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*Monies and Banking*

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# Monies and Banking <sup>1</sup>

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**Abstract:** This paper investigates the demand by households for transaction services from the financial sector. Households buy several goods with any of several media of exchange. The households choose the medium of exchange to use for each type of good, how much of each type of medium to hold, and the frequencies of commodity and financial transactions. The variety of financial services demanded by a household depends positively on the household's income, with households at the bottom of the income distribution demanding no financial services at all. Household demand for financial services also depends on how the household allocates its income among the available goods. Households with the same income but different allocations will demand different mixes of financial services. These results have several implications for the organization of the banking market, especially the location of bank branches, and the availability of banking services in different areas.

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## I. INTRODUCTION

A recurring issue in public policy is the whether the banking system provides adequate services to all groups of households. Recent data show that a substantial fraction of households have no transactions accounts of any kind and that these households tend to be poor, young, and non-white. Kennickell, Starr-McCluer, and Sunden (1997), using data from the 1995 Survey of Consumer Finances, report that about 13 percent of American families had no type of transactions account (checking, savings, money market account, money market mutual funds, or call accounts at brokerages), down slightly from 15 percent in 1989. Hurst, Luoh, and Stafford (1996), using 1994 data from the Panel Study of Income Dynamics, report the fraction to be 22 percent, up slightly from 19 percent in 1989. Furthermore, the two data sets agree that households without transactions accounts are disproportionately lower income, younger, and non-white. For example, according to the SCF data, 85 percent of families with no transactions accounts had incomes below \$25,000 (the average family income), and 48 percent had incomes below \$10,000. Also, 60 percent had heads under age 45, and 54 percent were non-white or Hispanic.

It is unsurprising that these statistics have raised questions of whether the financial system is serving the public properly. For example, Consumer's Union recently argued that

Some Americans are at risk of being shut out of the banking system entirely. Some low- and moderate-income consumers, in particular, are hurt because more banks are dropping inexpensive no-frills checking accounts, and because they are shutting full-service branches in less-affluent neighborhoods to reduce their costs.<sup>1</sup>

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<sup>1</sup> Consumer Reports, March 1996, pp. 10-11

Even more recently, the Comptroller of the Currency held a closed-door meeting with relevant members of the banking industry to seek solutions to the problem of under-provision of financial services to some segments of society.<sup>2</sup> Concerns such as these have led to proposals, and in some cases enactment, of government rules to require banks to maintain more branches in low-income neighborhoods, to offer checking accounts with low opening balances, and to offer products such as “life line banking” or minimum service accounts.

A major, though unstated, premise of the foregoing concerns and proposed legislative remedies is that the observed differences in the provision of banking services to particular segments of the population is a supply-side phenomenon. It is presumed that the financial sector is unable or unwilling to provide the services that some segments of society demand. How such a market failure could occur is unclear. With some 10,000 commercial banks, a number of alternative financial institutions, and the removal of most legal barriers to entry over the past 20 years, at the very least it is not obvious that the market for financial services is insufficiently competitive to respond to the demands of various segments of the population.

There is, of course, another side to the issue of the availability of banking services that has been notably absent from the entire discussion - the demand side. Before legislative or regulatory remedies are enacted or even properly written, it is necessary to have some understanding of the demand for banking services and how it varies with such things as income, purchasing patterns, and costs. Do low-income households want the same variety of banking services that middle- and upper-income households do? Do they want any banking

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<sup>2</sup>Although the meeting was held behind closed doors, its occurrence was reported in the press. See American Banker(1997).

relationship at all, given the relevant marginal costs of maintaining such accounts? To answer such questions, one must analyze the demand for financial services.

The principal services offered to the household by financial institutions are various kinds of deposits and loans. In this paper, we are concerned with the demand for different media of exchange and savings assets. We therefore restrict attention to the deposit component of the financial services array and ignore the demand for loans. The important new aspect of our analysis is the consideration of different kinds of transactions media - that is, different kinds of money - and how the demand for them depends on household characteristics such as income and composition of consumption expenditures. Our results suggest that the apparent "failure of the banking system to serve the needs of the low-income households" may not be a failure at all, but rather a reflection of low-income households demand for these services.

It is not at all surprising that the quantities of various financial services, including monies, demanded by a household depend on the household's income. What is much less obvious is that the variety of financial services demanded by households also depends on household income. The model we develop below shows that the lower the household's income, the fewer types of services it demands. In particular, the lowest income households will demand no financial services at all, and instead will finance all their transactions with cash. It is unsurprising, therefore, that the banking system provides fewer services to low-income neighborhoods.

The model also predicts that the variety of services demanded depends on the household's pattern of expenditures as well as its income level. Two households, or perhaps neighborhoods, with the same income but different allocations of that income among the

available goods will demand different mixes of financial services. Consequently, various market niches will emerge, reflecting different characteristics of demanders. The optimal bundle of interest rates and costs attached to a given type of account presumably differs for each niche. Therefore, the simultaneous existence of several "packages" for a given type of account may be socially desirable, not just the result of marketing ploys to differentiate products.

