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Choice of Intermediate Money Target in a Deregulated and an Integrated Economy with Flexible Exchange Rates 1/

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1. Introduction

In recent years most monetary authorities in industrial countries have chosen to announce money targets in advance. Germany (in 1974) and the United States (in 1975) had taken the lead in this respect and they were subsequently followed by other industrial countries. 2/

Numerous considerations explain this trend toward the announcement of money targets. First, there was the increased influence of monetarism, which stressed the importance of the money supply, especially in the determination of inflation. Second, there was a dissatisfaction with the performance of monetary policy. The use of the interest rate as an intermediate target had produced unsatisfactory results. Moreover, the explosion in monetary growth in the early 1970s and the inflation which followed had led to a rethinking about the importance of money. Third, with large and growing public sector deficits in the mid-1970s, money targeting was viewed as a means of constraining the potential for money creation. Fourth, with the breakdown of Bretton Woods and the freeing of exchange rates there was now thought to be a greater ability to control monetary expansion, thus providing greater credibility for targeting. Fifth, the announcement of a money growth target was thought to influence expectations and to provide a more predictable and stable financial environment. Sixth, in the fight against inflation a restrictive monetary policy, which is preannounced and credible, may influence expectations about future inflation, rapidly reduce wage demands, and in this way moderate the potential unemployment costs of the policy.

The particular money aggregate chosen for targeting by individual countries has been varied (Table 1). In some countries (Australia, France, Japan, the United Kingdom) broad aggregates have been selected; in others (Canada, Switzerland, the United States) narrow aggregates have been selected. In still others (Germany, perhaps also Switzerland) something approaching base money is targeted.

1/ Helpful comments were received from H. Schmitt, D. Mathieson, J. Boughton, and W. White.

2/ See on this Argy (1981), Chap. 18; OECD (1979); McClam (1978); Sumner (1980); Bryant (1980); Griffiths and Wood (1981); B. Friedman (1977); and Kimelman (1981).

There is now a very large empirical literature concerned with determining the "best" definition of money. There are three, not unrelated, approaches used here. One approach regresses income against the different definitions of money (sometimes adding fiscal and other variables) to see which definition provides the best "explanation" for movements in income. A second approach estimates money demand equations using different definitions of money as dependent variables; the best definition is now the one which gives the most stable money demand equation. 1/

The third approach focuses on estimating substitution elasticities amongst different monetary assets. 2/ This information is then used to construct a "money" series comprising not only currency and demand deposits but also other assets which are their closest substitutes. Logically, this approach requires an aggregate concept of money which attaches different weights to its components, depending on the "liquidity" of the individual components. The approach has its origins in the contributions made in the late 1950s by the Radcliffe Report 3/ and by Gurley and Shaw. 4/ These generated considerable interest during the early 1960s provoking then a large literature on both sides of the Atlantic.

More recently, it has been argued that if a particular definition of money (arrived at in any of these ways) is targeted by the authorities and hence its supply restricted this is bound to provoke financial innovations, leading to the creation of substitutes, which, in turn, will render the original money concept obsolete. This will then require a new extended concept of money but this in turn will also become obsolete. 5/

This paper does not attempt any additional empirical work both because this work is already exhaustive (without in fact any conclusion) and also, more importantly, because there are, in fact, conceptual difficulties with such empirical work as a basis for the selection of a monetary aggregate when the objective, say, is to stabilize income. 6/

1/ For a multicountry study of the latter, see Boughton (1979). For a recent study of the former, see Lawler (1981).

2/ Barnett et. al. (1981), Cockerline and Murray (1981), Broaddas (1975), Chetty (1969), Boughton (1981), and Berkman (1980).

3/ Radcliffe Report (1959).

4/ Gurley and Shaw (1960).

5/ Howard and Johnson (1982), Goodfriend et. al. (1980), Porter et al (1979), Solomon (1981), Wenninger and Sivesind (1979), Arak (1981, and Dotsey et al (1981).

6/ To illustrate this contention consider first money demand equations. Suppose the foreign interest rate appears in a broad money aggregate but not in a narrow money aggregate. Suppose, too, that the foreign interest rate is very unstable. Then, although a broad money aggregate in which the foreign interest rate appears as an argument is stable, it nevertheless might be quite unsuitable as a target. Again, M1 might be more stabilizing for real shocks than a broader money aggregate for reasons discussed in the text; but this would not be reflected in a more stable money demand for M1. These objections do not, however, apply to the first approach. The difficulties with this

Table 1. Intermediate Targets--Select Countries

Country	Intermediate Target
Australia	M3
Canada	M1
France	M2
Germany	Central bank money 1/
Italy	M2 2/
Japan	M2 + CD_1
Switzerland	M1
United Kingdom	Sterling M3 3/
United States	$M1_B$, M2 4/

1/ Currency in circulation plus minimum reserves (at base year reserve ratios) on the banks' domestic liabilities. It is closely associated with M3.

2/ Based on ceiling for total domestic credit expansion in 1981.

3/ Notes, coins in circulation, and all sterling deposits (including CDs) held by U.K. residents in both the public and private sectors. It differs from M3 in excluding foreign currency deposits by U.K. residents.

4/ More importance attaches to $M1_B$.

Instead, the paper looks in some detail at the theoretical issues underlying the choice of an intermediate target in a particular type of economy. 1/ The particular type of economy assumed in the analysis is one which is market oriented in three fundamental ways. First, the economy in question has no exchange controls (or its exchange controls are ineffective), so it is highly integrated with the rest of the world. Second, exchange rates are fully determined by market forces, without any management by the monetary authorities. 2/ Third, the banking system is assumed to be deregulated, in the sense that banks are free to adjust the interest rate on their time deposits and advances. 3/

6/ (Cont'd from p. 2) approach are (a) to decide what other variables to include (fiscal, exports, etc.), (b) to decide how to define these other variables, and (c) to interpret the overall findings from the point of view of the optimal money aggregate for targeting.

1/ Our results, therefore, are specific to the particular regime assumed.

2/ For a discussion of the experience with such management see Argy (1982a).

3/ Assumptions about institutional structure and the selection of the monetary aggregates to be evaluated were made with the United Kingdom

The paper compares the performance of four money aggregates: base money (H), narrow money (M1), a broader money aggregate which includes interest-bearing deposits (M3), and a still broader money aggregate which now also includes resident holdings of foreign currency (M3A).

