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# A SIMPLE SIMULATION MODEL OF INTERNATIONAL BANK LENDING

by

Henry S. Terrell and Robert S. Dohner

ABSTRACT

The paper develops a simple simulation model of international bank lending to test the extent to which targeting of fixed shares in the stock of total bank claims on a borrower can make lending flows unstable. The model is based on three distinct types of lending strategies: potentially volatile lending by one group of banks with limited long-term commitment to international lending; the targeting of a given share of the total lending market; and lending based on an assessment of the borrower's creditworthiness.

The results of the model's simulations suggest that lending flows can become quite unstable if more than one-half of international bank lending is predicated on the maintenance of market share. The model also indicates an ambiguous role for market information in preserving stability. To the extent that improved public information about the lending activities of banks causes more banks to target market share, such information can result in market instability. However, under a rational expectation version of the model, if the increased information about bank lending behavior is used by some banks to improve their forecasts of the reactions of other banks it can serve to stabilize the system.

# A Simple Simulation Model of International Bank Lending

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Henry S. Terrell* and Robert S. Dohner**

## I. Introduction

This paper starts with two stylized observations about international bank lending. First, an important element in decisions about international lending at many banks is the maintenance of the bank's desired share in the total stock of outstanding bank claims on a borrowing country. The second general observation is the tendency for the flow of international bank lending to be cyclical, oscillating from periods of excessive lending (sometimes referred to as overlending) to periods of contraction. The contractionary periods, sometimes referred to as "underlending," can mean an absolute decline in the stock of bank claims through the repayment (amortization) of existing bank exposure.

The first observation is simply an observation about human behavior. Decisionmakers at banks, like people in general, are often more comfortable when their decisions are ratified by similar decisions by others. Targeting a share of a given market is simply a way of keeping one's behavior in line with that of one's peers. Baumol has noted this tendency for businesses in general:

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*Staff Member, Division of International Finance, Board of Governors of the Federal Reserve System.
**Associate Professor, The Fletcher School of Law and Diplomacy.
This paper represents the views of the authors and should not be interpreted as reflecting those of the Board of Governors of the Federal Reserve System or other members of its staff. An earlier version of this paper was presented to the 12th Annual Convention of the Eastern Economic Association in Philadelphia on April 12, 1986.

> Management usually keeps its eye not only on the absolute magnitude of its operations, but also on their relationship to the levels of achievement of other firms in its group. Market share, for example, seems to be one of the barometers most widely utilized by businessmen. The result is that one firm's growth begets another's.[1]

Recent improvements in the availability of international banking statistics have heightened an individual bank's awareness of the activities of other banks, and thus have facilitated comparison of one bank's behavior with decisions of its peers.[2] The observation that banks condition some proportion of their international lending decisions on their actual and desired shares of total bank exposure to particular borrowers is also based on discussions with market participants who have developed detailed and timely monitoring procedures, and who are called upon to explain significant changes in market shares to their senior management.

Clearly targeting of market share levels, with adjustments made to outstanding claims to realize a desired market share, is not the sole decisionmaking criterion at any bank. Rather, it is one piece of information readily available to banks' decisionmakers. Other factors, including an appraisal of the general financial condition of the borrower, the prospects for collateral business, special relationships or information on other business opportunities to the potential lending bank, will also be inputs into any ultimate lending decision. However, a rapidly increasing (or decreasing) share of any bank's claims on a borrower will almost immediately raise the question of why that

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1. William J. Baumol, Business Behavior, Value, and Growth, p. 101. Herring and Guttentag (1984, p. 17) make the same point for commercial banks.

2. These developments include publication of detailed information on the positions of nine large U.S. banks in the Country Exposure Lending Survey, and requirements under the International Lending Supervision Act of 1983 that U.S. banks disclose large individual country exposures.

particular bank is moving in a direction that differs from its peer banks. In the absence of some strong presumption of a sound business reason for this differential behavior, a bank may alter its lending behavior to bring its exposure into closer conformity with its peers. Pressures by regulatory authorities on "outlier" banks may also increase the tendency for banks to target shares in particular markets.[3]

The issue of cyclical swings based on overlending and underlending by international banks, and the impact such swings in the availability of bank credit have on the economic performance of borrowers, has been discussed at length elsewhere and warrants little repetition here. In the period 1977-81 bank claims on developing countries increased by more than 20 percent per year, and developing countries in the aggregate experienced real economic growth of about 6 percent per annum. In the 1982-1985 period total bank claims on developing countries increased only about 2 percent per year and these countries averaged less than 1 percent growth in real terms. These broad averages obviously understate problems specific to the experiences of individual countries.[4]

The purpose of this paper is to construct a simulation model of bank lending behavior in which the targeting of market share plays an important role, and to investigate the implications of market share targeting for the stability of international bank lending. The model includes other motivations for bank lending, and is simulated under several types of lending shocks. The sensitivity of the results to the

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3. Guttentag and Herring (1984) have noted: "In the U.S. for example, bank examination procedures tend to focus on outliers among a group of otherwise comparable financial institutions. Exposures which conform to the average are less likely to be criticized." (page 12)

4. For a discussion of the swings in bank lending behavior see Brau et. al. (1983).

weights on each type of behavior in lending decisions is investigated, as is the implication of alternative expectations mechanisms.

## II. The Model

The model starts with the definition that the stock of total bank claims on a borrower at date t equals total bank claims on the previous date t-1 plus net new bank lending since that date:

$$(1) \quad C_t = C_{t-1} + L_t$$

For any given borrower there is assumed to be an optimal path for total bank credit defined as:

$$(2) \quad C_t^* = C_o \ (1 + R)^t$$

where $C_o$ is the stock of bank claims at some base date when the stock of bank credit relative to other economic magnitudes was at an "appropriate" level, and R represents the optimal growth of nominal bank debt. The optimal growth rate R is a long-run concept against which the predictive results of the model will be measured. In the shorter run the amount of optimal borrowings may be greater or less, and the rate R is not necessarily the same for all borrowers. This notion of a growing long-run optimal stock of debt refers to the accumulation of debt as a way of augmenting domestic savings and relaxing foreign exchange constraints to accelerate economic growth, and not debt finance to smooth consumption in the face of fluctuating income.[5]

Bank lending behavior is divided into three distinct types for purposes of modeling, which we refer to for convenience as three

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5. For a more complete discussion of his dichotomy of the role of external borrowing see McDonald (1982).

separate kinds of banks. In reality all three behavioral characteristics may be present to some extent in any bank. Thus the various types of lending behavior in the model refer to the distribution of behavior throughout the banking system. Total bank claims at any time t are defined as the sum of the claims of the three groups of banks:

$$(3) \quad C_t = C_t^o + C_t^1 + C_t^2$$

A. Autonomous Banks

Autonomous banks tend to be smaller institutions with tenuous connections to international lending. In good times they may expand their lending more rapidly than the optimal rate R, either by increased exposure of those smaller banks already involved in international lending, or by new bank entrants to the lending market. These banks have a limited long-term commitment to international lending, and when concerns about credit quality arise, they will attempt to withdraw quickly from that market. These institutions may withdraw completely from any new international lending and some may even attempt to reduce the stock of their international assets to zero.

