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A FRAMEWORK FOR MONETARY AND BANKING ANALYSIS

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Abstract

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The paper sets out and analyzes a simple model of money, banking, and price level determination. The model is first used to illustrate recent developments in the theory and analysis of banking, particularly the distinction between the portfolio management services provided by banks and their provision of transactions services. The assumptions are then extended to analyze price level determination in an economy that becomes an inside money economy as high-powered money goes out of use. The paper concludes by discussing the major unresolved questions about banking, money, and price level determination.

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A FRAMEWORK FOR MONETARY AND BANKING ANALYSIS*

Stanley Fischer**

One of the benefits of monetary instability is that it reminds us, both by inducing change in financial institutions and by bringing out the monetary cranks, that the monetary arrangements we take for granted are not immutable.

In this paper I set out and analyze a simple model of money, banking, and price level determination. The model is first used to illustrate recent developments in the theory and analysis of banking. The assumptions are then extended to analyze price level determination in an economy becoming an inside money economy as high-powered money goes out of use. The paper concludes by raising the major unresolved questions about banking, money, and price level determination.

The topics I shall discuss have only recently again become popular in the United States. But they have a long history at the center of monetary and macro-economics. The contributions of Wicksell (1936, original in 1898), Patinkin (1965), the Radcliffe Commission (1960), Tobin (1963), and Gurley and Shaw (1963) are the best known of the classic analyses. More recently, Black

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(1970), Fama (1980), and others[1] have returned to the questions of what, if anything, distinguishes banks from other financial intermediaries, how an inside money economy would operate, and what monetary arrangements other than current fiat money systems might be developed.

I. A Model of Banking and Price Level Determination

The economy consists of household, banking, and firm sectors. There is a government in the background, whose only role is to make lump-sum transfer payments to households, thereby augmenting the stock of high-powered money. Households maximize utility over infinite lifetimes. Firms maximize profits. So too do banks.[2]

The goods produced by firms are either bought by households or invested by firms, financed by banks. Purchases of goods by households are not costless. The purchases can be made either by using currency, together with labor,[3] or by using the services of a bank. The bank charges per unit transaction, and uses capital, reserves, and labor in its production process.

The Household: The representative household, infinitely lived but not growing, has a given amount of labor, L, allocated between work for pay, and time spent making purchases. Thus[4]

$$(1) \qquad L_C + L_M \leq L$$

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1. See Hall (1982) for further reference.

2. The model is similar to that in Fischer (1972).

3. The assumption that no capital is used by the household in making currency transactions is made purely for simplicity.

4. Time subscripts are omitted wherever possible.

Here L_C is the amount of labor used in making purchases with currency, and L_M is work for pay. Work for pay is done either in the banking sector, in amount L_B, or in the production of goods, in amount L_P.

$$L_M = L_B + L_P \tag{2}$$

The households may hold either high-powered money for use as currency, in real amount H_C/P, or deposits, of real value B. Households do not hold capital directly. Household wealth, A, is thus:

$$A = B + \frac{H_C}{P} \tag{3}$$

Households purchase an amount of consumption goods, C. The purchase of a consumption good requires the use of transactions services in making payment. The transactions services are provided by the households, and one unit of transactions services is needed per unit of the consumption goods purchased.

$$C = f(L_C, \frac{H_C}{P}) + g \tag{4}$$

Here $f(L_C, \frac{H_C}{P})$ is the amount of transactions made through the intermediation of currency, and g the amount made through the intermediation of the bank.[5] Thus the total number of units of transactions services is equal to the number of units of consumption goods bought. Equation (4) describes the transactions costs for making purchases; in addition, the household has to give up resources to pay for the goods.

The household's flow budget constraint is:

$$\dot{A} = wL_M + r_b B + x - p_B g - \pi \frac{H_C}{P} - C \tag{5}$$

The rate of increase in wealth is equal to income minus spending. Income consists of wages plus real interest on deposits, plus lump-sum transfers

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5. The proportional costs of transacting are a special assumption whose relaxation may account for some special features of the banking industry.

