THE KOREAN ECONOMIC REVIEW
Volume 16, Number 2, Winter 2000

AN EPIDEMIC MODEL OF THE DIFFUSION OF NOW/ATS ACCOUNTS

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This paper models the diffusion of banking and financial innovations as if they were "epidemics". The inventors of an innovation may be regarded as the source of a "disease". Potential depositors and investors may be persuaded to purchase the new commodity through interpersonal "infection" or through the mass-media. This paper captures and estimates the diffusion of NOW/ATS accounts as one example of a financial innovation by using an epidemic model. This paper also finds that the epidemic model is alive and well even after the opportunity cost of holding NOW/ATS accounts is included in the regression.

JEL Classification: E47, E50
Keywords: Financial Innovations, Epidemic Model, NOW/ATS Accounts

I. INTRODUCTION

In the wake of high inflation and correspondingly high interest rates in the 1970s, the Consumer Savings Bank of Worcester, Massachusetts, invented the Negotiable Order of Withdrawal (NOW) accounts in 1972 to have the opportunity to offer interests to checking accounts which had long been prohibited by regulations. The NOW account was technically a savings account, but could also be regarded as equivalent to an interest-bearing checking account, since it did not require prior notice and since the negotiable order functioned like a check. The NOW account paid interest like a savings account while providing the liquidity of a checking account. Similarly, the automatic transfer from savings (ATS) account was invented in the late 1978. These are just two important examples of financial innovations which occurred in the search for loopholes in regulations such as the restriction of interest rates paid on deposits.

Received for publication: April 18, 2000. *Revision accepted:* July 2, 2000.
* The first author wishes to acknowledge the financial support of the Kyung Hee University made in the program year of 1999. We appreciate valuable comments by anonymous referees, and Joon Park. All the remaining errors are ours.

NOW/ATS accounts started initially in Massachusetts and New Hampshire spreading through New England, then nationwide. They were officially included in M1 in January 1981. Understanding the spread of NOW/ATS accounts, and more generally the financial and banking innovations, is important for both academics and policymakers. Unfortunately, there is only a limited number of models that describe the diffusion of NOW/ATS accounts. One line of research concentrated on describing the diffusion of NOW/ATS accounts in a verbal tradition providing detailed descriptions of the early history of NOW accounts (Longbrake and Cohan (1974), Gibson (1975), and Crane and Riley (1978)). Another line of work performed some empirical studies: Basch (1982) tried to identify the factors that affected the decision to offer NOW accounts. Tatom (1990) examined whether the introduction of NOW/ATS accounts affected M1 and M2 demand. However, these previous studies did not quite provide an analytical model of the spread of NOW/ATS accounts. This paper aims to fill that gap in literature.

The spread of financial and banking innovations is reminiscent of an epidemic. Inventors of an innovation may be regarded as the source of a "disease". As individual and institutional depositors (or investors) purchase the new commodity, they become "infected" by the disease; they will be called "infectives". Other potential depositors (or investors) who will be called "susceptibles," may become infected through contact with those already infected or through the mass-media. Holders of the invented commodity (the infected) may lose interest in time and sell the commodity; these will be called "recovereds". As an example of this process, this paper uses data on NOW and ATS accounts and models their diffusion as an epidemic.

The diffusion of financial and banking innovations may be alternatively modeled as a herd behavior. Recently, some studies (for example, Banerjee (1992), Bikhchandani et al. (1992), and Avery and Zemski (1998)) set up models where people acquire information in sequence by observing the actions of others who precede them in sequence. However, as Shiller (1985) noted, it is hard to see how there could be a first mover who set the behavior of others in purchasing financial products; there are too many first movers who purchase financial products. Interpersonal conversations rather than information cascades seem more effective in persuading depositors to purchase a specific financial product. In reality, it seems that some people do not care much about the small differences in interest rates, degree of liquidity, etc., in selecting their bank accounts or purchasing financial products. They simply ask their friends or tellers which account is most appropriate, or just ask which account their friends have. If some reliable person has or recommends a specific account or a product, for example, the NOW/ATS accounts, many people would just open the same account. By following some reliable person's recommendations, we can save time and effort to figure out which bank and account are best for us. We believe that this process is not rare in financial markets and it may also lead to a herd behavior. Saving search costs and avoiding tedious efforts may provide another reason for a herd behavior that can be differentiated from the recent models of herd behavior which are based on information cascades.