The behavior of the autonomous banks may be represented as having total claims $C_t^o$ equal to:

$$(4) \quad C_t^o = [1 + R + D(t)]C_{t-1}^o + L\,(C_{t-1}/C_{t-2} - 1 - R)\,C_{t-1}^o$$

On the initial date, when the optimal and actual stock of bank credit to a borrower are assumed to be equal, and total claims of all banks are growing at the optimal rate R, the growth of claims of these banks would

proceed at the same rate. The term D(t) allows for random disturbances (positive or negative) in the lending behavior of this group of banks. A positive shock might, for example, indicate an influx of new banks into international lending.[6]

The second term in equation (4) describes a bandwagon reaction by these banks to lending by all banks. These banks will accelerate their lending when they perceive faster lending by other banks, and slow down their lending in response to a slowdown in total lending. The bandwagon coefficient L indicates the extent to which their lending is affected by the growth of total bank claims on that borrower in the previous period.

B Share Targeting Banks

As noted in the introduction, it appears that an unknown but potentially large proportion of international bank lending is conditioned upon some banks' attempts to maintain their desired share in the total stock of claims on a particular borrower. When their actual share in total claims exceeds their desired share, these banks will reduce the rate of their new international lending to bring their actual stock of claims into line with their desired stock. Conversely, if these banks' actual claims are less than their target share, possibly because of faster lending by other banks, these share-targeting banks will increase the rate of their international lending to attempt to recapture and maintain their desired market share.

The assumption about behavior based upon maintaining a desired share raises the question of how the desired share is established by any individual bank. No clear answer to this question that applies to all banks is possible. Desired shares in many cases are probably drawn from

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6. A study by Page and Rogers (1982) for the Group of Thirty estimated that an annual average of 66 new financial institutions entered the Euroloan market between 1973 and 1980.

past experience as well as from some perception of the size and importance of a bank relative to what it perceives to be its competitor banks. As noted earlier, banks may believe that major changes in market shares will draw criticism from regulators or stockholders. To affect behavior, the targeting of any given share may be a medium-term phenomenon with longer-term decisions about changing desired shares based on profitability or risk considerations taking place much more slowly.

As noted earlier, to the extent that any bank targets a share, its lending behavior is largely passive, being determined by the lending of other banks. Share-targeting banks may, however, impart a shock to the system if in the aggregate they decide to raise or lower their desired market share. For example, a changeover towards a more aggressive management may encourage lending officers to increase market shares, while a bank experiencing difficulties may pursue a strategy of reduction of particular market shares.

For purposes of modeling the claims of market share banks ($C_t^1$) define:

(5a) $s^*$ = their desired share in the stock of claims on the borrower,

(5b) $s_t$ = their actual share in the stock of total claims ($C_t$) on date t,

(5c) $s_t^e$ = their expected share in total bank claims on the next report date based upon their attempt to adjust partially from $s_{t-1}$ (actual) to $s^*$ (long-run desired) share in the next period when $s_{t-1}$ differs from $s^*$, so that:

(5d) $$s_t^e = s_{t-1} + p\,(s^* - s_{t-1}),$$

where p is the percentage of the adjustment towards their desired share these banks expect to accomplish in the next period.

Lending by these banks in time period t can be expressed:

$$(6)\quad L_t^1 = [s_{t-1} + p\,(s^* - s_{t-1})]\,C_t^e - s_{t-1}C_{t-1}$$

as lending by these banks in period t is designed to close p percent of the gap between desired and actual market shares.

$C_t^e$ is the expected total claims of all banks, against which the interim target share is applied. Thus the actions taken by the targeting banks depend upon their expectations of total lending by all banks.

The way in which banks form their expectations of total lending by all banks can have a significant effect on the behavior of the system. This can be illustrated by considering two types of expectations mechanisms. The first, extrapolative expectations, extends the most recent behavior of the system into the future. Banks forming their expectations by this process expect the same percentage rate of increase in total bank claims as that which occurred in the previous period. Extrapolative expectations are described in equation 7:

$$(7)\quad C_t^e = [C_{t-1}/C_{t-2}]C_{t-1}$$

The extrapolative expectations process is a very simple one requiring a minimum of information. An alternative approach is to assume that banks correctly utilize information to anticipate the behavior of other banks and the response of the banking system to changed circumstances.

This use of information need not mean that banks always forecast the lending behavior of others correctly. Events may occur which could not be anticipated at the time at which expectations were formed, and therefore those expectations may turn out to be in error. But the

expectations are rational in the sense that they make use of all information available when the expectations were formed, and would turn out to be correct if that information were complete. This behavior is expressed as:

$$C_t^e = E[C_t \mid I_{t-1}]$$

Anticipated bank claims outstanding are equal to the mathematical expectation of actual bank claims outstanding, given the information available in the previous period. (Alternately, the forecast error, $C_t^e - C_t$, has expectation zero.)

In the case of rational expectations, banks know the characteristics of their own and other banks' behavior. What they do not know are the unanticipated shocks that arise in the behavior of the autonomous banks, or shocks that result from changes in desired aggregate market share of the share-targeting banks. Thus expected total bank claims under rational expectations can be expressed as:

$$C_t^e = C_t - D(t)C_{t-1}^o - p\Delta s^*(t)C_t^e,$$

or,

$$(8) \quad C_t^e = E[C_t \mid I_{t-1}] = (1 + p\Delta s^*(t))^{-1} (C_t - D(t)C_{t-1}^o)$$

where $D(t)$ is the random disturbance in autonomous bank lending in equation (4), and $\Delta s^*(t)$ is the change in desired market share of the

share-targeting banks that occurs in period t.[7]

In the simulations of the model, both extrapolative and rational expectations will be considered.

C. Creditwatch Banks

The final group of banks condition their lending on an assessment of the creditworthiness of the borrower. That assessment of the borrower's creditworthiness is based upon the relationship of the expected stock of claims on the borrower relative to the optimal stock of claims. When the expected stock and optimal stock of claims are equal ($C_t^e/C_t^* = 1$) these banks will increase their claims ($C_t^2$) on the borrower at the steady state rate R. If the ratio exceeds unity, that is when the borrowers expected debt to banks exceeds the optimal level, these banks will reduce the rate of their new lending in some relation to the extent to which the expected stock of bank claims exceeds the optimal level. Conversely, if $C_t^e/C_t^*$ is less than one, then these banks will assess that the borrower can take on more debt, and they will increase their rate of net new lending. We assume that the creditwatch banks respond in a nonlinear fashion to deviations of actual from optimal credit stocks, that is they change their lending very little in response to small deviations from optimal debt levels, but react much more sharply in reducing net new lending as excesses of expected over optimal debt widen.