(x) from the government. In (5), w is the wage rate and r_B the deposit interest rate. For simplicity, it is assumed that no transactions costs are incurred in the receipt of income. This assumption can easily be removed, at the cost of introducing more variables without any compensating insights. Spending goes to pay the bank for making transactions, where p_B is the unit cost of a transaction service; for holding possibly depreciating currency, where π is the rate of inflation; and for the purchase of consumption goods. Note that there is an implicit assumption that wealth accumulation is transformed costlessly into either currency or bank deposits. This assumption is reasonable if payments are received in bank deposits or currency--but there is an extra assumption that transactions between currency and bank deposits are costless. These costs too could be modeled, but without providing much insight.

The representative household maximizes

$$V(\ ) = \int_o^\infty U(C_t)e^{-\delta t}\, dt \tag{6}$$

subject to the above constraints, where $U(C_t)$ is concave and at least twice differentiable, and δ is the discount rate.

Setting up the Lagrangean

$$\mathcal{L} = \int_o^\infty \Big\{ U(C_t) - \lambda_1(L - L_C - L_M) - \lambda_2\left(A - B - \frac{H_C}{P}\right) - \lambda_3\left(C - f\left(L_C, \frac{H_C}{P}\right) - g\right) - \lambda_4\left(\dot{A} - wL_M - r_B B - x + p_B g + \pi \frac{H_C}{P} + C\right)\Big\} e^{-\delta t}\, dt, \tag{7}$$

optimizing, assuming an interior optimum, and rearranging the resulting necessary first-order conditions, we obtain

$$U'(C_t) = \lambda_4(1 + p_B) \tag{8}$$

$$p_B f_1 = w \tag{9}$$

$$p_B f_2 = r_B + \pi \tag{10}$$

$$\dot{\lambda}_4/\lambda_4 = \delta - r_B \tag{11}$$

From (8) and (11):

$$\frac{U''\dot{C}}{U'} = \delta - (r_B - \frac{\dot{p}_B}{1 + p_B}) \tag{11}'$$

The interpretation of (8) through (11)' is straightforward. The effective cost of a unit of consumption goods is not one (in real terms) but one plus the transaction cost needed to acquire it--hence (8). Equations (9) and (10) say that labor and wealth should be efficiently allocated to the making of transactions using currency, relative to the alternative of letting the bank do it.

Equation (11)' is the standard dynamic equation for consumption. Consumption is increasing so long as the real interest rate measured in terms of the effective price of consumption goods ($r_B - \frac{\dot{p}_B}{1 + p_B}$) exceeds the rate of time preference. To choose its optimal rate of consumption, the household has to form expectations of future interest rates, wages, and prices of transaction services.

Banks: Banks do two things in this economy. First, they act as financial intermediaries. They hold all the non-currency assets of households, using them to buy claims on the capital used by production firms. Second, they provide transactions services, making payments as demanded by the households.

I assume there are constant returns to scale in banking, so that it is possible to talk of a representative bank.[6] The production function for transaction services is

$$(12) \qquad g = \phi(L_B, K_B, \frac{H_B}{P})$$

where K_B is the amount of capital used in banking, and H_B/P is the amount of high-powered money held by the bank. Transactions services are produced using the bank's physical capital--its building and its computers--along with labor and high-powered money. I assume for now that high-powered money is used by the bank in making payments, and that depositors can obtain high-powered money at a guaranteed price in exchange for deposits. There are no required reserves: banks hold reserves because that is an efficient way for them to provide transactions services.

The bank's balance sheet is

$$(13) \qquad B = \frac{H_B}{P} + K_P + K_B$$

where K_P is the amount of capital used in production of goods, equal to the loans banks have made to goods-producing firms.

Bank profits are

$$(14) \qquad R_B = p_B\phi(L_B, K_B, \frac{H_B}{P}) - wL_B - \pi\frac{H_B}{P} + rK_P - r_BB$$

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6. Given the economies provided by the law of large numbers, constant returns to scale cannot be expected to hold at all scales. The assumption is that returns to scale are constant beyond some scale that is small relative to the market.