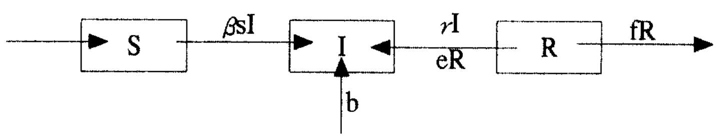
Applications of epidemic models to economics have been relatively rare. Among the few, Shiller and Pound (1989) described the diffusion of fads in financial markets as an epidemic and provided an extensive list of the epidemic literature. Kirschner and Rhee (1996) modeled the Real Business Cycle literature as an epidemic and predicted that the RBC theory would be a near-revolution. A similar approach, however, has long been popular in other fields, such as sociology and marketing. Hamilton and Hamilton (1981), Bass (1969), and Mahajan, Muller, and Bass (1990) are just a few examples.

This paper first sets up an epidemic model to describe the diffusion of NOW and ATS accounts in section 2. Section 3 contains the steady state analysis of the model. The spread of usage of an innovation is shown to generate a locally and globally stable steady state once the epidemic starts. Section 4 describes the data and reports the estimated results of the model. Lastly section 5 contains a brief conclusion and suggestions for future study.

II. THE MODEL

The population is separated into three mutually exclusive groups: potential depositors who may put their money in NOW/ATS accounts in the future (S); depositors who are presently holding NOW/ATS accounts (I); and depositors who have held NOW/ATS accounts, but are no longer holding these accounts (R). (We can relate the concept behind each group to that of susceptibles, infectives, and recovereds, respectively, in disease modeling.) It is possible to describe the dynamics of these populations by formulating a nonlinear ordinary differential equation model.

The flow chart below describes the interactions of these three populations.



As the economy grows, the number of potential depositors will also grow. In the model, new susceptibles flow in at the rate of $a>0$, which is assumed to be constant. The gain in the infective population is at a rate proportional to the number of infectives and susceptibles, shown as βSI, where $\beta>0$ is the constant infection rate. Potential depositors may be persuaded by bankers or existing holders to open this new type of account. This will be called interpersonal purchase. This gain in the infective population should be a loss for the susceptibles. Here, we implicitly assume that the incubation period is short enough to be negligible; potential depositors and investors purchase these accounts right away.

Another means of infection is through the mass-media via the press or the television. The positive parameter b represents the rate of mass-media induced purchase. Notice the distinction between interpersonally induced purchases and mass-media induced purchases of NOW/ATS accounts represented by the different gain terms βSI and b, respectively.

The rate of movement of infectives to the recovered population is proportional to the number of infectives, γI, where $\gamma>0$ is the constant withdrawal rate. This happens as holders of NOW/ATS accounts withdraw their money and alternatively invest in stocks, bonds, housing, etc.. Therefore, the gain for the recovered group will be a loss for the infectives. Some portion of these withdrawals will purchase these accounts again. This is analogous to recovered sufferers of a disease becoming reinfected. This notion is represented by the primary loss for the recovered group, eR, with $e>0$. The following loss, fR, with $f>0$, represents those who lose interest in the accounts and permanently shift their money to other investments.

Based on the flow chart, the following differential equations can be formed:

$$\frac{dS(t)}{dt} = a - \beta S(t)I(t) \tag{1}$$

$$\frac{dI(t)}{dt} = b + \beta S(t)I(t) - \gamma I(t) + eR(t) \tag{2}$$

$$\frac{dR(t)}{dt} = \gamma I(t) - eR(t) - fR(t). \tag{3}$$

Initial conditions for this system are:

$$S(0) = S_0 > 0,\ I(0) = I_0 > 0, \text{ and } R(0) = 0.$$

Here the inventors of an innovation (I_0) are assumed to be exogenously given.