The behavior of the creditwatch banks can be expressed:

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7. We are assuming here that the change in desired market share of the share-targeting banks is unanticipated. An alternative assumption is that the change in $s^*$ is correctly anticipated in the period before it occurs. In fact the simulation results under the two assumptions are almost identical. If an increase in desired share is anticipated other banks cut back on their lending in the period in which the desired share increases. But if the change is anticipated, share-targeting banks lend more than in the case of an unanticipated change.

$$(9a)\quad C_t^2 = (1 + R)\, C_{t-1}^2 \qquad \text{if } C_t^e = C_t^*$$

$$(9b)\quad C_t^2 = [1 + R - H\,(2^{10(C_t^e/C_{t-1}^*)})]C_{t-1}^2 \qquad \text{if } C_t^e \geq C_{t-1}^*$$

$$(9c)\quad C_t^2 = [1 + R + H\,(2^{-10(C_t^e/C_{t-1}^*)})]C^2{}_{t-1} \qquad \text{if } C_t^e \leq C_t^*$$

The H term in equations 9b and 9c indicates the extent to which the creditwatch banks react to any excess or deficiency of indebtedness relative to the optimal stock. The exponent 10 applied to the deviation of $C_t^e/C_t^*$ from unity implies a doubling of their reaction for each 10 percentage points that ratio deviates from unity.[8]

The creditwatch banks are a stabilizing force in the model. The other two groups of banks, through random shocks of new entrants, behavior that mechanically follows lending by other banks, or by attempts to change their market shares, will tend to make the flow of bank lending unstable. The creditwatch banks, by reducing their net lending (at an increasing rate) when debt burdens become excessive, and by increasing their lending when outstanding debt falls below the optimal amount, tend to stabilize total lending and drive it back towards its optimal growth rate.[9]

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8. To make the claims of creditwatch banks a continuous function, equations were approximated by the following function:

$$(9')\quad C_t^2 = [1 + R - H(2^{10(C_t^e/C_{t-1}^*)}) + H(2^{-10(C_t^e/C_{t-1}^*)})]C_{t-1}^2$$

which behaves very much like equation system (9) except when $C_t^e$ is very close to $C_t^*$.

9. The creditwatch banks are assumed to respond to deviations of actual and optimal claims. On the downside, if a shock by either autonomous or share-targeting banks were so great as to affect the borrower's ability
(Footnote continues on next page)

The model of the supply of bank lending does not have an explicit term for the price or spread over the cost of funds that is earned by the banks on such loans. Empirical research has failed to uncover any significant relationship between the yield to banks and their willingness to supply loans to international borrowers. At some point high spreads may be associated with high risks that exceed the higher yields, and banks may actually refrain from making loans because of concerns about criticisms from regulators, shareholders, and depositors.[10] The model is strictly a supply of bank credit model and actual realized lending will of course depend on the borrower's debt management policies as well as banks' lending decisions.

## III. Simulating the Model

The previous section developed a model of international bank lending. This section will simulate that model under different assumptions about various behavioral parameters, the relative importance of different lending strategies, and the type of expectations mechanism employed, to test which factors make a difference for the stability of the system.

The first assumption for the model is the initial weights of the three types of bank decisionmaking characteristics. As a baseline it is assumed that the autonomous banks hold 20 percent of total claims, share-targeting banks hold 40 percent, and creditwatch banks hold 40 percent. The system starts from an equilibrium where the actual and

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(Footnote continued from previous page)
to service debt, then the creditwatch banks might also stop lending which would drive the system further from the optimal.

10. Survey articles by McDonald (1982), Eaton, Gersovitz, and Stiglitz (1986) and unpublished empirical research by Lewis Alexander at the Federal Reserve Board have failed to report a systematic relationship between yields to banks and the supply of bank credit.

optimal stock of bank claims are equal, and, where desired and actual shares are also equal for the share-targeting banks.

Two other parameters are the steady-state optimal growth rate for total claims and the bandwagon coefficient, L in equation (4), which captures induced autonomous bank lending in response to changes in lending by all banks. As a baseline it is assumed that the steady-state optimal growth path for bank claims is 12 percent, about one-half the rate of actual lending in the late 1970s. This 12 percent includes 5 percent for real growth, 5 percent for lending to offset the inflationary erosion of the existing stock of debt, and a small time-trend of 2 percent to reflect the borrower's increasing integration into the world's financial system.[11] The bandwagon parameter L for smaller banks is assumed to be 1, i.e., they adjust the percentage rate by which they increase their claims on the borrower to changes in the percentage growth of total bank claims on the borrower in the previous period on a one-to-one basis.

The other two parameters are H, the extent to which creditwatch banks react to a deviation of actual from optimal lending, and the percentage p of the deviation of their actual from desired shares that the share banks attempt to correct in the next period. Initially H is set at 10 percent, which implies a reduction in lending from the optimal rate by creditwatch banks of 2 percentage points when $C^e_t/C^*_t = 1.10$; 4 percentage points at 1.20; and 8 percentage points at 1.30. The adjustment parameter for the share-targeting banks is assumed to be one-half, that is, they plan their net new lending in the next period to

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11. Inflation normally erodes the real value of debt. Lenders, however, protect themselves from this erosion by lending at floating interest rates which rise with inflation. To avoid having to amortize real debt by running surpluses to pay the higher nominal interest rates, borrowers will increase debt by the same rate as the interest rate premium for inflation to retain the real value of outstanding indebtedness.

adjust one-half of the deviation of their actual and desired share in total claims.

