultural liberalization is estimated to result in a 2½ to 3 percent rise in real wages, and a 2½ percent rise in labor's share of national income.

Second, support for agriculture has acted as a tax on other tradable sectors in the economy, in particular export-oriented manufacturing. The elimination of border protection to agriculture, by lowering consumer prices, also would lead to a reduction in the overall domestic cost structure. This would lead to an improvement in the competitiveness of nonagricultural sectors of the economy. Thus, while agricultural liberalization would result in a surge in food imports and a large drop in agricultural output, it would be accompanied by an expansion of exports and output in manufacturing. In Scenario A, the estimated increases in exports in four key export-oriented industries—machinery, transport equipment, other industrial equipment, and transport and communications—range from 2 to 8 percent; in Scenario B they range from 5 to over 18 percent. Indeed, as is suggested by the results of a third simulation that assumes constant real (rather than constant nominal) wages, if nominal wages were to fall in line with consumer prices, the increase in Japan's exports would exceed the increase in agricultural imports.

Table 7. Vincent Model: Projected Short-to-Medium-Term Impact of Unilateral Agricultural Liberalization in Japan
(Percentage deviations from baseline)

	Scenario A[1]	Scenario B[2]
Real GDP	−0.31	0.12
Real domestic expenditure	—	0.02
Total exports[3]	3.16	6.09
Total imports[3]	5.44	5.59
Trade balance[4]	−0.38	—
Consumer price index	−2.89	−3.52
GDP deflator	−2.10	−2.73
Nominal wages	—	−1.06
Real wages[5]	2.89	2.47
Labor share of national income	2.48	2.35

Source: Vincent (1988).
[1] Constant nominal wages and aggregate real domestic expenditure.
[2] Constant aggregate employment and trade balance.
[3] In foreign currency.
[4] In percent of baseline GDP.
[5] CPI deflated.

[30] The supply side of the model is disaggregated into 19 different industries in the agricultural, primary, food-processing, other manufacturing, and service sectors.

Vincent also presents a simulation of the longer term effects of agricultural protection in Japan, by allowing, under the assumptions of Scenario B, capital to be mobile between sectors. While he notes that the results obtained are similar to those in Scenario B, because capital in addition to labor moves from the agricultural to nonagricultural sector, the efficiency and welfare gains are larger. Correspondingly, the increases in both exports and imports are larger, as are the gains in output and real labor income.

The OECD Economics and Statistics Department also has been conducting a major project called the World Agricultural Liberalization Study (WALRAS), with the objective of quantifying the economy-wide effects of agricultural policies in OECD countries.[31] The WALRAS model links six separate general equilibrium models for Australia, Canada, the European Community, Japan, New Zealand, and the United States, and a residual rest-of-the-world block. The production side of each sub-model specifies 13 industries, with the agricultural sector disaggregated into livestock and other agriculture, and the food-processing sector disaggregated into the meat, dairy, and other food products industries. Both labor and capital are assumed to be mobile between sectors. The model also specifies in detail the structure of consumption, government spending and revenues, foreign trade flows, and saving and investment.[32]

Martin and others (1990) present simulation results that gauge the effects of a full multilateral removal of the average 1986–88 levels of agricultural assistance in the six countries/regions. As the simulation is intended to measure the long-run impact of agricultural liberalization, both the government balance and the current account are assumed to remain unchanged.[33] The results suggest that multilateral liberalization would improve welfare—as measured by household real income—by almost 1 percent on average in the OECD countries. In Japan, the welfare gain is 1.1 percent. This gain is smaller than that estimated in the Vincent study, mainly reflecting a large terms-of-trade loss of 3½ percent that is estimated to result from multilateral liberalization. The removal of agricultural support leads to a rise in world market prices and world trade volumes of agricultural products, and Japan's import prices increase by 4½ percent, whereas in the Vincent study import prices are assumed not to respond to changes in Japan's agricultural policies.

Notwithstanding the rise in import prices, consumer prices in Japan would fall by 2 percent, owing to substantial declines in domestic producer prices in the agricultural and food-processing sectors. As in the Vincent study, the removal of agricultural support policies results in a rise in output in nonfood manufacturing and service industries that offsets large output declines in agriculture and food processing.

Martin and others also present the results of the economic effects of unilateral liberalization of agricultural policies by the various countries/regions. While the welfare gains are comparable for most countries, in Japan's case, unilateral liberalization results in a rather larger gain of 1.6 percent. This is mainly attributable to a substantially smaller terms-of-trade loss of only 1 percent under unilateral liberalization. At the same time, however, because world agricultural prices rise less, the decline in output in Japanese agriculture is higher in this case. Thus, as the study emphasizes with respect to all OECD countries, liberalization may be most achievable on a multilateral rather than unilateral basis, since it would impose a smaller adjustment burden on the agricultural sector.

Concluding Comments

Japan's farm sector has continued to supply most of domestic consumption in spite of a sharp decline in comparative advantage. As outlined above, a wide range of supportive measures were put in place that have preserved an increasingly inefficient productive structure and have pushed up domestic prices to several times those on the world market. While the key objectives of rural-urban income parity and food security have been achieved, this has not come without considerable cost to consumers and taxpayers.

As suggested by several studies, support for agriculture also has resulted in a welfare loss for the Japanese economy as a whole, with the cost to the general public being greater than the benefit received by producers. Thus, while certain steps to reduce support for agriculture have been taken, a full-fledged reform would be highly desirable. Moreover, the net benefits that would accrue would provide room for adequate adjustment assistance —as deemed necessary—in order to ease adjustment costs associated with the reallocation of resources.

Finally, agricultural trade liberalization may not lead to any substantial changes in Japan's aggregate current account balance. By increasing the overall cost of wage goods and diverting resources into less efficient produc-

[31] A detailed description of the WALRAS model is provided in Burniaux, and others (1990), and the simulation results may be found in Martin, and others (1990).

[32] It should be noted that the foreign trade sub-model treats imports originating in different countries/regions as imperfect substitutes, which implies that reductions in the level of agricultural protection can result in terms-of-trade losses. It is also assumed, however, that the price elasticity of consumer demand for food products is relatively low, so that welfare gains from the efficient reallocation of resources outweigh any terms-of-trade losses.

[33] Tax rates on consumer incomes are varied to maintain the government balances, and real exchange rates adjust to keep current accounts unchanged.

tive endeavors, agricultural support policies also work to depress the performance of other sectors of the economy. Hence, agricultural liberalization would make these sectors more competitive internationally, and the net effect on the external balance is ambiguous. This conclusion supports the view that agricultural reform in Japan should be pursued primarily with the objective of improving resource allocation and consumer welfare. While agricultural liberalization measures are likely to help relieve trade tensions, they should not be counted on to result in a measurable change in Japan's aggregate current account balance.

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