An important question is whether the innovation will diffuse or not given the initial conditions, and if it does, how it develops over time and when it will start to subside. From equation (2) the following equation can be derived.

$$\left.\frac{dI}{dt}\right|_{t=0} = \beta S_0 I_0 - \gamma I_0 \gtrless 0 \text{ if } S_0 \gtrless \frac{\gamma}{\beta} = \rho. \tag{5}$$

Notice that b is not included in equation (5). This is the threshold condition. If $S_0 > \rho$, the innovation starts to spread. Only if $S_0 > S_c = \gamma/\beta$, is there an epidemic. The ratio $\beta S_0/\gamma$ is the reproduction rate of the initial purchase of NOW/ATS accounts; the number of secondary purchases produced by one primary purchase in a wholly susceptible population. Here, $1/\gamma$ is the average infectious period. If more than one secondary purchase is made from one primary purchase, $\beta S_0/\gamma > 1$, then the innovation starts to diffuse.

Similarly, at some time t,

$$\left.\frac{dI}{dt}\right|_t = b + \beta S(t)I(t) - \gamma I(t) + eR(t) \gtrless 0 \text{ if } b + \beta S(t)I(t) + eR(t) \gtrless \gamma I(t). \quad (6)$$

This means that the innovation will continue to spread if the rate of inflow is greater than the rate of outflow from the infectives at each time. If we assume that a constant proportion, k, of withdrawals γI (recoveries from I to R) repurchase NOW/ATS accounts, this condition simplifies to

$$\left.\frac{dI}{dt}\right|_t = b + \beta S(t)I(t) - \gamma I(t) + k\gamma I(t) \gtrless 0 \text{ if } S(t) \gtrless \frac{(1-k)\gamma I - b}{\beta I} \quad (7)$$

Ⅲ. Steady State Analysis of the Model

A steady state analysis can be carried out by equating the right sides of equations (1)-(3) to zero. One solution arises: $R_{ss} = (a+b)/f$, where the subscript "ss" stands for the steady state. The corresponding steady state values for the other populations at the value of $R_{ss} = (a+b)/f$ are:

$$S_{ss} = \frac{a\gamma f}{\beta(a+b)(e+f)} \text{ and } I_{ss} = \frac{(a+b)(e+f)}{\gamma f}$$

Notice that I_{ss} is a multiple of R_{ss}.

To test for stability, consider the Jacobian matrix J for the system (1)-(3) at the steady state (S_{ss}, I_{ss}, R_{ss}):

$$J = \begin{pmatrix} -\beta I_{ss} & -\beta S_{ss} & 0 \\ \beta I_{ss} & \beta S_{ss} - \gamma & e \\ 0 & \gamma & -e-f \end{pmatrix}.$$

This steady state will be locally asymptotically stable if and only if all of the eigenvalues of the Jacobian matrix J have negative real parts. The eigenvalues can be determined by solving the characteristic equation det $(J - \lambda I)$, evaluated at the steady state, equals zero. For our system, this is:

$$\lambda^3 + \left[e + f + \frac{(a+b)(e+f)\beta}{\gamma f} + \frac{(ae+be+bf)}{(a+b)(e+f)}\right]\lambda^2$$
$$+ \left[\frac{(a+b)(e+f)^2\beta}{\gamma f} + \frac{b\gamma f}{(a+b)} + \frac{(a+b)(e+f)\beta}{f}\right]\lambda + (a+b)(e+f)\beta = 0.$$

or

$$\lambda^3 + \alpha_1\lambda^2 + \alpha_2\lambda + \alpha_3 = 0 \tag{8}$$

By the Routh-Hurwitz criteria, a necessary condition for the roots of the characteristic equation (8) to have negative real parts is

$$D_1 = a_1 > 0, \quad D_2 = \begin{vmatrix} a_1 & a_3 \\ 1 & a_2 \end{vmatrix} > 0, \quad a_3 > 0.$$

These conditions are satisfied, and therefore this steady state is locally asymptotically stable.

To discuss global stability, we introduce the function $L(t) = S + I + R$. Using (1)-(3), $dL/dt = a + b - fR$. This is negative if $R > (a+b)/f$, which is the steady state value for R. As shown above that the steady state is locally stable, the trajectories will approach it in a neighborhood about it. For values greater than the steady state, as $t \rightarrow \infty$, $L(t)$ approaches the steady state. Under this assumption about R, it follows that this steady state is globally asymptotically stable.