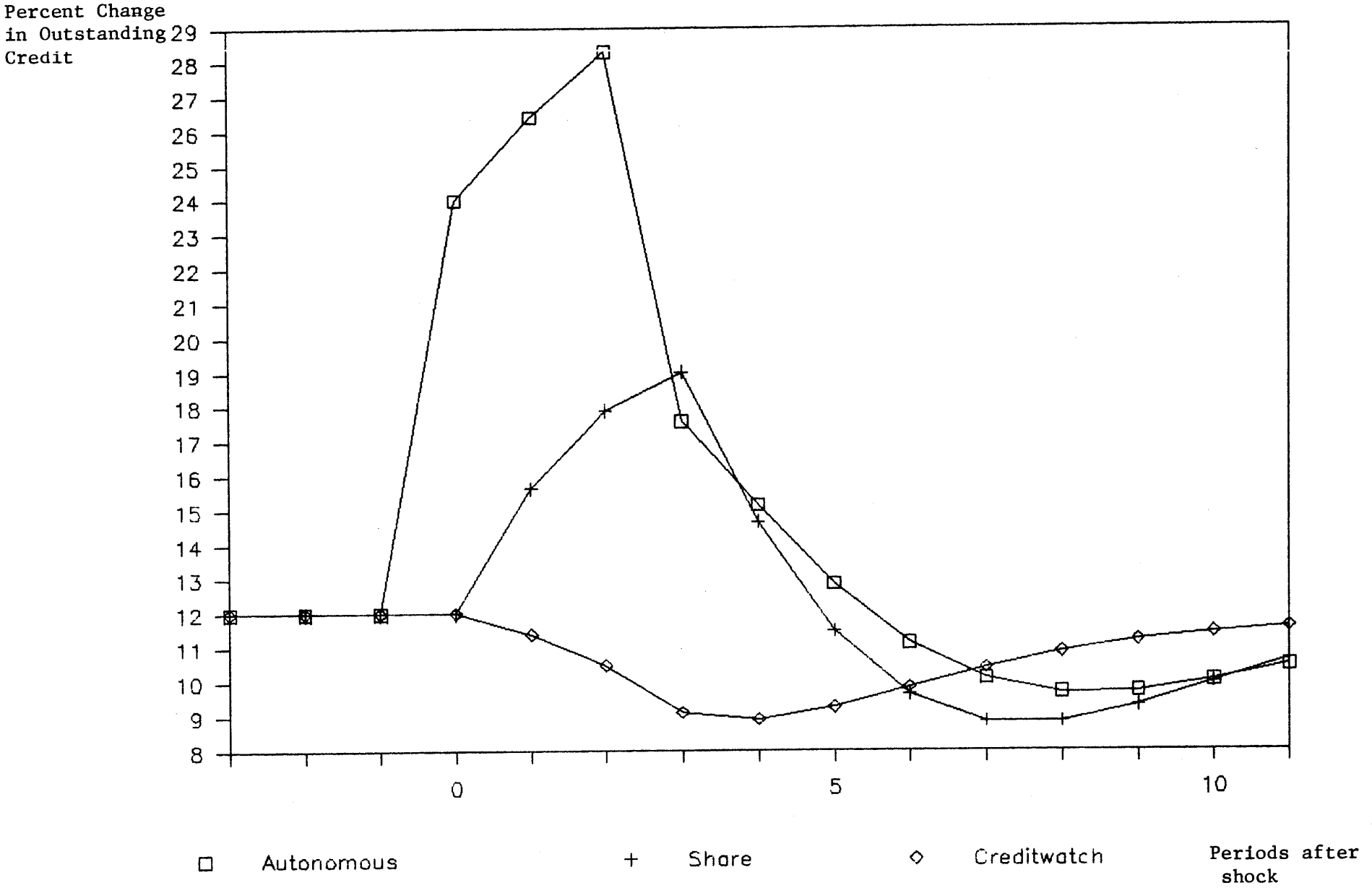
The model is assumed to start at an equilibrium level and is subjected to two types of shocks. The first shock is an increase in lending by autonomous banks, either through expanded participation by banks already involved in lending or lending by new entrants. This shock results in a doubling of new lending by autonomous banks for three years. This shock is analagous to the lending done by newcomer banks throughout most of the 1970s.

Under extrapolative expectations the expected level of outstanding bank claims, $C_t^e$, is a predetermined variable, and the claims of each type of bank can be solved for directly. With rational expectations, expected bank claims and the actual claims of each of the three groups of banks form a system of non-linear equations that can be solved for each of the variables.

Chart 1 traces the time path of new lending by the three groups of banks in response to the shock of an increase in lending by the autonomous banks, in the case when banks have extrapolative expectations regarding the future. The first reaction to the increase in lending by the autonomous banks is the share-targeting banks find their market share diminished from their desired level. To recapture their desired market shares these banks accelerate their lending, which drives the system further from the optimal level. In the fourth period, the extra lending by the autonomous banks ceases. However, total claims continue to grow at a rate above the optimal for several periods, as the rapid growth in lending induces additional bandwagon lending from autonomous banks, and as share banks attempt to regain their desired share of the market.

Chart 1

Response to Autonomous Bank Lending Shock
Extrapolative Expectations



Contrary to the behavior of these two groups of banks, the creditwatch banks become concerned about the debtor's excess burden and reduce their willingness to supply new credits below the optimal rate R. As their willingness to provide new credits diminishes, it becomes easier for the share-targeting banks to move up to their desired share. This tendency is reinforced by the slowing of bandwagon lending by autonomous banks in response to a general slowing of new lending.

Chart 2 shows the same simulation in the case where banks form rational expectations of the future stock of outstanding bank claims. The broad outlines of bank behavior are similar for both expectations processes. In the rational expectations case the increase in lending by the share-targeting banks is less pronounced than with extrapolative expectations, and for all banks the approach to the steady state is smoother under rational expectations.

Chart 3 captures the time path of new lending in response to the second type of shock, a desire by banks targeting shares to increase their share by 5 percent in the aggregate. The dynamic response of the system is roughly similar. The increased lending by the share-targeting banks will induce bandwagon lending by the autonomous banks because it raises the rate of total bank lending. As the share banks approach their desired shares they will slow their new lending, which will in turn slow lending by the autonomous banks. The creditwatch banks play their role as stabilizers by reducing their lending rates as total debt exceeds the optimal amount. Chart 3, like Chart 1, assumes that banks form extrapolative expectations to predict the next period stock of outstanding claims. With rational expectations (not shown) the general behavior of the three groups of banks is similar, but there is a more pronounced initial increase in lending by the share-targeting banks who