## **II. THE THEORETICAL MODEL**

We use a standard transactions model of money demand to analyze the issues in question. We adopt the usual Baumol-Tobin assumptions, except that (1) we allow consumers to hold inventories of goods, as in Santomero (1974) and, (2) we allow several goods and several media of exchange.<sup>3</sup> The use of transaction demand theory seems appropriate in the present context, for our interest centers on purchasing patterns and the demand for banking services. Other models of money demand are limited to Euler equations and implicit transaction functions and do not permit us to characterize the transaction patterns with sufficient specificity.<sup>4</sup> The Baumol-Tobin framework has limitations, of course, but they seem inconsequential for the issues we address. We discuss them briefly after we present the model.

### **A. The Model.**

In the most general version of our model, there would be a large number of goods and

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<sup>3</sup> The model is adapted from that presented by Santomero and Seater (1996).

<sup>4</sup> See, for example, Mizrach and Santomero (1990) or the models reviewed in McCallum and Goodfriend (1992).

another large number of possible media of exchange, i.e., cash plus various types of bank accounts. However, all the important results emerge from a model with just two goods and two media of exchange, so we restrict attention to that case.

The household receives a fixed income  $Y$  every fixed payments period, and exactly exhausts that income by buying fixed amounts,  $X_g$ , of two different goods:

$$(1) \quad Y = X_1 + X_2$$

Consumption of goods occurs at a constant rate that just exhausts the goods purchased each period, but consumption expenditures (i.e., purchases of goods) occur at discrete intervals chosen optimally by the household. Between such "shopping trips," the household holds inventories of the two goods, which it gradually consumes until exactly exhausting them at the moment it is time to make another shopping trip. A separate shopping trip is required for each type of good. Each type of commodity inventory pays a unique rate or return,  $r_{Xg}$ . This rate may be an explicit return, such as a capital gain, or may be entirely implicit, such as a convenience yield. It may even be negative, such as a spoilage rate.

There are two media of exchange,  $M_i$ , available to the household. The household can use either or both types of money to buy each type of good. Denote the quantity of good  $g$  bought with money  $i$  by  $X_{gi}$ . The household may use one medium  $M_j$  on some shopping trips for good  $g$  and the other medium  $M_k$  on others. Thus

$$(2) \quad X_g = X_{g1} + X_{g2}$$

There are  $Z_{gi}$  trips to purchase good  $g$  with money  $i$ . Each such trip has associated with it the shopping cost  $\beta_{gi}$ , a lump-sum amount paid each trip but not depending on the amount spent. This cost may be explicit, such as a delivery charge or a check-cashing fee, or implicit, such as a time cost.

The household spends only a fraction of its income on any one shopping trip. Unspent income is held in a single savings asset,  $S$ , and in money balances. Savings earn the rate of return  $r_S$ , and the two kinds of money earn rates of return  $r_{Mi}$ . We suppose that  $r_S > r_{Mi} > r_{Xg}$ .<sup>5</sup> The household periodically converts some of  $S$  into money by making a "trip to the bank." There are  $T_i$  conversion trips to obtain  $M_i$ , and each such trip has associated with it the conversion cost  $\alpha_i$ . This cost, like shopping trip costs, is a lump-sum amount paid explicitly or implicitly each time a conversion is made but does not depend on the size of the conversion. As in the simple Baumol-Tobin model, optimal conversions are evenly spaced. Shopping trips occur between conversion trips and also are evenly spaced.<sup>6</sup> There are  $N_{gi}$  shopping trips to buy good  $g$  with money  $i$  per conversion of  $S$  into  $M_i$ . The total number of shopping trips,  $Z_{gi}$ , to buy good  $g$  with money  $i$  is thus  $T_i N_{gi}$ .

Finally, each of the assets,  $S$  and  $M_i$ , carries a fixed cost  $F_i$  that must be paid if that asset is held at any time during the payments period. These fixed costs capture such things as monthly account fees.

The household seeks to maximize the profit from managing its assets:

$$(3) \quad \begin{aligned} \pi = & r_S \bar{S} + \sum_{i=1}^2 r_{Mi} \bar{M}_i + \sum_{g=1}^2 r_{Xg} \bar{X}_g - \sum_{i=1}^2 T_i \alpha_i \\ & - \sum_{i=1}^L \sum_{g=1}^2 Z_{gi} \beta_{gi} - F_S I(S) - \sum_{i=1}^2 F_i I(M_i) \end{aligned}$$

where  $I(X)$  is an indicator function that is 1 if average holdings of asset  $X$  are positive and is 0

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<sup>5</sup>It is not necessary that all money interest rates exceed all inventory rates of return, but imposing that requirement simplifies the discussion. It is trivial to show that, in the more general case, money  $i$  will not be used to purchase good  $g$  if the rate of return  $r_{Xg}$  on good  $g$  exceeds the rate of return  $r_{Mi}$  on money  $i$ .

