

OPTIMAL FIDUCIARY MONETARY SYSTEMS

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In a fiduciary monetary system, there is a social agreement to quote prices and denominate financial instruments in terms of a specific paper liability of the government. What are the best terms for this paper instrument? I investigate a system where the terms involve not only paying market interest rate on the monetary instrument, as proposed by many economists earlier, but also indexing the returns to the price level. The result is a homeostatic monetary system with a highly stable price level in the face of shifts in money demand and other disturbing influences. The paper examines the performance of the new fiduciary standard in equilibrium and disequilibrium models.

1. Objectives

A monetary system is a social agreement upon the interpretation of the numbers merchants write on goods and upon the ways for conveying purchasing power. Because a monetary system is a collective endeavor, government is typically involved, though there is no logical necessity for government action. Two general classes of agreements on the interpretation of prices have been seen historically — quotation in terms of physical units of a commodity or in terms of special financial instruments of government. The second, the fiduciary monetary system, has come to dominate in the late twentieth century. Almost everywhere in the world, governments issue non-interest-paying bearer notes; prices and financial obligations are quoted in terms of these notes.

My purpose in this paper is to examine the design of a fiduciary monetary system. Could existing systems be improved by changing the terms of the special financial instruments which define prices? I approach the question of the terms of the instrument at a more general level than the traditional issue of paying interest on reserves. Not only should the monetary instrument earn market interest, but it should be indexed to the price level as well, according to the analysis of the paper. Moreover, a suitably designed monetary instrument will make the price level insensitive to developments in the private economy, so it is unnecessary to limit the creation of close substitutes by private institutions.

*All opinions are mine alone. I am grateful to Alexander Rawls for assistance and to Eugene Fama for helpful discussions.

The criteria used here for judging monetary systems are both microeconomic and macroeconomic. At the micro level, elimination of deadweight loss is the goal. As usual in monetary analysis, this criterion calls for saturating the economy in monetary instruments, which are free to produce. At the macro level, stabilization of the average price level is one goal. The other is keeping real output close to its equilibrium level. Whether or not a policy rule is necessary or helpful in achieving the second goal is a controversial question. The last part of the paper studies a case where policy can be helpful, but nothing earlier rests on the hypotheses of that case.

2. The choice of monetary instrument

In a fiduciary monetary system, the government creates a special kind of liability, which I will call a reserve certificate. How it differs from other liabilities is an issue of the design of the monetary system. What is uniquely important about the reserve certificate is its role in quoting prices and defining financial obligations. The government, in essence, offers the reserve certificate as a convenient way to quote prices and write contracts. In very few cases is any compulsion involved. No law in the United States requires that prices be marked in dollars or that contracts be written in dollars. But use of the dollar is almost universal for these purposes. A uniform custom for stating economic values seems a valuable public good. Even in countries like Israel, where the purchasing power of the reserve certificate is too unstable to make it usable for writing forward contracts, prices for immediate delivery are generally quoted in the national reserve certificate.

Nothing in the nature of a fiduciary system requires that the reserve certificate functions as the medium of exchange. In advanced economies, the overwhelming bulk of transactions are carried out by private action without actual movements of certificates. Rather, what is absolutely essential for the reserve certificate is that it has positive purchasing power. If the relative price of reserve certificates in equilibrium is zero, they cannot function as numeraire. Were reserve certificates dominated in every respect by some other form of government debt, the fiduciary system could not function.

The designers of a monetary system must take care to create a reserve certificate with positive demand. For this purpose, the government has two classes of policies. First, through regulation, the public can be forced or induced to hold reserve certificates. Second, certificates can be made financially attractive through the return they pay.

Regulatory policy to stimulate the demand for reserve certificates is a standard feature of almost all fiduciary monetary systems. Banks and other financial institutions are required to hold reserves in proportion to their liabilities. Reserve certificates themselves circulate to mediate small transactions because the government prohibits private institutions from

issuing bearer securities in small denominations. Much of the motivation for these regulations is fiscal — the government raises revenue by requiring the public to use its product at an artificially high price. But the same regulations also ensure that reserve certificates trade at positive prices. Eugene Fama (1980) has elaborated this point.

Among economies with less than extreme inflation, the financial terms of reserve certificates are uniform — there is no cash return at all. The real yield of reserve certificates is just the negative of the rate of inflation. Improvements in the financial terms of reserve certificates is one of the main areas of exploration of this paper. As reserve certificates become more financially attractive, it becomes less necessary to stimulate their demand through inefficient regulation.