The bank receives revenue from the sale of transactions services and from interest on its loans to goods-producing firms, made at the market rate, r. It makes wage payments, interest payments to depositors, and it suffers capital losses on its holdings of reserves.

The individual bank sells transactions services at price p_B, attracts deposits at interest cost r_B, and chooses its optimal level of loans to firms. Because returns to scale are constant, the size of the bank is indeterminate, in two respects. First, the amount of transactions services sold is indeterminate. Second, so is the size of the portfolio. Competition and constant returns to scale will determine prices and rates of return, and demand conditions will determine the volume of real deposits and loans.

Substituting (13) into (14) and maximizing with respect to K_p, the size of the bank's holdings of productive assets, yields the first order condition

$$r_B = r. \tag{15}$$

Since the bank does not itself control these rates, we should interpret (15) as a competitive market equilibrium condition. Equilibrium requires that the deposit rate be equal to the return on capital.

In addition, a zero profit condition for the bank is that the price of the transaction service be equal to its cost:

$$p_B = w\ell_B + (\pi + r)\frac{h_B}{P} + rk_B \tag{16}$$

where ℓ_B, h_B, k_P are per-transaction levels of the equivalent uppercase variables.

The pricing rules (15) and (16) are the right rules for banks to use. Using these pricing rules will ensure those making more transactions face the appropriate costs.[7] In particular, since reserves are held for making transactions, depositors should be charged for their indirect use of reserves by a transactions charge, rather than by a reduction in the interest rate on deposits. And the pricing rules ensure that factors of production are efficiently allocated among sectors. Note in particular that the interest rate on deposits is not reduced by a proportion reflecting holding of reserves. If on the other hand, there were legal reserve requirements, competition would reduce the rate on deposits appropriately. Or if there were costs associated with portfolio management, those would be appropriately reflected in the deposit rate.

From (14), we derive the first-order conditions

$$\phi_1 = \frac{w}{p_B} \tag{17}$$

$$\phi_2 = \frac{r_B}{p_B} \tag{18}$$

$$\phi_3 = \frac{r_B + \pi}{p_B} \tag{19}$$

These conditions can only determine factor proportions; scale is determined by demand.

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7. This has been emphasized by Black (1975).

Now the formulation of the pricing rules (15) and (16) throws light on one of the central tenets of the "new" banking theory: There is no necessary connection here between the portfolio and the transactions aspects of the bank. The bank could set itself up with two divisions: the portfolio division and the transactions division. The portfolio division receives deposits and holds as its assets, capital in goods-producing firms and loans to the transactions division, for which it charges the market interest rate r. The transactions division in turn rents capital and high-powered money to make transactions, and repays the portfolio division out of the proceeds of its charges.

The clean separation of the portfolio and transactions divisions in the model reflects the assumption underlying the production function (12) that there is no link between the provision of the transactions services and the individual's bank deposits. Nothing in the set-up of the entire model so far has tied transactions together with the ownership of bank deposits. It is of course possible to imagine institutions that make transactions without requiring any corresponding asset holdings. The postal giro system is the most important example. A company making C.O.D. deliveries is another. And, to go a little further, credit card companies make transactions while providing credit, rather than requiring the user of their services to maintain an asset balance. Overdraft banking, not a common American institution, operates similarly.

It is not obvious what advantages there are to particular bundlings of financial transactions, nor why national practices appear to differ. The bank that manages its transactions customers' assets presumably is better informed about the ability of the customer to pay than is a credit card company; this may be the reason that banks have traditionally combined the transactions and asset management functions. Or it may be that the transactions costs for banks of transferring claims are lower when one of the claims to be transferred is a deposit with the bank.

Production Firms: There are again constant returns to scale. Firms maximize profits

$$R_P = F(L_P, K_P) - wL_P - rK_P \tag{20}$$

where $F(L_P, K_P)$ is a neoclassical production function. Maximization leads of course to

$$F_1 = w \tag{21}$$

$$F_2 = r \tag{22}$$

The firm's total output goes either to consumption or investment:[8]

$$F(L_P, K_P) = \dot{K} + C \ . \tag{23}$$

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8. Note that the firm's transactions costs have been omitted. It is relatively straightforward to include them.