<sup>6</sup>The proof that optimal trips are evenly spaced is tedious and unimportant to the issues we discuss, so we omit it. See Tobin (1956) for details.

otherwise. To do this, the household chooses optimal values of average asset holdings, trip frequencies, and the  $X_{gi}$ . This problem can be simplified in the usual way, by noting that the average asset values can be written in terms of the remaining variables (see the Appendix for details):

$$(4) \quad \bar{S} = \sum_g \frac{X_g}{2} - \sum_i \sum_g \frac{X_{gi}}{2T_i}$$

$$(5) \quad \bar{M}_i = \frac{\sum_g X_{gi}}{2T_i} - \frac{\sum_g X_{gi}}{2Z_{gi}}$$

$$(6) \quad \bar{X}_{gi} = \frac{X_{gi}}{2Z_{gi}}$$

Substituting these expressions in the profit function gives

$$(7) \quad \begin{aligned} \pi = & r_S \left[ \sum_g \left( \frac{X_g}{2} - \sum_i \frac{X_{gi}}{2T_i} \right) \right] + \sum_i r_{Mi} \left[ \sum_g \left( \frac{X_{gi}}{2T_i} - \frac{X_{gi}}{2Z_{gi}} \right) \right] \\ & + \sum_g r_{Xg} \left( \sum_i \frac{X_{gi}}{2Z_{gi}} \right) - \sum_i T_i \alpha_i - \sum_i \sum_g Z_{gi} \beta_{gi} \\ & - F_S I(S) - \sum_i F_i I(M_i) \end{aligned}$$

By solving for the optimal values of the  $T_i$  and  $Z_{gi}$  in terms of the  $X_{gi}$  (see the Appendix) and substituting in (3), we can write the profit function as

$$(8) \quad \begin{aligned} \pi = & r_S \frac{X_1 + X_2}{2} - [2\alpha_1(r_S - r_{M1})(X_{11} + X_{21})]^{1/2} - [2\alpha_2(r_S - r_{M2})\{(X_1 - X_{11}) + (X_2 - X_{21})\}]^{1/2} \\ & - \{[2\beta_{11}(r_{M1} - r_{X1})X_{11}]^{1/2} + [2\beta_{21}(r_{M1} - r_{X2})X_{21}]^{1/2} \\ & - \{[2\beta_{12}(r_{M2} - r_{X1})(X_1 - X_{11})]^{1/2} + [2\beta_{22}(r_{M2} - r_{X2})(X_2 - X_{21})]^{1/2}\} \\ & - F_S I(S) - F_1 I(M_1) - F_2 I(M_2) \end{aligned}$$

The only thing that remains is to find the optimal values of  $X_{11}$  and  $X_{21}$ . The first-order conditions are

$$(9) \quad \frac{\partial \pi}{\partial X_{11}} = 0$$

$$(10) \quad \frac{\partial \pi}{\partial X_{21}} = 0$$

However, the second-order conditions indicate that the profit function is convex:

$$(11) \quad \frac{\partial^2 \pi}{\partial X_{i1} \partial X_{j1}} > 0 \quad \text{for } i, j = 1, 2$$

$$\det H > 0$$

where H is the Hessian. Consequently, the interior extremum is a profit minimum, so the maximum occurs at a corner. This implies that, although the household is free to use more than one medium of exchange to buy a given good by using one medium on some shopping trips and the other medium on the remaining trips, it always chooses to use only one medium to buy a given good.

There are four possibilities:

( $S > 0, X_{11} = X_1, X_{21} = X_2$ ) hold S, use  $M_1$  to buy  $X_1$  and  $X_2$

( $S > 0, X_{11} = X_1, X_{21} = 0$ ) hold S, use  $M_1$  to buy  $X_1$  and  $M_2$  to buy  $X_2$

( $S > 0, X_{11} = 0, X_{21} = X_2$ ) hold S, use  $M_2$  to buy  $X_1$  and  $M_1$  to buy  $X_2$

( $S > 0, X_{11} = 0, X_{21} = 0$ ) hold S, use  $M_2$  to buy  $X_1$  and  $X_2$

The foregoing possibilities all assume implicitly that the household chooses to use the savings asset. In fact, it may choose otherwise. We thus have four more possibilities:

( $S = 0, X_{11} = X_1, X_{21} = X_2$ ) do not use S, use  $M_1$  to buy  $X_1$  and  $X_2$

( $S = 0, X_{11} = X_1, X_{21} = 0$ ) do not use S, use  $M_1$  to buy  $X_1$  and  $M_2$  to buy  $X_2$

( $S = 0, X_{11} = 0, X_{21} = X_2$ ) do not use S, use  $M_2$  to buy  $X_1$  and  $M_1$  to buy  $X_2$

( $S = 0, X_{11} = 0, X_{21} = 0$ ) do not use S, use  $M_2$  to buy  $X_1$  and  $X_2$

The household therefore has eight possible usage patterns to consider. It chooses among them by comparing the profit functions associated with each of the eight possible patterns and picking the one with the highest profit. The respective functions  $\pi_{ijk}$  are given in Table 1, where the subscripts of the profit functions take the following values:

$i = S$  if the saving asset is used, 0 otherwise

$j = 1$  or  $2$  as  $M_1$  or  $M_2$  is used to buy good 1

$k = 1$  or  $2$  as  $M_1$  or  $M_2$  is used to buy good 1

We discuss the characteristics of the solution presently.