Chart 2

Response to Autonomous Bank Lending Shock
Rational Expectations

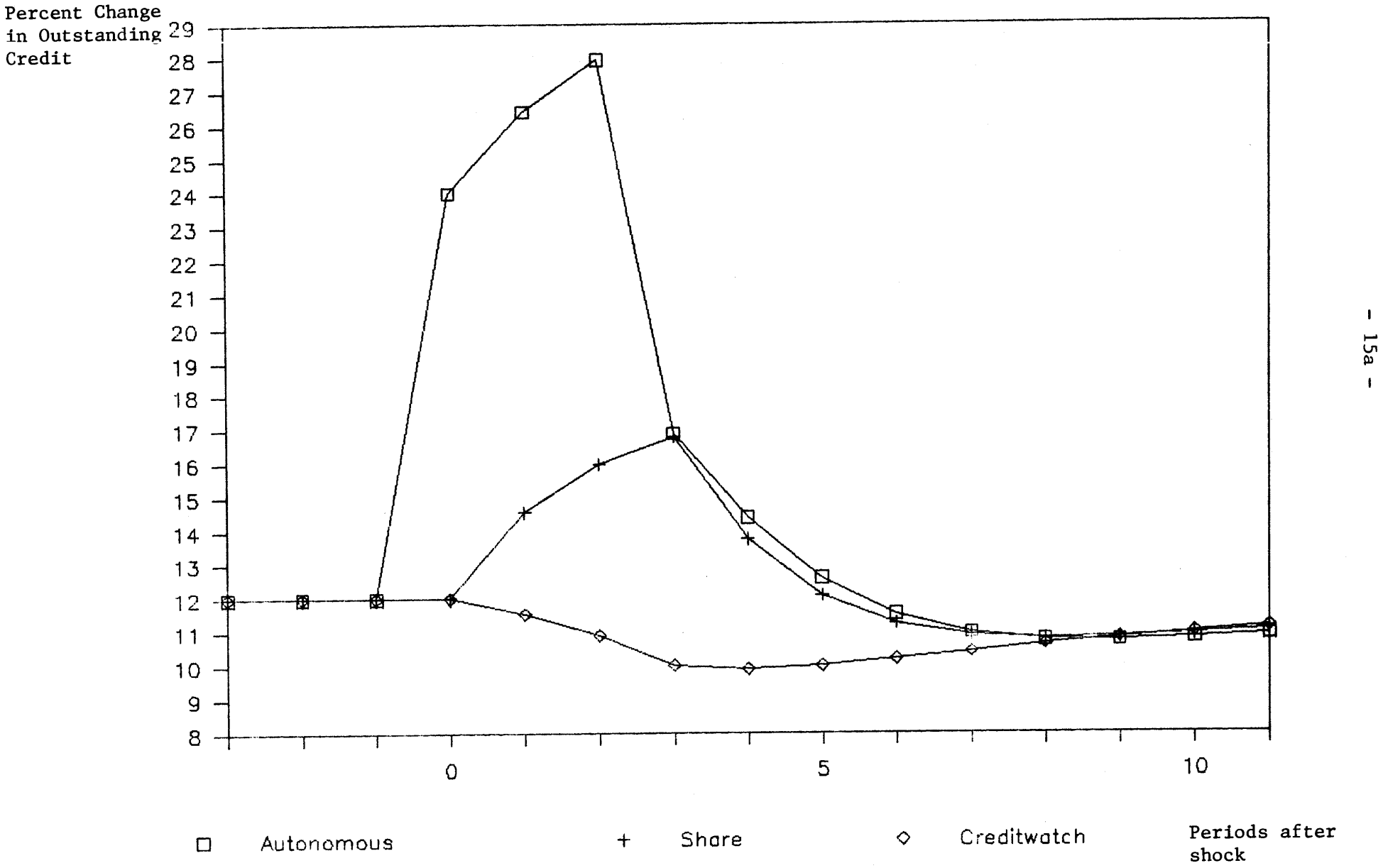
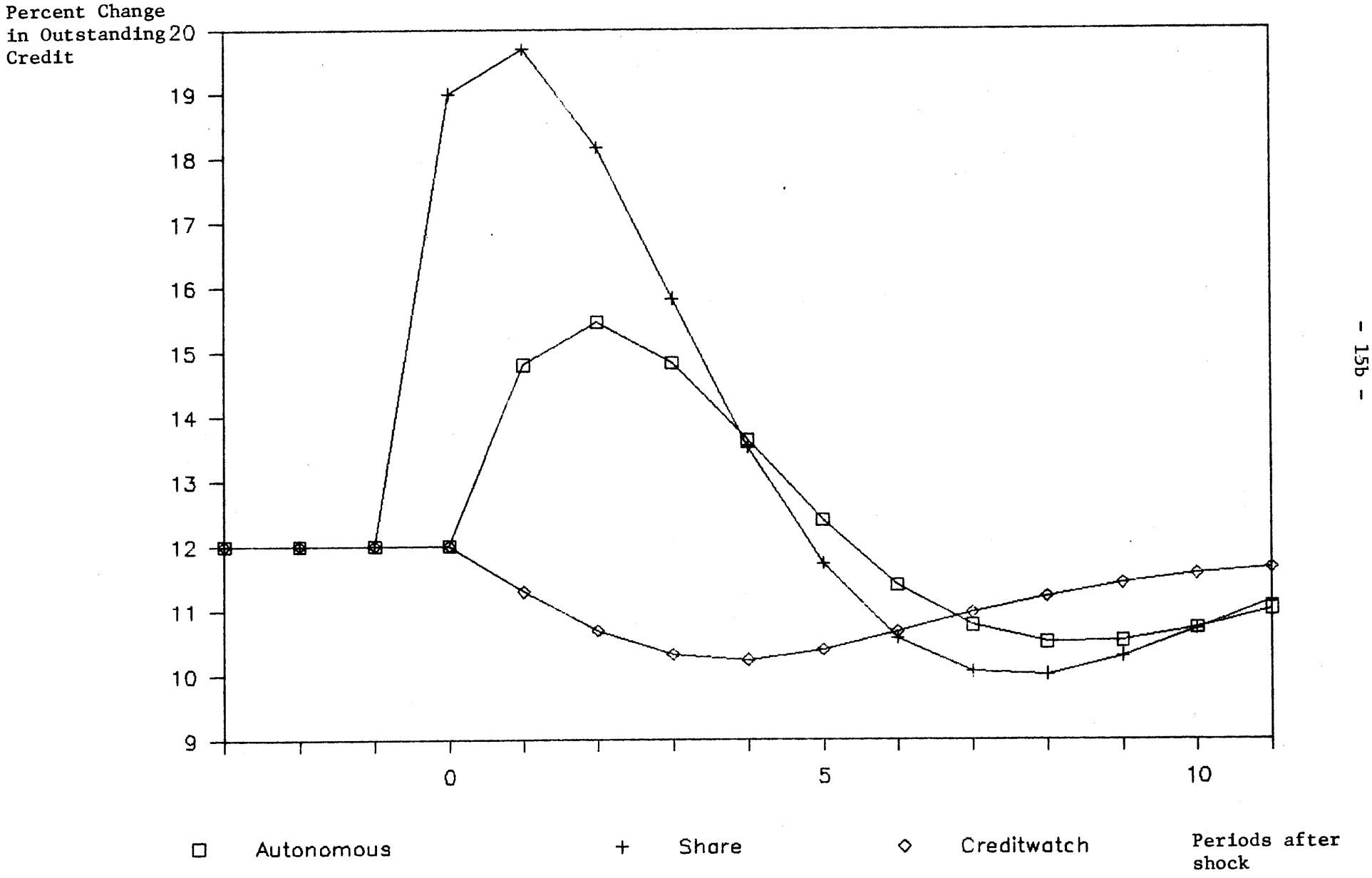