We consider now the issue of the methodological framework to be used in the selection of a money target. 1/

The monetary authorities will have several ultimate objectives in mind in designing their monetary policy over a time horizon of, say, a year. They may attach varying weights to expected balance of payments developments, to inflationary developments and to levels of employment. To simplify slightly, we are going to suppose that the monetary authorities have initially in mind some target rate of growth of GNP so, in effect, the objective of policy is to minimize the welfare losses from deviations from this target. 2/

It is convenient, in analyzing this problem, to deal, first, with the case of perfect foresight (the deterministic case). Suppose the monetary authorities have a model (implicit or explicit) of the economy. This model will contain exogenous variables, which include known past values of certain variables and other variables (e.g., fiscal policies, overseas conditions, etc.) which will need to be forecast for the year ahead. At

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3/ (Cont'd from p. 3) particularly in mind, although, of course, the analysis is also highly relevant to other economies with similar institutional structures (e.g., Canada) or to economies proposing to move toward such institutional structures (e.g., Australia). (See Committee of Inquiry into the Australian Financial System.) In the United Kingdom exchange controls were abandoned in 1979 (but there is, in any event, some question about how effective they had been previously; also, although there is currently (1981/82) some rethinking about exchange rates, exchange rates have since late 1977 been principally determined by market forces. "Competition and credit control" (CCC), which came into force in September 1971, effectively deregulated the banking system. After that, the use of the "corset" on an on/off basis and the imposition of some relatively minor controls over interest rates reintroduced various forms of banking regulation. Since 1980, however, the banking system has again been free of interest rate regulation. [For an analysis of these banking regulations see Argy (1982c)]. Finally, the United Kingdom initially flirted, briefly, with a very broad money aggregate (M3A) as the target; after that, it set a target in sterling M3. There has, however, been a very lively debate about different money aggregates as potential targets, with considerable interest shown in a base money or a narrower money aggregate. [See Artis and Lewis (1981), Savage (1980), National Institute Economic (1982), Buiter and Miller (1981) and Bank of England Quarterly Bulletin (1982)].

1/ The seminal work here is by Poole (1970). Bryant (1980) in his recent book has an insightful analysis of methodological issues in target choice in the open economy.

2/ The question of whether the authorities ought to announce a target growth of GNP, by passing money altogether, is discussed in Argy (1982b).

the same time, the model will contain structural coefficients indicating how certain variables (e.g., interest rates, income) affect some other variables in the model (e.g., consumption, investment, the demand for money, etc.). If the forecasts of the exogenous variables are made with perfect accuracy and if the structural coefficients are also known with certainty the monetary authorities would not have a problem choosing the appropriate money target. The ultimate outcome (a given rate of growth of GNP) could be made consistent with any potential money target. In other words, we could solve our model for any one of a number of money targets, each of which could, in principle, be targeted. In this context, then, and at this level, the question of choosing a target is a trivial and irrelevant one.

In reality, of course, there are bound to be potential errors (uncertainties in the model). (The model, in other words, becomes "stochastic" rather than "deterministic.") The uncertainties can take two forms: there may be uncertainties attaching to the structural coefficients of the model or there may be uncertainties attaching to the forecasts of the "exogenous" variables in the model. The latter has been extensively treated and allowed for in the literature; the first type of error, however, is less well treated and raises even more difficult issues. In our own analysis, to make the treatment manageable, we are going to assume coefficient certainty but allow for errors and uncertainties only in the exogenous variables. Now, taking account of potential "forecast" errors, it is no longer true that the monetary authorities will be indifferent to the choice of target. It is the fact of uncertainty which gives meaning to the choice of a money target.

We recognize several sources of errors in projections (unanticipated disturbances). These, we assume, originate at two levels. First, there are disturbances in financial (asset) markets. Second, there are expenditure disturbances. We also assume that these individual disturbances are uncorrelated with one another.

We allow for six asset market disturbances. Four originate within the domestic economy. Two represent shifts across international frontiers. Domestic disturbances include the following. First, a shift out of currency into demand deposits. Second, an increase in the demand for free reserves on the part of the banking system. Third, a shift out of demand into time deposits. Fourth, a shift out of time deposits into domestic bonds. International disturbances include, first, a shift out of demand deposits denominated in the home currency into demand deposits denominated in a foreign currency (the currency substitution case) 1/ and, second, a change in the foreign interest rate.

Using a macromodel, we evaluate each money aggregate for each disturbance in terms of our objective of minimizing fluctuations in income. At the same time, we review the implications for exchange rate volatility of selecting a particular money aggregate. Also, we examine the implications of "deregulation" for interest rate, exchange rate, and income volatility and for the choice of a money aggregate.

1/ The case is highlighted in McKinnon (1982).

Attention is also paid to the question of what happens, for each disturbance, to the behavior of the money aggregates other than the one which is targeted. We assume that the monetary authorities, in fact, target a broad money aggregate (M3) (which excludes resident holdings of foreign currency). We also assume that the target is achieved. We then look to see in what degree the other money aggregates need to deviate from their originally "projected" levels. The objective of this exercise is to indicate how, in the face of different disturbances, different money aggregates can move in different directions.

Our principal conclusion is that a narrow money aggregate such as M1 actually performs relatively well. We demonstrate that, for realistic assumptions about the sources of disturbances, M1 will tend to outperform the other money aggregates by our criterion of minimizing the fluctuations around a target growth of GNP.

2. A description of the model used

This section will try to describe verbally the kind of model used. Technical details and solutions are given in an Annex.

Residents are assumed to hold six financial assets: currency, demand deposits, time deposits (on which interest is paid), domestic bonds, foreign currency deposits, and foreign bonds. The sum of these six assets makes up private financial wealth. The sum of currency and demand deposits comprises M1. The addition of time deposits gives M3. The further addition of foreign currency deposits gives the broadest money aggregate M3A.

There are four rates of return on assets: the interest rate on foreign bonds; the expected depreciation of the foreign currency, the interest rate on domestic bonds and the interest rate on time deposits. In a deregulated system the interest rate on time deposits is assumed to respond, partially at least, to changes in the domestic interest rate.