Ⅳ. ESTIMATION OF THE SYSTEM

The data used here are the seasonally adjusted monthly M2 and NOW/ATS accounts (more precisely, other checkable deposit accounts) at all depository institutions between January 1979 and December 1993. We chose this sample period because the ATS account was introduced in late 1978 and the new sweep programs between the NOW/ATS and MMDAs were introduced in January 1994.

The model was set up in terms of the number of potential depositors in NOW/ATS accounts and the number of current holders of these accounts. However, these figures are not available. Consequently, in the empirical analysis, the number of each population is replaced by total balances of the corresponding population.

In our estimation, we measure the susceptible population as total balances in M2 less total balances in NOW/ATS accounts. This is because NOW/ATS accounts provide both higher liquidity and a better return compared with the other components of M2. Here we notice that the M2 less ATS/NOW accounts steadily grows through time except at the end of the sample period where it stays steady as shown in Figure 1. This seems like a departure from the epidemic model since the epidemic model's dynamics have as an important feature that in the course of an epidemic, the number of susceptibles eventually becomes depleted. Then the epidemic can no longer sustain itself and the epidemic dies out. However, we need to modify the epidemic model when applied to economic time series, since the number of susceptibles is expected to grow with the growth of the economy. Nonetheless, our empirical results suggest that the path of the M2 less NOW/ATS accounts is indeed hump shaped as shown in Figure 2.

We still face a problem in estimating the parameters of the model because the data for the recovery cases are not available. One way to avoid this problem is to simplify the three equation system into one equation and estimate it as in Shiller and Pound (1989). In the face of serious data limitations, this may be a sensible approach. However, the one equation model does not provide us with information-rich patterns of the diffusion of NOW/ATS accounts. To generate interesting patterns of diffusion ex-ante, such as a hump shape, requires additional restrictions on the error terms or on the model itself.

Instead of simplifying the whole model into one equation to describe the diffusion of NOW/ATS accounts, this paper estimates equations (1)-(2). To circumvent the problem that data on recovereds are unavailable, we assume that a constant proportion of withdrawals from NOW/ATS accounts by recovereds are immediately used to repurchase NOW/ATS accounts and that the remaining withdrawals leave the M2 category looking for other investment opportunities. In other words, the proportion $(1-k)\gamma$ invests in other investment opportunities such as stocks, bonds, and housing. Equation (2) now becomes

$$\frac{dI(t)}{dt} = b + \beta S(t)I(t) - (1-k)\gamma I(t). \tag{2$'$}$$

For the estimation, we employ a discrete time approximation to the continuous

[Table 1] The SUR of the System of Equations (1)-(2)′

$$\frac{dS(t)}{dt} = a - \beta S(t)I(t) \tag{1}$$

$$\frac{dI(t)}{dt} = b + best S(t)I(t) - (1-k)\gamma I(t) \tag{2$'$}$$

Sample Periods: 1979:1-1993:12

	a	b	β	$\gamma(1-k)$	R^2
(1)	11.74 (15.10)		$4.70 \cdot 10^{-6}$ (3.96)	0.012 (2.91)	99.9
(2′)		2.01 (6.43)	$4.70 \cdot 10^{-6}$ (3.96)	0.012 (2.91)	99.9

Numbers in parentheses are t values.

R^2 is for the level of the left hand side variables, S and I.

in (1)-(2)′ with the first differences of the corresponding terms and replace the time model. To perform the discrete time estimation, we replace the derivatives levels on the right sides of (1)-(2)′ with the corresponding lagged values. Thus, we now have to estimate a system of equations, not a simultaneous equation.

