Financial Structure and Economic Activity

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A recent development in economic science is the attempt to integrate monetary theory with the theory of general economic equilibrium. This work takes as its starting point the idea that money cannot have value in standard, general equilibrium models. In these, too much trade can be accomplished in centralized markets (see Robert Clower, 1969, 1971; Frank Hahn, 1973; or Neil Wallace, 1980). Thus, to decentralize or break up the structure, either exchange must be made costly or there must be restrictions on who can trade with whom, and thus such choice-theoretic models offer the intriguing possibility that real and monetary phenomena can be understood as intimately related.

This paper continues in the relatively brief, choice-theoretic tradition, motivated by real and monetary phenomena associated economic development and growth:

1) To be noted first is Simon Kuznets' seminal work on national income (1971). In a cross-section study of fifty-seven countries in 1958, Kuznets shows that the share of the agricultural sector, including forestry, fishing, and hunting, in Gross Domestic Product is inversely correlated with Gross Domestic Product per capita. The share of the industrial sector, including transportation and communication, is closely and positively associated with per capita product. The share of the service sector tends to be positively but weakly associated with per capita product, but the share of banking, insurance, and real estate shows a striking rise as one shifts from low- to higher-income countries. Moreover, the evidence suggests that the ratio of industrial prices to agricultural prices is perhaps lower the higher is per capita income, though the evidence on relative prices for the service sector is inconsistent. Turning to long time-series for thirteen developed and four less developed countries, Kuznets finds dramatic evidence for a decline of the agricultural sector and a rise in the industrial sector with per capita income, at least in developed countries. Again, results for the service sector are mixed, but Canada, France, and the United States are positive exceptions. The share of a transport-communication subsector rises quite consistently. Turning next to shares of sectors in the labor force, Kuznets finds, both on a cross-sectional and secular basis, that all the above movements are at least mirrored and in many cases amplified. In particular, both components of the share of the service sector, services and commerce, rise substantially with Gross Domestic Product per capita.

2) To be noted second is the extensive work of Raymond Goldsmith on financial structure and financial intermediation. For the United States, Goldsmith (1958) finds that the activity of intermediaries, as measured by their share in national assets, in tangible assets, and in all claims, has shown a substantial rise from 1860 to 1952. Similarly, Goldsmith (1969) finds that the ratio of financial institutions' assets to Gross National Product rises substantially from 1860 to 1963 in both developed and less developed countries, including Switzerland, Great Britain, the United States, Japan, Argentina, and India. Related, the number of households with savings accounts, the number with life insurance policies, and the number with stock ownership expressed as percents of the population are all low for less developed countries relative to developed countries, and

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the first two measures tend to increase with per capita income.

3) To be noted third are the cross-sectional and secular studies of (aggregate) asset velocities. Ronald McKinnon (1973) shows that the ratio of a broad monetary aggregate (M_2) to national income increases as one moves from less developed to semi-industrialized countries. Moreover, the ratio of private credit to national income does increase roughly with income per capita in cross-country comparisons, but the ratio of currency to income shows no systematic pattern (see Section VIII). McKinnon also shows that countries such as postwar Japan and Germany, which experienced high and sustained increases in national income over time, also experienced substantial increases in the ratio of M_2 to national income. This is true as well of the ratio of private credit to income, though the ratio of currency to national income either remained constant or decreased slightly in these countries (see Section VIII). A rather substantial secular decline in the ratio of currency to national income is provided by the U.S. experience, 1869–1929, as documented by Phillip Cagan (1965). (There has been a subsequent reversal.) The ratio of M_2 to national income increased substantially in this period.[1]

4) One may note fourth the long-standing controversy in macroeconomics over the relationship of various monetary aggregates to economic activity and as to whether the distinction should be made between money and credit. One of the more recent contributions is that of Benjamin Friedman (1981).

This paper, of course, does not pretend to offer a model which might account for the above-mentioned phenomena or settle any controversies. The degree of abstraction is too great. But it does seek to establish that choice-theoretic models can be used to address such observations and provide a useful conceptual framework. The key idea is that the degree of interconnectedness of traders determines both the amount of production and trade as well as the types of assets which are used to facilitate exchange. Thus real and monetary phenomena are indeed intimately related. Moreover, as one varies the degree of interconnectedness one can generate interesting comovements, of per capita national income with economywide asset holdings, for example.

The basic model of the paper in terms of endowments, preferences, and technology, is presented in Section I. The model builds on Robert Lucas' version of the David Cass and Menahem Yaari (1966) circle as presented in my 1980 paper, modified here to allow for variable labor supply. Its key feature is the absence of double coincidence of wants for bilateral pairings, a feature which dates back to Knut Wicksell (1935), at least. In a Robinson Crusoe economy, in which households are completely isolated one from another, each household can consume at most the fruits of its own labor. This autarkic exchange regime is described in Section II. In a structure with spatially separated markets (essentially with bilateral pairings), a highly stylized asset, fiat money, partially overcomes the absence of double coincidence of wants. The decentralized, fiat money regime and its equilibrium are described in Section III. That regime is consistent with Clower's (1967) dictum that money buys goods and goods buy money, but goods do not buy goods. In a structure with centralized, Walrasian markets, another stylized asset, trade credit, delivers Pareto optimal allocations. The centralized, trade credit regime and its equilibrium are described in Section IV. In it there is a sense in which goods buy goods.

It is next established that the cost of market-produced commodities relative to home-produced commodities is infinite in autarky and is high in the decentralized, fiat money regime relative to the centralized, trade credit regime. The essential idea is that fiat money from the sale of home-produced commodities is held one period in the fiat money equilibrium (i.e., has unit velocity),

[1]With regard to cyclical fluctuations, there is the widely cited experience at the outset of the depression, when high-powered money increased though other monetary aggregates decreased—see the papers of Cagan and of Milton Friedman and Anna Schwartz. Moreover, Cagan argues that countercyclical movements in the currency to money ratio and in the currency to income ratio obtain more generally, even if one excludes episodes associated with financial panics.

whereas trade credit can be used for contemporary purchases in the trade credit equilibrium (i.e., has infinite velocity).[2] Thus, on the assumption that substitution effects dominate income effects, labor supply will increase, consumption of home-produced commodities will decrease, consumption of market-produced commodities will increase, trade will increase, and welfare will increase as one moves from autarky to the decentralized, fiat money regime to the centralized, trade credit regime. A formal analysis of these substitution effects is contained in Section V.

Finally, by consideration of countries with an internal mix of exchange regimes, one can deliver theoretical, cross-country comparisons on the state of economic development. That is, one can examine how per capita consumption of home-produced commodities, per capita consumption of market-produced commodities, the volume of trade, the degree of financial intermediation, and per capita asset holdings all move with per capita income. Similarly, one can examine how these variables move in a country which becomes more centralized over time. In effect, this delivers a model of economic growth. In short, following Adam Smith, the specialization (division) of labor, the volume of trade, and the complexity of financial instruments are all limited by the extent of the market; all move in a systematic way with the degree of interconnectedness of the households. These cross-country comparisons and the growth model are contained in Sections VI and VII, respectively.