In principle, the demand for each financial asset will be a function of own and other rates of return and income, subject to the wealth constraint. 1/ However, to be realistic and to simplify a little, we have assumed that some of these coefficients are zero. For example, we do not allow currency to respond to any rate of return; demand deposits do not respond to the foreign interest rate, and foreign currency deposits respond only to income and the expected devaluation.

Although in the formal model the demand for each financial asset must be determined by overall financial wealth, we, nevertheless, do not allow, over our time horizon, changes in financial wealth to affect the

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1/ The portfolio balance model is now widely used. Its origins for the closed economy are in Tobin (1979) and it has since been extended to the open economy by, among others, Kouri and Porter (1974); Kouri (1976); and Branson (1980). A recent review of these models is to be found in Murphy and Van Duyne (1980). See also White (1981).

demand for any asset. Changes in financial wealth come from two sources: changes in stocks, from the current account or from budget deficits, and changes in valuation from exchange rate adjustment. 1/ The former, clearly, has more relevance in a longer-term context; the omission of the latter can be justified on the ground that residents are more concerned with the "expected value" of their wealth and, in the context of a short-run model dealing with short-run reversible disturbances, this expected value may not adjust significantly to current changes in exchange rates.

Since we assume that our economy is highly integrated, expected returns on domestic and foreign bonds are assumed to be equalized. This is represented by the interest rate parity equation. Risk aversion is disregarded and the forward rate assumed to be equal to the expected spot rate. Moreover, since this is a short-run model concerned with the effects of unanticipated random shocks, the expected spot rate is assumed to be stationary. This is not implausible and indeed would be consistent with rationally formed expectations.

There is also a banking sector in the model. The banking system holds only two assets: reserve assets and domestic bonds. There is a mandatory reserve requirement on total deposits and a free reserve component which is influenced by total deposits and, as well, (negatively) by the domestic interest rate. Using this representation of the banking system we can generate a money supply equation, where the supply of money is determined by base money (the sum of bank reserves and resident holdings of currency) income and the interest rate. Other things being equal (OTBE), a rise (fall) in income increases (decreases) resident demand for currency, depletes (increases) reserves of the banks and forces a contraction (expansion) in the money supply. Again, OTBE, a rise (fall) in the domestic interest rate reduces (increases) the demand for free reserves and so increases (decreases) the supply of money. Finally, OTBE, an increase in base money will increase the supply of money through a familiar multiplier process.

The model also incorporates a simple goods market. Aggregate demand is determined by the domestic interest rate and the exchange rate (which is assumed to have a normal nonperverse effect). Given the short-term nature of the analysis, prices are taken as unresponsive to changes in aggregate demand.

Shocks are easily incorporated in the model. A shift out of currency into demand deposits is represented by a negative disturbance term in the demand for currency and the same positive disturbance term in the demand for demand deposits. Shifts out of demand into time deposits or out of time deposits into bonds, or out of domestic into foreign deposits, are represented in similar ways. Since the foreign interest rate appears explicitly in the demand for time deposits, a change in this interest rate has a direct effect on the demand for M3 and M3A. Finally,

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1/ If a country is a net creditor (debtor), a devaluation will increase (decrease) financial wealth.

an exogenous change in free reserves is represented by a disturbance term in the banks' demand for free reserves. It then appears as a disturbance term in the money supply equation (see Annex).

We are concerned with the relative effects on income, for each disturbance and for each money aggregate taken as a target. To illustrate, suppose M3 were the target. We then sum the three asset demands to get a composite demand for M3. The time deposit interest rate is then solved out by allowing it to respond to the domestic interest rate. If M3 is the target it can be assumed to be fixed. This equation, then, combined with the interest rate parity equation and, as well, the goods market equation allows us to solve for income (our principal concern) the domestic interest rate and the exchange rate. We can proceed along very similar lines for M1 and M3A, combining each of these in turn with interest parity and the goods market equation to get our solutions.

When base money is the target the money supply is allowed to respond through the money supply equation. This equation, combined with the corresponding money demand equation, allows us to solve for base money in terms of income, the interest rate, the exchange rate and disturbance terms. This equation is then used to obtain solutions for income, the interest rate, and the exchange rate.

3. The results

The results of the analysis using the model described in the previous section are summarized in Table 2. We now try to explain in some detail our findings.

Consider first the case of a shift out of currency into demand deposits (e1). If high-powered money were targeted the banks would be left with excess reserves and this would lead to a multiple expansion of deposits. The interest rate and the exchange rate would both fall while income would rise.

Suppose one of the other money aggregates were targeted. Now the moment excess reserves would start exerting upward pressures on the money supply the monetary authorities would take corrective action (e.g., sell bonds to the banks) to remove these reserves. In the end then the exchange rate, the interest rate, and income will all remain unchanged.

If M3 were actually targeted, M1 and M3A will also conform to the implicit projections for these aggregates. H, however, will now deviate from its projection. As shown above, the removal of excess reserves to restore M3 means that base money will now be allowed to fall below the projection (Table 2, last column).

Consider now the case where there is an exogenous increase in the demand for free reserves (e5). If base money were the target, this would be allowed to follow its course. There will now be downward pressures on the money supply, upward pressures on the interest rate and on the exchange rate and income will fall. If, however, the other money aggregates were

targeted, the incipient downward pressures on the money supply would be offset by the injection of base money. The monetary authorities would end up accommodating the increased needs of the banking system, again leaving interest rates, exchange rates, and income all unchanged.

As in the previous example, if M3 were actually the target, M1 and M3A would be in line with projections while base money would now be above its projected level.

For "money supply" shocks, then, base money is a poor performer while the three other money aggregates are equally good performers, in each case completely sheltering exchange rates, interest rates, and income from such shocks. Again, in the face of such shocks, if M3 were in fact targeted, only base money would record deviations from its projections.

We now consider a variety of "money demand" shocks. Suppose first there were an exogenous shift out of demand into time deposits (e2). Now M1 will fall but M3 and M3A will remain unchanged. If M3 or M3A were the money target, no corrective action would be taken and interest rates, exchange rates, and income would all remain unaffected. Also, if base money were targeted, it, too, would be unchanged by the shift so no corrective action would need to be taken and this would again ensure that the economy is completely sheltered from the disturbance.

The situation, however, is different if M1 were the money target. With M1 down the monetary authorities would now need to take corrective action to restore the original target and so base money would be injected into the economy. This will lead to a fall in interest rates and in the exchange rate and, as well to a rise in income.

