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The Role of the Government in Stabilizing Prices and Regulating Money

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INTRODUCTION

Dominant macroeconomic doctrine holds the government responsible for stabilizing the price level and assigns monetary policy the operating role in achieving price targets. According to the doctrine, inflation is a monetary phenomenon and control of monetary growth is the core of any anti-inflationary program. But monetary control typically involves deep intervention in financial markets. The money stock cannot be controlled if unfettered competition prevails in money markets. There is growing recognition of the strain between the macroeconomic goal of monetary control and the microeconomic goal of competitive markets.

This paper examines some of the foundations of macroeconomic doctrine on prices and money. It posits that maintenance of a stable price level carries significant positive externalities and therefore is an important function of government. The problem is to find the most benign form of intervention to achieve price stability without limiting the efficiency of resource allocation. The ideal policy would come into play only when the price level departed from its target. In normal conditions the economy would be exactly competitive.

I conclude that one of the best available government interventions for price stabilization involves the establishment of a real bundle of resources as legal tender and the continual revaluation of the monetary unit relative to the resource bundle to stabilize prices. In theory, this achieves the theoretical

ideal very closely. A more conventional but somewhat less efficient alternative involves the creation of monetary reserves, the imposition of regulations to create an artificial demand for the reserves, and the pegging of prices through the deliberate manipulation of the quantity of reserves. In both cases, virtually all current government regulation of monetary institutions could be eliminated without impairing price stabilization.

Three general classes of government intervention are considered here. The first is strictly fiscal. Can the government use the power of taxation to push prices to the point where the cost of a specified basket of commodities is unity? Fiscal interventions ad hoc have been advocated by economists who are dissatisfied with the apparently adverse real effects of monetary deceleration to control inflation. The idea pursued here is more radical--exclusive use of fiscal instruments for price stabilization and complete decontrol of monetary markets. With complete decontrol, prices are quoted in a universally-accepted abstract accounting unit. There is no money as such, but anyone can offer transactions services without hindrance from the government. Prices are just numbers that merchants put on goods. In no sense do they serve as the value of a single asset called money. Eugene Fama's important paper (1980) describes the operations of such an economy in considerable detail. Within such an economy, I examine a fiscal system involving subsidy of goods production whenever prices and wages are too high and taxation whenever they are too low. Under special conditions,

the system will indeed prevent any competitive equilibrium except one satisfying the target on the price level. Further, in equilibrium, subsidies and taxes are zero, so the system is efficient. However, the conditions are so special as to disqualify the system from practical consideration. The point of the discussion is that price stabilization is not intrinsically a monetary issue.

The second general type of intervention to peg prices uses the power of the government to define legal tender. The government simply defines the monetary unit as a certain bundle of resources or assets. The gold exchange standard is the best-known example of this approach to price stabilization, but an interesting alternative has recently been proposed by John Bilson (1980) in which a share in a mutual fund becomes the standard. Resource exchange standards can be varied over time to peg the level of consumer prices or incomes; they do not necessarily require that the price level vary in proportion to the relative valuation of the underlying commodity or asset. This neglected aspect of commodity-based monetary units overcomes the principal objection of most economists to this approach to price stabilization. The pegging of prices through the legal tender power need not involve any creation of government money or other intervention in money markets.

A third general class of price stabilization techniques creates a special government liability to function as a reserve and declares reserves to be legal tender. Through reserve requirements, the government creates an artificial demand for

reserves. By adding a real commodity to the economy and pegging its price, the whole vector of prices is normalized. Though the system could work with reserve requirements against almost any economic activity, in practice reserves are required against certain classes of financial intermediaries. To create a stable artificial demand for reserves, strict controls on the selling of transactions services are imposed, even though principles of microeconomic efficiency call for competition in this market as in every other market. The government issues licenses (reserves) to offer transaction services. The market rental value of these licenses, the nominal interest rate (less any interest paid on reserves) measures the extent of control imposed by the government on the prices and also the inefficiency of the regulation. The two are inseparable--prices cannot be regulated through this technique except by creating a wedge between the cost of providing transaction services and the price paid by the public.