The central idea of this paper, that market fragmentation can play a key role in a theory of economic activity and in a theory of finance, is not new. Goldsmith (1969), John Gurley and Edward Shaw (1960), and McKinnon all contain that idea. Neither is the idea that structural change can cause systematic changes in economywide asset holdings new. James Tobin argues that Milton Friedman and Anna Schwartz should have taken that into account in their explanation of the decline in U.S. velocity, arguing in the spirit of Irving Fisher that

> ... an account of the demand for money [should be] closely tied to its function as means of payment. He [Fisher] would have wished to hear about the frequency and timing of wage payments and bill settlements, the speed and cost of communications, the trend of industrial integration, the scope of the barter and subsistence economy relative to the money economy, the volume of total transactions relative to income generating transactions, and so on.
> [Tobin, 1965, p. 473]

In fact, several cross-country studies on the demand for money, that of E. M. Doblin (1951) and that of Jacques Melitz and Hector Correa (1970), for example, argue that institutional features should be taken into account. More recently, Michael Bordo and Lars Jonung (1981) offer a time-series study of money velocity in five countries, explicitly using measures of the degree of monetization and financial sophistication to account for the typical U-shaped pattern of velocity. In fact, these measures are closely tied to the stylized facts mentioned at the outset, though the model specification is somewhat *ad hoc*. More generally, the work of Bordo and Jonung builds on Wicksell, especially his account of the substitution of credit for currency. What is new about this paper is that, at the cost of considerable abstraction, it presents an explicit model in the general equilibrium, microeconomic tradition; that is, what is offered here is a highly stylized, choice-theoretic model which accounts for the relationship between economic activity and financial structure. Again, the model should be regarded as a first step. Some of the obvious caveats are contained in Sections VIII and IX.

[2] One might suppose a priori, from contemporary observations, that money balance holdings are small and that changes in the trading frictions which account for money balance holdings cannot account for much movement in real variables. Economic history seems to provide some counterevidence, however. For example, Rondo Cameron (1967) argues that "working capital" was significant relative to "fixed capital," and in effect argues that trading frictions and the absence of banks and trade credit were a severe restriction on growth at the beginning of the industrial revolution in England.

I. The Underlying Structure: Preferences, Endowments, and Technology

Imagine an economy with a countable set of household types, indexed by the positive and negative integers, with a countable set of produced commodities, again indexed by the positive and negative integers, and with labor. Each household of type i can produce commodity i *alone* at date t, by supplying labor at date t; that technology is linear, so one can let n_{it} denote both labor supplied and produced output of commodity i. Suppose that labor supply is bounded from above. Suppose also that each household of type i cares about units of consumption c_{it} and $c_{i+1,t}$ of commodities i and $i+1$, respectively, at date t, as well as units of labor supply n_{it}, and thus has preferences represented by a utility function $U(c_{it}, c_{i+1,t}, n_{it})$ which is strictly concave and continuously differentiable, strictly increasing in the first two arguments and strictly decreasing in the third. Also, as will be made clear in Section V, the function $U(.,.,.)$ is such that substitution effects of price changes dominate income effects. Each household i discounts the future at rate β; that is, preferences over the infinite horizon of its lifetime are represented by the utility function

$$\sum_{t=0}^{\infty} \beta^t U(c_{it}, c_{i+1,t}, n_{it}).$$

Many of the above assumptions can be relaxed, but the current model does allow rather tight characterizations of competitive equilibria in the autarkic, decentralized, and centralized versions of the economy.

II. The Autarkic Regime

Suppose that households are entirely isolated one from another, as if each were residing on a separate island. Then, in this Robinson Crusoe-type economy, each household makes a straightforward, period-by-period, production-consumption decision; whatever is produced is consumed—there can be no trade. Thus, indexing the choices made by households of type i in parentheses after the variables, the problem confronting each household of type i is

Problem 1:

$$(1) \quad \text{Max} \sum_{t=0}^{\infty} \beta^t U[c_{it}(i), c_{i+1,t}(i), n_{it}(i)]$$

by choice of $c_{it}(i), n_{it}(i)$, subject to

$$(2) \qquad c_{it}(i) \leq n_{it}(i),$$

where $c_{i+1,t}(i) \equiv 0$, yielding necessary and sufficient first-order conditions for an interior maximum

$$(3) \quad U_1[c_{it}(i), 0, n_{it}(i)] = -U_3[c_{it}(i), 0, n_{it}(i)];$$

$$(4) \qquad c_{it}(i) = n_{it}(i).$$

Now one may take the solution to (3) and (4) to be symmetric across household-types i and constant over time, that is,

$$c_{it}(i) = \mathring{c}^1, c_{i+1,t}(i) = \mathring{c}^2 = 0, n_{it}(i) = \mathring{n}$$

for all the produced commodity, the nonproduced commodity, and labor supply, respectively. Note in particular that the consumption of the nonproduced commodity is identically zero. Finally note for subsequent reference that (3) and (4) can be cast in the form

$$(5) \qquad U_1[\mathring{c}^1, \mathring{c}^2, \mathring{n}]/U_2[\mathring{c}^1, \mathring{c}^2, \mathring{n}] = \gamma,$$

$$(6) \qquad -U_3[\mathring{c}^1, \mathring{c}^2, \mathring{n}]/U_2[\mathring{c}^1, \mathring{c}^2, \mathring{n}] = \gamma,$$

$$(7) \qquad \mathring{c}^2 = \mathring{n} - \mathring{c}^1,$$

where it is supposed that γ is some positive real number less than the discount rate β and $\mathring{c}^2 = 0$.

III. A Decentralized Exchange Regime with Fiat Money

A crucial feature the decentralized regime will explain is the use of fiat money. To ensure this, imagine that, at date t, each

household of type i can trade only with a household of type $i+1$ and a household of type $i-1$. Under the assumed preference orderings, the household of type i has no commodity the household of type $i+1$ wants, and this creates the possibility for the exchange of fiat money (see Lucas' version of the Cass-Yaari circle in my 1980 paper). Moreover, to rule out private debt or futures contracts in fiat money, it is imagined that there is no chain of pairings or dealings among households such that debt can be redeemed by the issuer.