We may expect that the error terms in the system are contemporaneously correlated. For example, changes in interest rates, stock prices, housing prices, or other financial innovations may affect the error terms in equations (1)-(2)′. If so, the OLS estimates are inefficient, while Seemingly Unrelated Regression (SUR) estimation is efficient. Table 1 reports the results from the SUR estimation of the system of equations (1)-(2)′. All the parameters have the expected signs and all of them are highly significant statistically. The fit is also good. The estimate of a, the rate of inflow into the susceptible population is 11.74 each month and is highly significant. The estimate of b, the rate of inflow into the infective population is about 2.01 each month. This implies that the outstanding value of NOW/ATS accounts increases on average by 2.01 billion dollars each month. Remember that this parameter b, represents the mass-media induced infection rate. The interpersonally induced infection rate is 4.7010^{-6}. Since the average of the susceptible population ($2242.8 billion) times the average of the carrier population ($182.0 billion) is $408.190 trillion, this implies that the interper sonally induced purchase of NOW/ATS accounts per month is $4.70\times10^{-6}\times408190$ =$1.92 billion. It is as large as the mass-media induced purchase per month of $2.01 billion. The estimate for the withdrawal rate combined with the repurchase rate $(1-k)\gamma$, is 0.012. This estimate implies that most of the withdrawals each month roll over again and are used for the repurchase of NOW/ATS accounts. This interpretation can be supported by the fact that the debits of NOW/ATS accounts, a flow variable, are much larger than the total balances in NOW/ATS accounts, a stock variable, implying $\gamma>1$. With $\gamma>1$, the repurchase rate k, should be close to one; otherwise $(1-k)\gamma$ could not be so small.

We cannot exclude the possibility of the error terms being serially correlated. If errors are serially correlated, SUR cannot provide consistent estimates since we have lagged dependent variables on the right hand sides of the system (1)-(2′). The IV regression or FIML would provide consistent estimates in this case. Though we do not report the results from the 3SLS that is asymptotically equivalent to the FIML to save space, we could not find any qualitative differences at all.

We also have to consider the possible non-stationarity of the time series. Intuition suggests that the derivatives on the left sides are stationary due to the stability of the steady state. For example, at the initial stage of the diffusion of the innovation, the derivative of infectives with respect to t is close to zero. As the innovation diffuses, the derivative rises and as the innovation converges to the steady state, the derivative again approaches zero. This implies that there is a mean reversion in the derivative of S and I with respect to t. For the regression to have meaning when the dependent variables are stationary, the explanatory variables on the right hand sides should be stationary or they should be cointegrated if each of them is integrated of order 1. It is controversial whether the various money stock data have a unit root. If we cite just a few among the many, Nelson and Plosser (1982) argues that the money stock has a unit root whereas Sims (1988), Perron (1989), DeJong and Whiteman (1991) suggest that most macroeconomic time series including money stock, are indeed trend stationary, not difference stationary. However, examining the existence of the unit root is beyond the scope of this paper. Instead, we decide to follow Park(1992)'s Canonical Cointegrated Regression (CCR) approach which can be applied both when the regressors are stationary and when they are cointegrated. Table 2 reports the estimation results from the heteroskedasticity autocorrelation consistent seemingly unrelated canonical cointegrated regression (HAC SUCCR). Again, all the coefficients have the expected signs and are highly significant, except the estimate of $(1-k)$. The estimate of $(1-k)$ is not significant at the conventional significance level. This may be due to the well-known fact that the t-values tend to be much smaller once the CCR transformation is performed.

To confirm the validity of the epidemic model as a model of diffusion of a financial innovation, we include opportunity cost terms for holding the NOW/ATS accounts in equations (1)-(2)′. The opportunity cost is measured as the difference between the average return for M2 components and the average return for other checkable deposits which are mostly NOW/ATS accounts. The data is from the Fed, and the appendix which is available upon request shows how to construct the average return series. If the opportunity cost term (COST in the regression) is included in the system, it is expected to have a positive sign in equation (1)

[Table 2] The HAC SUCCR of the System of Equations (1)-(2)′

$$\frac{dS(t)}{dt} = a - \beta S(t)I(t) \tag{1}$$

$$\frac{dI(t)}{dt} = b + \beta S(t)I(t) - (1-k)\gamma I(t). \tag{2$'$}$$

Sample Periods: 1979:1 - 1993:12

	a	b	β	$\gamma(1-k)$	R^2
(1)	12.32 (7.67)		$6.08 \cdot 10^{-6}$ (2.30)	0.014 (1.55)	99.9
(2′)		1.44 (2.50)	$6.08 \cdot 10^{-6}$ (2.30)	0.014 (1.55)	99.9

Numbers in parentheses are t values.