### **B. Limitations of the Modelling Framework.**

The foregoing model has the usual limitations of the Baumol-Tobin framework. The two most important are: (1) even as a model of demand, it is limited in that the household's profit from portfolio management does not feed back into the budget constraint and so never is spent, and (2) it considers the demand side only, and does not allow for the general equilibrium interplay between supply and demand. A number of contributions have extended the analysis of money demand to address these issues, e.g., Romer(1986), and Prescott(1987). We have not incorporated any such extensions in our analysis because they apparently would contribute little to the results but would complicate the analysis enormously. Omitting portfolio management profit from the budget constraint is not a serious practical matter; such profit is minuscule compared to other sources of income and could have only negligible quantitative effects on the household's choices. General equilibrium issues are simply irrelevant to the questions we address, which hinge on the characteristics of demand alone. For example, irrespective of how interest rates are determined, once they are determined the

demands for financial services will vary systematically among households of different income levels in the way we discuss below.

None of this is to deny that extending the model to allow for a fully specified budget constraint or to account for general equilibrium would be useful. Undoubtedly, such extensions would allow one to address more questions than we can address in our more limited framework. However, for the questions we do address, these extensions are not necessary but would be extremely costly analytically. Consequently, we have omitted them.

### **III. DEMANDS FOR TRANSACTIONS ASSETS**

The important question for the present analysis is how the household's choice depends on income and expenditure patterns.

#### **A. Level of Income.**

We can see the effects of income on the use of media of exchange and the savings asset by comparing the difference in cash management profit from (8), which is of the form  $[\pi_{ijk} - \pi_{ij'k}]$ . To examine income's effect on the choice of medium of exchange, start with a household whose income  $X_1 + X_2$  is very low and which therefore also has very low values of  $X_1$  and  $X_2$ . In all profit differences,  $[\pi_{ijk} - \pi_{ij'k}]$ , all terms are positively related to  $X_1$  and  $X_2$  except for the fixed cost terms,  $F_i$ . Therefore, the former terms are negligible. Thus, only the fixed costs matter in choosing among possible usage patterns of financial assets.

For expository clarity, we designate  $M_2$  as the medium with the lower fixed cost, so that  $F_2 < F_1$ . In particular, if  $M_2$  is currency, then  $F_2 = 0$ . In this case, the household will make its choice to minimize total fixed costs, which is done by not using the savings asset and by

using only medium  $M_2$ ; that is, the household chooses the pattern ( $S=0, X_{11}=0, X_{21}=0$ ).<sup>7</sup> If, in particular,  $M_1$  is checking accounts and  $M_2$  is currency, then very low income households will choose to be "unbanked" and will conduct all commodity market transactions with cash only. This pattern corresponds to what we observe: a disproportionately large fraction low-income households are unbanked and use only cash to conduct their business.

As income rises, other terms besides the fixed costs become significant in the profit difference, leading to different choices of usage patterns. Just what sequence of usage patterns emerges as income rises depends on the magnitudes of the various transactions costs and interest rates, and also on the relative sizes of  $X_1$  and  $X_2$ , which may change as income changes. However, we can say that as income rises, the household (1) definitely begins to use the savings asset at some point and continues doing so for all higher values of income, and (2) has a tendency to use  $M_1$  for at least one good and possibly both. Thus, the household becomes "banked" as its income rises.

To see the effect of income on the use of the savings asset, compare the difference between any two profit functions  $\pi_{Sij}$  and  $\pi_{0ij}$  that have the same usage pattern for  $M_1$  and  $M_2$  but differ in whether the saving asset  $S$  is used. For example, consider  $[\pi_{S11}-\pi_{011}]$ :

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<sup>7</sup>For example, consider  $\pi_{011}-\pi_{022}$ :

$$\begin{aligned} \pi_{011}-\pi_{022} = & (r_{M1}-r_{M2})\frac{X_1+X_2}{2} - [2\beta_{11}(r_{M1}-r_{X1})X_1]^{1/2} + [2\beta_{12}(r_{M2}-r_{X1})X_1]^{1/2} \\ & - [2\beta_{21}(r_{M1}-r_{X2})X_2]^{1/2} + [2\beta_{22}(r_{M2}-r_{X2})X_2]^{1/2} - F_1 + F_2 \end{aligned}$$

All terms but the last two are negligible for small income, the profit difference is negative when  $F_2 < F_1$ , and the household chooses to use  $M_2$  rather than  $M_1$ .

$$(12) \quad \pi_{S,1,1} - \pi_{0,1,1} = (r_S - r_{M1}) \frac{X_1 + X_2}{2} - [2\alpha_1(r_S - r_{M1})(X_1 + X_2)]^{1/2} - F_S$$

The first term is positive and increases linearly with  $X_1 + X_2$  (which equals income), whereas the second term is negative and increases in magnitude with the square root of  $X_1 + X_2$ . Thus, the difference as a whole tends to become positive as income rises. Indeed, for high enough income, the use of S is guaranteed. The intuition here is that as income rises, the volume of transactions rises, and therefore the opportunity cost of not using the savings asset also increases. For large enough income, this opportunity cost is sufficiently large to induce the household to start using the saving asset.