A timing-location scheme which generates these restrictions is displayed in Figure 1. Each (representative) household of type i consists of a pair of agents and is imagined to be located on some real line at integer i. There are countably infinite such real lines, indexed by the positive and negative integers, and displayed on top of one another in Figure 1. The integer i on each line is inhabited by a (representative) household of type i. At each date, each member of household type i is capable of moving horizontally (on the line where the household is located) one-half the distance to each of the two adjacent integers, $(i+1)$ and $(i-1)$. Thus, at each date t, each household-type i is physically capable of carrying out transactions with a household of type $(i-1)$ and a household of type $(i+1)$ in two spatially separated markets, say, $(i-1, i)$ and $(i, i+1)$. Between dates, households move about. Each household of type i, i even, is imagined to move vertically downward to the next line, while each household of type i, i odd, stays in its fixed location. Thus, for example, debt issued by a household of type i, i even, can only be passed along to households vertically above the issuer. (See the turnpike-exchange model in my 1980 paper for a similar construction, to prevent the issue of private debt.)

Now let $M_t(i)$ denote the number of units of fiat money carried over by household-type i to the beginning of date t, a decision made at date $t-1$. Here again the i in parentheses indicates a decision made by household-type i. Note also that here and below all households of type i are to be treated identically, independent of location. Let $M_0(i)$ denote a fixed initial condition, at date zero. At the beginning of date t, household-type i decides how much of commodity i to produce, surrendering the requisite labor. Then one member of household-type i travels to market $(i-1, i)$ with some of commodity i and sells it for fiat money at price p_{it} in terms of fiat money (again, note the symmetry). Similarly, the other member of household-type i travels to market $(i, i+1)$ with the beginning-of-period fiat money balances and purchases commodity $i+1$ at price $p_{i+1,t}$. At the end of date t, both members of household-type i return to their original location to consume. Thus taking the price sequence $\{p_{it}, p_{i+1,t}\}_{t=0}^{\infty}$ as given, each household of type i is confronted with

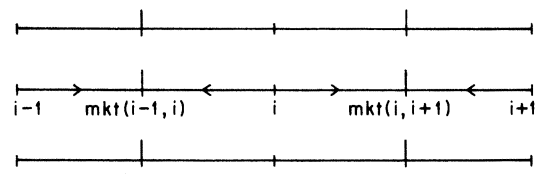

FIGURE 1

Problem 2:

$$\text{(8)}\quad \text{Max} \sum_{t=0}^{\infty} \beta^t U\left[c_{it}(i), c_{i+1,t}(i), n_{it}(i)\right]$$

by choice of $c_{it}(i), c_{i+1,t}(i), n_{it}(i), M_t(i)$, subject to

$$\text{(9)}\quad p_{i+1,t}c_{i+1,t}(i) + M_{t+1}(i) \leq M_t(i) + p_{it}\left[n_{it}(i) - c_{it}(i)\right],$$

$$\text{(10)}\quad p_{i+1,t}c_{i+1,t}(i) \leq M_t(i),$$

given $M_0(i)$. Here (9) is the fiat money balance accumulation equation, that is, the date t budget constraint, and (10) is the date t constraint that the valuation of consumption of commodity $(i+1)$ by household-type i cannot exceed the beginning-of-period fiat money balances $M_t(i)$. Thus (10) is a liquidity constraint, generated by the assumed exchange technology of the model. It captures what Clower (1967) has termed a key feature of money.

The above specification leads to the obvious definition of a perfect foresight competitive equilibrium.

DEFINITION 1: *A fiat money equilibrium is a sequence of finite, positive prices p_{it}^* for each commodity i and sequences of decisions for consumptions $c_{it}^*(i), c_{i+1,t}^*(i)$, labor supply $n_{it}^*(i)$, and fiat money balances $M_t^*(i)$ by each household-type i, such that the following two conditions hold.*

Maximization: The sequences $c_{it}^*(i)$, $c_{i+1,t}^*(i), n_{it}^*(i), M_{t+1}^*(i)$ solve Problem 2 for each household-type i given the price sequences $p_{it}^*, p_{i+1,t}^*$.

Market clearing: The sequences $c_{it}^*(i)$, $c_{i+1,t}^*(i), n_{it}^*(i)$ satisfy

$$c_{it}^*(i-1) \le n_{it}^*(i) - c_{it}^*(i) \tag{11}$$

over all commodities i and all dates t.

Note that in market-clearing condition (11), only households-type i and $(i-1)$ consume commodity i and only household-type i can produce commodity i. Since in any market, commodities are exchanged for fiat money, commodity balance (11) thus implies equality in demand and supply of fiat money balances as well.

To search for a fiat money equilibrium, consider the first-order conditions for an interior solution of household-type i's maximization problem:

$$\beta^t U_1[c_{it}(i), c_{i+1,t}(i), n_{it}(i)] - \lambda_t p_{it} = 0, \tag{12}$$

$$\beta^t U_2[c_{it}(i), c_{i+1,t}(i), n_{it}(i)] - \lambda_t p_{i+1,t} - \phi_t p_{i+1,t} = 0, \tag{13}$$

$$\beta^t U_3[c_{it}(i), c_{i+1,t}(i), n_{it}(i)] + \lambda_t p_{it} = 0, \tag{14}$$

$$-\lambda_t + \phi_{t+1} + \lambda_{t+1} = 0. \tag{15}$$

Here λ_t is the positive Lagrange multiplier on the date t budget constraint (9), and ϕ_t is the nonnegative Lagrange multiplier on the date t liquidity constraint (10). Now suppose that the prices of all commodities are equal at each date and constant over time; that is, $p_{it} = 1$ over all commodities i and all dates t. Suppose also that consumption is constant over time for the produced and nonproduced (market-produced) commodities and the same across household types; that is, $c_{it}(i) = \bar{c}^1$, $c_{i+1,t}(i) = \bar{c}^2$. Also suppose that labor supply is constant over time and across household types; that is, $n_{it}(i) = \bar{n}$. Then (12)–(15) yield

$$U_1[\bar{c}^1, \bar{c}^2, \bar{n}]/U_2[\bar{c}^1, \bar{c}^2, \bar{n}] = \beta, \tag{16}$$

$$-U_3[\bar{c}^1, \bar{c}^2, \bar{n}]/U_2[\bar{c}^1, \bar{c}^2, \bar{n}] = \beta. \tag{17}$$

Of course, in such a symmetric, steady-state fiat money equilibrium, market-clearing condition (11) at equality is equivalent with

$$\bar{c}^2 = \bar{n} - \bar{c}^1. \tag{18}$$

It is supposed that the utility function is such that there exists an interior solution $\bar{c}^1, \bar{c}^2, \bar{n}$ to equations (16)–(18). To complete the specification of this symmetric, steady-state, fiat money equilibrium, let $M_t(i) = \bar{c}^2 \equiv \bar{M}$ over all dates t and all households-type i; thus, all of the beginning-of-period fiat money balances are spent on the market-produced commodity each period and are replenished each period with the sale of the produced commodity. (Note that the liquidity constraint (10) is always binding.)