Though monetary control is necessarily inefficient as a way to peg prices, relative to a competitive economy with indeterminate prices, the inefficiency can be made small. The paper proposes a radical variant on monetary control, in which transaction services are unregulated. Reserves are required to be held by all businesses, in proportion to their value added. One dollar of reserves is a license to pay, say, \$100 in nominal income. This system controls nominal GNP directly, instead of operating through transactions. Like conventional monetary control, it is necessarily inefficient, but the inefficiency is spread evenly

through the economy, instead of being concentrated in the transactions industry. Further, the degree of inefficiency can be made very small. This variant of reserve money could dramatically improve the price stabilization performance of monetary policy.

THE LOGIC OF PRICE STABILIZATION

Consider the abstract exchange model of general equilibrium. The economy has a vector of excess demands, $D(p)$, which depend on the vector of prices, p . The overall level of prices is indeterminate--if p is an equilibrium with $D(p) = 0$, then a multiple of p , say θp , is also an equilibrium. The problem considered here is how the government can force the economy to choose the one price vector that satisfies a normalization. The government defines a cost of living index, based on the market value of a fixed bundle, b , of goods. The normalization requires that the price index be unity: $b'p = 1$.

As usual in general equilibrium models, the list of goods includes ones that will be delivered in future years. If the market actually met just once and arranged future deliveries, with payments made immediately in the arbitrary units in which prices are stated, then there would be no good reason to seek a normalization of prices. In the real world, the market meets repeatedly. Without normalization, there is no connection between the accounting units it settles on in one year and the units of the next year. In particular, it is unwise for market participants in one year to write a contract specifying payment in the accounting units of a future year; this year, the real value of the future units is completely indeterminate. All contracts for future payment must be stated in terms of future delivery of goods.

In an economy like the U.S. economy today, agents face a

problem almost as severe, because of the government's lack of success in imposing a normalization. Sophisticated contractors make extensive use of indexing clauses that amount to promises of future delivery of goods. But a surprisingly large number of standard contracts for individuals still promise future payments in dollars, even though the future real value of the dollar is quite uncertain. Moreover, most of these contracts have yet to adapt to the simple fact that the value of the dollar is declining along a somewhat predictable trend. Two of the most conspicuous examples are retirement annuities and mortgages. The insurance value of annuities has almost disappeared under inflation, because their stream of equal dollar payments is so highly front-loaded in real terms. Most annuitants will survive to the point that their annuities are almost worthless, so they offer almost no protection against the contingency of an extra-long life. Similarly, the graduated-payment mortgage is widely misunderstood and little used.

The economist's answer to this problem has been wider use of indexing. But 15 years of inflation has promoted remarkably little indexing. People stick tenaciously to the dollar as a way to contract future payments. I conclude that there is a lot to be said for normalizing the dollar instead of indexing. The precise definition of the normalization does not seem to be a major issue--it could be to set the Consumer Price Index to unity, the GNP deflator, or an index of wages. Elsewhere I have argued the virtues of normalizing nominal GNP, but that idea does not have a major role here. It seems to be much more important

to normalize some nominal quantity than to worry about which quantity.

FISCAL INTERVENTION TO PEG PRICES

Though the manipulation of taxes and transfers to moderate inflation is widely advocated by practical economists, the literature seems to lack an examination of the following basic question: Can the price level be pegged by a non-distorting fiscal intervention?

The following simple general equilibrium model lends itself to an investigation of this question. Define

p: price of the single produced goods, quoted in abstract accounting units

w: wage, in the same units

y: full income of household, after lump-sum transfers

$L(p,w,y)$: labor supply function

= $1 - y/2w$ (the endowment of time is normalized at one)

$D(p,w,y)$: goods demand function

= $y/2p$

The technology uses one unit of labor to produce one unit of output. In the absence of fiscal intervention, the price and the wage are equal. Full income is just p, and labor supply and goods demand (which is also labor demand) are both 1/2. The price level is indeterminate, as in any general equilibrium model.

Suppose the economy reaches equilibrium in the usual Walrasian

way: an auctioneer announces a (p,w) at random. If it equates labor supply and labor demand, he stops. If not, he keeps trying (p,w) pairs at random until one works. This process achieves $p=w$, but their common value is unnormalized. Now let the government intervene as follows. After the auctioneer announces a (p,w) , the government establishes a tax-subsidy system. Then private agents respond to p and w as modified by fiscal measures. Again, the auctioneer repeats (p,w) s until equilibrium is achieved. The government tailors its intervention so that $(1,1)$ is the only equilibrium price-wage pair. Further, when this is achieved, there is to be no actual intervention. The role of government is to block all competitive equilibria with the wrong price level.

