**PORTFOLIO AND FINANCING ADJUSTMENTS FOR U.S. BANKS
SOME EMPIRICAL EVIDENCE**

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ABSTRACT

This paper presents a model of the portfolio and financing adjustments of U.S. banks over the business cycle. At the core of the model is a moral hazard problem between depositors/bank regulators and stockholders. The solution to this problem takes the form of shared management of the bank. Stockholders manage the bank's portfolio and the regulator manages the financing of the portfolio. The model predicts that portfolio adjustments are made to conform to the risk aversion of shareholders and financing adjustments are made to offset changes in portfolio risk. Regression evidence for 1955-2000 fails to reject these predictions.

JEL Classification E3, G2, L2

I. INTRODUCTION

There is a substantial body of research indicating that a well-developed financial system makes a positive contribution to the average long-run growth rate in the real output of a country (see for example Levine 2002 and Beck and Levine 2002). Moreover it does not seem to matter whether the country has a stock market oriented financial system like those in the U.K. and the U.S., or, a bank oriented system like those in Germany and Japan. Apparently the only thing that does seem to matter is whether the financial system is built on the substructure of an efficient legal system that respects property rights and contracts (see LaPorta, Lopez-de-Silanes, Shleifer, and Vishny 1998 and Beck, Demirguc-Kunt, and Levine 2003). This growth does not come free since there is also a substantial body of research indicating that both the stock market and the banking system in a financially well-developed country like the U.S. amplifies fluctuations in real economic activity. Volatility in share valuations in the stock market induces volatility in real corporate investment and GDP as the evidence of Polk and Sapienza (2002), Panagreas (2003), Gilchrist, Himmelberg, and Huberman (2004), and Kau, Linck, and Rubin (2004) indicates. According to this research firms "just can't say no" to the stock market. The stock market is not the only financial source of instability in the real economy. There is also considerable research indicating that volatility in bank lending amplifies and prolongs fluctuations in real corporate investment and GDP. However in the case of banks the "excessive" asset adjustments in the form of procyclicality in bank lending is not attributable to excessive volatility in bank share valuations in the stock market, but instead to other factors (see Lang and Nakamura 1992, Stanton 1998, Borio, Furfine, and Lowe 2001, and Catarineu-Rabell, Jackson, and Tsomocos 2002 among others).

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What are these other factors that cause banks to both overfund and underfund real corporate investment thereby prolonging and amplifying fluctuations in real economic activity? In this connection Bernanke and Gertler (1989), Bernanke, Gertler, and Gilchrist (1996), and Kiyotaki and Moore (1997) develop models of investment and finance based on agency costs resulting from asymmetric information and moral hazard problems between firms and suppliers of external finance. In these models agency costs are countercyclical. This is because outside lenders like banks require collateral and/or a net worth cushion to back-up any loans they make because of the asymmetric information and moral hazard problems associated with the firm's opaque investments. It is then argued that the collateral value of a firm's assets and the magnitude of it's net worth follow a procyclical path thereby tightening these two-financing constraints in periods of recession and relaxing the two constraints in expansions. The end result is that the availability of bank loan finance is procyclical thereby prolonging and amplifying cyclical fluctuations in real economic activity.

The models of Bernanke, Gertler, Gilchrist, Kiyotaki, and Moore were primarily used to explain the phenomena of a "credit crunch" and how a credit crunch could prolong and amplify recessions.[1] Rajan (1994), on the other hand, developed a model where banks under certain circumstances over-lend to their customers; i.e., fund negative NPV projects that in turn prolong and amplify cyclical expansions. To get this result Rajan invokes two key assumptions: i) banks are able to credibly manipulate their earnings over a given short period of time; and ii) investors in bank shares value managerial ability relatively more in normal states of the economy than in recessions where it is expected that all managers will perform poorly. To see how this model works consider some bank (i) that has just learned that some of its loans have funded negative NPV real projects. Should bank (i) terminate these loans and realize a loss, or, continue to finance the negative NPV projects that still provide illusory short-term profits? According to

Rajan bank (i) is more likely to continue financing these negative NPV projects in a normal state of the economy if some competitor bank (j) announces a positive return on their loans. For bank (i) to terminate the bad loans and realize the losses in the good state will make (i) look relatively worse than bank (j). This is something bank (i) will try to avoid since their managers are comparatively evaluated only in the good states by assumption. If enough bank (i's) herd in this way a cyclical expansion will eventually occur caused by overinvestment in negative NPV projects financed with bank loans.[2]