Because reserve certificates serve as numeraire, there are limitations on the way they can earn a cash return. The problem is more profound than the familiar inconvenience of paying interest on currency. If all the year's earnings of a certificate are paid to the owner of the certificate on, say, January 1, then the price of the certificate must fall by the amount of the earnings on January 1, just as the price of a stock falls the moment it starts trading ex dividend. But the price of a reserve certificate is always unity. If the year's earnings are paid January 1, then the whole price level must rise on January 1 to bring about the necessary decline in the value of the certificate. A good monetary system avoids all fluctuations in the price level, so annual payment of earnings to owners of reserve certificates is unacceptable.

Instead, the earnings of reserve certificates must accrue to their owners each day. Somebody who owns a certificate from May 13 to August 13 must receive, in due course, the earnings of the certificate for exactly that period. Two arrangements suggest themselves. First, reserve certificates could be accounts with balances reckoned in dollars and cents, with interest paid into the account at the end of each day in proportion to the balance during the day. Second, reserve certificates could come only in large denominations, like Treasury bills today, and the government could pay out the return by writing a check to the owner on a regular monthly or quarterly schedule and also at the moment the certificate changed hands.

In principle, there is almost no difference between these two systems. Treasury bills today are no more than accounting entries anyway. For the purposes of the rest of the paper, it does not matter exactly how the government sets up the reserve certificate. What will be important is the payment of a continuously accrued cash return to reserve certificates.

I will not make any assumptions about the demand for reserve certificates. Throughout the economy, an obligation stated in dollars is now, and would continue to be, an obligation to deliver reserve certificates upon the request of the recipient. From this source, there may arise a demand to hold wealth

in reserve certificates as a reserve against a request for such delivery. Banks and other institutions issuing instruments promising redemption on demand at face value have a particular need for reserves. I contemplate an economy free of formal reserve requirements, though much of what I have to say remains relevant with those regulations.

The case where reserve certificates are perfect substitutes for other forms of government or private debt is particularly interesting. As a general matter, the price level will be indeterminate in this case. However, I will show that a particular form of indexing eliminates the indeterminacy.

The central problem with a fiduciary monetary system is the following: In the absence of inefficient regulatory intervention, the demand for reserve certificates is unpredictable and possibly unstable. But the purchasing power of the certificate is determined precisely by that demand. How can the price level be kept on target in an economy with a fiduciary monetary system with unregulated financial institutions? The answer pursued in this paper is to make the demand for reserve certificates highly elastic with respect to the price level. Small changes in the price level are then enough to offset large shifts in the demand for reserve certificates.

Linking the earnings of reserve certificates to the price level is the technique explored in this paper for improving the performance of a fiduciary monetary system. The basic idea is easiest to understand in the case where the reserve certificate is perfectly substitutable for other components of the government debt; that is, nobody wants to hold certificates because of their unique monetary role, but only because they are interest-bearing instruments with the same return as Treasury bills. Then the public's demand for reserve certificates will have a knife-edge character — demand will be zero if RCs pay less than TBs, indeterminate if they pay the same, and very high if RCs pay more than TBs. Let the policy for paying interest on RCs be the following: an RC earns the TB interest rate plus an extra 1 percent per year for each percent by which the price level exceeds 100. Then the only possible price level is 100. If prices exceed 100, RCs pay more than TBs, and the public will want to move all of its wealth from TBs to RCs. Changes in interest rates cannot clear the market, for the interest on RCs is linked to the market TB rate. On the other hand, if prices fall short of 100, RCs earn less than TBs, and nobody will want RCs at all. Again, the market cannot clear at this price level. If prices are exactly 100, the public willingly holds whatever combination of RCs and TBs that the government has decided to put on the market. Therefore, the only possible price level is 100, and that is the competitive equilibrium price level.

If there is a little demand for RCs because of their unique monetary role, the analysis becomes a little more complicated; it is the subject of the next section. In essence, the equilibrium price level is a bit below 100, so that RCs earn slightly less than TBs in order to offset their monetary return.

The critical function of the reserve certificate in the type of monetary system I envisage is to serve as the standard of value. Once the purchasing power of the RC is firmly established through the linkage of its return to the price level, a wide variety of unregulated private institutions can flourish to provide stores of wealth and media of exchange denominated in reserve certificates. Banks could issue currency, for example. A dollar bill issued by the Bank of America would be an instrument redeemable on demand for one dollar in a reserve account. Instruments like private currency that are currently prohibited because they are close substitutes for the existing form of reserve certificates (Federal Reserve bills and deposits) need not be restricted once the financial terms of the reserve certificate are modified.