Instantaneous Equilibrium: Given the rate of consumption, C, equilibrium is determined by

$$(24) \qquad L_C\left(\frac{w}{p_B}, \frac{r_B}{p_B}, \frac{r_B+\pi}{p_B}\right) + \ell_p(w,r)F(\,) + \ell_B\left(\frac{w}{p_B}, \frac{r_B}{p_B}, \frac{r_B+\pi}{p_B}\right)g = L$$

$$(25) \qquad k_p(w,r)F(\,) + k_B\left(\frac{w}{p_B}, \frac{r_B}{p_B}, \frac{r_B+\pi}{p_B}\right)g = K$$

$$(26) \qquad \frac{H_C}{P}\left(\frac{w}{p_B}, \frac{r_B}{p_B}, \frac{r_B+\pi}{p_B}\right) + \frac{h_B}{P}\left(\frac{w}{p_B}, \frac{r_B}{p_B}, \frac{r_B+\pi}{p_B}\right)g = \frac{H}{P}$$

$$(27) \qquad f(L_C, \frac{H_C}{P}) + g(L_B, K_B, \frac{H_B}{P}) = C$$

$$(28) \qquad F(L_p, K_p) = C + \dot{K}$$

$$(29) \qquad r = r_B$$

$$(30) \qquad p_B = \ell_B w + k_B r + h_B(\pi + r)$$

Lowercase letters are per unit-output demand functions of corresponding uppercase letters.

Equations (24) through (26) are, respectively, equilibrium conditions in the markets for labor, capital, and high-powered money. Equation (27) ensures that sufficient transactions services are provided to purchase the given quantity of consumption goods; (28) accounts for the disposition of output; and (29) and (30) are banking industry equilibrium conditions. The seven equations, together with (9)-(10), (17)-(19), (21)-(22), and given C, $\dot{p}_B$, π and x, the rate of monetary transfers, are sufficient to determine all variables of interest.[9]

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9. These are: r, r_B, w, p_B, $f(\,)$, g, $\dot{K}$, L_C, L_P, L_B, K_P, K_B, H_B/P and H_C/P.

One question to be considered is whether the solution allows for positive quantities of both real currency and bank deposits. In particular, it is possible that the banking technology dominates the private technology for making transactions, and that only banks are used for that purpose. Whether this is so is a technical matter, depending on the marginal cost of making the first transaction through the home (currency) technology compared with the cost of making that transaction using the bank. In this section I assume there is an interior solution; in section III I assume the banking technology may eventually dominate.

It remains to discuss the determinants of the rate of consumption, C, and and the rate of inflation, π. For any given expected paths of the real interest rate, $r_B(t)$, rate of change of p_B, and inflation rate $\pi(t)$, the rate of consumption is obtained from the consumer's optimization problem and conditions (8)-(11)'. In a full perfect foresight equilibrium, the rate of consumption and the resulting rates of inflation and interest will be consistent with the expectations under which the consumption path was chosen. It is well known that convergence of such paths in a monetary economy is a difficult issue, but it is not one on which I wish to focus.

I shall instead assume that the economy converges to a steady state, the characteristics of which we now examine. All relative prices are constant, as are all quantities. The real interest rate is determined by the rate of time preference, and is equal to δ. The inflation rate is determined by the rate of growth of the money stock, denoted θ and concealed hitherto in x, the rate of transfer payments. The aggregate capital stock is such that the marginal product of capital in both banking and production of goods is equal to δ. The real value of high-powered money is determined by demand, as in equation (26).

Price Level Determination

Price level determination in this economy is entirely conventional. The nominal quantity of high-powered money is fixed exogenously; the real quantity and therefore the price level is endogenous, given the inflation rate.

But we have also to recognize that the issue of price level determination is put here in a very specific way. We have implicitly defined the price level as the exchange rate between consumption goods and high-powered money. That appears to suggest high-powered money is the numeraire. However, nothing in the model ensures that it is the numeraire. Indeed, most variables in the analysis are defined in real terms, suggesting that perhaps the consumption good is the numeraire. In any event, it is necessary to note that there is nothing in this analysis, or in most monetary analyses, that determines the choice of numeraire. Yet in talking about price level determinacy, long a major concern of monetary analysis, we are typically asking what determines prices in terms of the numeraire.