It is apparent from its construction that the above specification satisfies the necessary first-order conditions for an interior solution to each household's maximization problem, and that markets clear at each date. This is not quite equivalent with establishing the existence of a monetary equilibrium in the *infinite* horizon economy, but that *is* readily established by a slight modification of the arguments given in my 1982 manuscript, with the utility function bounded (see Theorem (4.3) there and the discussion in section (5)).

IV. A Walrasian, Centralized Exchange Regime with Trade Credit

Now suppose there is a centralized market for all the households on each of the real lines described in the previous section, that

is, one centralized market per line. In each such centralized market at each date, there is an intermediary or Walrasian auctioneer, who may well be one of households, operating a credit-debit exchange system.[3] In particular, the Walrasian auction story will be taken literally, though it is not standard to do so. Let $r_{i+1,t}$ be the per unit price of commodity $(i+1)$ in terms of some abstract unit of account, so that $r_{i+1,t}c_{i+1,t}(i)$ denotes the number of units of intraperiod debt incurred by household-type i given units of consumption $c_{i+1,t}(i)$ of commodity $i+1$ which household i demands from the intermediary. Similarly, let r_{it} be the per unit price of commodity i in terms of some abstract unit of account, so that $r_{it}[n_{it}(i)-c_{it}(i)]$ denotes the number of units of intraperiod credit extended by the intermediary to household-type i given units of output $[n_{it}(i)-c_{it}(i)]$ supplied. Then, taking prices parametrically, the problem confronting household-type i is

Problem 3:

$$(19)\quad \text{Max}\, U\left[c_{it}(i), c_{i+1,t}(i), n_{it}(i)\right],$$

by choice of $c_{it}(i), c_{i+1,t}(i), n_{it}(i)$, subject to

$$(20)\quad r_{i+1,t}c_{i+1,t}(i) \le r_{it}\left[n_{it}(i)-c_{it}(i)\right].$$

The crucial feature of private debt in this model is that contemporaneous rather than past labor-output decisions are financing contemporaneous consumption decisions. That is, the household need not forego current consumption—there are no "idle" money balances. Putting this yet another way, trade credit has infinite as opposed to unit velocity; no stock of that asset is carried over from period to period. Note in this regard that the spatial separation of Section III might well have been retained; what is crucial here is the existence of a centralized, credit-debit system. Thus, it might have been supposed that a member of household-type i travels to market $(i, i+1)$, buys commodity $i+1$, and writes a check payable to the bearer, in this case, household-type $i+1$, for a specified number of units of account. Meanwhile a member of household-type i travels to market $(i-1, i)$, sells commodity i, and is paid with a check from household-type $i-1$. At the end of the period, checks are cleared (somehow) and accounts must balance. Of course, checks per se are superfluous in this system; electronically communicated bookkeeping entries will do. Such a system would not seem particularly farfetched, given contemporary financial developments. Again, the key idea is that one can use trade credit for within period purchases, with accounts cleared at the end of the period, using credit from within period sales.

It might be noted also at this point that the centralized credit regime as specified above has active markets at each date. Of course, nothing in the technology of exchange precludes the operation of an initial, complete, date-contingent commodity market, but, as it turns out, none of the substantive conclusions herein would be altered with that alternative specification. In particular, the equilibrium consumption and labor-supply decisions themselves would not be altered, and the qualitative properties of debt would remain unchanged. It might also have been supposed, despite the existence of centralized credit markets, that all households are endowed with a positive number of units of fiat money, say, with a number equal to the initial condition of the fiat money equilibrium in Section III. Under that specification, fiat money would be held, but never used in exchange. More formally, we are searching for a trade credit equilibrium in which the price of fiat money is zero.

To continue, then, consider

DEFINITION 2: *A date t trade credit equilibrium is a specification of commodity prices r_{it}^* for each commodity i and a specification of decisions for consumptions $c_{it}^*(i), c_{i+1,t}^*(i)$ and labor supply $n_{it}^*(i)$, such that the following two conditions hold.*

Maximization: The decisions $c_{it}^*(i)$, $c_{i+1,t}^*(i)$, $n_{it}^*(i)$ solve Problem 3 for household-type i given the prices $r_{it}^*, r_{i+1,t}^*$.

[3] There may well be more than one intermediary; more generally, the present structure abstracts from the market assignment and price determination process. See my 1983 article for an explicit treatment of intermediaries and an explanation of the competitive outcome.

Market clearing: *The decisions* $c^*_{it}(i)$, $c^*_{i+1,t}(i)$, $n^*_{it}(i)$ *satisfy*

$$(21) \qquad c^*_{it}(i-1) \leq n^*_{it}(i) - c^*_{it}(i)$$

over all commodities i.

To search for a date t trade credit equilibrium, consider the first-order conditions for an interior solution of household-type i's maximization problem:

$$(22) \qquad U_1[c_{it}(i), c_{i+1,t}(i), n_{it}(i)] - \xi r_{it} = 0,$$

$$(23) \qquad U_2[c_{it}(i), c_{i+1,t}(i), n_{it}(i)] - \xi r_{i+1,t} = 0,$$

$$(24) \qquad U_3[c_{it}(i), c_{i+1,t}(i), n_{it}(i)] + \xi r_{it} = 0.$$

Here ξ is the positive Lagrange multiplier on the budget constraint (20). Now suppose the prices of *all* commodities are set equal to unity; that is, $r_{it} \equiv 1$ over all commodities i. Also, as Problem 3 does not depend on the date t in any essential way, one may look for a solution which is independent of t, say $\hat{c}^1$, $\hat{c}^2$, and $\hat{n}$ for produced and nonproduced (market-produced) commodities and for labor supply, respectively. Thus (22)–(24) yield

$$(25) \qquad U_1[\hat{c}^1, \hat{c}^2, \hat{n}]/U_2[\hat{c}^1, \hat{c}^2, \hat{n}] = 1,$$

$$(26) \qquad -U_3[\hat{c}^1, \hat{c}^2, \hat{n}]/U_2[\hat{c}^1, \hat{c}^2, \hat{n}] = 1,$$

and from (21) at equality,

$$(27) \qquad \hat{c}^2 = \hat{n} - \hat{c}^1.$$

It is readily verified that, in general, there exists a solution $\hat{c}^1, \hat{c}^2, \hat{n}$ to equations (25)–(27). In fact, that solution is the unique Pareto optimum among interior allocations which treat households symmetrically. That is, $\hat{c}^1, \hat{c}^2, \hat{n}$ solves

Problem 4: $\underset{\{c^1, c^2, n\}}{\text{Max}} \; U[c^1, c^2, n]$

subject to $\qquad c^2 = n - c^1,$

if one is not driven to some boundary. Finally, one may take $\hat{D} \equiv \hat{c}^2$ as the measure of credit (per capita) in a trade credit equilibrium.