In this economy, a simple intervention does the job: If p is not equal to w , do nothing--this will not be an equilibrium anyway. If p equals w , but the two are not equal to the target, unity, subsidize producers at a rate of $p-1$ per unit of output. Then a producer buys labor for p , sells the output for p , and receives a subsidy of $p-1$. There is a net pure profit of $p-1$. If p exceeds one, there is an infinitely profitable arbitrage opportunity in production. If p is less than one, no output will be produced. Neither can be an equilibrium. The only competitive equilibrium satisfies the price peg, $p=1$.

The essence of the intervention is the creation of an economic situation that is incompatible with equilibrium whenever prices do not satisfy the price peg. If the economy contains a productive activity with constant returns to scale, then subsidy

of this activity may be able to create an infinitely profitable arbitrage opportunity and so block an inappropriate equilibrium. In order to carry out this policy, the government must know the unit cost function of the activity and must observe its complete set of input prices. In short, the informational requirements are about the same as for price controls. Nothing in the history of price controls suggests the government is capable of administering this kind of a system.

If the government observes just product prices, it cannot impose a neutral price peg. For example, subsidy of output whenever prices are too high, instead of only when prices and wages are too high by the same amount, is completely defective. Instead of creating an arbitrage opportunity, a subsidy can sustain an equilibrium where an activity earns zero pure profit after the subsidy--wages are higher than prices by the amount of the subsidy. Such an equilibrium is inefficient, and, in any case, indeterminate. In the simple model just presented, if the government pays the subsidy $p-1$ whether or not p equals w , then the equilibrium is indeterminate, with any positive wage, w , and corresponding price, $p=(w+1)/2$. The level of output and employment is $2w/(3w+1)$, which departs from the efficient level of $1/2$ whenever w is different from 1 . This kind of subsidy is both ineffective and inefficient.

Government purchases and sales of goods are another potential intervention to peg prices. Again, the hope is to block any equilibrium that has inappropriate prices. If prices are too low, the government could buy output and finance the expenditure

through a lump-sum tax. Any purchase less than total potential output remains compatible with equilibrium and so fails to peg prices. The purchase must exhaust total output and drive full incomes down to zero to prevent equilibrium. The government's threat to carry out this draconian plan would not be credible. Purchases of goods in general seems an unpromising way to block unwanted equilibria.

In an economy producing a number of goods from a number of factors, the government has some scope for shifting relative prices through purchases and sales of one good. It might be able to peg the price of one good, but this type of intervention fails the test of efficiency--the intervention would not disappear when it achieved its goal. In this case, the inefficiency would take the form of unused stocks of commodities held by the government.

No practical fiscal intervention reviewed here pegs prices efficiently. Even though no substantive economic forces is needed to shrink or expand all prices in proportion to meet a prescribed normalization, and the government has available immensely powerful fiscal instruments, no one has yet found a neat way to use fiscal policy to peg prices.

PEGGING PRICES WITH THE LEGAL TENDER POWER

The government's power to define legal tender provides close to the ideal method for normalizing prices. By setting the terms under which debts are settled in the private economy, the government can force the accounting unit to take on a stable real value.

Defining legal tender need not involve the creation of government money or intervention in the private market for transactions services. The following very simple case illustrates the basic idea. Consider a small country whose economy is completely dominated by a surrounding larger country. The small country is purely a price-taker in all markets. But the small country is dissatisfied with the instability of the purchasing power of the large country's monetary unit. It decides to create its own monetary unit with stable purchasing power, and so adopts a legal tender law with the following provisions: All prices must be quoted and all contracts written in terms of the local monetary unit. Local financial intermediaries must credit accounts at par when legal tender is deposited, and must pay legal tender on demand. Legal tender is defined as x units of the large country's currency, where x is the most recently available index of the cost of living in the large country.

The effect of the law is to create a local monetary unit with stable real value. Financial intermediaries are forced to carry out transactions services in the government-defined unit alone,

because if they use any other units, the rights of their customers to present or collect legal tender would give unbounded arbitrage profits to the customers and losses to the intermediaries. There is no need to create any local government money--defining the large country's currency as legal tender does the job perfectly.