If M3 were in fact the target of policy, M3A and H would stay on their projected levels but M1 would be allowed to fall by the amount of the switch (Table 2, last column).

The case of a shift out of time deposits into bonds (e4) is more complicated. Suppose, to begin, M1 were the target. The shift would initially put downward pressure on the interest rate and on the exchange rate. In turn this will exert upward pressure on income. With interest rates also falling on time deposits (by assumption, we allow some adjustment in line with market rates) and income rising, there will be some observed increase in M1. At this point the monetary authorities will take some action to reduce the growth of M1. In doing this they will restore the original exchange rate, interest rate, and nominal income. In other words, so long as income is above the original level and the interest rate below the original level, the observed M1 will be above its target level, so action to restore the target will serve to completely stabilize the economy.

The economy will not, however, be stabilized if any of the other money aggregates were targeted in the face of this particular shock. Compare high-powered money with M3. If M3 were the target the above effects on interest rates, exchange rates, and income would be allowed

to follow their course. If H were the target the outcomes would be different. With income rising there would be an increased demand for currency, so with the same targeted level of H the money supply would be forced down. At the same time, with interest rates falling the banks will now wish to hold more excess reserves in relation to their deposits; this will also force down the money supply. The fall in the money supply will serve to partially stabilize the level of income. For these reasons, then, H will be a better stabilizer than M3.

M3, however, will be a better stabilizer than M3A. The reason is that as income increases there is, by assumption, a fall in demand for foreign currency deposits. If M3A were the target, the monetary authorities would try and offset the fall in foreign deposits by increasing domestic money (M3), which will be destabilizing.

If M3 were in fact the target, M1 and H would end up being above projection, while M3A would be below projection. M1 would be above the projected level because, as indicated above, the rise in income and the fall in interest rates would raise M1. H would be above the projected level because, again as shown above, if it were the target M3 would be forced down below its target, so to restore target M3, H must be allowed to rise. Finally M3A would fall because foreign currency holdings will be reduced.

Consider now the case of a currency substitution (e3). Compare first M3 and H. The considerations here are similar to the case of a switch out of time deposits into bonds. There is a fall in the demand for M3, domestic interest rates and the exchange rate fall and income rises. H is the better stabilizer for reasons discussed in the previous case: with H targeted, M3 will fall because of both currency and free reserves pressures. M3A, however, will now be a perfect stabilizer. By keeping an eye on M3A the monetary authorities will reduce the supply of M3 to offset the increased holdings of foreign currency. The economy will thus be completely stabilized.

M1 is now an ambiguous performer. The initial switch is out of M1 so there is, effectively, an exogenous fall in the demand for M1. If M1 is targeted this will lead to some fall in interest rates and in the exchange rate and to some rise in income. Compare now M1 and M3. The test here is what happens to M1 if M3 were targeted. If M1 rises (falls) M1 would be the better (inferior) stabilizer. What in fact happens to M1 is ambiguous. There is an initial fall in the demand for M1 but M1 will also increase both from the fall in interest rates and the rise in income.

We now consider the case of a foreign interest rate disturbance (rf). This case is more complicated than the others. Compare, to begin, M3 and H. If M3 is the target there will be an excess supply of M3, interest rates and the exchange rate will fall and income will rise. The higher foreign interest rate will also exert further pressures on exchange rates (through the interest rate parity equation) and in turn on income and domestic interest rates. In the end the domestic interest rate will rise

but by less than the foreign interest rate while the exchange rate will fall, opening up a forward premium on the domestic currency to offset the interest rate differential. At the same time income will rise.

If base money were the target, M3 could rise or fall depending on the relative effects of income and interest rates. The first influence reduces the money supply by increasing currency demand and depleting bank reserves; the second increases the money supply by reducing the demand for free reserves. It is likely that the first effect will be the dominant one; in this case H is the preferred target.

For reasons already discussed, M3 is preferred to M3A. Compare now M1 and M3. The rise in interest rates will tend to reduce M1, but the rise in income will increase M1. If the latter is dominant, as seems likely, M1 will be the better stabilizer.

Finally, we consider the important case of a real expenditure disturbance (u_1). As in the case of a foreign interest rate disturbance, none of the money aggregates would serve as perfect stabilizers. Compare first H and M3. In both cases the increase in expenditure will put upward pressure on the currency and the interest rate but income will rise. If, with H as the target, M3 fell (rose), H would be preferred (inferior) to M3. Whether M3 will in fact rise or fall if H were targeted depends on the relative influences of rising income (which, as we have seen, increases currency demand and puts downward pressures on bank reserves) and the rise in interest rates (which reduces the demand for free reserves). We have argued that it is likely that the first effect would be the dominant one; in this case H would be the preferred target.

Compare now M1 and M3. The rise in income will tend to raise the level of M1; the rise in interest rates, however, will reduce M1 because there will now be an incentive to shift into time deposits. If M1 rises (falls), on balance, M1 will be a better (worse) stabilizer because now corrective measures will require that less (more) base money be injected into the economy. As we have previously argued, it seems reasonable to suppose that M1 will rise in the face of an expenditure shock, so M1 is more likely to be the better performer, but this conclusion becomes weaker the greater the adjustment of the time deposit rate to market interest rates.

For reasons already discussed, too, M3 will be a better stabilizer than M3A. As income rises, falling foreign currency holdings will, if M3A were the target, force the authorities to actually increase M3.

M1 and H are, however, more difficult to compare. The issue may be put as follows: If H were the target, what would happen to M1? If M1 fell (rose) H would be the better (inferior) target. Suppose the currency drain effect offsets the free reserves effect; there would be downward pressures on M3 but not necessarily on M1: M1 might nevertheless rise because of the income/interest rate effects noted above. On balance, then, it is difficult to judge the relative performance of M1 and H.

If M3 were the target what will now happen to the other money aggregates? H will probably be above projection (because, as noted, with H targeted, M3 would probably fall); M1 will probably also be above projection (assuming income is the dominant influence on M1) while finally M3A will be below projection.

4. Differential reserve requirements, and the performance of the money aggregates

In some economies (e.g., the United States and Germany) there are different reserve requirements on demand and time deposits. This possibility has been disregarded in the formal model. We now need to ask, briefly, how our results might be different if reserve requirements were higher on demand than on time deposits.