High-powered money is neutral in that changes in its stock, with the growth rate of money given, result in proportional changes in the price level. High-powered money is not superneutral in that changes in the growth rate of money affect real balances, thereby change the amounts of labor and capital devoted to making transactions, and affect the steady-state level of consumption. The presumption is that an increase in the steady-state inflation rate reduces the steady-state rate of consumption. More of the capital stock is drawn into the banking industry and the aggregate physical capital stock may either rise or fall.

II. Money as Medium of Transactions

In this section I comment on the role of money in the above analysis, and on topics on which the model throws some light.

There is no real need in the above analysis to define the stock of money. Indeed, there is nothing that suggests the concept is one we need think about. The price level is determined by the stock of high-powered money, given real variables including the inflation rate. But real variables do affect the price level and there is no exact sense in which inflation could be described as a purely (high-powered) monetary phenomenon. It may, however, be useful to focus on high-powered money as the most likely source of major inflations, in that the real variables in the system do not ordinarily vary enough to generate large-scale aggregate price movements.

The implied institutional arrangements in which all non-currency household assets are deposits leave little room for definitions of the money stock other than all possible combinations of household and bank holdings of currency, and deposits. If the transactions technology were modeled in more detail, it might turn out to be efficient for the banking system to get depositors who plan to make frequent transfers to signal their intentions by segregating certain assets into a particular account. In such a situation it begins to be possible to identify as money a collection of assets that are held for transactions purposes, and that are close substitutes for each other.

Whether a particular definition is useful depends on its use. The definition may be useful for understanding price level or income determination. Or it may be useful for formulating monetary policy rules. But the logical procedure is not to formulate a monetary policy rule in terms of the stock of

money and then cast around for the best definition, but rather to formulate a rule in terms of existing and potential categories of assets and then see whether that can sensibly be interpreted as a money rule.

In this model, the stock of high-powered money is the exogenous nominal variable, the quantity of which ultimately determines the price level. But that analytical fact has no direct policy consequencs. If other classes of assets were close substitutes for high-powered money, and if the composition of the aggregate of those assets and high-powered money fluctuated, it would be more stabilizing for the price level to target the aggregate than the stock of high-powered money. Such a monetary rule is an efficient way of adjusting the nominal supply of high-powered money for shifts in the real demand.

Money and Consumption Loans: The model outlined above imposes the view that currency is used for making transactions, and that it is different from bonds. Transactions do not happen costlessly and require the intermediation of currency and labor, or of a resource-using bank. This view differs from that implicit in the frequent use of the consumption loans model as the basic monetary model.

In the conventional consumption loans overlapping generations model, there is no inefficience in the nonmonetary equilibrium if individuals are effectively infinitely lived. Thus the usual demonstration of the usefulness of money in the finite horizon versions of the model is a result of the role of money in making possible previously impossible intergenerational transfers. This is a restrictive view of the intermediation role of money, and one that is avoided in the present setup by requiring the use of transactions services

in transactions between households and firms. But there would be no difficulty in requiring the use of transactions services in the making of current transactions in the overlapping generations model--and doing so might help distinguish the roles of money and bonds in such models.[10]

The Optimum Quantity of Money: In the model of Section I, in which taxes are nondistorting and the government determines the inflation rate by the rate of its monetary transfers, the optimal rate of inflation is equal to the negative of the real interest rate. This result assumes that both real currency holdings and real reserves are productive at the margin in enabling households and banks to economize on other transactions-producing resources.

As is well known, there are two potential difficulties with the optimum quantity of money prescription. First, there may be no nondistorting taxes available. In that case, the taxes that are levied to reduce the money stock will be distorting, and it will probably be advisable to stop short of the optimum. Second, the menu costs of changing absolute prices may be higher at a negative than at a zero inflation rate.