Nothing stops a large country from defining the currency of another large country as legal tender, but it is interesting to investigate the application of this idea to other assets. Let the government define a physical resource unit comprising certain fixed quantities of homogeneous, widely traded commodities. Gold could be included, but other commodities have better characteristics for the purpose. In choosing the composition of the resource unit, the government should strive for as little variation as possible in the price of the unit relative to the cost of living. Then the government should use its legal tender power to define the dollar as the number of resource units necessary to buy the basket of goods underlying the consumer price index. Let x be the ratio of the CPI to the dollar price of a resource unit. Then define the dollar as x resource units.

Within the abstract problem stated at the outset of this paper, the adjustable resource exchange standard achieves precisely the desired effect. The unique price vector that both clears the market and satisfies the government's definition of the dollar is the one with $D(p) = 0$ and $b'p = 1$.

A slight modification of the simple model of the previous section will help clarify the idea. Suppose that the resource

unit is a single commodity, y , available in completely inelastic supply, Y , and selling for price z . Full income is now $w + zY$; let the constant-expenditure-share demand function be $(w + zY)/3z$. The demand is for the actual consumption of the resource and applies whether or not the government relates legal tender to the resource. There is no money in the utility function here or anywhere else in the paper. Let the demand function for the single produced good have the same form, $(w + zY)/3p$, and finally let the labor supply function be $1 - (w+zY)/3w$.

As before, the technology produces one unit of the good from one unit of labor, so $p = w$ in equilibrium. I will call their common value p . The competitive equilibrium of the economy determines only the relative price,

$$p/z = 2Y .$$

If the government declared one unit of the resource as legal tender, then z would be unity and p would be $2Y$. Instead, suppose it consults the equilibrium relative price and defines legal tender as enough resource units to buy one unit of output. Then the monetary unit is $2Y$ resource units, one resource unit is $1/2Y$ monetary units, and so p must be unity. This is the unique equilibrium, and it satisfies the price normalization. No substantive intervention in the economy has taken place. In this simple model, the adjustable resource exchange standard fits all the criteria for the ideal intervention to normalize prices.

Monetary institutions and regulation under the resource exchange standard

In the economy we know in the United States today, the workings of the resource exchange standard are somewhat more complicated than in the simple model. Here I want to discuss the practical microeconomics of the operation of the system. In the next subsection, I will take up some macroeconomic questions of its operation with sticky wages.

With the adoption of a resource exchange standard, the government would cease controlling the quantity of money and would dismantle the elaborate regulatory apparatus now in place to limit transaction services. Because the standard controls the price level through a very different principle than the one underlying the current system, the quantity of money would no longer be an interesting economic variable. It is important to understand that the exchange standard is not an alternative way to impose monetary discipline on the economy--it is an alternative way to normalize prices and operates in an economy where private intermediaries can create money without hindrance or control.

The government's influence on prices rests entirely on its legal power to define the dollar. In the resource exchange standard, the government defines the dollar as a physical bundle of commodities. Anyone signing a dollar contract or posting a

dollar price can ask for the bundle in payment or offer the bundle to discharge a debt or make a purchase. Only rarely do bundles actually change hands, of course. The purpose of the legal tender law is to establish an unambiguous definition of the dollar. Participants in the economy are free to employ agents to execute transactions in dollar units without moving commodities. The government imposes a substantive restriction on these agents (who are typically intermediaries of one kind or another): when they take on an obligation to pay dollars, they must stand ready to deliver the resource bundle. Similarly, they, like everyone else in the economy, can refuse to accept dollar payments unless they are in resource bundles or in some other form of equal value.

In this system, the relation of most intermediaries and other transactors to the resources themselves is the same as the relation of the typical commodity speculator today to commodities. The closest the participants ever come to the commodities is to hold claims on future deliveries or warehouse receipts. Bank accounts are simply commodity accounts reckoned in a particular set of units prescribed by the government. The difference between a commodity dealer and a bank would become blurred. The Merrill-Lynch cash management account is a preview of the type of services that would be offered by transaction businesses under the resource-exchange standard. Today, the cash management account permits convenient transactions in a wide variety of assets, all denominated in fiat dollars of the U.S. government. Under the standard, the denomination would be in

terms of the dollar defined by the standard. A question that is bothering policy-makers today--are the balances in a cash management account money that needs to be controlled to stabilize prices?--is literally irrelevant under the standard.