To begin, the results for M1, M3, and M3A are basically unaffected by different reserve requirements. If these money aggregates were targeted and, by assumption, controlled, the results would all remain the same. It is different, however, with base money. Now different reserve requirements, for given base money, do affect the money supply process and hence outcomes.

Everything turns on what happens to the composition of deposits between demand and time deposits. If the weight of demand deposits increases, the higher reserve requirements will force a contraction in the money supply. The weight of demand deposits will increase (decrease) when income rises (falls) and interest rates fall (increase). When income and interest rates move in the same direction the outcome for demand deposits is strictly ambiguous. We have, however, suggested that the income effect might be the dominant one. Bearing in mind these comments, we now consider briefly each disturbance in turn.

For a shift out of currency into demand deposits the weight of demand deposits will increase and this will be stabilizing. For an increase in the demand for free reserves the weight of demand deposits will fall and this again will be stabilizing because it will slow down the contraction in the money supply.

For a shift from demand into time deposits there will now be some expansion in the money supply, which is destabilizing. For a shift from time deposits into bonds the weight of demand deposits will increase and this should be stabilizing. For a currency substitution the outcome is ambiguous. For a change in the foreign interest rate the outcome is also strictly ambiguous; if, however, we assume that the income effect is dominant, the effects on the money supply will be stabilizing. Finally, for an expenditure disturbance again the outcome is strictly ambiguous because income and interest rates both rise. If, however, again the income effect is dominant the outcome will also be stabilizing.

To conclude, then, there is only one unambiguous case where the performance of high-powered money actually worsens when there are differential reserve requirements. In all other cases, the outcome is either

ambiguous or favors high-powered money. On balance, it would seem that the performance of high-powered money as an intermediate target is probably enhanced by the existence of differential reserve requirements.

5. Some conclusions about the performance of the money aggregates

The following would seem to be the principal conclusions of the analysis:

a. Except for the single case of currency substitution, the broadest money aggregate, which includes foreign currency holdings, turns out to be inferior to M3. There is, it appears, little to be said for such a broad money aggregate.

b. In general, M1 appears to be a better performer than M3. Only in the case where there is an exogenous switch out of demand into time deposits is M3 unambiguously the better performer. For money supply shocks the two perform equally well. For expenditure shocks as well as for two money demand shocks, M1 appears to be the better performer.

The principal reason why M1 performs well is that M1 is predominantly income determined. If the objective is to stabilize income, M1 will rise and fall as income rises and falls. By targeting M1 and correcting for these fluctuations in M1, the authorities will help to stabilize income.

The more demand deposits are used almost exclusively for transactions purposes, the less sensitive demand deposits will be to interest rate shifts and the less will tend to be the exposure to exogenous shifts from demand to time deposits. This increases the relative advantage of M1 as a money target. 1/

c. A good theoretical case could be made for announcing targets in several money aggregates and, as well, using target bands for each aggregate (as, for example, in the United States). One could then exploit information which becomes available in the course of the year about disturbances to decide what deviation will be allowed from the mean target for each money aggregate. To provide a concrete illustration suppose a target band were announced for M1 and M3. If all projections are realized, the authorities will aim at the mean target growth in the two money aggregates. Suppose, however, in the course of the year it were known that there was an exogenous movement out of demand into time deposits. In this case M1 would be allowed to fall below its mean target while M3

1/ It is most worthy of note that the new money series constructed by the U.K. authorities conforms almost exactly to the concept identified here. See Bank of England, Quarterly Bulletin (1982). "The objective is to design a new measure which could be expected to be more directly related to transactions in goods and services than sterling M3, and somehow less sensitive to interest rates than M3." Thus, if the reasoning in the text is correct this ought to be the money definition the authorities should target from now on.

would be observed. Now suppose that income is growing too rapidly and this is reflected in an unexpected growth of M1 above the mean target. Then in this case, the monetary authorities would be trying to maintain the mean M1 target but allow M3 to fall below the mean target.

In practice this fine tuning might be very difficult to achieve. Nevertheless, there is still a case to be made for multi-targeting with bands in that it allows the authorities some discretion in cases where reliable information is available.

d. H is a particularly poor performer for money supply shocks. Its performance vis-à-vis M1 is ambiguous for several disturbances. Given these uncertainties it would seem reasonable to conclude that M1 is "safer" as an intermediate target than H.

6. Exchange rate effects

It is of some interest to examine the implications for exchange rates of selecting different money aggregates as intermediate targets.

It is easily shown that, except in the case of an expenditure shock, the larger the income effect the larger will be the exchange rate adjustment. Hence for all monetary shocks (supply or demand) the monetary aggregate which best stabilizes income will also be the one which best stabilizes exchange rates.

For expenditure shocks, however, the opposite holds. To illustrate this point, compare M3 and H. If M3 were the target an expenditure shock creates an excess demand for money (the domestic interest rate rises and the currency appreciates, thus opening up an expected depreciation which offsets the higher domestic interest rate). The higher interest rate as well as the appreciation serve to dampen the rise in income. Suppose now H were the target and suppose, as we have contended, that in these circumstances M3 would be likely to fall. This will serve to raise interest rates and strengthen the currency further and thus will now be stabilizing. So the money aggregate which is the more stabilizing will also be associated with a larger exchange rate adjustment. There is here then a trade-off. Stabilizing income will in this case destabilize exchange rates.

7. Implications of deregulation for the volatility of interest rates, income, and exchange rates and for the choice of intermediate target

Table 3 sets out in some detail the implications of deregulation for the volatility of market interest rates, income, and exchange rates.

The results for H, M3, and M3A are very similar and they can be readily summarized. For all monetary shocks, other than that arising from changes in foreign interest rates, deregulation at once tends to destabilize income, interest rates, and exchange rates. The reason is straightforward enough. Interest rate effects will tend to be magnified by deregulation because time deposit rates will adjust, partially at

least, to market rates. Suppose market rates were falling; time deposit rates will adjust downward; this further reduces the demand for broad money lowering market interest rates further, thus accentuating income and exchange rate effects.

For real shocks or shocks due to changes in foreign interest rates, the conclusions, for the same money aggregates, are different. Consider a real shock. Market interest rates rise; with deregulation time deposit rates will also adjust upward increasing the demand for money which in turn pushes market interest rates up further. This attenuates the increase in income but accentuates the upward movement in the currency. Thus, for real effects, deregulation stabilizes income but destabilizes interest rates and exchange rates. For a rise in the foreign interest rate, deregulation forces the interest rate up further which again stabilizes income but now also stabilizes the currency (which is falling).