Whether or not private currency should be permitted is an issue of public finance more than one of providing a stable monetary standard. There is some logic to capturing the seignorage profits from currency as government revenue. The competitive equilibrium with private non-interest-bearing currency involves wasteful expenditures of resources in keeping currency in circulation. With appropriately indexed reserve certificates, there is little or no connection between fiscal decisions about capturing seignorage and monetary decisions about the price level.

Similarly, decisions about the role of the government in mediating transactions by check are essentially separate from decisions about the price level. Under present arrangements, the government handles a large volume of transactions in reserve certificates within the Federal Reserve System. If the Fed begins to pay an indexed return on reserves, it might well remain in the business of handling transactions. Alternatively, most or all of the transactions could be carried out by private banks or brokers. Again, there are essentially no implications for the price level. Decisions about the government's role in mediating transactions should be made according to the same principles that should govern decisions about how mail is handled, for example. None of the aspects of the monetary system discussed in this paper depend on whether or not reserve certificates participate directly in the mediation of transactions.

3. The optimal reserve certificate in an equilibrium economy

This section works through some aspects of optimal policy in an economy with perfectly flexible prices. The goals of policy are to reduce deadweight loss and to stabilize the price level.

The points I want to make are adequately conveyed in a simple model. Suppose the nominal demand for reserve certificates has the form,

$$a \frac{Y}{r-z} (p-x),$$

where Y is real output, determined exogenously in the real economy, r is the nominal interest rate, z is the yield paid on reserve certificates, p is the price level, and x is a random disturbance, measured along the price axis. This demand function has the critical characteristic that demand becomes infinite if reserve certificates earn the same yield as other government debt, that is, as z approaches r . The parameter a describes the public's desire to hold reserve certificates when they earn less than other debt. At the end of this section, I will separately work out the case where the public treats RCs as perfect substitutes for other government debt; this case is not adequately characterized by setting a to zero.

Suppose the government fixes the number of outstanding reserve certificates at the level M . Then the price level will adjust to equate supply and demand:

$$M = a \frac{Y}{r-z} (p-x) \quad \text{or} \quad p = \frac{Mr-z}{a} \frac{1}{Y} + x.$$

One of the goals of policy is to keep p at a constant level, say $p=1$. The necessary value of the yield, z , is

$$z = r - aY/M + (aY/M)x.$$

In words, the government should pay the holder of RCs the market interest rate r less an amount that depends on output, Y , plus an amount that depends on the demand fluctuation, x .

For the other goal, limiting deadweight loss, it is apparent that the efficient value of z is as close to r as possible — complete saturation occurs when RCs earn the market rate of interest. If an effective policy for setting $p=1$ is in effect, saturation occurs when M is as large as possible. Here I follow Milton Friedman's (1966) original argument and abstract from considerations of taxes.

Although the weight, aY/M , given to x in the optimal policy for z is close to zero under saturation, it is not true that a simple policy of paying almost the market interest rate on RCs is even close to optimal. The price level,

$$p = \frac{Mr-z}{a} \frac{1}{Y} + x$$

is highly sensitive to z at saturation. It always shifts point-for-point with x unless z is linked to x or its equivalent. The small adjustment of z to x under saturation is critical for stabilizing prices.

Linking the yield on RCs to the shift, x , in the RC demand function is not altogether satisfactory; x is not observed directly, and the case for linking to

what would be in practice a regression residual would be hard to make to legislators and policy makers. A natural question is whether linking instead to an observed variable, specifically, the price level, can achieve price stability. The answer is favorable.

Consider the family of indexing formulas,

$$z = r - d + b(p - 1).$$

As in the earlier formula containing x , the link between the market interest rate, r , and the yield on RCs, z , is point-for-point. The second term is just a parameter, d , which should be slightly positive; in tandem with M it controls the degree of saturation. The third term, $b(p - 1)$, links the RC yield to the departure of the price level from its target, $p = 1$. The coefficient, b , is positive to provide the appropriate negative feedback — when prices are above target, the higher yield on RCs raises demand for them and so depresses the price level.

A reasonable choice for M , given some slightly positive d , is the value that will achieve the target $p = 1$ when the random shift x equals zero. That value is

$$M = aY/d$$

and inserting it together with the formulas for z into the formula for the price level gives

$$p = 1 - b \frac{p-1}{d} + x \quad \text{or} \quad p = 1 + \frac{1}{1 + b/d} x.$$

A combination of a reasonably large value of b (the indexation of the RC yield to the price level) and a small value of d (to give saturation) makes $1/(1 + b/d)$ small and so keeps p close to one even for large disturbances, x .