Chart 3

Response to Increase in Desired Market Share
Extrapolative Expectations



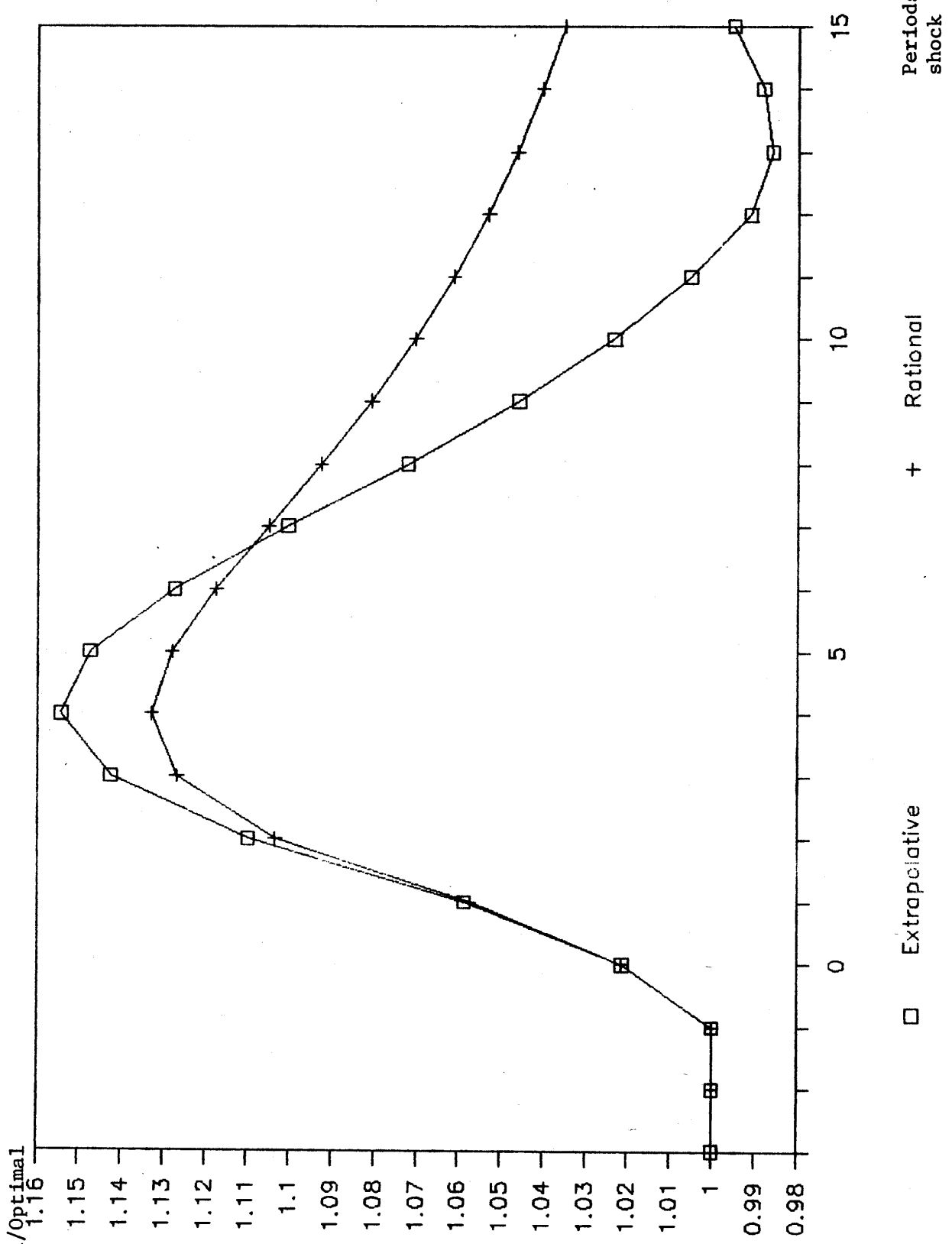
anticipate the response of other banks and increase their lending accordingly.

The differences between the two expectational processes are shown more clearly when we examine the behavior of the total stock of bank claims over time. Chart 4 plots the ratio of outstanding bank claims to the optimal stock $C_t/C_t^*$, under the baseline assumptions, and with an unexpected increase in lending by autonomous banks. With rational expectations the extent of the deviation of actual from optimal bank claims is not as great as with extrapolative expectations. However the actual stock of outstanding bank claims exceeds the optimal stock for a far longer period of time under rational expectations. Moreover, under rational expectations the stock of bank claims regresses smoothly toward the optimal level, while repeated but damped cycles occur under extrapolative expectations.

The cycles observed under extrapolative expectations are purely a consequence of the backward looking expectations process. Whenever the growth rate of actual bank claims is less than the growth of optimal claims, 12 percent in this example, the ratio graphed in Chart 4 declines. With extrapolative expectations, by the time this ratio reaches 100 again (roughly period 11 in Chart 4) where actual claims are equal to their optimal level, the deviation of actual from desired shares for the share-targeting banks has all but disappeared. Creditwatch banks are no longer reacting to over or underlending, so that the lending process is driven entirely by expectations. Previous growth rates of bank claims were less than the optimal growth rate (hence the fall in the ratio in Chart 4.) Thus a rate of growth insufficient to sustain actual claims at their optimal level is extrapolated into the future, and as a result lending by autonomous and

Chart 4

Autonomous Bank Lending Shock
Ratio of Total Bank Claims to Optimal



share-targeting banks falls short of the optimal level, and the ratio continues to fall.

The actions of creditwatch banks are critical here, both because they lend at the optimal rate, and because they expand their lending as actual claims fall below optimal. Because of this, actual lending turns out to be larger than the targeting banks expected; targeting banks find their market share lower than expected, and they begin to expand their lending. The system overshoots on the upswing for similar reasons, but each cycle is a damped version of the previous one, leading to eventual convergence.

The ratio of actual to optimal outstanding bank claims, when there is an unanticipated increase in share-targeting banks' desired market share, is shown in Chart 5. An increase in targeting banks' desired market share by 5 percentage points leads to a somewhat smaller deviation of actual bank lending than did the increase in lending by the autonomous banks in Chart 4. As in the case of the first shock, under rational expectations the deviation of actual from optimal claims is not as extreme and the adjustment back to the optimal path is more prolonged than under extrapolative expectations.

Table 1 reports the results of simulations under alternative assumptions about the structural parameters to test the sensitivity of the results to the baseline parameters and to test which factors make a difference in systemic stability. The criterion for systemic stability is the maximum ratio of actual to optimal claims. The first test raises the proportion of share-targeting banks from 40 percent to 60 percent of the total. The results of that test, discussed more fully below, suggest that increasing the proportion of banks targeting shares can make the system considerably less stable.