To conclude then, if H, M3, or M3A were the money targets deregulation always destabilizes market interest rates, but what happens to income and exchange rates depends on the kind of shock to the system. Income will be stabilized for real and foreign interest rate shocks. The exchange rate, however, will be destabilized except for the foreign interest rate shock. Thus, deregulation is almost certain to destabilize both interest rates and exchange rates but may stabilize or destabilize income.

The results for M1 are different again. For monetary shocks other than those due to changes in foreign interest rates (more particularly, e2 and e3), deregulation stabilizes interest rates, income, and exchange rates. Consider, by way of illustration, a shift out of demand into time deposits. With regulation there would be monetary expansion and market interest rates would fall. If interest rates are deregulated, the interest rate on time deposits would adjust downward; this increases the demand for M1. The monetary authorities will try to reverse this by reducing bank reserves; this will now force up market interest rates and slow down the increase in income and the fall in the currency.

For a real shock interest rates will rise. Without regulation this will be followed by a rise in time deposit rates. This, in turn, reduces the demand for M1 which now forces the monetary authorities to be more expansionary. This attenuates the rise in market interest rates and in the currency but accentuates the rise in income.

For a foreign interest rate shock again the interest rate will be higher. Without regulation there will be a sympathetic upward movement in time deposit rates; this reduces the demand for M1 which again forces the monetary authorities to be more expansionary. Thus, while the effect on the interest rate is dampened, the effects on income and the currency are accentuated.

For M1, then, deregulation actually serves to stabilize interest rates; it also almost certainly stabilizes exchange rates. What it does to income, however, depends on the source of the shock.

Is it possible, in the light of our results, to say anything about the implications of deregulation for the choice of intermediate target? If M1 were chosen in preference to H, M3, or M3A, interest rates and exchange rates would be stabilized. The relative advantage of M1 as an income stabilizer may, however, be weakened if the dominant shocks are real and/or come from changes in foreign interest rates.

ANNEX

Technical Representation of Model and Solutions

Notation

C = Currency held by households

DB = Domestic bonds held by households (fixed market value--flexible rates)

DB_F = Foreign currency-denominated bonds held by households

DC = Demand deposits held by households

DC_F = Demand deposits held by households in foreign banks, denominated in foreign currency

DT = Time deposits held by households

E = Exchange rate (units of domestic currency per unit of foreign currency)

Ee = Expected exchange rate

F = Forward exchange rate

FR = Free reserves of the domestic banking system

GR = Gross reserves of the domestic banking system

H = Base money (high-powered money)

M1 = Narrow money--includes currency and domestic demand deposits held by households

M3 = M1 plus DT

M3A = M3 plus DC_F

RR = Mandatory reserve requirements against total deposits of the banking system

rd = Domestic interest rate

rf = Foreign interest rate

r_t = Interest rate on time deposits

W = Household financial wealth

Y = Gross national product

Key definitions

$$M1 = C + DC$$

$$M3 = C + DC + DT$$

$$M3A = C + DC + DT + DC_F$$

$$W = C + DC + DT + DB + E.DC_F + E.DB_F$$

$$GR = RR + FR$$

$$H = GR + C$$

Household demand for financial assets

1. $C = -b_1 rd - b_2 rt - b_3 rf - b_4 \left(\frac{Ee-E}{E}\right) + b_5 Y + b_6 W - e_1$

2. $DC = -b_7 rd - b_8 r_t - b_9 rf - b_{10}\left(\frac{Ee-E}{E}\right) + b_{11} Y + b_{12} W + e_1 - e_2 - e_3$

3. $DT = -b_{13}\, rd + b_{14} r_t - b_{15}\, rf - b_{16}\left(\frac{Ee-E}{E}\right) - b_{17} Y + b_{18} W + e_2 - e_4$

4. $DB = b_{19} rd - b_{20} rt - b_{21} rf - b_{22}\left(\frac{Ee-E}{E}\right) - b_{23} Y + b_{24} W + e_4$

5. $E.DC_F = -b_{25} rd - b_{26} rt - b_{27} rf + b_{28}\left(\frac{Ee-E}{E}\right) - b_{29} Y + b_{30} W + e_3$

6. $E.DB_F = -b_{31} rd - b_{32} r^t + b_{33} rf + b_{34}\left(\frac{Ee-E}{E}\right) - b_{35} Y + b_{36} W$

Given the wealth constraint the following would hold:

$$b_6 + b_{12} + b_{18} + b_{24} + b_{30} + b_{36} = 1$$

$$b_{19} = b_1 + b_7 + b_{13} + b_{25} + b_{31}$$

$$b_{14} = b_2 + b_7 + b_{20} + b_{26} + b_{32}$$

$$b_{33} = b_3 + b_9 + b_{15} + b_{21} + b_{27}$$

$$b_{28} + b_{34} = b_4 + b_{10} + b_{16} + b_{22}$$

$$b_5 + b_{11} = b_{17} + b_{23} + b_{29} + b_{35}$$

e_1 represents the currency to demand deposit switch.

e_2 represents the demand to time deposit switch.

e_3 represents currency substitution.

e_4 is the shift from time deposits to domestic bonds.

ANNEX

As explained in the text, the model we work with is considerably simplified. Wealth is dropped out of the equations and several coefficients are constrained to be zero. The asset demands we use are:

7. $C = \alpha_1 Y - e_1$

8. $DC = -\alpha_2 rd - \alpha_3 rt + \alpha_4 Y + e_1 - e_2 - e_3$

9. $DT = -\alpha_{20} rd + \alpha_5 r_t - \alpha_6 (rf + \frac{Ee-e}{E}) - \alpha_7 Y + e_2 - e_4$

10. $E.DC_F = \alpha_8 Y + \alpha_9 (\frac{Ee - E}{E}) + e_3$

The constraints we impose on the original model are:

$$b_1 = b_2 = b_3 = b_4 = b_8 = b_9 = b_{10} = b_{25} = b_{26} = b_{27} = 0$$

Also $b_{15} = b_{16}$.