Other considerations also give cause for thought before action is taken to provide the optimum quantity of money by deflating. One is that we know very little about how a system would work with capital and real money holdings earning approximately the same real return. In models in which the real interest rate is not tied down by the rate of time preference--for instance in overlapping generations models with both money and capital[11]--

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10. Wallace (1981) has attempted to differentiate between the roles of money and bonds in a simple form of the consumption loans model. It may be useful to add that some criticisms of the consumption loans model as a basis for monetary theory take the model too literally. The two-period setup is a convenient simplification, not an assumption that all contracts are made for 25 years. Most of the results of interest go through if there are 50 periods per person, rather than two.

11. Drazen (1979), Weiss (198)

the increasing attractiveness of money may displace capital accumulation as the inflation rate falls. This suggests that the optimum may be short of full liquidity. Second, there may be other ways of achieving the same goals. If interest could be paid on currency and on reserves, the optimum quantity of money can be achieved without deflating. There is certainly no technical difficulty in paying interest on reserves--which leaves only currency as the source of the inefficiency that the optimum quantity of money literature seeks to correct.

Fiat and Commodity Monies: The creation of high-powered money in the model of Section I uses no real resources. There is no economic case for using a commodity that is costly to produce as the medium of transactions, so long as the monetary authority is well behaved. The case for using a commodity money turns entirely on the propensity of monetary authorities to misuse fiat money systems. But if it is possible to impose by law a commodity money system, then it should be possible by law to impose a fiat money system that achieves the same behavior of the monetary base as would a commodity money system.

By a commodity money system I mean one in which the commodity itself is used as currency or as high-powered money. I do not mean a system in which all prices are in effect indexed to the price of some commodity or commodity basket, while the monetary system continues to operate with a costlessly produced medium of exchange.

The Currency Monopoly: It has been assumed so far that there is a single asset, issued by the government, that serves as both hand-to-hand currency

and reserves. Reserves are kept both to facilitate transactions the bank makes and because it is assumed that depositors have a claim on high-powered money, and not because reserves are required. Reserves in the United States are no doubt much higher than they would be without reserve requirements, but they would not disappear if the requirements were removed.

While currency is used for some transactions, the model is consistent with payment through banks being made by the transfer of claims on capital. A deposit holder in one bank who makes payment to a depositor in another bank does not care how his bank settles the debt--and if claims on capital are easily transferable, they are one possible medium for doing so.

I defer to later the question of whether there are better monetary arrangements, possibly not built around the premise that currency continues to be used and is an obligation of the government. In the next section I allow the system to operate as a purely inside money economy, and discuss issues of monetary efficiency in that context.

III. Technical Progress in Banking

Assume now that there is technical progress in banking, so that the production function becomes

$$(12)' \qquad g(t) = \phi\left(\mu_1(t)L_B(t),\ \mu_2(t)K_B(t),\ \mu_3(t)\frac{H_B}{P}(t)\right)$$

with $\mu_i(t)$ increasing through time for $t > 0$. Assume that the economy was in steady state at time zero, with constant stock of high-powered money and no technical progress taking place or expected. The price level was constant.

Once technical progress gets under way, the price level likely begins to rise,[12] as the demand for both reserves and currency falls. The demand for reserves is likely to fall for one main reason that is not explicitly modeled: the proportion of transactions carried out with currency is falling, and the call for banks to provide high-powered money to their depositors in exchange for deposits is likely to fall. Banks' desired reserve ratio will fall.

The declining demand for real high-powered money will generate ongoing inflation, so long as the money supply is kept constant. Because real high-powered money is productive, the prospect of continuing inflation need not necessarily cause an immediate flight out of the currency. There is instead a continuing decline in the real value of currency and a continuing increase in the proportion of transactions carried out using bank deposits.

Such a process need not cause inflation. The monetary fiscal authority can levy taxes that reduce the money supply at just the rate that will maintain the price level constant. Now, what is the limiting behavior of the real stock of high-powered money during this process, in which monetary/fiscal policy maintains the price level (in terms of units of high-powered money) constant?

That is entirely a technical question, dependent on the details of the transactions technologies represented by (12)' and the function f( ) describing the household's use of currency and labor for making transactions.