V. Substitution Effects and Exchange Regime Comparisons

Now imagine three countries, one in autarky, one with a decentralized fiat money regime, and one with a centralized trade credit regime. Suppose one were asked to compare labor supply, output, consumption, trade volume, and welfare levels in the three countries. It turns out that this comparison is straightforward, at least on the assumption that substitution effects dominate income effects. To see why, recall that in autarky there is no trade at all; in the decentralized regime, fiat money from the sale of the produced commodity cannot be used immediately in exchange for the nonproduced (market-produced) commodity, that is, fiat money is held one period; and in the centralized regime, credit from the sale of the produced commodity can be used in the same period for consumption of the nonproduced (market-produced) commodity. Of course, in all three regimes, the future is discounted by the parameter β, and thus the marginal rate of substitution of future for present consumption equals $1/\beta$ along any constant consumption path. Thus, put somewhat crudely, the cost of consumption of the nonproduced (market-produced) commodity in terms of labor, or, in terms of the produced commodity, is infinite in autarky and is high in the decentralized regime relative to the centralized regime. Thus, one would anticipate labor supply to increase, output of the produced commodity to increase, consumption of the nonproduced (market produced) commodity to increase, consumption of the produced commodity to decrease, trade volume to increase, and welfare levels to increase as one moves from autarky to the decentralized regime to the centralized regime.

It is useful to begin with a direct comparison of the decentralized regime with the centralized regime; that is, to compare equations (16)–(18) with (25)–(27). These systems are identical apart from the right-hand sides of the first two equations; in effect, discount

rate β is set equal to unity in (25) and (26). Thus, to make the specified regime comparisons, it is enough to determine how the solution to system (16)–(18) moves with parameter β. In short, totally differentiate system (16)–(18) with respect to parameter β and the solution variables c^1, c^2, and n to yield

$$\begin{bmatrix} U_{11}-\beta U_{21} & U_{12}-\beta U_{22} & U_{13}-\beta U_{23} \\ U_{31}+\beta U_{21} & U_{32}+\beta U_{22} & U_{33}+\beta U_{23} \\ 1 & 1 & -1 \end{bmatrix} \begin{bmatrix} dc^1 \\ dc^2 \\ dn \end{bmatrix} = \begin{bmatrix} U_2 \\ -U_2 \\ 0 \end{bmatrix} d\beta.$$

Though it is somewhat tedious to solve, a set of sufficient conditions can be established for the desired result, namely, $dn/d\beta > 0$ $dc^1/d\beta < 0$ $dc^2/d\beta > 0$. These conditions are not vacuous; they are satisfied independent of the value of β if the utility function is separable, for example.[4] Thus, with such an assumption, the labor supply, output, consumption, and trade volume comparisons across the decentralized and centralized regimes are as described earlier. The increase in welfare as one moves from the decentralized to the centralized regime follows immediately from the fact also noted earlier that the centralized regime delivers an allocation which is the unique Pareto optimum among allocations which treat households symmetrically.

It is also possible to make labor supply, output, consumption, trade volume, and welfare comparisons between the decentralized regime and autarky. The argument is entirely similar. In particular, consider the solution to system (16)–(18) as parameter β goes to zero. From the above analysis, it is clear that in such solutions c^1 increases and n decreases, so that $c^2 = n - c^1$ goes to zero from above. Now suppose that the limit is attained when the parameter β equals some positive number γ. Then, the system (16)–(18) is equivalent with the system (5)–(7), so the limit is the equilibrium of the autarkic regime. Again, it is known how the solution to system (16)–(18) moves with parameter β, so it is known that labor supply, output, and trade volume all decrease as one moves from the decentralized regime to autarky. The decrease in welfare follows from the fact that autarky is a feasible solution in the decision problem of the representative household in the equilibrium of the decentralized regime, a solution not adopted.

[4] The assumed dominance of substitution effects over income effects is used by Lucas and Leonard Rapping (1969) and by Lucas (1972) to ensure the Phillips curve slopes the "right way." Its use here is entirely similar.

VI. Some Cross-Country Comparisons on the State of Economic Development

Let us now consider a country with an internal mix of exchange regimes, in particular, with a mix of decentralized and centralized regimes. In terms of the formalism of the present paper, one might suppose, for example, that some fraction λ of household lines are in centralized, Walrasian markets. That is, suppose households are associated with real lines as in Section III, lines which are numbered, and every tenth line is centralized, part of the "developed" sector. (Here then, $\lambda = .10$.) The decentralized sector is as in Section III, but real lines are no longer numbered consecutively; that is, some numbers are missing there. Now to make labor supply, output, consumption, and trade volume comparisons, find the sector location of the line numbered zero and determine the per capita variables of households there (recall that households are treated identically). Next, find the location of the line numbered one and find the per capita variables of households there. Then determine the *average* per capita variable levels across households in the two lines. Continue in this way for lines numbered two, three, and so on, determining the average per capita variable levels at each step. Clearly these averages will approach the appropriate limits, averages of the per capita variables in the decentralized and centralized regimes with specified weights (here nine-tenths and one-tenth, respectively) as more and more household lines are included in the "sample." Of course, this method of counting is applicable also to countries with a mix of all three exchange regimes.

Now suppose one were to make comparisons across countries which are more and more centralized, say, to continue with the above example, with higher and higher values of λ. We may take as measures of per capita labor supply, per capita consumption of the home-produced commodity, and per capita consumption of the market-produced commodity

$$n = (1-\lambda)\bar{n} + \lambda\hat{n}, \tag{28}$$

$$c^1 = (1-\lambda)\bar{c}^1 + \lambda\hat{c}^1, \tag{29}$$

$$c^2 = (1-\lambda)\bar{c}^2 + \lambda\hat{c}^2, \tag{30}$$

respectively. Thus n and c^2 increase with λ, and c^1 decreases with λ, under the assumed substitution effects. Also, with prices fixed at unity in equilibrium, n could be taken as a measure of per capita national income, y. On the other hand, it might be supposed that only market activities are measured in national income accounts, so that c^2 be taken as a measure of per capita national income (or, more aptly, per capita national expenditure). Of course, c^2 is also the measure of trade volume. In practice, adjustments are made for nonmarket activities in national income accounts, so here we might suppose per capita national income to lie between n and c^2. The important point, though, is that per capita national income would increase as one moves across countries which are more and more centralized, this being the sum of substitution effects which increase labor supply *and* decrease consumption of the home-produced commodity. That is, *measured* national income might increase even if there were no increase in actual labor supply.

One can also consider the per capita share of labor devoted to market-produced commodities, $(1-\lambda)(\bar{c}^2/\bar{n}) + \lambda(\hat{c}^2/\hat{n})$, in this model. The derivative of this expression with respect to λ is more difficult to sign, but it is more likely to be positive, the greater is the substitution effect increasing consumption of market-produced commodities, and the less is the substitution effect increasing labor supply. Here, however, measurement problems make the comparison more tenuous. If labor supply is measured only in the production of market-produced goods, then, of course, there will be no effect.