The banking system and the money supply equation

11. $RR = d_1 (DC + DT)$

12. $FR = d_2 (DC + DT) - d3rd + e5$

These represent the equations for required reserves and for free reserves, respectively.

These equations together with the definition of base money and M3 allow us to derive a money supply equation for M3. The equation is:

13. $M3 = \frac{1}{m} H - \frac{\alpha 1(1-m)}{m} Y + (\frac{1-m}{m}) e_1 + \frac{3}{m} rd - \frac{1}{m} e_5$

where $m = d_1 + d_2$

The economics underlying this money supply equation is explained in the text.

Deregulation and the banking system

p represents the proportion of total deposits held as cash on which interest rk may or may not be earned. Suppose that a proportion (α_{30}) of the bank lending is longer term on which the interest rate is fixed, so ($1 - \alpha_{30}$) represents the proportion of the loan portfolio on which the new interest rate may be earned. If total bank assets are given, how will time deposit interest rates (r^t) adjust to a change in the market interest rate?

The increased earnings on loans and cash resulting from the increase in the market interest rate will be:

14. $(1 - \alpha_{30})\ (1 - p)\ (DC + DT)\ \Delta rd + p\ (DC + DT)\ \Delta rk$

In a competitive banking system, to offset these increased earnings we require:

15. $DT_{\Delta} r^t = (1 - \alpha_{30})\ (1 - p)\ (DC + DT)\ \Delta rd + p\ (DC + DT)\ \Delta rk$

Suppose that:

16. $\Delta rk = \alpha_{50}\ \Delta rd$ where $\alpha_{50} < 1$

Then we have

17. $\Delta r_t = [(1 - \alpha_{30})\ (1 - p) + p\ \alpha_{50}]\ \frac{DC+DT}{DT}\ \Delta rd$

with α_{30}, p, and α_{50} all less than 1, the bracketed expression must be less than 1. The expression will approach 1 as $\alpha_{30} \to 0$ and $\alpha_{50} \to 1$. With $\frac{DC+DT}{DT} > 1$, the coefficient of adjustment could be greater than 1.

We now write

18. $\Delta r^t = \alpha_9 \Delta rd$ where $\alpha_9 = [(1 - \alpha_{30})(1 - p) + p\alpha_{50}]\ (\frac{DC+DT}{DT})$

Interest rate parity

19. $rd = rf + \frac{F+E}{E}$

20. $F = Ee$

Returning to the original set of demands for financial assets, the assumption of perfect integration implies that $b_{19} = b_{31} = b_{21} = b_{33} = b_{22} = b_{34} = \infty$. The two equations for bonds (4 and 6) in effect drop out of the system and are not needed.

Money demand and base money equations

21. $M1 = (\alpha_1 + \alpha_4)Y - (\alpha_2 + \alpha_3\alpha_9)rd - e_2 - e_3$

Aggregating equations 7-8 and substituting equation 18:

22. $M3 = (\alpha_1 + \alpha_4 - \alpha_7)Y - (\alpha_2 + \alpha_3\alpha_9 + \alpha_{20} - \alpha_5\alpha_9)rd - \alpha_6(rf = \frac{Ee-E}{E})$

$-e_3 - e_4$

Aggregating equations 7-9 and substituting equation 18:

23. $M3A = (\alpha_1 + \alpha_4 - \alpha_7 - \alpha_8)Y - (\alpha_2 + \alpha_3\,\alpha_9 + \alpha_{20} - \alpha_5\,\alpha_9)rd - \alpha_6 rf$
$- (\alpha_6 - \alpha_9)\,\frac{Ee-E}{E} - e_4$

Aggregating equations 7-10 and substituting equation 18:

24. $H = [\alpha_1(1 - m) + m(\alpha_1 + \alpha_4 + \alpha_7)]Y - (1 - m)\,e_1 - m(e_3 + e_4) + e_5$
$-m\alpha_6(rf + \frac{Ee-E}{E}) - [d_3 + m(\alpha_2 + \alpha_3\alpha_9 + \alpha_{20} - \alpha_5\alpha_9)]\,rd$

Combining equations 13 and 22.

To simplify a little we are going to assume that $\alpha_6 = \alpha_9$ so the expression for the expected per cent change in the exchange rate drops out of the equation altogether. This amounts to saying that if there is a change in exchange rate expectations there is an equivalent switch out of time deposits into foreign demand deposits.

The goods market

25. $Y = - \alpha_{10}rd + \alpha_{11}E + u_1$

Aggregate demand is determined by the interest rate, the exchange rate, and a disturbance term u_1.

The effects of a change in exchange rate expectations

It is worth noting that the effects of an exogenous change in exchange rate expectations (Ee) in the model are exactly the same as the effects of a change in the foreign interest rate for M1, M3, and H. There is, therefore, no need to treat this as an additional disturbance, insofar as these three alternative money targets are concerned.

However, for the broadest money aggregate (M3A) there is an important distinction between the two disturbances stemming from the particular assumptions we have made about asset demands. This is easily seen by looking again at Equations 21-24. If we remove rd from each of these equations by using equations 19-20 it is seen that the coefficients for rf and Ee are the same for M1, M3, and H, but not, however, the same for M3A.

The solutions

As described in the text, the solutions are obtained by deriving a money market equation for each money aggregate to be targeted as above and then combining it with interest rate parity and the goods market equation. These solutions are shown in Table 4.

ANNEX

We argued in the text that, if M1 were purely demand determined (i.e., used only for transaction purposes and insensitive to interest rates), M1 would be very stabilizing vis-à-vis income. This special case would be represented by $\alpha_2 = \alpha_3 = 0$. Now only shifts from demand to time and currency substitutions produce any real effects. In all other cases the effect on income is zero.