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12. The qualifier is included because unbalanced technical progress could increase the banks' demand for reserves as the demand for bank transactions services rises.

It is possible that the banking transactions technology becomes so efficient that no transactions are made through currency. Currency is no longer used and nor therefore are reserves.

The system ends up in this case as a purely inside money system. Payment is made entirely through the banking system, which transfers claims on capital to settle claims among depositors. These claims on capital are of course serving as the medium of transactions.

Price Level Determination: How is the price level determined in this inside money economy? We have first to clarify the question, which is rather two questions. First, in what units will prices be quoted, or what is the numeraire? And second, given the numeraire, what determines the level at which prices settle in terms of the numeraire?

There is nothing in the analysis that provides an answer to the first question, of what is the numeraire. The natural question we asked in Section I was what was the exchange rate between high-powered money and consumption goods. But now there is no high-powered money, and there are no transactions taking place that enable us to answer the question.

It is possible that the memory of the stable price level that existed when currency was a medium of exchange is powerful enough to leave the currency as the unit of account, like the famous ghost monies of Europe.[13] As Patinkin (1965) has emphasized, the unit of account need not exist. An alternative is that one good in the system could be adopted as the unit of account. Or a basket of goods could become the unit of account. Most

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13. Cipolla (1967)

likely bank deposits, which are serving as medium of transactions, would become the numeraire. Bank deposits might be denominated in terms of claims on capital.

Given the numeraire, it is possible to discuss the determination of the price level. Going back to the model of Section I, which previously had fourteen equations in fourteen variables, we no longer have any high-powered money in the system, and there are therefore thirteen equations. We cannot any longer determine P, the exchange rate between high-powered money and consumption goods. But all other prices and quantities of interest are determinate. If bank deposits, denominated in units of claims on capital, are the numeraire, then all prices can be stated in terms of that numeraire. The price level is completely determinate in terms of that variable. There is no obvious difficulty, indeterminacy or instability, in the operation of the economy described in Section III, beyond the indeterminacy of the numeraire.

But that does not appear to be a serious difficulty. The medium of exchange for that economy is, by assumption, bank deposits. The question of how economic agents write their price tags does not appear to have important consequences. And of course, economic agents in such an economy would find themselves using some numeraire. The failure of the model to discover what that numeraire is reflects on the model, not on the working of the real world.

This is not to deny that it is possible to imagine price level indeterminacy in an inside money economy, given the numeraire. Wicksell (1936) invented one such economy. The basic source of price level indeterminacy

in that economy is the rule for money creation--that the stock of money increases when the bank loan rate is below the natural interest rate. But that indeterminacy has nothing necessarily to do with an inside money economy. The same problem would occur with that money supply rule in an outside money economy.

Price level indeterminacy is possible in an inside money economy--but it is also possible in an outside money economy. And, given the numeraire, price level determinacy is possible in both inside and outside money economies as well.

IV. Further Considerations

Will Currency Disappear? Currency/income ratios have fallen in most of the developed economies in the last thirty years, but not much in Germany and Japan. The striking feature of the classic hyperinflations was that currency continued to be used in those economies despite the costs of holding currency. Currency is a convenient way of making small transactions that appears unlikely to disappear soon.

I do not believe that the shift to a complete inside money pure banking method of transacting is close. Rather currency will likely continue to decline in importance as alternative means of making payments become cheaper. This raises several issues.

Competitive Provision of Currency: Historically, monetary systems have developed to the point where the state is a monopoly issuer of currency. Recent research on competitive provision of money (Klein, 1974, Hayek, 1978, Taub, 1982) has discussed the question of whether competition alone

is sufficient to ensure efficiency in the provision of fiat monies.

There are two questions. First, if the supplier has to guarantee convertibility of his currency into a commodity or dominant currency, will efficienty ensue? Second, can purely unregulated issuers of currency without convertibility guarantees emerge, and usefully so? The insights of Auerheimer (1974) and Calvo (1978) that governments maximizing inflation tax revenue have an incentive to be dynamically inconsistent appear to carry over to private profit-maximizing currency issuers who provide no convertibility guarantee. But this means such institutions will not get off the ground.