Periodic adjustment of the resource definition of the dollar is required to stabilize the purchasing power of the dollar. Many redefinitions would be partly or fully anticipated in financial markets and so would be offset by corresponding changes in the returns to dollar-denominated assets. For example, suppose that the government's formula called for a 1 percent increase in the dollar value of the resource bundle because the cost of living was one percent too low. The definition of the dollar would change discontinuously at midnight on Saturday. Anyone who could borrow at a reasonable annual interest rate could make a large arbitrage profit by buying the resource bundle at the old price on Friday and selling at the new price on Monday. Interest rates on weekend loans would rise to just over 365 percent per year to eliminate the arbitrage opportunity. In stock and bond markets, fully anticipated jumps of one percent would occur over the weekend. The value of the dollar relative to foreign monetary units would jump by one percent, and so on. In the case of savings instruments held by the public, intermediaries would offer a choice, just as they do now. They could offer accounts with interest rates fixed in advance, or money-market funds where interest payments depend on the earnings and changes in value of the portfolio.

From the microeconomic perspective, the resource exchange

standard offers all of the advantages of fully unregulated intermediation as laid out by Fama (1980). The concept of money as a special asset would be eliminated. Instead, a wide variety of transaction services offering easy movement from one asset to another would flourish. The asset at the base of the system would be a real bundle of resources instead of government-issued base money.

Currency presents a special problem in an economy organized by these principles. With stable prices, it is difficult to reach a proper equilibrium where the marginal benefit from currency equals its marginal cost, without paying interest. One answer, as pointed out by Milton Friedman, is to deflate sufficiently rapidly that nominal interest rates are near zero and discount bills and currency are effectively the same thing. But this sacrifices the advantages of a monetary unit of constant purchasing power. The second answer is to let the private economy figure out all the ways that it can to get near the efficient equilibrium. Credit and debit cards with automatic electronic processing go a long way in this direction.

Inevitably there will remain some cases where currency is still the best way to transact, and wasteful expenditure of resources on the part of currency suppliers to try to get their currency in circulation would occur. The economic situation would be the same as government price fixing at excessively high prices. A simple solution is to let the government issue all currency and capture all of the potential profit as a tax. Government currency would not be legal tender--only the resource bundle can

have that role.

The demand for currency would fluctuate as anticipations of adjustments in the definition of the dollar occurred. When the dollar price of the resource bundle was slated to rise over a weekend, people would trade in their dollar bills for any other asset--the dollar bill would be unique in failing to participate in the general rise in all asset prices as the bundle is revalued. If currency remains a government monopoly, then it will have to guard against issuing currency when the dollar price of the resource bundle is expected to decline in the near future--the dollar is then the only asset whose price does not decline discontinuously. The government could issue currency just once a month, on the day after the redefinition of the dollar, to limit this problem.

Mutual fund money

Within the framework of the general idea of a resource exchange standard, it is possible to evaluate John Bilson's novel proposal for monetary reform (1980) based on defining money in terms of a mutual fund of real assets. Bilson proposes that each share in the fund be defined as a dollar, presumably through legal tender provisions, though he does not emphasize how the government enforces uniform use of the unit. The essence of the proposal is

the definition of the dollar as a certain collection of real assets. Bilson proposes that the quantities of assets in the definition be raised over time by the amount of the returns to the assets, so the price level would fall at the real return to the portfolio. This has the merit of making currency an efficient way to carry out transactions. His description of the system puts emphasis on the creation of the actual government money through a mutual fund holding the prescribed collection of assets as its portfolio and issuing dollars as its obligations. It is not clear that government operation of the fund and creation of money has any benefits. Anything the government does along these lines could be done equally well by the private economy, and, for that matter, anything the government does can be undone by the private economy. The crucial role of the government is the establishing and enforcing the definition of money through its legal tender power. The actual creation of money can be done perfectly efficiently by the private sector without government regulation or stimulus once the definition is made.