Another class of economic arguments lay the blame for procyclical lending on the human frailty of bank loan officers and bank regulators. In this vein Borio, Furfine, and Lowe (2001) argue that procyclicality is the result of lenders mismeasuring risk. Risk is underestimated in cyclical expansion when lenders are exuberant, and overestimated in recessions when lenders are pessimistic. This cyclical mismeasurement of risk arises because of the short-term horizon of lenders. In expansions when the demand for loan finance by firms is high (along with lucrative up-front fees), lenders tend to ignore the risks of the real projects that are being financed with loans and focus their attention on returns. The reverse occurs in recession when lenders ignore returns and focus their attention on risk. In this way too many negative NPV loans are made in expansions and too many positive NPV loans are passed-up in recessions. A variant of this line of economic reasoning is found in Berger and Udell (2003),. They argue that there is an "institutional memory" problem in bank lending. As time moves on from the depths of the previous recession with its peak in loan defaults, the memory of this bad event fades away. As a result credit standards are eased and bank loans increasingly finance negative NPV projects thereby temporarily prolonging the expansion. Part of the memory loss is the result of experienced loan officers just forgetting the previous bad times, and part is the result of newly hired loan officers that never experienced the bad times. Eventually the losses on the negative

NPV projects are realized resulting in loan defaults, and the economy then slips into a recession. As this occurs banks tighten their credit standards and some positive NPV projects go unfunded thereby amplifying and prolonging the recession. According to Berger, Kyle, and Scalise (2001) bank supervision reinforces this procyclicality with lax supervision in and around cyclical expansions and stifling supervision during recessions.

All of the above-mentioned literature has something useful to say on the asset adjustment decisions of banks, and the effect these adjustments have on the real economy. And yet it is somewhat surprising that in this literature the stock market plays no role whatsoever in the portfolio adjustments of banks. Why should the stock market play an important role in the investment decisions of nonfinancial enterprises and yet play no role in the investment decisions of banks? Is it really the case that bank managers can say no to the stock market? We believe this to be an oversight in the banking literature. Stock market valuations provide information on the risk aversion of investors. It would therefore seem that this information would be useful to managers of banks and nonfinancial enterprises in formulating their ex-ante asset adjustment and financing adjustment decisions. Moreover, market valuations also reflect investors' ex-post evaluations of these decisions when they have been implemented by managers. This signaling and evaluation function of an efficient stock market would seemingly be useful in a study of both banks and nonfinancial enterprises. For these reasons financial and nonfinancial enterprises will be viewed in more or less the same way; namely, as firms that manage their balance sheet in some purposeful way.

The next section presents a macroeconomic framework of analysis that describes the investment decisions and financing decisions for a representative enterprise over the business cycle. There are many ways in which a bank is different from a steel company, but in terms of asset adjustments and rational financing adjustments over the business cycle the two are

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remarkably similar. In previous work (Krainer; 1985, 1992, 1996, 2000, and 2003) we have described and measured these asset adjustments and financing adjustments for nonfinancial enterprises. This research indicates that shock-induced changes in equity valuations initiate asset adjustments. Rising (or falling) equity share valuations cause nonfinancial enterprises to increase (or decrease) their investments in speculative inventories and plant and equipment thus causing cyclical expansions (or contractions) in business activity, and increases (or decreases) in the operating risk of firms. We also found that when nonfinancial enterprises adjust the asset side of their balance sheet by investing more (or less) in these risky assets, they match that investment strategy by financing more of their investments with equity (or debt). In other words, economic expansions are financed at the margin with equity while recessions are supported with debt. Long-term financial leverage and financial risk is countercyclical. In Section III below we present similar empirical evidence on these asset or portfolio adjustments and financing adjustments for the entire U.S. banking sector over the period 1956-2000. We will see in this section that U.S. banks invest more heavily in private risky loans (or cash and securities) in response to increases (or decreases) in lagged bank share valuations. Moreover, when banks adjust the asset side of their balance sheets by investing more (or less) in business and consumer loans, they finance more (or less) of their assets with equity compared to deposits. Furthermore, these asset adjustments and financing adjustments for U.S. banks are observed in the data long before the enactment of the FDIC Improvement Act of 1991 that implemented the prompt and corrective action feature of risk-based capital requirements for depository institutions. Finally, this paper concludes in Section IV with a short summary of the main results.

II. ASSET ADJUSTMENTS AND FINANCING ADJUSTMENTS FOR NONFINANCIAL AND FINANCIAL ENTERPRISES

This section presents an overview of a model of asset allocation and financial

adjustments that will guide the empirical work on U.S. banks in the next section. Towards this

end consider an enterprise with total assets A—e.g., real productive assets such as inventories,

plant, and equipment, or, financial assets such as government securities and private loans—

generating expected nominal returns of $\overline{X}$. If the assets of this enterprise are financed with

equity A(E) and debt/deposits A(D), then the existence of risk aversion and the legal priority of

debt/deposits over equity requires the existence of a positive risk premium; namely,

$$R(d) < R(e)$$

where

$R(d) = \overline{X}(d)/A(D)$ is the rate of return on debt/deposit type securities.

and

$R(e) = \overline{X}(e)/A(E)$ is the rate of return on levered equity securities.