It is entirely possible, though, that with a requirement of convertibility into a dominant currency, competition among private currency issuers will not be harmful. If the monetary authority were well behaved there would be little to gain from private issues of currency, for proliferation of private currencies would inevitably require increased attention to the credit standing of the issuer, and to possible forgeries. If, however, monetary authorities continue to keep the cost of using government currency high, private provision of currency with some mechanism for ensuring a slower depreciation rate than that of government currency, would be beneficial.

Alternative Monetary Systems and Indexation: A variety of monetary reforms are described in Hall (1982). The schemes are based on Fisher's (1934) plan for stabilizing the dollar by adjusting its value in terms of a price index. All contracts would be made in terms of dollars, but the value of the dollar would be specified in terms of goods. In essence these come down to schemes for compulsory indexation.

Since the economy has not been prevented from indexing itself, the question arises why compulsory indexation is desirable. The answer is that a partially indexed system may be worse than a nonindexed system. But a fully indexed system may perform better than a nonindexed system.

The reason a simultaneous compulsory move to indexation may be needed is that many institutions and individuals will only want to switch if both assets and liabilities become indexed at the same time. Financial intermediaries prefer to hedge by holding assets of similar risks to their liabilities. Households will only be willing to borrow indexed if their income streams are indexed. Of course, such a switch would in a modern economy require major governmental action, including indexing of the national debt and the tax system.

The question of determinacy of the price level in a fully indexed system is similar to that of the determinacy of the price level in the inside money economy of Section III. To know the price level, it is necessary to know the numeraire. In a fully indexed system the numeraire might well be a consumption basket. In that case, the fully indexed economy would have a determinate price level.

But it is more likely that indexation introduced in the near future would still leave currency as a nominal asset. Control over the quantity of currency would then still keep the price level, in terms of dollars per consumption good, determinate. If technical change in banking were to continue, the demand for currency would fall over time. A question of some interest is whether control over the price level is reduced as the currency/income ratio falls. There seems to be no a priori answer to this, beyond a

skepticism that little tails can wag big dogs. But it would be true in such a system that the smaller the currency/income ratio, the less important was the inflation rate as a real economic variable. Indexation might well make the price level more unstable, but instability with indexation would on average be preferable to more price level stability with less indexation.

International Aspects: A system in which all domestic prices were indexed and there were no outside money appears difficult to operate at the international level. But there is no great difficulty. Banks would be transferring claims on different assets--in the setup of Section III an American wishing to purchase British goods would instruct his bank to transfer ownership over his deposits worth the appropriate amount to the account of the British exporter. The exchange rate, instead of being one between currencies, would be between particular assets.

Residual Doubts: Descriptions of alternative monetary systems, indexed economies, ghost monies, and the like are at a minimum entertaining and mind-stretching. But they do leave doubts. The doubts arise from the difficulty of explaining the apparent advantages of using nominal prices and the question of what economic function inflation serves in current economies. We quote prices in the currency of circulation, and this is not an isolated phenomenon--it is precisely because the exceptions are rare that the guinea and other ghost monies are so celebrated. And we do not have a good explanation yet of why nominal prices appear to be sticky. Possibly the use of the currency and nominal pricing provide some information or other service that we have as yet not identified.

Residual doubts about our understanding of monetary systems are a good thing, but they are not an excuse for regarding each monetary system as the best of all possible worlds until it evolves, by accident or design, into the next one.[14] Better to think about the design beforehand, taking into account the likelihood that piecemeal improvement may be less effective than system-wide changes.

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14. A contrary view is contained in the warning of Sir Robert Giffen (1892, p. 471), "I hardly think that of late years the enormous practical dangers of meddling with a settled monetary system, which hardly any theoretical gain would compensate, have been sufficiently realized by our younger economists, fresh from the universities and but little acquainted with the conditions of money and business, and I trust that what has been said here will be of some use as a caution." Giffen was objecting at the time to a proposal that paper pounds be issued, redeemable into bullion of fixed real value. This idea is essentially that adopted later by Irving Fisher.

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