Behavior of the aggregate economy under the adjustable resource exchange standard

A system that benignly normalizes prices in an abstract general equilibrium model might have unpleasant real side effects in a modern economy with sticky wages, some would argue. This paper

will not take a position on the issue of the practical importance of disequilibrium in the U.S. economy, though this issue is hotly debated today. Believers in full equilibrium (at least from one year to the next) have already been shown that the adjustable resource exchange standard closely pegs the cost of living at unity, and that this pegging has no real consequences. The next few pages deal with a disequilibrium model and should be skipped by those believers. Because all attempts I have seen to create disequilibrium models based on individual optimization have led inexorably to equilibrium theories, I will investigate the crudest kind of disequilibrium, where wages are sticky and move according to the simplest Phillips curve. My views on what is right and what is wrong with this kind of model have appeared elsewhere (Hall (1980)) and will not be repeated.

With sticky wages, the introduction of the price normalization system may have a real effect because changes in the dollar price of the resource do not bring about equal changes in the price of output. This problem can be illustrated in an effective-demand version of the simple model set forth earlier in the paper. In this version, individuals make no labor supply decision. Instead, they work an amount, L , which is demanded by employers. The sticky, predetermined money wage is w . Workers' earnings are wL , and the value of their endowments of resources is zY . With the preferences outlined earlier, their effective demands for goods are $(wL + zY)/2p$ and for resources are $(wL + zY)/2z$. The level of employment where the labor demand of employers equals the effective demand for goods is

$$L = Yz/w$$

Recall that the competitive equilibrium involves a relative price, z/w , of $1/2Y$. Here, when the relative price has that value, employment is $1/2$, its efficient (and competitive equilibrium) level. Otherwise, if the government sets a low z in an attempt to obtain $w=1$, when the sticky w remains above one, the effect will be to depress employment to inefficient levels instead.

The upshot of the effective demand model is to make employment positively unit-elastic with respect to the supply of resources, Y , and with respect to the price of resources, z , and negatively unit-elastic with respect to the wage, w . Now let me redefine the variables as logs and set up a simple dynamic model.

Employment is

$$L_t = Y + z_t - w_t .$$

Wages respond to L_t according to the simplest possible Phillips curve,

$$w_t = w_{t-1} + \phi(L_t - L^*) ;$$

L^* is the log of the equilibrium level of employment, $1/2$. Then

$$w_t = w_{t-1} + \phi(Y + z_t - w_t) + w^* .$$

Let the government's policy for setting z_t be exactly as described earlier--it is the ratio of the most recently observed dollar price of the resource to the dollar price of output (the wage):

$$z_t = z_{t-1} - w_{t-1} \cdot$$

In this model, however, resetting the dollar price of the resource does not immediately peg the price of goods at unity, because relative prices change. The economy is governed by the pair of difference equations,

$$w_t = ((1-\phi)/(1+\phi))w_{t-1} + (\phi/(1+\phi))z_{t-1} + w^*$$

and

$$z_t = z_{t-1} - w_{t-1} \cdot$$

The characteristic roots of the system are always complex: $(1 \pm \phi i)/(1+\phi)$ and have modulus $1/(1+\phi)$, which is always less than one. The unique steady state of the system is the competitive equilibrium already described, with the log of the wage equal to zero. From any starting point, the economy cycles toward the equilibrium. The rate of convergence depends, not surprisingly, on the coefficient of wage flexibility, ϕ .

In the economy described so far, there is no good reason for

changing the definition of the dollar as time passes. If the government simply sets z to its equilibrium value, $1/2Y$, then the wage will follow the first order difference equation,

$$w_t = (1/(1+\phi))w_{t-1}$$

and converge monotonically to zero from any starting value. The effect of the policy of leaning against the wind by lowering z whenever w is too high and vice versa is to make the economy cycle toward equilibrium instead of approaching it smoothly. The overall rate of convergence, as measured by the modulus of the characteristic roots, is the same $1/(1+\phi)$ in both cases.