Finally, to continue with the example, we may note that the decentralized regime functions entirely on one asset, outside credit, or fiat money, and the centralized regime functions entirely on another, inside money, or private credit. Again, depending on the conventions used for initial conditions, fiat money may be held in the centralized regime but is not used in exchange. The important point is that the mix of assets is determined by the degree of centralization λ and thus moves with measures of per capita national income. Here, for example, under the counting conventions described earlier, per capita fiat money balances, $M = (1-\lambda)\overline{M}$ or $M = \overline{M}$ should either decrease or stay constant, and per capita private credit, $D = \lambda\hat{D}$ should increase as one moves across countries which are more and more centralized and thus have higher and higher per capita income. Moreover, suppose one were to examine the inverses of aggregate asset velocities, that is, the ratio of fiat money outstanding to income and the ratio of credit outstanding to income,

$$M/y = \left[(1-\lambda)\overline{M}\right] / \left[(1-\lambda)\bar{c}^2 + \lambda\hat{c}^2\right] \tag{31}$$

or

$$M/y = \overline{M}/[(1-\lambda)\bar{c}^2 + \lambda\hat{c}^2],$$

$$D/y = \lambda\hat{D}/\left[(1-\lambda)\bar{c}^2 + \lambda\hat{c}^2\right], \tag{32}$$

respectively, on the assumption y is defined by (30) for example. Then it is easy to verify that the former decreases and the latter *increases* as one moves across countries which are more and more centralized. The intuition behind the last result seems clear: both per capita income and per capita credit increase with λ, but the marginal household to be "transferred" from the decentralized to the centralized sector, as one moves across countries, experiences only an *incremental* increase in consumption $(\hat{c}^2 - \bar{c}^2)$ though financing its *entire* consumption expenditure with credit, $\hat{D}$.

Similarly, suppose one were to examine the share of claims on intermediaries relative to *all* claims, that is, $D/(M+D)$ in this

model. Then, by the above analysis, this measure of intermediation increases with per capita income.

Of course, one can make comparisons across countries which have an autarkic sector as well. It is clear, for example, holding the fraction of households in the centralized sector fixed, that the larger the fraction of households in the decentralized sector relative to the autarkic sector, the higher will be per capita national income and the higher will be per capita holdings of fiat money. In fact, the ratio of fiat money balances to national income, M/y, would increase under such a comparison. In general, though, the measure of centralization must be two-dimensional (since there are three sectors), and this complicates the comparisons. On the incredible assumption that development proceeds sequentially, one might predict, for example, an initial increase in M/y with D/y at zero, and then a decrease in M/y with an increase in D/y, as one moves across countries with higher and higher per capita incomes. In practice, one might expect this movement and other movements to be blurred considerably.

VII. A Theory of Economic Growth

Now suppose one modified the model in a way that allowed for an increase in the number of households in the intermediated or centralized sector over time (again supposing the autarkic sector is negligible). In particular, suppose the event that all households in a specified (numbered) real line are thrown into a centralized credit market at the beginning of date t takes place with probability q. Suppose also that these events are independent across household lines in the decentralized sector at any date and independent over time for any given household line. Also suppose that the probability of financial collapse is zero; once in a centralized sector, there is no movement back to a decentralized sector.

Households may carry beginning-of-period fiat money balances with them in the event that there is an integration into a centralized credit market, but, as noted earlier, the value of such balances there would be zero. Alternatively, such balances may be surrendered in lump sum fashion to the monetary authority. The important point, though, is that under either specification, there are essentially no beginning-of-period state variables over which the household has any control in the event of centralization. In the absence of centralization, it is supposed that fiat money balances remain intact and thus serve the same role as before, as in the fiat money equilibrium. Analytically then, a household in the decentralized sector faces "death" —departure from the decentralized sector —as an independent event with probability q each period. Thus $(1-q)\beta$ becomes the effective discount rate, denoted β^*, and the entire analysis of Section III for the fiat money equilibrium applies. In particular, there exists a fiat money equilibrium in the decentralized sector, with constant prices as before, characterized by conditions (16)–(18) with β replaced by β^*. (Note that per capita output in the decentralized sector will be less than in the equilibrium of Section III due to the lower effective discount rate; i.e., β^* is less than β.) Finally, note that equilibrium behavior of households in the centralized credit market remains as before, as in Section IV, since there households face a sequence of unconnected static decision problems.

Though financial integration is a random event as far as the individual household is concerned, the movement of economywide average time-series is deterministic. Independence of integration across the countably infinite number of household lines in the decentralized sector means, by the law of large numbers and the counting convention described earlier, that essentially fraction q of household lines in the decentralized sector become integrated each period. Thus beginning with zero integration, the fraction of household lines in the intermediated sector increases from 0 to q to $q+(1-q)(q)$, and so on, with a corresponding decrease in the fraction of household lines in the decentralized sector. From the analysis of the previous two sections, this delivers time-series which display an increase over time in per capita income, an increase in per capita credit, and a decrease in (or constant level of) per capita fiat money balances. (Of course, the rate of

growth of output, for example, will diminish over time, but this diminution will be negligible for sufficiently small parameter q.) Finally, as before, the ratio of fiat money balances to national income should decrease over time, the ratio of credit to national income should increase over time, and the ratio of claims on intermediaries relative to all claims should also increase over time.[5]

VIII. The Relationship of the Theory to Observations

To reiterate, the theory of this paper is abstract. No doubt it is missing much. Thus any attempt to match the conclusions of the theory with actual observations has to be viewed as somewhat heroic, at best. That effort will be reviewed in this section, with an inclusion of some of the obvious warnings.

First, the key variable of the theory is the degree of centralization of the economy; that is, the degree of interconnectedness among households or the facility with which households can trade with one another. As the degree of interconnectedness increases, both cross sectionally (across countries) and over time (in a given country), the theory predicts an increase in the specialization (or division) or labor; that is, an increase in the consumption of market-produced commodities. More generally, and more liberally interpreted, more and more labor is devoted to the production of commodities which are not used directly by the household itself. Of course, this increase is associated with a decrease in the relative price of market-produced commodities, and an increase in per capita income.

These are the movements which Adam Smith had in mind, movements documented by Kuznets, as noted in the introduction. Note again that the share of transportation, communication, and commerce in Gross Domestic Product is positively associated with per capita product. This is direct evidence for the degree of centralization. Further, one may interpret the decline in the share of the agricultural sector and the rise in the shares of the industrial and service sectors as evidence of the specialization of labor. The decline in the price of industrial goods relative to agricultural goods is consistent with that interpretation.