Chart 5

Increase in Desired Market Share
Ratio of Total Bank Claims to Optimal

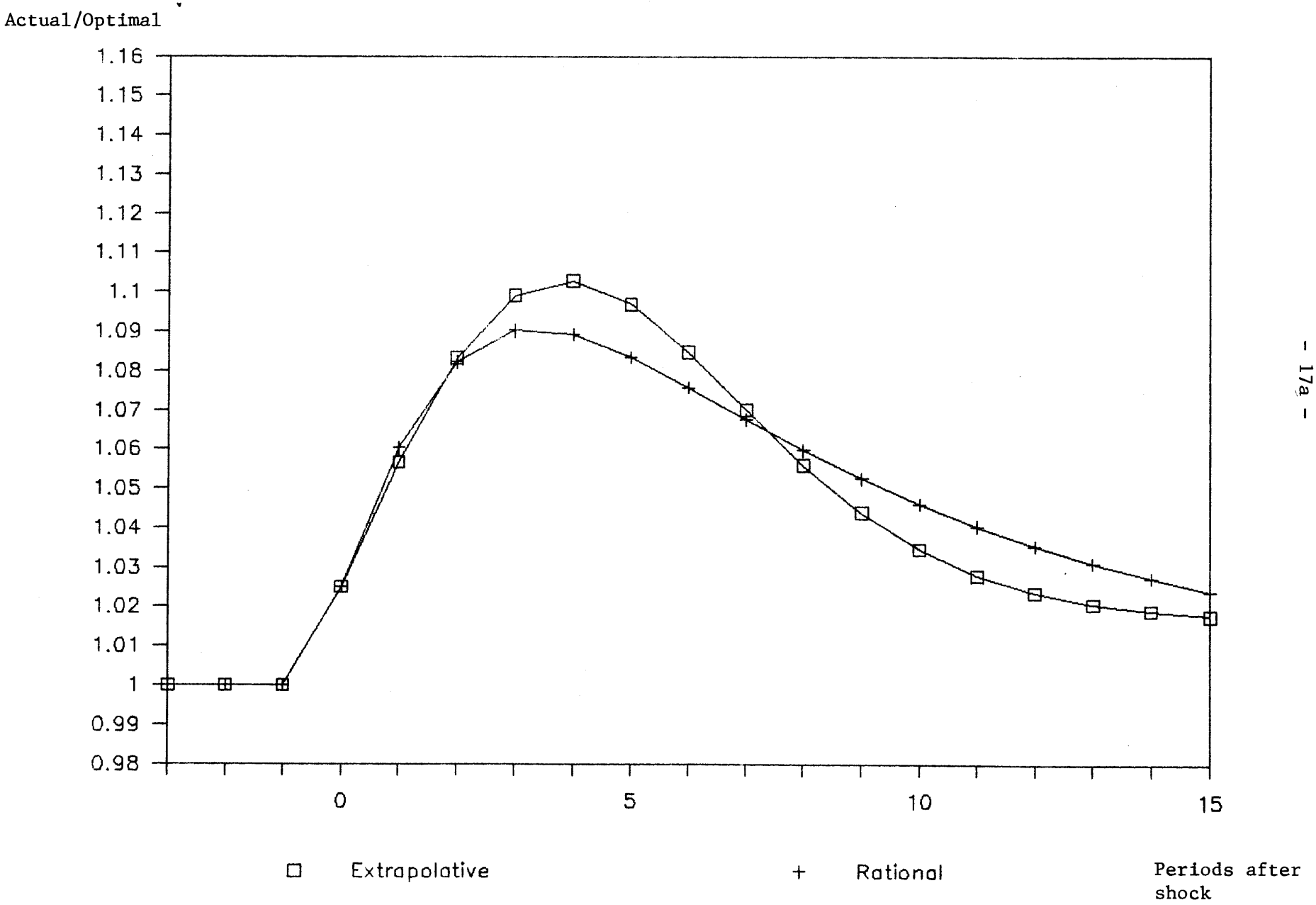


Table 1

Maximum Ratio of Outstanding to Optimal Stock of Bank Claims (percent)

| | Autonomous Bank Lend at Double Optimal Rate for Three Years | | Market Share Banks Attempt to Increase Share 5 Percentage Points | |
|---|---|---|---|---|
| Assumptions | Extrapolative | Rational | Extrapolative | Rational |
| Baseline[1] | 115 | 113 | 110 | 109 |
| Share Banks Have 60 percent Initial Share | 131 | 126 | 121 | 118 |
| Creditwatch Adjustment Parameter Increased to 20 percent | 112 | 111 | 108 | 107 |
| Optimal Growth Rate Reduced to 8 percent/ year | 110 | 109 | 110 | 109 |
| Bandwagon Parameter for Autonomous Banks Reduced to .5 | 112 | 111 | 109 | 107 |

1. Baseline assumptions are:
   (1) Original weights =
   20 percent for Autonomous banks
   40 percent for Share-targeting banks
   40 percent for Creditwatch banks

   (2) Adjustment parameter for Creditwatch banks = 10 percent.

   (3) Optimal growth rate = 12 percent.

   (4) Bandwagon parameter for Autonomous banks = 1.

Table 1 presents the effect of three other alternatives to the baseline parameters. A tightened lending response by the creditwatch banks reduces systemic instability as does a reduced bandwagon parameter for lending by autonomous banks, although neither of these adjustments made nearly as great an impact as altering the proportions of banks targeting shares. A reduction in the optimal rate of growth of claims also reduces systemic instability, although this largely results from the reduction in the absolute size of the shock when autonomous banks lend at twice the optimal rate.

In almost all cases the effect of rational expectations is to lower the maximum ratio of actual to optimal claims. The difference between the two expectation processes is most pronounced as the initial weight of claims held by the share-targeting banks is increased.

Since share-targeting behavior appears to be the principal determinant of instability in the supply of bank credit, the impact of that variable is considered in more detail in Charts 6 and 7. Chart 6 plots the impact of an increase in lending by the autonomous banks on the maximum ratio of actual bank claims to optimal claims, as a function of the initial weight of banks targeting market shares of the initial weight of banks targeting market shares. Chart 7 plots the same information in a response to the increase of 5 percent in the desired share of the share-targeting banks. The horizontal axis in Chart 6 and Chart 7 varies the proportion of share-targeting banks, assuming that autonomous banks always account for 20 percent of original bank claims. Thus a larger percentage of share-targeting banks comes at the expense of the creditwatch banks.[12] Both Charts 6 and 7 compare the results with extrapolative and rational expectations.

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12. Baseline assumptions (Table 1) are used for the other parameters.

Chart 6 yields some very interesting results. Up to an initial weight of about 40 percent, changes in the weight of banks targeting market shares have very little impact on the extent to which shocks emanating from increased lending by autonomous banks cause the system to deviate from the optimal path. Beyond 40 percent, however, the impact of share-targeting on systemic stability quickly becomes much more pronounced. At a 60 percent initial weight for targeting banks the system becomes quite unstable, with large deviations from the optimal path resulting in response to the shocks from the autonomous banks.

The same dependence on the initial weight of the share-targeting banks holds when the shock is an increase in desired market shares as shown in Chart 7. In the case of this shock the system also becomes quite unstable as the initial weight of banks targeting market shares exceeds 60 percent.

Charts 6 and 7 also point up to the differences in systemic stability resulting from different expectations mechanisms. In both the case of the shock of increased lending by autonomous banks, and the shock of attempts by some banks to increase their market shares, rational expectations about lending by other banks resulted in less dramatic systemic instability then under the more mechanical extrapolative expectations.

## IV. Summary and Conclusions

This paper has developed and simulated a model of international bank lending based on three separate types of commercial bank lending strategies. Simulations of the model have resulted in deviations of actual lending from an optimal norm on the order of 10-30 percent. The model indicates clearly that the supply of international bank lending becomes increasingly unstable as the proportion of banks targeting a