The virtues of leaning against the wind become apparent when there are economic forces influencing the price of goods relative to the price of the resource unit. To maintain the wage-price peg, the government must accommodate these forces by changing the definition of the dollar, z . In the model developed here, movements in the inelastic resource supply, Y , are the only source of variations in the relative price of goods and resources. Because shifts in supply are likely to be persistent, a natural simple stochastic specification is a random walk; that is, $Y_t - Y_{t-1}$ is a completely unpredictable random variables. If the government keeps z constant rather than leaning against the wind, the wage obeys the first order autoregressive, first order integrated process,

$$w_t = (1/(1+\phi))w_{t-1} + (\phi/(1+\phi))Y_t$$

The wage drifts over time in much the same way that Y_t drifts. Its variance is infinite. The stochastic behavior of employment is first order autoregressive:

$$L_t = (1/(1+\phi))L_{t-1} + (1/(1+\phi))(Y_t - Y_{t-1}) \quad .$$

Employment fluctuates around its equilibrium value, but is frequently far from equilibrium because of the need to induce large movements in the sticky wage. The variance of employment is $s^2/(2\phi+\phi^2)$; s^2 is the variance of the change in Y .

On the other hand, an active policy of pegging the wage at unity yields a system where the wage does remain near the target--its process is second order autoregressive:

$$w_t = (2/(1+\phi))w_{t-1} - (1/(1+\phi))w_{t-2} + (\phi/(1+\phi))(Y_t - Y_{t-1}) \quad .$$

Employment is second order autoregressive, first order moving average:

$$L_t = (2/(1+\phi))L_{t-1} - (1/(1+\phi))L_{t-2} + (1/(1+\phi))((Y_t - Y_{t-1}) - (Y_{t-1} - Y_{t-2}))$$

The formula for the variance of employment under the policy of leaning against the wind is too complex to be illuminating, but a comparison of the ratio of this variance to the variance under constant z at various values of ϕ is

ϕ	Ratio of variances
0.1	0.094
0.2	0.174
0.5	0.372

With annual time units, empirical estimates of Phillips curves yield estimates of ϕ of no greater than 0.2, which would imply that the advantages of the active policy are very substantial.

In an economy with sticky wages, the use of a resource exchange standard can create real disturbances if the equilibrium relative price of resources and consumption goods shifts randomly. A fixed standard is particularly troublesome in such an economy, because it fails to stabilize the cost of living and the wage; the large equilibrating movements in the wage require large departures from equilibrium employment. An adjustable resource exchange standard offers the double advantage of pegged prices and much more stable employment.

RESERVE MONEY

The essential features of pegging prices through the control of reserve money have been discussed perceptively by Fama (1980). In order to peg prices, the government must create an artificial need for its money and must pay less than the market return to the holders of the money. In practice, the artificial need is created by imposing reserve requirements on depository institutions, but, as Fama points out, there is no logical necessity for the demand to come from the monetary sector. He gives the imaginative example of reserve requirements on the owners of spaceships.

In this section I will work out the case where the government creates the artificial demand by requiring businesses to hold reserves against value added. Though this happens to be an easy case to expound, it also has some practical content--there are substantive economic advantages to making valued added the criterion for reserve requirements. In particular, the quantity of reserves is exactly proportional to nominal GNP, so monetary policy pegs nominal GNP simply by setting the level of reserves.

Within the simple model set forth earlier in the paper, the implications of the reserve requirement can be studied rather simply. In this application, the model describes the steady state of an economy of long-lived individuals with time preference r . Suppose, first, that the government auctions N permits, each allowing a business to pay \$1 in wages each period. Let the market price of a permit be v dollars. Its rental price

is rv ; r is the steady-state interest rate. This rental price adds to the labor cost, w , of producing a unit of output, so the equilibrium price is

$p = (1 + rv)w$. Market-clearing is described by the labor supply equation,

$$L = 1 - \frac{w + rvN}{2w}$$

and the balance of permits,

$$wL = N .$$

There is, as usual, a one-dimensional indeterminacy. For any non-negative value of the permit price, v , there is a market-clearing wage,

$$w = (2 + rv)N$$

and level of employment,

$$L = \frac{1}{2 + rv}$$

The higher is the price of permits, v , the lower is the level of employment. The permits put a wedge between the real wage and the real marginal product of labor which depresses the level of employment below its efficient level, $1/2$. The efficient level does prevail if permits are free. The fiscal intervention involved in selling permits to pay wages is very much like the

product tax considered earlier--its effect is indeterminate and may be seriously inefficient. The economy could settle at an equilibrium with a relatively high nominal wage, low real wage, low level of employment and output, and high permit price. No substantive economic force would drive it away from this equilibrium.