Second, the theory of the paper predicts an increase in the extent of intermediation or middlemen activities with an increase in the extent of centralization and hence with an increase in per capita income. To some extent, Kuznets' observations on the increasing share of banking and insurance (with real estate) in Gross Domestic Product and the increasing share of the service component are consistent with this, though in the theory of the paper, intermediation per se is not resource using and thus would *not* show up in the national income accounts. More consistent with the theory are the observations of Goldsmith, that the share of intermediaries in national assets and the ratio of financial institutions' assets to Gross National Product rise over time, with increases in per capita Gross National Product. (Recall that in the theory of the paper $D/(M+D)$ and D/y both increase with y, as households are shifted from the decentralized to the centralized sector.)

Third, and closely related, the theory of the paper predicts a change in economywide average asset holdings with changes in the underlying structure of the economy, in particular, a shift toward trade credit relative to fiat money. No doubt such asset shifts do occur in actual economies,[6] but measuring

[5] Unlike the growth model just examined, one might suppose that the extent to which the economy is centralized or interconnected is random, with no central tendency. To accomplish that in the present context, it might be imagined that the events that specified household lines are thrown into centralized credit markets are not independent one from another. That is, suppose the movements over household *groupings* are described by a Markov process. With some demanding assumptions on the taxation of fiat money balances, this model will deliver random movements in economywide average times-series for per capita labor supply, output, consumption, and asset holdings. It may be noted in particular that a relative movement out of the centralized credit markets to the decentralized sector will be associated with a decrease in labor supply per capita, a decrease in a national income per capita, a decrease in private credit per capita, and increase in fiat money balances per capita. Similarly, the ratio of credit to income should move "procyclically" and the ratio of fiat money to income should move "countercyclically." See fn. 1.

[6] Again, see Cameron.

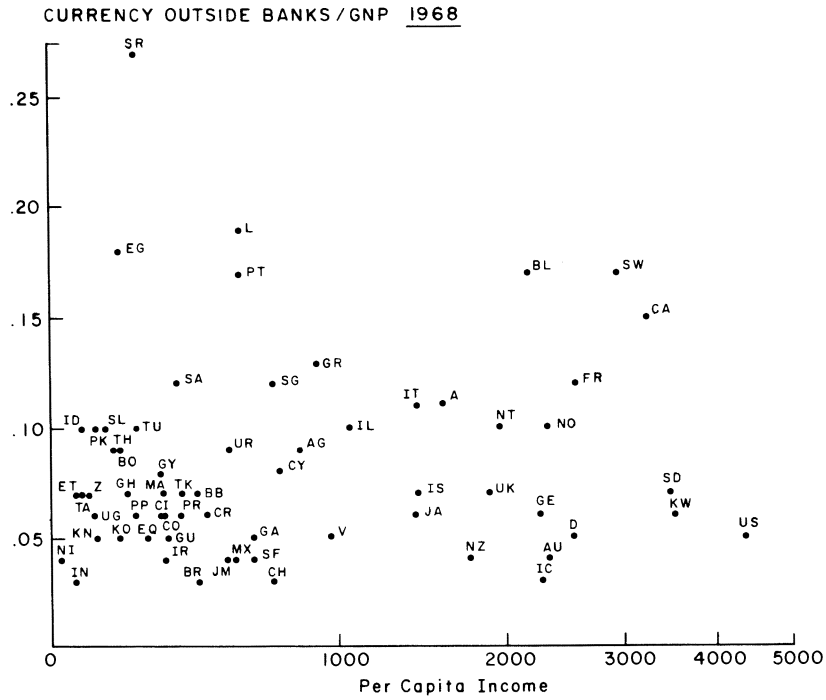

FIGURE 2

the shifts is problematic. That is, the highly stylized assets of the paper must be matched with analogues in the data. Though one can match fiat money with currency in the hands of the public, for example, the association is not straightforward. Currency measures may well include high velocity, circulating *private* debt, such as bank notes in the United States, whereas the fiat money of the paper is entirely *outside* debt. Of course, the theory of the paper offers no basis for a distinction between currency outside banks and high-powered money. Nor does the theory of the paper offer any guide as to which monetary aggregate to match with trade credit.

Notwithstanding this criticism, suppose one does match fiat money with currency in the hands of the public and, for want of a better alternative,[7] trade credit with private credit, generally. Then, following McKinnon, one can plot the ratio of currency to Gross Domestic Product and the ratio of private credit to Gross Domestic Product against per capita income (log scale) for a cross section of countries. This is done in Figures 2 and 3, respectively, for the year 1968.[8] As is evident, the ratio of currency to *GNP* shows no systematic pattern against per capita income.[9]

[7]One alternative might be some measure of trade credit, as Arthur Laffer (1970) has suggested. But a reading of Laffer also suggests some nontrivial problems in definition.

[8]The country code for the figures is as follows: Argentina AG, Australia AU, Austria A, Barbados BB, Belgium BL, Bolivia BO, Brazil BR, Canada CA, China CI, Columbia CO, Costa Rica CR, Cypress CY, Chile CH, Denmark D, Egypt EG, Equador EQ, Ethiopia ET, Finland FN, France FR, Gabon GA, Germany GE, Ghana GH, Greece GR, Guatamala GU, Guyana GY, Iceland IC, India ID, Indonesia IN, Iran IR, Ireland IL, Israel IS, Italy IT, Jamaica JM, Japan JA, Kenya KN, Korea KO, Kuwait KW, Lebanon L, Malaysia MA, Mexico MX, Netherlands NT, New Zealand NZ, Nicaragua NI, Norway NO, Pakistan PK, Peru PR, Philippines PP, Portugal PT, Saudi Arabia SA, Singapore SG, So. Africa SF, Spain SP, Sri Lanka SL, Sweden SD, Switzerland SW, Syria SR, Tanzania TA, Thailand TH, Tunisia, TU, Turkey TK, Uganda UG, United Kingdom UK, United States US, Uruguay UR, Venezuela V, Zaire Z.