Chart 6

Autonomous Bank Lending Shock
Maximum Ratio of Actual to Optimal Claims

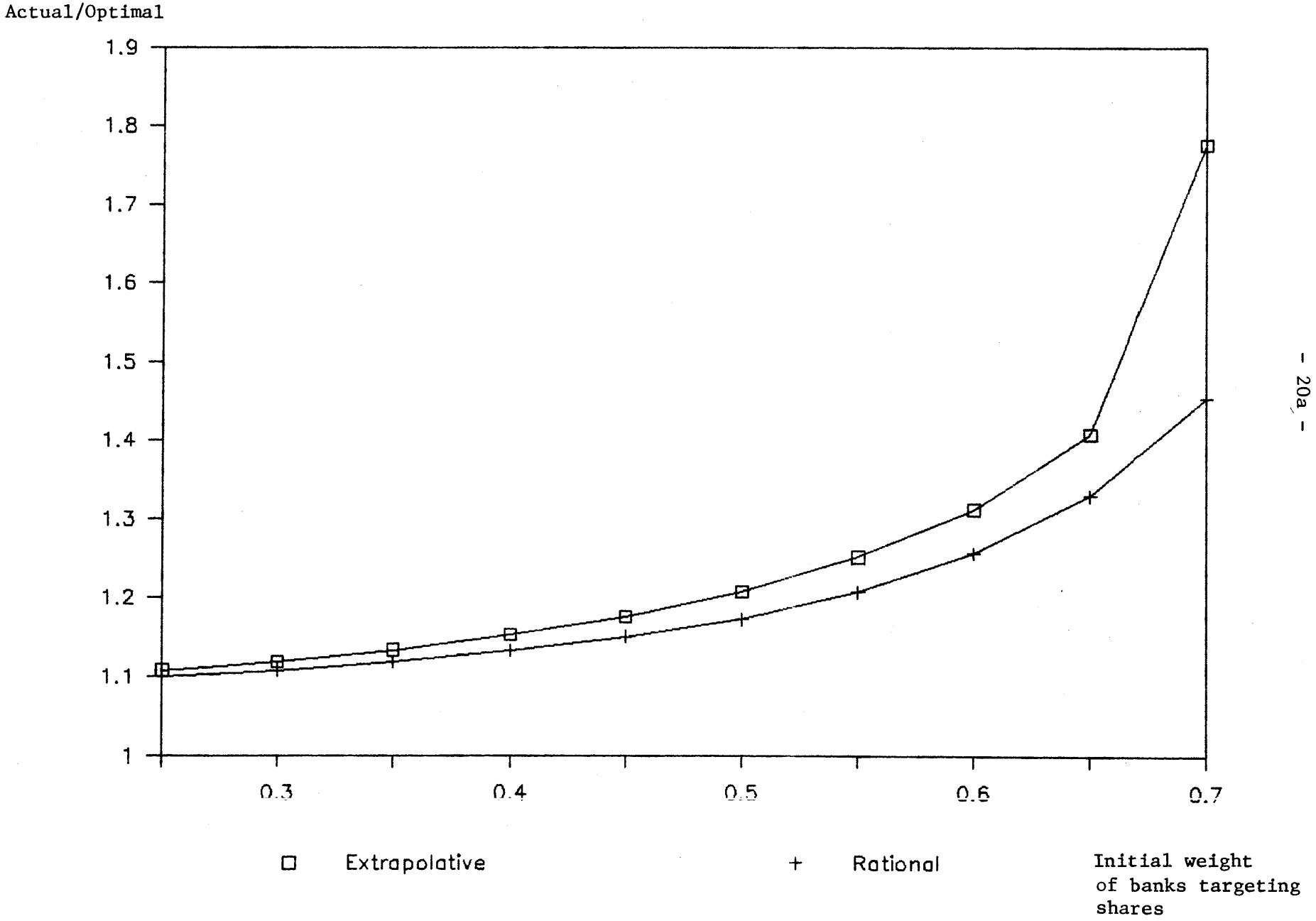
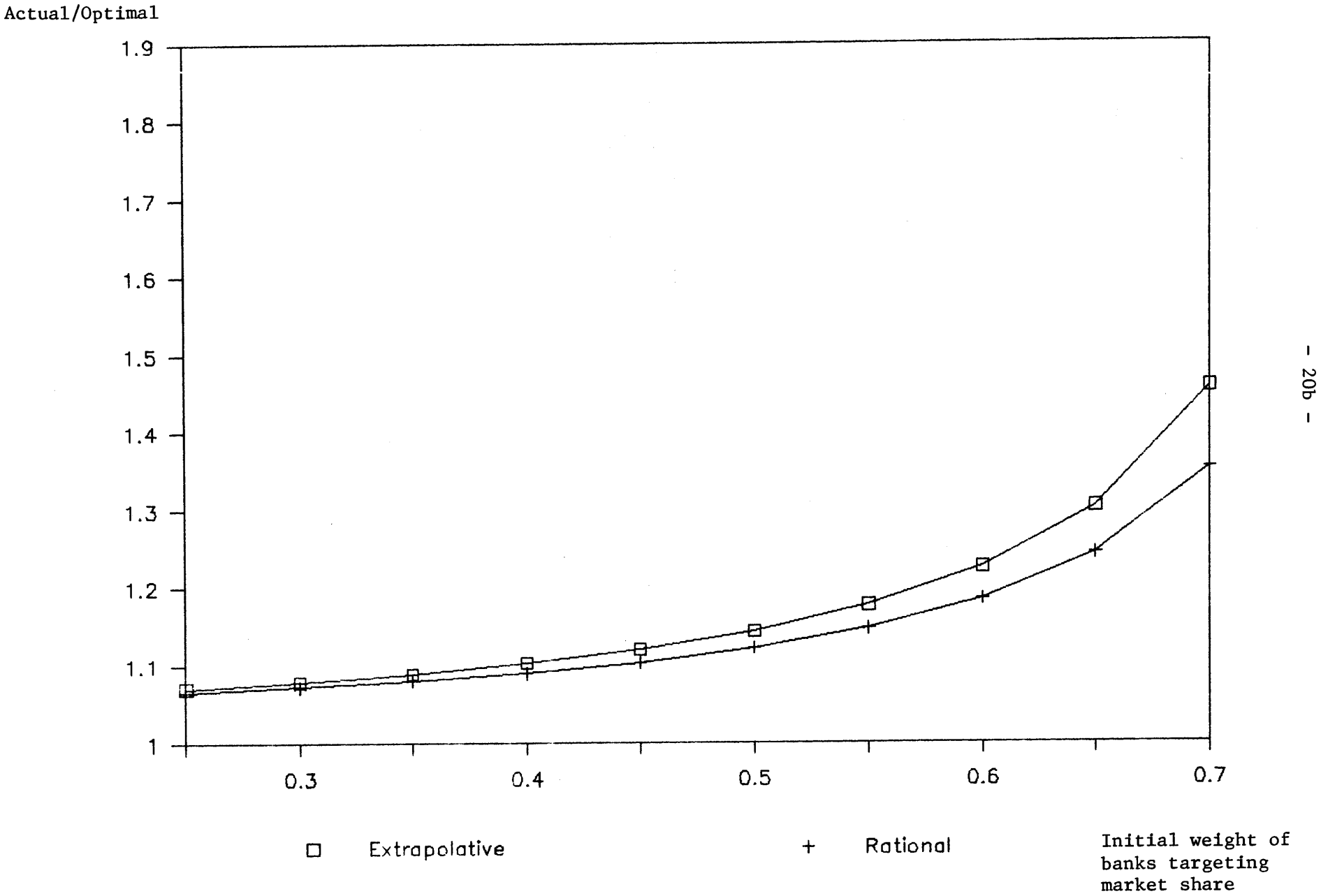


Chart 7

Maximum Ratio of Actual to Optimal Claims
Increase in Desired Market Share



share of the total lending market increases, particularly as that share approaches and exceeds one-half.

The model also indicates an ambiguous result from increased published information about lending behavior of individual banks or groups of banks. To the extent that published information causes more banks to target market shares it will tend to make the system less stable. Offsetting this tendency for information to make the system less stable is the case where increased information causes sophisticated lending banks to incorporate information about the behavior of other banks into their own decisions about future lending to a particular borrower.

The major policy implication of the model is that targeting of market shares by lending banks is not only a passive business strategy but a potential cause of systemic instability. Bank supervisory and regulatory agencies should encourage lending banks to develop independent analytic capabilities which may well result in a diversity of lending exposure ratios rather than focusing on banks whose behavior does not conform to the group norm.

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