The extreme case where the public views RCs as perfect substitutes for other forms of government debt is sufficiently important to work out separately. In that case, the demand for RCs is perfectly elastic at the point of equality of yields. In any equilibrium where the public holds both RCs and other debt, the two yields must be equal:

$$z = r.$$

Putting this into the indexation formula makes it possible to derive the unique price which is consistent with equality of the yields:

$$r = r - d + b(p - 1) \quad \text{or} \quad p = 1 + d/b.$$

The price level is just enough above the target value of 1 in order to raise the yield on RCs to the market rate. Other price levels are inconsistent with equilibrium involving both RCs and other debt. Were the price level lower, nobody would hold RCs. Were it higher, nobody would hold other government debt.

Let me say a little more about the nature of the indexation to the price level. It is not the purpose of the indexation to compensate the holders of RCs for lost purchasing power on account of increases in the price level. Such compensation is important, but it is already provided by the point-for-point indexation to the market nominal interest rate. Instead, the point of indexation to the price level is to offset all changes, permanent or transitory, that make RCs less attractive to the public and so cause the price level to be too high. A system with price level indexation of the RC yield is robust with respect to new developments affecting RC demand. It is not even necessary that the public have any special demand for RCs *qua* reserves — a small rise in the price level is enough to raise the RC yield to equality with the yield on other instruments and so to generate the appropriate demand for RCs to clear the market at a price close to the target.

So much for the simple model. Next I will restate some of the points of this section outside the specific model. Fig. 1 shows the basic setup in the RC market, holding the nominal interest rate constant, as appropriate for the comparison of alternative steady-state price levels. The price level clears the RC market. The two demand curves describe the situation with and without indexing to the price level, with identical values of the yield differential, d , and the RC stock, M . Without indexing to p , the demand for RCs is homogeneous of degree one in the price level, so the demand function is a ray. With indexing the demand function is flatter at the point where it passes through $p=1$. Further, demand becomes very large as p approaches the critical level $1+d/b$. Above this price level, RCs yield more than other instruments.

Flattening the demand curve reduces the response of prices to horizontal shifts in the demand curve, or, for that matter, to shifts in the supply of RCs.

To summarize the conclusions about the optimal terms of the reserve certificate in an equilibrium economy with complete price flexibility: The demand for RCs is likely to be unstable, especially with completely unregulated financial markets. Therefore, the price level will be correspondingly unstable if the number of RCs and their yield is held constant. Standard arguments establish that the RC should earn close to the market interest rate. A further suggestion is to index their return to the price level. When the demand for RCs shifts downward, prices rise, and the yield of RCs rises to offset the downward shift. When the economy is nearly saturated in RCs, and the RC yield is indexed moderately to the price level, the equilibrium price level is almost completely insulated from shifts in the

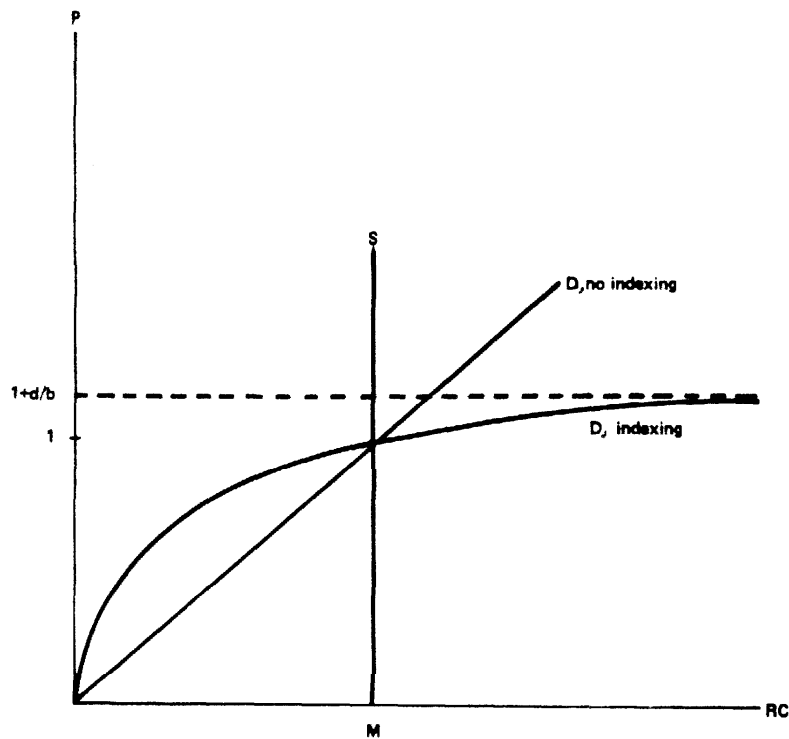


Fig. 1. The RC market with and without indexing.

RC demand function. A simple, robust policy rule gives price stability without compromising microeconomic efficiency.