[9]But recall that if one allows for an autarkic sector a relative shift from autarky toward the fiat money regime would cause the ratio of currency to *GNP* to *increase*

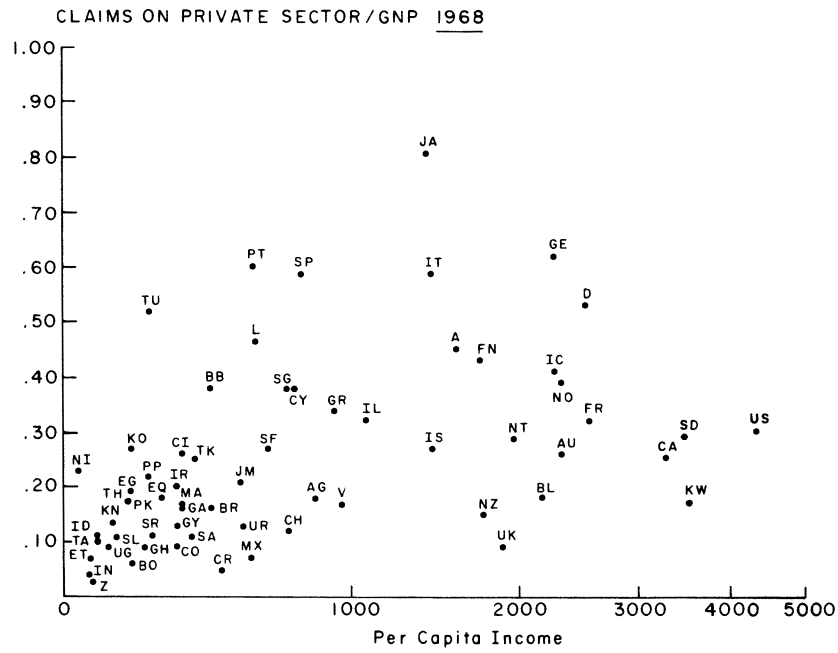

FIGURE 3

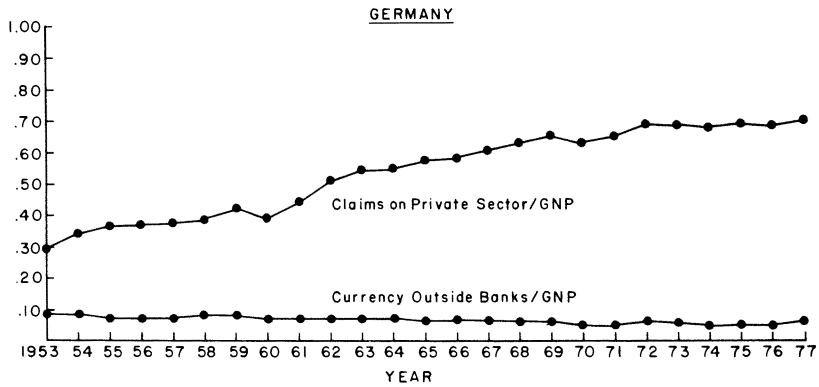

FIGURE 4

But, in contrast, the ratio of private credit to *GNP* shows a rough increase as one moves from low- to high-income countries.[10,11] Perhaps more striking are such time-series plots for Germany and Japan, from 1953–77, in Figures 4 and 5. For both these countries, the ratio of private credit to *GNP* increased rather dramatically while the ratio of currency to *GNP* either stayed constant or declined slightly.[12]

against per capita income. This effect would confound the decrease discussed in the text.

[10]The increase is especially noticeable if countries are grouped into two classes, say less developed vs. semi-industrialized and industrialized.

[11]The same pattern appears when domestic credit, including claims on the government, are plotted against per capita income. This holds true as well for the individual country comparisons below.

[12]Marshall Robinson (1961) argues that the shift in the credit to income ratio has occurred in the United

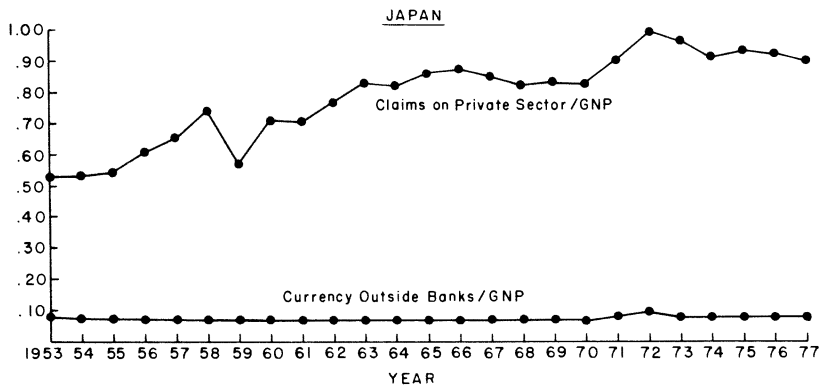

FIGURE 5

IX. Caveats and Welfare Economics

The theory of this paper does not *explain* economic development or economic growth. The key ingredient, the extent to which households in the economy are centralized, is exogenously manipulated by the modeler, and there is little else. Thus the "theory" of economic development is virtually tautological—countries are not developed because markets are fragmented. Similarly, the theory of economic growth is missing much. Absent are the key factors which Edward Denison (1967) has singled out as contributing to economic growth, especially growth in factor inputs—the labor force and the capital stock. Also absent, apparently, is the technological progress which Denison and especially Kuznets have emphasized, growth in output not explained by growth in factor inputs. There is a sense though in which technological progress *is* doing *all* the work. Suppose one takes consumption expenditures per capita of the *market*-produced good as output y on the assumption that *only* market activities are measured. Then, in the model of economic growth, y/n increases over time, though the underlying production function displays constant returns to scale. Indeed, the model delivers economic growth in this way even if there is no increase labor supply over time, though labor is the only factor of production. Thus the measure of centralization, λ, is the analogue of technological progress in other stylized growth models. Still, and more to the point, technological progress is not explained here.[13]

A more satisfactory theory might model the intermediation process in a deeper way. In particular, intermediaries might be viewed as utilizing resources to match households faced with the vagaries of the yield on their portfolios (see my 1978 and 1983 articles). One might envision nontrivial borrowing-lending and capital-formation activities as well. In this more general setting, then, the extent to which households and firms are matched would be endogenous, and one might ask whether more or less intermediation, at a point in time and over time, is a good thing. The present paper has only trivial and perhaps misleading welfare implications in this regard. More intermediation is unambiguously welfare improving. It is associated with growth in one monetary aggregate (private credit) and a decrease in another (fiat money). But there is no real scope for policy in the present model.

There is, however, one policy which might be contemplated in the present model: a deflation in the fiat money regime engineered by beginning-of-period, lump sum taxation of fiat money balances. In my 1980 paper,

States as well, though the recent work of B. Friedman, among others, suggests that the postwar experience is mixed.

[13] Even more of a burden is placed on the measure of centralization λ in the theory of fluctuations mentioned in fn. 5; there λ varies over time in an exogenously specified stochastic way. Again, there is no explanation of financial integration or collapse.

with exogenous labor supply, such a deflation achieves the unique Pareto optimal allocation of resources, whereas the *laissez-faire* competitive equilibrium does not. In effect, there is with deflation increased lending on the part of the government relative to the *laissez-faire* regime, lending which is precluded among households in the decentralized regime, due to spatial separation and limits on communication. Thus one wonders if this policy implication is misleading, whether in effect the government is given an exogenous advantage over the private sector in coordinating economic activity, a coordination which the agents might well achieve themselves in a more fully specified model. But that is left as an open question.

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