The use of S complicates the decision surrounding the use of  $M_1$  because the latter is affected by whether the household uses S or not. First consider a low-income household not using S or  $M_1$ . As its income rises, it may want to change its pattern of asset usage. It makes this decision by examining profit differences of an alternative exchange pattern, relative to  $\pi_{022}$ . Continuing the analysis for the case of the usage patterns in which the savings asset continues to be unused, a typical profit expression is  $\pi_{012} - \pi_{022}$ :

$$(13) \quad \pi_{012} - \pi_{022} = (r_{M1} - r_{M2}) \frac{X_1}{2} - [2\beta_{11}(r_{M1} - r_{X1})X_1]^{1/2} + [2\beta_{12}(r_{M2} - r_{X1})X_1]^{1/2} - F_1$$

The first term increases linearly in  $X_1$  whereas the second and third terms increase in the square root of  $X_1$ . The profit difference becomes positive as income grows, assuming  $X_1$  is normal. Thus, the household tends to move away from exclusive use of  $M_2$  as its income grows.<sup>8</sup> Furthermore, as long as S continues unused, increases in household income drive the

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<sup>8</sup>If  $X_1$  is not normal, then  $\pi_{012} - \pi_{022}$  falls as income rises. However, if  $X_1$  is not normal, then  $X_2$  is, and the profit difference  $\pi_{021} - \pi_{022}$  grows as income rises by the same argument as for  $\pi_{012} - \pi_{022}$  when  $X_1$  is normal. Thus eventually at least one of  $\pi_{012} - \pi_{022}$  or  $\pi_{021} - \pi_{022}$  becomes positive as income grows, and the household moves away from using just  $M_2$ .

household toward exclusive use of  $M_1$ . To see this, consider the profit differences  $\pi_{021}-\pi_{022}$

and  $\pi_{011}-\pi_{022}$  in conjunction with (13):

$$\pi_{021}-\pi_{022} = (r_{M1}-r_{M2})\frac{X_2}{2} - [2\beta_{21}(r_{M1}-r_{X2})X_2]^{1/2} + [2\beta_{22}(r_{M2}-r_{X2})X_2]^{1/2} - F_1 \quad (14)$$

$$\pi_{011}-\pi_{022} = (r_{M1}-r_{M2})\frac{X_1+X_2}{2} - [2\beta_{11}(r_{M1}-r_{X1})X_1]^{1/2} + [2\beta_{12}(r_{M2}-r_{X1})X_1]^{1/2} \\ - [2\beta_{21}(r_{M1}-r_{X2})X_2]^{1/2} + [2\beta_{22}(r_{M2}-r_{X2})X_2]^{1/2} - F_1 \quad (15)$$

As income rises, both (13) and (14) tend to become positive. In general, one of them becomes positive before the other, but exactly which one depends on the relative magnitudes of the interest rates, adjustment costs, as well as  $X_1$  and  $X_2$ . It is immaterial which becomes positive first, so suppose it is (13). As income continues to rise, (14) also becomes positive. At that level of income, (15) also is positive and exceeds both (13) and (14) because it is just the sum of (13) and (14) plus  $F_1$  and  $F_2$ . Thus, the household tends to use only  $M_1$  as its income rises - if the household continues not to use the saving asset.

If the household starts using the savings asset, it is impossible to say what combination of  $M_1$  and  $M_2$  it will use. Once income is high enough to make the saving asset is positive, usage patterns will be determined by profit differences of the form  $\pi_{Sij}-\pi_{Si'j'}$ ; for example,

$$\begin{aligned} \pi_{S12} - \pi_{S22} = & -[2\alpha_1(r_S - r_{M1})(X_1)]^{1/2} - [2\alpha_2(r_S - r_{M2})(X_2)]^{1/2} + [2\alpha_2(r_S - r_{M2})(X_1 + X_2)]^{1/2} \\ & - [2\beta_{11}(r_{M1} - r_{X1})X_1]^{1/2} + [2\beta_{12}(r_{M2} - r_{X1})X_1]^{1/2} - F_1 \end{aligned} \quad (16)$$

It is not possible to say how the sign of this expression depends on income, a characteristic shared by all profit differences of the form  $[\pi_{Sij} - \pi_{S'ij}]$ . This result is not as surprising as it may seem. Once the household is using the savings asset, the linear opportunity cost term is the same in all profit expressions and so cancels from all profit differences. The terms that remain in the profit differences reflect the trade-off between interest earnings and transactions costs associated with each medium. Which terms dominate depends on the relative magnitudes of all the interest rates and transactions costs, so it is not possible in general to decide in the abstract which usage pattern maximizes the profit from portfolio management.

Although there is some ambiguity in the effect of income on the household's usage pattern, it is clear that higher-income households are more likely to be "banked" than lower-income households. Higher income always leads to use of the savings asset and often leads to use of  $M_1$  as well.