R^2 is for the level of the left hand side variables, S and I.

and a negative sign in equation (2)'. Table 3 reports the estimation results from the SUR with the opportunity cost term in equations (1)-(2)'. The results generally resemble those in Table 1. All the parameters of the epidemic model have the right signs and become more significant than those in Table 1. However, the opportunity cost term, surprisingly, has the wrong sign, even though it is imprecisely estimated. This implies that opportunity cost terms do not carry any additional information once the diffusion of a financial innovation is modeled as an epidemic. Of course, proponents of the more traditional approach may simply regard the model proposed in this paper as being misspecified and do not agree with us.

Table 4 reports the results from the HAC SUCCR when we include the opportunity cost term in the regression. Again the results are encouraging for the epidemic model. All the parameters of the epidemic model have the right signs and become more significant than those in Table 2 and the estimate of $(1-k)$ is now significant at about 8 percent.

Figure 1 shows the actual data of NOW/ATS and M2-NOW/ATS. NOW/ATS steadily grows through time and M2-NOW/ATS grows steadily until 1992 and then it stays steady. Figure 2 shows the projected path of NOW/ATS and M2-NOW/ATS. We used the estimated values from Table 2 for the simulation. Simulation results are robust to the use of different parameter values from other tables. There are two main types of behavior as the system approaches the steady state value. It can reach it via an asymptotic approach (a sigmoid pattern) or via a hump-shaped pattern where the trajectory reaches a maximum,

[Table 3] The SUR of the System of Equations (1)-(2)' with the Opportunity Cost Term

$$\frac{dS(t)}{dt} = a + \alpha Cost(t) - \beta S(t) I(t) \tag{1}$$

$$\frac{dI(t)}{dt} = b - \alpha\, Cost(t) + \beta S(t) I(t) - (1-k)\gamma I(t). \tag{2'}$$

Sample Periods: 1979:1-1993:12

	a	b	β	$\gamma(1-k)$	R^2	
(1)	11.92 (14.88)		-0.12 (-0.91)	$4.89 \cdot 10^{-6}$ (4.07)	0.012 (2.93)	99.9
(2')		1.84 (5.05)	-0.12 (-0.91)	$4.89 \cdot 10^{-6}$ (4.07)	0.012 (2.93)	99.9

Numbers in parentheses are t values.
R^2 is for the level of the left hand side variables, S and I.

[Table 4] The HAC SUCCR of the System of Equations (1)-(2)′ with the Opportunity Cost Term

$$\frac{dS(t)}{dt} = a + \alpha Cost(t) - \beta S(t) I(t) \tag{1}$$

$$\frac{dI(t)}{dt} = b - \alpha Cost(t) + \beta S(t) I(t) - (1-k)\gamma I(t). \tag{2$'$}$$