Table 2. Relative Performance of Money Aggregates

Disturbances	Performance of Money Aggregates 1/	Behavior of H, M1, M3A When M3 Targeted (Deviation from Projection)
1. Money supply e_1	$M_1 = M_3 = M_{3A} > H$	M_1, M_{3A} no deviation H will fall below projection
e_5	$M_1 = M_3 = M_{3A} > H$	M_1, M_{3A} no deviation H will now be above projection
2. Money demand e_2	$M_3 = M_{3A} = H > M_1$	H, M_{3A} no deviation M_1 will be below projection
e_4	$M_1 > H > M_3 > M_{3A}$	M_1 and H above projection M_{3A} below projection
e_3	$M_{3A} > H > M_3$ $M_{3A} > M_1$ M_1 ambiguous vis-à-vis H and M_3	M_1 ambiguous. H above projection M_{3A} above projection
rf	$M_1 > M_3 > M_{3A}$ 2/ $H > M_3$ 2/ M_1 and H difficult to compare	H and M_1 above projection 2/ M_{3A} below projection
3. Real (expenditure) u_1	$M_1 > M_3 >^{(2)} M_{3A}$ $H > M_3 >^{(2)} M_{3A}$ M_1 and H difficult to compare	H and M_1 above projection 2/ M_{3A} below projection

1/ From best to worst:
- e_1 = Shift out of currency into demand deposits.
- e_5 = Increase in banks' demand for free reserves.
- e_2 = Shift out of demand into time deposits.
- e_4 = Shift out of time deposits into "bonds."
- e_3 = Shift out of domestic demand deposits into foreign currency deposits.
- rf = A change in the foreign interest rate.
- u_1 = An expenditure shift.

2/ Probable outcome. See text.

Table 3. Effects of Deregulation on Volatility of Y, E, and rd for Each Money Aggregate 1/

Disturbance	rd	Y	E
e_2	H, M_3, M_{3A} = 0 M_1↓	H, M_3, M_{3A} = 0 M_1↓	H, M_3, M_{3A} = 0 E↓
e_1	M_1, M_3, M_{3A} = 0 H↑	M_1, M_3, M_{3A} = 0 H↑	M_1, M_3, M_{3A} = 0 E↑
e_5	M_1, M_3, M_{3A} = 0 H↑	M_1, M_3, M_{3A} = 0 H↑	M_1, M_3, M_{3A} = 0 H↑
e_4	H↑ M_1 = 0 M_3↑ M_{3A}↑	H↑ M_1 = 0 M_3↑ M_{3A}↑	M_1 = 0 H↑ M_3↑ M_{3A}↑
e_3	H↑ M_3↑ M_{3A} = 0 M_1↓	H↑ M_3↑ M_{3A} = 0 M_1↓	H↑ M_3↑ M_1↓ M_{3A} = 0
rf	M_1↓ H↑ M_3↑ M_{3A}↑	H↓ M_1↑ M_3↓ M_{3A}↓	H↓ M_1↑ M_3↓ M_{3A}↓
u_1	H↑ M_1↓ M_3↑ M_{3A}↑	H↓ M_1↑ M_3↓ M_{3A}↓	H↑ M_1↓ M_3↑ M_{3A}↑

1/ ↑ = Increases volatility.
↓ = Decreases volatility.
0 = No effect on volatility.

Table 4. Solutions for Income

Disturbance	H	M_1	M_3	M_{3A}
e_1	$\frac{\frac{1-m}{m}(\alpha 10 + \alpha 11)}{D_1}$	0	0	0
e_2	0	$\frac{\alpha 10 + \alpha 11}{(\alpha_1 + \alpha_4)(\alpha_{10} + \alpha_{11}) + \alpha_2 + \alpha 3 \alpha 9}$	0	0

$$D_1 = (\alpha_1 + \alpha_4 - \alpha_7)(\alpha_{10} + \alpha_{11}) + \alpha 6 + \alpha 2 + \alpha 3 \alpha 9 - \alpha 5 \alpha 9 + \alpha 20 + \frac{d3}{m} + \frac{\alpha_1(1-m)}{m}(\alpha 10 + \alpha 11)$$

$\alpha 5 > \alpha 3$

Table 4 (continued). Solutions for Income

Disturbance	H	M_1	M_3	M_{3A}
e_5	$-\frac{\frac{1}{m}(\alpha 10 + \alpha 11)}{D_1}$	0	0	0
e_4	$\frac{\alpha 10 + \alpha 11}{D_1}$	0	$\frac{\alpha 10 + \alpha 11}{D_2}$	$\frac{\alpha 10 + \alpha 11}{D_3}$
e_3	$\frac{\alpha 10 + \alpha 11}{D_1}$	$\frac{\alpha 10 + \alpha 11}{(\alpha_1+\alpha_4)(\alpha_{10}+\alpha_{11})+\alpha_2+\alpha_3\alpha_9}$	$\frac{\alpha 10 + \alpha 11}{D_2}$	0

$$D_3 = (\alpha_1 + \alpha_4 - \alpha_7 - \alpha_8)(\alpha_{10} + \alpha_{11}) + \alpha_6 + \alpha_2 + \alpha_3\alpha_9 - \alpha_5\alpha_9 + \alpha_{20}$$

$$D_2 = (\alpha_1 + \alpha_4 - \alpha_7)(\alpha_{10} + \alpha_{11}) + \alpha_6 + \alpha_2 + \alpha_3\alpha_9 - \alpha_5\alpha_9 + \alpha_{20}$$

Table 4 (concluded). Solutions for Income

Disturbance	H	M_1	M_3	M_{3A}
rf	$\frac{\alpha 11(\alpha 6+\alpha 2+\alpha 3\alpha 9-\alpha 5\alpha 9+\alpha 20+\frac{d3}{m})}{D_1}$	$\frac{\alpha 11(\alpha 2+\alpha 3\alpha 9)}{(\alpha 1+\alpha 4)(\alpha 10+\alpha 11)+\alpha 2+\alpha 3+\alpha 9}$	$\frac{\alpha 11(\alpha 6+\alpha 2+\alpha 3\alpha 9-\alpha 5\alpha 9+\alpha 20)}{D_2}$	$\frac{\alpha 11(\alpha 6+\alpha 2+\alpha 3\alpha 9-\alpha 5\alpha 9+\alpha 20)}{D_3}$
u_1	$\frac{(\alpha 6+\alpha 2+\alpha 3\alpha 9-\alpha 5\alpha 9+\alpha 20+\frac{d3}{m}}{D_1}$	$\frac{\alpha 2+\alpha 3\alpha 9}{(\alpha 1+\alpha 4)(\alpha 10+\alpha 11)+\alpha 2+\alpha 3\alpha 9}$	$\frac{\alpha 6+\alpha 2+\alpha 3\alpha 9-\alpha 5\alpha 9+\alpha 20}{D_2}$	$\frac{\alpha 6+\alpha 2+\alpha 3\alpha 9-\alpha 5\alpha 9+\alpha 20}{D_3}$

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