## **B. Relative Expenditures.**

Consider now the effect of expenditure composition on the choice of usage pattern. We hold total income  $X_1 + X_2$  constant while allowing the division of income between  $X_1$  and  $X_2$  to change. The decision on whether to use the saving asset depends on the four profit differences of the form  $\pi_{Sij} - \pi_{0ij}$ . Two of these,  $\pi_{S11} - \pi_{011}$  and  $\pi_{S22} - \pi_{022}$ , depend only on the sum  $X_1 + X_2$  and not on the allocation between  $X_1$  and  $X_2$ ; e.g., equation (12). Expenditure composition is irrelevant in these two cases. The other two differences,  $\pi_{S12} - \pi_{012}$  and  $\pi_{S21} - \pi_{021}$ , depend on the individual values of  $X_1$  and  $X_2$  but not on the sum  $X_1 + X_2$ . For example:

$$\pi_{S12} - \pi_{012} = (r_S - r_{M1}) \frac{X_1}{2} + (r_S - r_{M2}) \frac{X_2}{2} - [2\alpha_1(r_S - r_{M1})X_1]^{1/2} - [2\alpha_2(r_S - r_{M2})X_2]^{1/2} - F_S \quad (17)$$

It therefore is possible that two households with identical income will make different choices on the use of the savings asset.

The choice of usage pattern for media of exchange also depends on expenditure composition. To analyze this dependence, start with a provisional choice of not using  $M_1$  at all, and then consider whether it would be better to make a different choice. For expository ease, assume that  $r_{M1} > r_{M2}$  and confine attention to the case where S is not used. We begin by making the two profit comparisons  $\pi_{012} - \pi_{022}$  and  $\pi_{021} - \pi_{022}$ , which indicates whether the household should start using  $M_1$  to buy at least one good:

$$\pi_{0,1,2} - \pi_{0,2,2} = (r_{M1} - r_{M2}) \frac{X_1}{2} - \{[2\beta_{11}(r_{M1} - r_{X1})]^{1/2} - [2\beta_{12}(r_{M2} - r_{X1})]^{1/2}\} X_1^{1/2} - F_1 \quad (18)$$

$$\pi_{0,2,1} - \pi_{0,2,2} = (r_{M1} - r_{M2}) \frac{X_2}{2} - \{[2\beta_{21}(r_{M1} - r_{X2})]^{1/2} - [2\beta_{22}(r_{M2} - r_{X2})]^{1/2}\} X_2^{1/2} - F_1 \quad (19)$$

As  $X_1$  becomes larger and  $X_2$  smaller, (18) tends to become positive and (19) tends to become negative. The opposite occurs for the converse case of falling  $X_1$  and rising  $X_2$ . Thus, the larger the share of total expenditure that a particular good commands, the more likely is the household to use the high-interest medium to buy it. As with the relation between income level and medium choice, this relation reflects the opportunity cost associated with holding a medium of exchange. The more one spends on a good, the larger the average balances held, the larger the interest foregone compared with holding the savings asset, and so the greater the importance of using a medium paying a high rate of interest.

Suppose (18) is positive and (19) is negative. The household then will change its provisional usage decision and begin using  $M_1$  to buy  $X_1$  while continuing to use  $M_2$  to buy  $X_2$ .

Next, the household must decide whether to use  $M_1$  for both goods, which it does comparing

$\pi_{011}$  and  $\pi_{012}$ :

$$(20) \quad \pi_{0,1,1} - \pi_{0,1,2} = \frac{(r_{M1} - r_{M2})}{2} X_2 - [2\beta_{21}(r_{M1} - r_{X2})X_2]^{1/2} - [2\beta_{22}(r_{M2} - r_{X2})X_2]^{1/2} + F_2$$

This expression can be positive even if (19) is negative because of the different fixed cost terms in (19) and (20). The household thus may choose to use only  $M_1$  in making purchases. However, this outcome is less likely the smaller is the share of total expenditure commanded by  $X_2$  because then (20) is less likely to be positive.

We thus have two results. The household tends to use the higher-interest medium to buy the larger-share good, and a split use of media of exchange is more likely to occur the more unequal are the expenditures  $X_1$  and  $X_2$ . Clearly, households having the same income and facing the same interest rates and transactions costs may choose different usage patterns of media of exchange solely because their tastes in consumption goods differ.

#### **IV. IMPLICATIONS FOR MARKET ORGANIZATION**

The preceding analysis of consumer demand offers new insight into the issues of bank location, the availability of banking services, and the need for concern over the percentage of the population that has no banking relationship. The model above indicates that the likelihood of choosing to have either a demand deposit account, or a banking relationship of any kind, relates directly to income level. In addition, we have seen that the range of asset use decreases as household income falls, even if one of the chosen media of exchange represents a bank liability product. It follows directly, therefore, that low-income households will desire fewer banking relationships, and, beyond this, constitute a disproportionate share of the "unbanked"

public. The tendency of low-income households to use cash exclusively, and not hold bank accounts may reflect appropriate consumer choice, rather than their inability to gain access to checking and savings accounts. In short, given the cost of maintaining an account, captured by  $F_i$  above, low income consumers may have made a rational choice to forego a banking relationship in favor of direct cash transactions. Indeed, the data corroborate this view. The Survey of Consumer Finances asks those families with no transactions accounts why they have no such accounts. Kennickell, Starr-McCluer, and Sunden (1997) report that for 1995 only 1.2 percent of families with no transactions balances cite inconvenient hours or location of banks as the reason they have no accounts. Most of the rest cite such economic reasons as excessively high minimum balances or service charges, not writing enough checks to make the accounts worthwhile, and not having enough money.