Sample Periods: 1979:1-1993:12

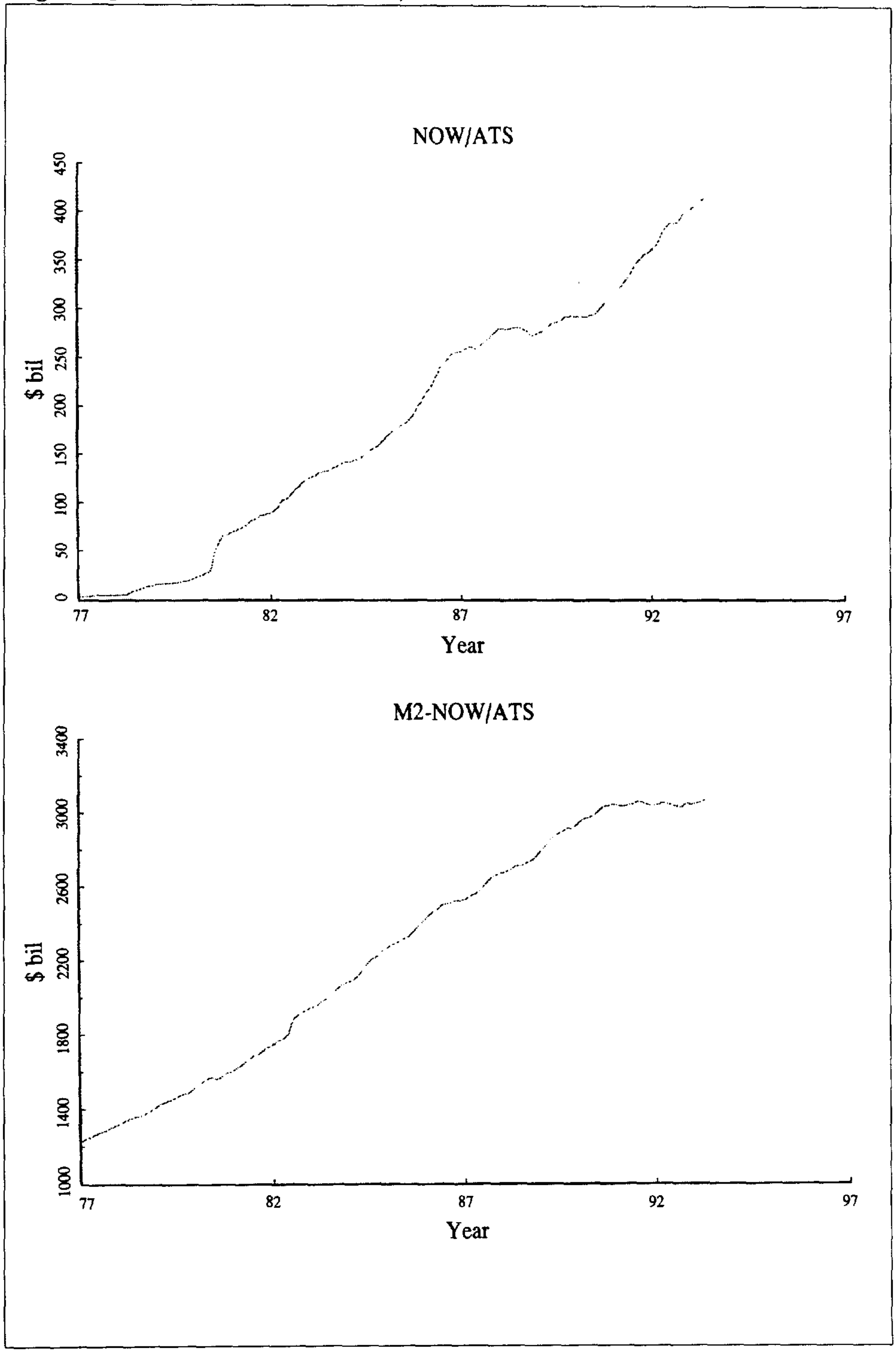
	a	b	β	$\gamma(1-k)$	R^2	
(1)	12.85 (8.83)		-0.05 (-0.24)	$6.44 \cdot 10^{-6}$ (2.38)	0.016 (2.13)	99.9
(2′)		1.66 (3.09)	-0.05 (-0.24)	$6.44 \cdot 10^{-6}$ (2.38)	0.016 (2.13)	99.9

Numbers in parentheses are t values.
R^2 is for the level of the left hand side variables, S and I.