4. Monetary arrangements in disequilibrium

By examining the problem of designing a monetary system with good properties in disequilibrium, I do not mean to take a position on whether the major fluctuations of modern economies are the result of real, equilibrium phenomena or the result of nominal disturbances and disequilibrium failure of market-clearing. Rather, it seems to me that a good policy is robust on this point — it performs well in either kind of economy.

Because robustness is the central issue, I will examine the extreme form of disequilibrium macro model, where the price level evolves according to an old-fashioned Phillips curve. The first component is an RC demand function that is a slight generalization of the one treated in the previous section

$$(Y/f^s)p.$$

Here, f is the differential between the nominal interest rate and the yield paid on RCs; $f = r - z$ in the earlier notation. The parameter g is the elasticity of RC demand with respect to the yield differential and was taken as unity earlier. The condition for clearing of the RC market is

$$M = (Y/f^g)p.$$

Let y , m , p , and f be the logs of Y , M , p , and f , respectively. Then market-clearing involves

$$y = m - \log a - p + gf = y_0 - p + gf.$$

The parameter y_0 embodies the RC stock and should be thought of as a potential policy instrument.

The second component is the policy rule for the yield differential, f . The rule examined in the previous sections, now stated in logs, is

$$f = d - (b/d)p$$

(the linearization of this formula at the point $p=1$ is precisely the earlier formula). By excluding the interest rate from the rule for f , I have made the implicit restriction that the yield on RCs will always respond point-for-point to the nominal interest rate. This restriction gives a crucial simplification in the macro model — by making the LM curve vertical, it makes the IS curve irrelevant for the determination of output. The macro model follows the simple quantity theory, not because the demand for RCs is interest-inelastic, but because changes in interest rates leave the differential yield unaffected.

The third component is the elementary Phillips curve:

$$\dot{p} = \phi(y - y^*).$$

Here y^* is the equilibrium, full-employment level of the log of output. Prices rise when output exceeds equilibrium and fall when output is short of equilibrium. The price level is predetermined and unresponsive to the current state of the economy.

Given the predetermined price, the level of output in this model is

$$y = y_0 + gd - (1 + gb/d)p.$$

As usual in effective-demand models, the higher the price level, the lower is the level of output. If some outside force discontinuously raises p , y falls. This formula provides the simplest possible analysis of something like an oil price shock. Indexation of the RC yield to the price level intensifies the

negative response of output to prices — in this model, the elasticity is unity with no indexation, and rises above unity by the amount gb/d when the indexing parameter, b , is positive. The same property holds for any price-stabilization policy. The policy move needed to offset a high price level is invariably contractionary for real output. Indexing the RC yield has no special magic to defeat this central dilemma of macro policy.

The formula also shows how the economy responds to shifts in aggregate demand and aggregate supply. Real output responds with unit elasticity to changes in aggregate demand as measured by y_0 . Indexation of the RC yield has no effect on this elasticity. Real output does not respond at all to shifts in aggregate supply as measured by y^* , until the price level responds. Again, indexation has no influence on this response.

In addition to its effect on the response to price shocks, indexation also changes the dynamics of this simple model — after a deflection from equilibrium, both prices and output return to equilibrium more quickly when the RC yield is linked to the price level. The differential equation governing real output is

$$\dot{y} = -\phi(1 + gb/d)(y - y^*).$$

The negative coefficient on y , which indicates stability of the system, becomes more negative when b is positive and indexation is in operation. The differential equation for the price level is

$$\dot{p} = \phi(y_0 + gd - y^* - (1 + gb/d)p)$$

and has the same properties as the one for output.

The equilibrium of the simple Phillips curve model, in the sense of its mathematical rest point, is exactly the equilibrium described in the previous section. In particular, the equilibrium price level is

$$p^* = (y_0 + gd - y^*) / (1 + gb/d).$$

Again, a reasonable value of b coupled with a small value of d insulates the price level against the forces of demand and supply, as measured by y_0 and y^* .

The major defect of the simple indexation of the differential yield to the price level is the exacerbation of the adverse effect of price shocks on real output. Not only does an exogenous jump in prices depress output through the standard quantity-theory-inflexible-price mechanism, but that effect is amplified by the contractionary response through indexation — a higher

price level makes RCs more attractive and restricts the economy just as would a downward adjustment in the RC stock. The strong response of output in the short run to aggregate demand shifts and the zero response to aggregate supply shifts are also defects of the simple indexation scheme. Ideally, the situation would be just the opposite — the efficient level of output responds fully to supply and not at all to demand.