It then is not surprising that financial institutions operate fewer offices in low-income neighborhoods, where the costs of maintaining an office will be borne only by those customers that find the expense of bank products is warranted for their exchange volume and pattern. A low density of offices in low-income neighborhoods need not reflect any inappropriate discrimination by the financial institutions but rather an outcome associated with the current state of the U.S. income distribution.

The trend toward downsizing retail networks and the closure of inner-city offices also could be explained, at least partially, by these same demand-side forces. It is well known that U.S. income and wealth distribution have been developing “fatter tails” over the last decade.<sup>9</sup>

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<sup>9</sup>The PSID data discussed by Hurst, Luoh, and Stafford (1996) presents clear evidence of this continuing trend.

This change may have led households to reduce their demands for banking services and decreased the size of the market in low income areas. Faced with high fixed costs, rational bank managers may well be reducing physical branch capacity in response to this declining demand. Using this line of reasoning, the decline in bank locations in low income areas is more a symptom of the problem of wealth distribution than a cause of the declining quality of life in these communities. We also have seen that the usage patterns of media of exchange differ among households with the same income but different allocations of income among consumption goods. Consumption patterns presumably partly reflect cultural background, so it may not be surprising to find some neighborhoods with fewer financial institutions than other neighborhoods of the same income level, especially in large cities where neighborhoods often are ethnically segregated. Again, these different levels of financial activity need not reflect any active discrimination by financial institutions, nor do they offer any particular insight into the state of excess demand in any one area. Supply differentials may merely reflect differences in demand.

The dependence of media of exchange usage patterns on income levels and consumption patterns also suggests that we should expect to see the "same" product offered with different pricing vectors, which include such things as minimum balances, interest rates and fixed costs. Conversely, households facing the same interest rates, transactions costs, and fixed costs may demand different combinations of media of exchange. They may demand different quantities of those media they choose to use, and households demanding a given amount of some medium of exchange may prefer different combinations of interest rates and costs. We observe such differences in the real world, and our theory suggests that perhaps

they are socially optimal, rather than merely useless product differentiation associated with advertising and market segmentation.

## **V. CONCLUSION**

We have presented a generalization of the Baumol-Tobin model in which the household maximizes its profit from managing the portfolio of financial services used to conduct consumption transactions. Our analysis shows that the types of financial services the household demands depends systematically on the household's income level and expenditure patterns. In particular, the lowest income households choose to be totally unbanked, using no financial services at all and conducting all their business with cash. This outcome corresponds to what we observe in the real world.

It is an empirical fact that financial institutions provide different levels of service to localities and neighborhoods, which differ in economic characteristics, such as income and expenditure patterns. Are those differences in service levels the result of imperfect competition or inappropriate discrimination? We cannot answer this question, but our analysis does suggest that at least some of the observed market outcomes may reflect the desires of the demanders of financial services. Before drawing conclusions about the motivation of such variations in services offered or trying to remediate a situation presumed to be the result of supply-side imperfections, such as discrimination, one must remember that every market has both a demand and a supply side. Good policy requires understanding both aspects of the market, not just one.

**TABLE 1****Profit Functions**

$$\begin{aligned}
\Pi_{S,1,1} &= r_S \frac{X_1+X_2}{2} - [2\alpha_1(r_S-r_{M1})(X_1+X_2)]^{1/2} \\
&\quad - [2\beta_{11}(r_{M1}-r_{X1})X_1]^{1/2} - [2\beta_{21}(r_{M1}-r_{X2})X_2]^{1/2} - F_S - F_1 \\
\Pi_{S,1,2} &= r_S \frac{X_1+X_2}{2} - [2\alpha_1(r_S-r_{M1})X_1]^{1/2} - [2\alpha_2(r_S-r_{M2})X_2]^{1/2} \\
&\quad - [2\beta_{11}(r_{M1}-r_{X1})X_1]^{1/2} - [2\beta_{22}(r_{M2}-r_{X2})X_2]^{1/2} - F_S - F_1 - F_2 \\
\Pi_{S,2,1} &= r_S \frac{X_1+X_2}{2} - [2\alpha_1(r_S-r_{M1})X_2]^{1/2} - [2\alpha_2(r_S-r_{M2})X_1]^{1/2} \\
&\quad - [2\beta_{21}(r_{M1}-r_{X2})X_2]^{1/2} - [2\beta_{12}(r_{M2}-r_{X1})X_1]^{1/2} - F_S - F_1 - F_2 \\
\Pi_{S,2,2} &= r_S \frac{X_1+X_2}{2} - [2\alpha_2(r_S-r_{M2})(X_1+X_2)]^{1/2} \\
&\quad - [2\beta_{12}(r_{M2}-r_{X1})X_1]^{1/2} - [2\beta_{22}(r_{M2}-r_{X2})X_2]^{1/2} - F_S - F_2 \\
\Pi_{0,1,1} &= r_{M1} \frac{X_1+X_2}{2} - [2\beta_{11}(r_{M1}-r_{X1})X_1]^{1/2} - [2\beta_{21}(r_{M1}-r_{X2})X_2]^{1/2} - F_1 \\
\Pi_{0,1,2} &= r_{M1} \frac{X_1}{2} + r_{M2} \frac{X_2}{2} - [2\beta_{11}(r_{M1}-r_{X1})X_1]^{1/2} - [2\beta_{22}(r_{M2}-r_{X2})X_2]^{1/2} \\
&\quad - F_1 - F_2 \\
\Pi_{0,2,1} &= r_{M1} \frac{X_2}{2} + r_{M2} \frac{X_1}{2} - [2\beta_{21}(r_{M1}-r_{X2})X_2]^{1/2} - [2\beta_{12}(r_{M2}-r_{X1})X_1]^{1/2} \\
&\quad - F_1 - F_2 \\
\Pi_{0,2,2} &= r_{M2} \frac{X_1+X_2}{2} - [2\beta_{12}(r_{M2}-r_{X1})X_1]^{1/2} - [2\beta_{22}(r_{M2}-r_{X2})X_2]^{1/2} - F_2
\end{aligned}$$