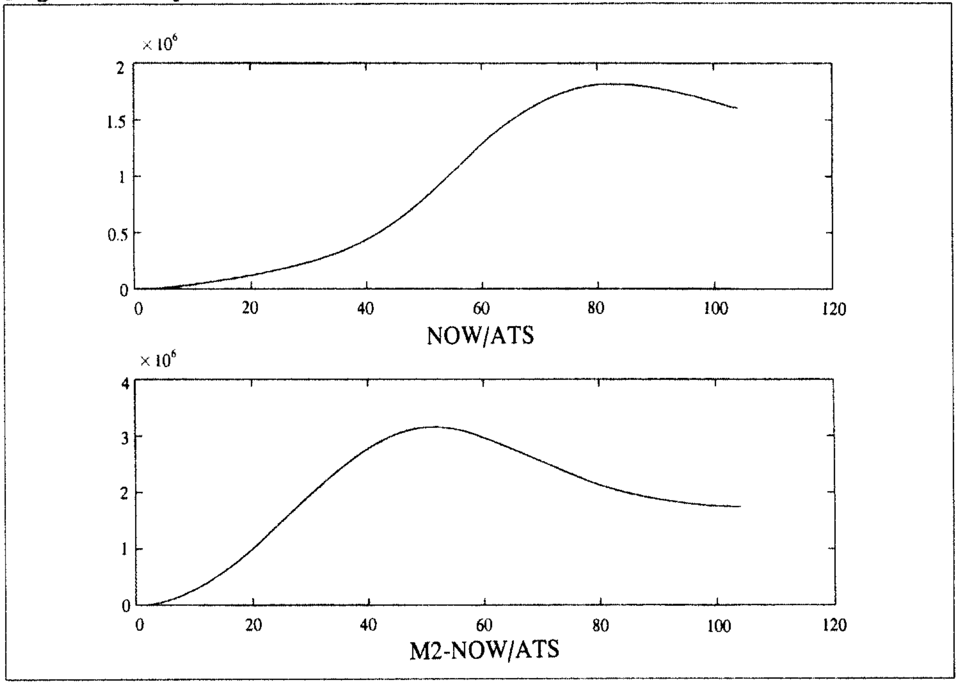
begins decreasing, then reaches the steady state asymptotically. The diffusion path of NOW/ATS accounts, which is our main concern, follows an ever increasing pattern for a very long time, converges to the top, then slowly declines. Thus, though the path of NOW/ATS looks like a sigmoid pattern initially, it eventually shows a hump-shaped pattern. The path of M2-NOW/ATS accounts also follows a hump-shaped pattern, although the hump comes much earlier than the hump of the NOW/ATS.

We can think of other monetary aggregates as proxies for the susceptible population. In a sense, our susceptible population can be regarded as a substitute for the NOW/ATS. M1 and M3 can be regarded as a possible substitute for the NOW/ATS. The epidemic model does not seem to fit when we use M1 as a proxy for the susceptible population. However, if we use M3 as a proxy for the susceptible population, the results are more favorable to the epidemic model as a diffusion model of a financial innovation than when we use M2 as a proxy. Unfortunately, we are not able to report this case since we do not have the average return data for M3. All these results suggest that M3, rather than M2, rather than M1 was a close substitute for the NOW/ATS accounts. They also suggest that NOW/ATS accounts offered liquidity to interest-bearing accounts more than they offered interest to liquidity accounts.

[Figure 1] NOW/ATS vs. M2-NOW/ATS



[Figure 2] Projected Path of NOW/ATS and M2-NOW/ATS



V. CONCLUSION

This paper was motivated by a modest aim of modeling the diffusion of NOW and ATS accounts as an epidemic. The empirical results show that the epidemic model is indeed a reasonably good model of diffusion of a financial innovation. All the parameters except (1-k) in Table 2 have the correct signs and are statistically significant at conventional significance levels. It is forecasted that the path of both NOW/ATS and M2-NOW/ATS will follow a hump shaped pattern, with the hump of the M2-NOW/ATS beginning much earlier than that of the NOW/ATS.

Some caveats are required. While most financial innovations may look like an infection, they are actually not quite the same. For one, there are many shocks and factors that contribute to the creation and expansion of financial instruments. Policy shocks and changes in both domestic and foreign financial systems can also contribute to the creation and expansion of financial innovations, but they are not explicitly modeled here. Continuously occurring shocks can thus significantly limit the applicability of the model.

This study can be regarded as just a modest attempt toward the more ambitious research agenda of understanding the diffusion of banking and financial innovations and the connections between an epidemic model of diffusion of financial innovations and an optimization model of financial investors and/or bankers. Modeling an epidemic behavior as a near rational behavior of financial investors should prove interesting. When we follow other person's suggestion in purchasing a financial product, it may be regarded as fads. However, it can also be regarded as an optimizing behavior of saving search costs and economizing the decision process of financial investments.

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