Another problem with direct indexation of the yield on RCs to the price level might arise in practice, where price data are available only monthly. A transitory jump in prices or an error in measuring prices might push the yield on RCs above the yield on other government debt. The ensuing month might see a large shift of demand into RCs and out of other debt, with contractionary consequences for real activity.

All of these defects in direct indexation to the price level can be ameliorated by a modified indexing scheme. Essentially what is needed is a method for stabilizing prices in the longer run that is better capable of rolling with the punch in the short run. Simple indexation operates directly from the actual price level. The modified indexation formula operates from the expected future price level. An analogy to more conventional monetary policy might help convey the basic idea. Today, a number of economists advocate conducting monetary policy according to a price rule: If prices are above target, contract the money stock; if below target, expand. Every upward blip in prices is met with a contraction in monetary policy. An alternative with a much more forgiving effect on real activity in the short run is the following: Create a billion dollars each of two types of federal debt. Both are seven-year amortized notes paying a fixed coupon rate. One pays in current dollars and the other pays in dollars of the base year, through indexation to the cost of living. Whenever the seven-year average of expected future prices exceeds the current price level, the indexed note will trade at a premium. The monetary authorities are instructed to engage in open-market operations as necessary to keep the two notes at par with each other. In an economy with sticky prices, the average of expected future prices is much more responsive to policy than is the current price level, and targeting on future prices avoids the harsh effects of targeting on the price level.

It is a simple matter to set up the payment of returns on RCs in such a way to achieve indexation to the average future price level. Instead of paying a return each day on the balance that day, pay each holder a return on the average number of RCs he has held for the past seven years. From the point of view of the decision of a potential investor to hold one RC for, say, one day, the relevant return is the average for the forthcoming seven years of the rate paid by the government. This rate can be indexed directly to the observed current price level.

In a model a seven-year moving average is a little tricky, but can be approximated effectively with geometrically declining weights applied to

future prices. The specific indexing formula I will study is

$$f = d - \frac{b}{d} k \int_0^{\infty} e^{-k(s-t)} p(s) ds.$$

Here k is a parameter controlling the length of the moving average — the lower is k , the longer is the average. In discussing the rational expectations solution, I will not distinguish notationally between expected and actual values of p and other variables. Some simple and standard manipulations can restate the integral definition as a differential equation,

$$\dot{f} = -k(d - f - (b/d)p).$$

Together with the implicit transversality condition that f not become indefinitely large or negative, this equation has the same content as the integral.

The other two equations of the model are the same as earlier — the quantity equation and the Phillips curve:

$$y = y_0 - p + gf, \quad \dot{p} = \phi(y - y^*).$$

Differentiating the quantity equation with respect to time and substituting the policy rule for f gives a two-equation model in terms of prices and output:

$$\dot{y} = k(1 + gb/d)p + (k - \phi)y + \phi y^* - gkd - ky_0,$$

$$\dot{p} = \phi(y - y^*).$$

The phase diagram analysis of this model appears in fig. 2. To the left of the vertical line at y^* , output is below equilibrium and prices are falling; to the right they are rising. Above the line labeled $\dot{y}=0$, output is rising; below it is falling. The slope of the $\dot{y}=0$ locus is ambiguous and depends on the relative values of k and ϕ . The likely case is that ϕ is larger than k and the locus slopes downward, as drawn. The two arrows show the paths of output and prices from any initial price level. If prices start above their equilibrium level, output starts below equilibrium. As prices decline thanks to the Phillips curve, output gradually rises to its equilibrium. The process operates in reverse if initial prices are below equilibrium.

Standard manipulations involving the characteristic roots of the two-equation system yield various insights about the operation of the economy when the yield on RCs is indexed to future prices. Formulas for some of

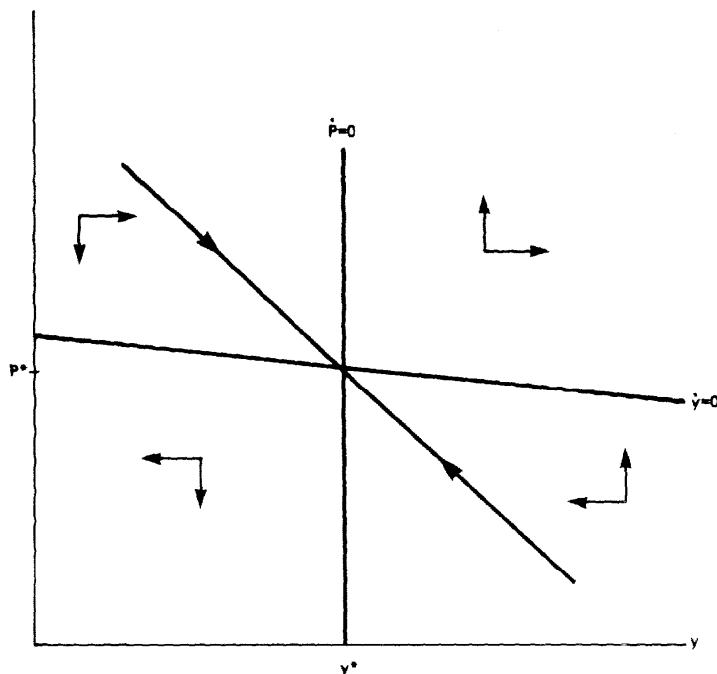


Fig. 2. Phase diagram for indexation to future prices.