NOTE: The subscripts in the profit expression  $\pi_{ijk}$  have the following meanings:

i = S if the saving asset is used, 0 otherwise

j = 1 or 2 as  $M_1$  or  $M_2$  is used to buy good 1

k = 1 or 2 as  $M_1$  or  $M_2$  is used to buy good 2

## APPENDIX

**1. Average assets.** Average total assets are

$$\begin{aligned}\bar{A} &= \bar{S} + \sum_{i=1}^L \bar{M}_i + \sum_{g=1}^G \bar{X}_g \\ &= \bar{S} + \sum_{i=1}^L \left( \bar{M}_i + \sum_{g=1}^G \bar{X}_{gi} \right)\end{aligned}$$

We also have, because trips are evenly spaced and the rate of consumption is constant,

$$\begin{aligned}\bar{A} &= \sum_g \frac{X_g}{2} \\ \bar{M}_i + \sum_g \bar{X}_{gi} &= \sum_g \frac{X_{gi}}{2T_i} \\ \bar{X}_{gi} &= \frac{X_{gi}}{2Z_{gi}}\end{aligned}$$

We then have

$$\begin{aligned}\bar{M}_i &= \left( \bar{M}_i + \sum_g \bar{X}_{gi} \right) - \sum_g \bar{X}_{gi} \\ &= \frac{\sum_g X_{gi}}{2T_i} - \frac{\sum_g X_{gi}}{2Z_{gi}} \\ \bar{S} &= \bar{A} - \sum_i \left( \bar{M}_i + \sum_g \bar{X}_{gi} \right) \\ &= \sum_g \frac{X_g}{2} - \sum_i \sum_g \frac{X_{gi}}{2T_i}\end{aligned}$$

**2. Optimal values of  $T_i$  and  $Z_{gi}$ .** Substituting the foregoing expressions in the profit function

gives

$$\begin{aligned}\pi &= r_S \left[ \sum_g \left( \frac{X_g}{2} - \sum_i \frac{X_{gi}}{2T_i} \right) \right] + \sum_i r_{Mi} \left[ \sum_g \left( \frac{X_{gi}}{2T_i} - \frac{X_{gi}}{2Z_{gi}} \right) \right] \\ &\quad + \sum_g r_{Xg} \left( \sum_i \frac{X_{gi}}{2Z_{gi}} \right) - \sum_i T_i \alpha_i - \sum_i \sum_g Z_{gi} \beta_{gi} \\ &\quad - F_S I(S) - \sum_i F_i I(M_i)\end{aligned}$$

The first-order conditions for  $T_i$  and  $Z_{gi}$  are

$$\frac{\partial \pi}{\partial T_i} = 0$$

$$\frac{\partial \pi}{\partial Z_{gi}} = 0$$

which give the solutions

$$T_i = \left[ (r_S - r_M) \sum_g \frac{X_{gi}}{2\alpha_i} \right]^{1/2}$$

$$Z_{gi} = \left[ (r_{Mi} - r_{Xg}) \frac{X_{gi}}{2\beta_{gi}} \right]^{1/2}$$

**3. Average assets again.** Substituting these last expressions into those above for average assets gives

$$\bar{X}_{gi} = \left[ \frac{X_{gi} \beta_{gi}}{2(r_{Mi} - r_{Xg})} \right]^{1/2}$$

$$\bar{M}_i = \left[ \frac{\alpha_i}{2(r_S - r_M)} \sum_g X_{gi} \right]^{1/2} - \sum_g \left[ \frac{\beta_{gi} X_{gi}}{2(r_{Mi} - r_{Xg})} \right]^{1/2}$$

$$\bar{S} = \sum_g \frac{X_g}{2} - \sum_i \left[ \frac{\alpha_i}{2(r_S - r_M)} \sum_g X_{gi} \right]^{1/2}$$

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