The government can resolve the indeterminacy in a favorable way by declaring the permits as legal tender. Suppose it requires that a permit be accepted as a fraction m of a dollar. Then the dollar price of a permit, v , must equal m . With a sufficiently small m , the level of employment in the now-determinate equilibrium,

$$L = \frac{1}{2+rm}$$

can be made close to the efficient level of $1/2$. Under the legal tender declaration, the N permits become $M = mN$ dollars. The price level is

$$\begin{aligned} p &= (1 + rm)w \\ &= (1 + rm)(2 + rm)N \\ &= ((1 + rm)(2 + rm)/m)M \end{aligned}$$

so prices are proportional to the money stock with a ratio determined by the reserve requirement m .

In actual practice the economic effects of a reserve requirement against value added would be more complicated. Enforcement of the requirement would entail some penalty for

firms whose value added exceeded the level permitted by their reserve holdings; the expected amount of the penalty would widen the wedge between the real wage and the marginal product of labor. Precise control of nominal GNP would call for a large penalty, but this would enlarge the inefficiency of the system. Even so, the deadweight loss from the system would be very small.

Control of the price level through manipulation of the quantity of fiat money rests on a stable artificial demand for the money. It is not the control of money in general, private and public, that pegs the price level. Rather, it is the stability of the artificial demand that stabilizes prices. Within a system with stable demand, private transaction services could be fully unregulated. In an economy with stable equilibrium real output, imposing reserve requirements on value added would provide a highly stable demand, so all the benefits of completely competitive money markets would be available. By contrast, the current system based on reserve requirements against certain types of financial intermediation is incapable of providing a stable demand for reserves. It is particularly vulnerable to the development of unregulated transaction services which depress the demand for reserves and raise the price level. In this sense, stabilization of the price level does require the control of money of all kinds. But this is a pure artifact of the choice of criterion for reserve requirements. There is no fundamental relation between private money and the price level. The movement in the United States toward more extensive, uniform reserve requirements on wider and wider classes of intermediaries is

unlikely to improve control of the price level. Instead, some other way to provide a stable, artificial demand for reserves should be sought. The purpose of reserve requirements is not to control the creation of private money--it is to create a market for a particular government liability that can then be declared legal tender.

Whatever device is used to create demand for reserves (including the current requirements against deposits), prices can be stabilized through deliberate manipulation of the quantity of reserves. There is a close correspondence between the economy described in this section of the paper where the government uses fiat money to control prices, and the economy of the previous section, where the government sets the dollar price of a resource unit. The stock of money and the price of the resource unit have very similar roles as policy instruments. Both shift the price level in exact proportion in a market with immediate clearing of markets, and both act on prices with a lag if the wage is sticky. Both economies face possible shifts in the relation between the policy instrument and the price level--in the first because of shifts in resource supply, and in the second because of shifts in the demand for reserves. In both, a natural feedback rule for stabilizing prices is to depress the policy instrument this year by the same percentage that prices exceeded the peg last year. The analysis of the dynamics of such a policy in an economy with sticky wages presented in the previous section applies more or less without change to the case of manipulation of reserves. Pegging prices not only meets the goal of price stability, but

drastically limits the magnitude of the real disturbances following from the shifts in the demand for reserves.

CONCLUSIONS

These thoughts suggest a spectrum of reforms, ranging from the practical to the radical. With no important changes in the existing system of fiat money and reserves against deposits, it would make sense to adopt an explicit policy rule to peg prices. Such a rule would protect the economy against the real and price consequences of the shifts in the demand for reserves that are likely to occur as transactions technologies continue to improve. A more drastic reform would change the basis for reserve requirements to value added for all businesses, instead of the liabilities of certain intermediaries. This reform would bring better macroeconomic control and permit full deregulation of all financial intermediation and transactions services. It would liberate price-stabilization policy from its present excessively narrow focus on controlling money.

The most startling move would be the complete elimination of government money and monetary control and its replacement by a resource exchange standard. The government's intervention for price stabilization would be limited to an announcement of the definition of the dollar and its enforcement by the courts. All of the microeconomic benefits of full competition in intermediation and transaction services would be available, and the minor inefficiency of reserve requirements would be unnecessary. Whether this system is actually superior to an improved fiat money system in practice is unsettled.