them will involve the quantity,

$$A = \left((k - \phi)^2 + 4\phi k \left(1 + g \frac{b}{d} \right) \right)^{1/2}.$$

The negative of the slope of the $y-p$ path leading from an initial price to the equilibrium is

$$m = 2k(1 + gb/d)/(k - \phi + A).$$

This slope controls the response of prices and output to all three types of disturbance. First, if the price level is deflected upward in the amount Dp by some exogenous force, output falls by the amount mDp . Recall that direct indexing to the price level made output fall by $(1 + gb/d)Dp$. For positive values of b , k , and ϕ , it is a simple matter to show that m is smaller than $1 + gb/d$. Output is less sensitive to price shocks under indexing to future prices than to the current price. The mechanism is simple — the public

knows that future prices will respond to the price stabilization policy, so their expectation of the average future price level responds less than in proportion to the current deflection of prices. On the other hand, price shocks affect output more in an economy with indexation to future prices than in an economy with an exogenous policy on the yield differential and quantity of RCs. Under an exogenous policy, one percentage point of price shock depresses output by 1 percent, whereas it is simple to show that m exceeds one. Again, indexation to future prices does not overcome the basic feature of the Phillips curve that price stabilization has real consequences.

The analysis of a shift in aggregate demand appears in fig. 3. Ultimately, the economy moves from the equilibrium price level p_0^* to the higher equilibrium price p_1^* . Of course, if the economy is close to saturation in RCs (d is small) and indexation to future prices is moderate (b is not too small), then the change in the equilibrium price is small. As in all the models considered in this paper, the change in the equilibrium price from a change in aggregate demand of Dy_0 is

$$Dp^* = \frac{1}{1 + gb/d} Dy_0.$$

In fig. 3, when y_0 rises discontinuously, the economy moves immediately to the right along the path with the arrow, and then ascends the path leading up and to the left to the new equilibrium. The magnitude of the immediate increase in output is just m times the change in the equilibrium price, which turns out to be

$$Dy = 2k/(k - \phi + A).$$

In a model with an exogenous RC policy, or a policy linking the yield differential to the current price level, Dy/Dy_0 is unity. Because A exceeds $k + \phi$, Dy/Dy_0 is less than one with indexing to future prices. The logic is straightforward: when the public learns that aggregate demand has risen, it immediately raises its expectations of the future average price level and with it, expectations of the return that will eventually be earned by investing in RCs today. The resulting increase in RC demand offsets part of the increase in aggregate demand. By choosing a high enough b/d , an economy can insulate itself almost completely from aggregate demand disturbances — Dy/Dy_0 can be made arbitrarily small.

The analysis of aggregate supply shifts appears in fig. 4. The economy starts in equilibrium at p_0^* and y_0^* . When y^* increases discontinuously to y_1^* , the economy moves immediately to the right and then descends along the stable path to the new equilibrium. A simple argument establishes that output must increase as soon as y^* increases: the slope of the line connecting

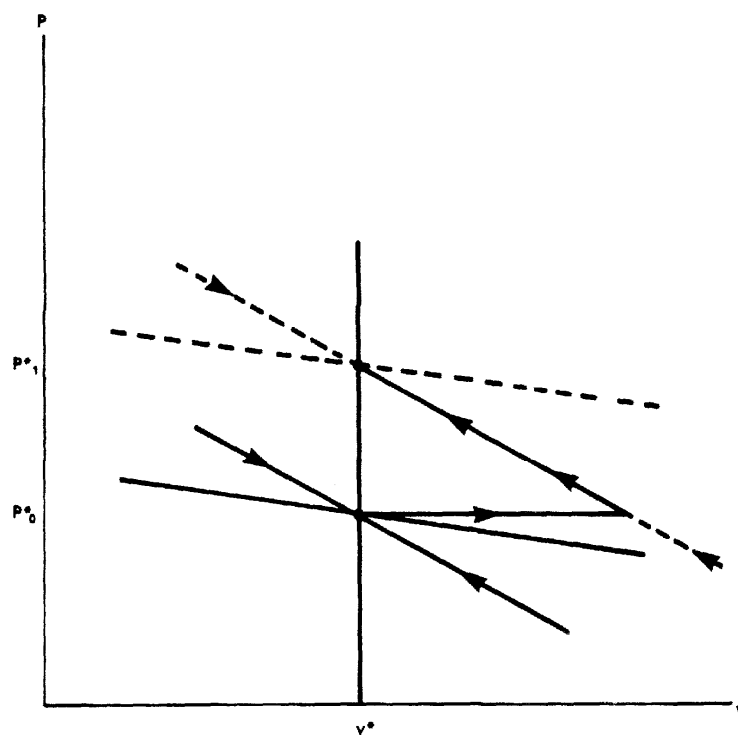


Fig. 3. Effect of a shift in aggregate demand.

the two equilibrium points is $1 + gb/d$, whereas the slope of the arrowed path is m , which I have already noted is less than $1 + gb/d$. Thus the path must pass above and to the right of the old equilibrium point. The economic mechanism is the same as in the aggregate demand shift, operating in reverse. When the public learns of an increase in aggregate supply, they realize that future prices will be lower, so RCs become less attractive and aggregate demand is stimulated. Again, with a large enough value of b/d , the immediate response of output to a shift in aggregate supply can be made arbitrarily close to its efficient level of point-for-point.

5. Conclusions

A fiduciary monetary system of the type in operation in most economies today has a number of undesirable features:

- (1) Instabilities in the demand for government money imply corresponding instabilities in the price level and, possibly, in the level of real activity.

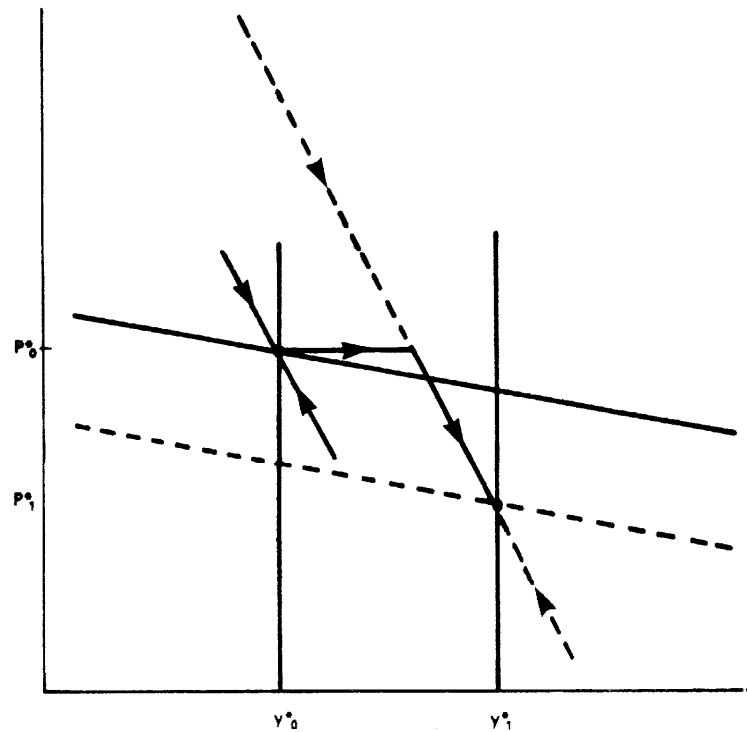


Fig. 4. Effect of a shift in aggregate supply.

- (2) Elimination of reserve requirements and other forms of financial deregulation desirable on microeconomic grounds will **aggravate** the instability.
- (3) If the rigid-price, effective demand model describes the behavior of the economy, output is sensitive to the level of aggregate demand, which is inefficient.
- (4) Similarly, with price rigidity, output does not respond immediately to shifts in aggregate supply, which is again inefficient.

As the regulatory props for the demand for government money are dismantled, they need to be replaced by rules for adjusting the yield paid on money in order to stabilize the demand for government money, or reserve certificates, and thus to stabilize the price level. The best rule of this kind makes the yield on RCs depend on the future expected price level, a relationship easily achieved by paying interest on the moving average of past RC holdings. Such a rule has a robustness property — it performs well in

stabilizing prices in an equilibrium economy with complete price flexibility, and also performs well in stabilizing prices and keeping output close to equilibrium in an economy with price rigidity. All of the problems just listed are solved by linking the yield on RCs to the future price level. The only defect is one shared by all price stabilization policies in an economy with rigid prices — the actions needed to offset an exogenous change in prices tend to amplify the consequences of those price shocks for real output.

References

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