Figure 1 presents a geometric description in the form of an Edgeworth-Bowley box

diagram of this enterprise. The horizontal axis of this box diagram measures the total assets A

invested in the enterprise, and the vertical axis measures the expected returns $\overline{X}$ generated on

those assets. The point Z in the box represents a particular combination of equity finance A(E)

on the upper horizontal axis and debt/deposit finance A(D) on the lower horizontal axis, along

with their respective expected returns of $\overline{X}(e)$ and $\overline{X}(d)$ on the right and left vertical axis. Note

also that in and around the small neighborhood of Z the rates of return R(d) along DD and R(e)

along EE are assumed to be constant indicating the firm is a price-taker in the financial market.

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The sharing of finance and expected returns among debt/depositor investors and equity investors described in Figure 1 can be presented in a somewhat different way. To see this in the context of the box diagram in Figure 1 note that,

1. $\overline{X}(d) = R(d)A(D)$ is the required income for debt/depositor investors.

For the enterprise as a whole we have,

2. $\overline{X} = R[A(D) + A(E)]$

         where $R = \overline{X}/A$

         leaving

3. $\overline{X}(e) = \overline{X} - \overline{X}(d)$ or the expected income for the equity investors.

Substituting the rhs of (2) for $\overline{X}$ in (3) and then dividing the result into (1) and rearranging yields,

4. $$\frac{\overline{X}(d)}{\overline{X}(e)} = \frac{A(D)/A(E)}{\dfrac{R}{R(d)} + \left[\dfrac{R - R(d)}{R(d)}\right]\dfrac{A(D)}{A(E)}} \geq 0$$

a concave relationship between $\overline{X}(d)/\overline{X}(e)$ and A(D)/A(E). A linear approximation to (4) is presented in Figure 2 and labeled dd. The dd schedule presents the combinations of expected income sharing between debt/depositor investors and equity investors, and financial leverage for which the rate of return R(d) in the small neighborhood of Z in Figure 1 is a constant.

An equity market schedule based on the small neighborhood in and around point Z in Figure 1 can also be computed in the same way. In this connection note that

5. $\overline{X}(e) = R(e)A(E)$ is the required income for an investment of $A(E)$ for equity investors. For the enterprise as a whole we again have,

2. $\overline{X} = R[A(D) + A(E)]$

   leaving

6. $\overline{X}(d) = \overline{X} - \overline{X}(e)$ or the expected income for debt investors.

Substituting the rhs of (2) into (6), and then dividing (6) by (5) and rearranging yields

7. $\dfrac{\overline{X}(d)}{\overline{X}(e)} = \dfrac{R - R(e)}{R(e)} + \dfrac{R}{R(e)}\left[\dfrac{A(D)}{A(E)}\right] \geq 0$

a linear relationship between $\overline{X}(d)/\overline{X}(e)$ and $A(D)/A(E)$. This linear relationship is also presented in Figure 2 and labeled the ee schedule. Everywhere along this ee schedule the rate of return on equity $R(e)$ is the constant given by the slope of the EE schedule in and around point Z in Figure 1.

Equations (4) and (7) indicate that both the dd and ee schedules slope upward. It can be shown (Krainer; 2003, pp. 42-43) that when $R(d) < R(e)$, the ee schedule intersects the dd schedule from below as drawn in Figure 2. The (+) and (−) around the dd and ee schedules in the figure indicate the direction of increasing and decreasing rates of return on debt securities and equity securities, and are the direct implication of equations (4) and (7).

Figure 2 describes a production economy of fixed size in terms of A and $\overline{X}$ in Figure 1. However, from the perspective of business cycle analysis the interesting question is what happens to the length and height of the box in Figure 1 during cyclical expansions and recessions

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along with the embedded risk associated with various levels of investment. To begin answering

this question it is necessary to understand how expected returns, $\overline{X}$, and a measure of risk, σ,

vary with different levels of productive assets in the enterprise/economy. In this connection it

will be assumed that the return generating process takes the following form.

8. $\overline{X} = f(A)$ $f' \geq 0,$ $f'' \leq 0$

                and

9. $\sigma = g(A)$ $g' > 0,$ $g'' \geq 0$

        where

        A = Investments in productive assets.

Equation (8) indicates that expected income increases with investments in productive assets at a

decreasing rate. Equation (9) indicates that risk is an increasingly convex function of

investments in productive assets. This is a less common assumption than (8) although it is not

without precedent.[3] Together equations (8) and (9) imply that the ratio of expected returns to

risk, $\overline{X}/\sigma$, for the enterprise/economy declines (or increases) with increasing (or decreasing)

levels of investment in productive assets. In other words the return to risk tradeoff or Sharpe

ratio generated by the productive assets of enterprises deteriorates during business cycle

expansions and improves during recessions for the return generating process given in equations

(8) and (9). This assumption on the return generating process suggests that in order for an

enterprise/economy in this model to increase (or decrease) its investments in productive assets

and thereby create cyclical expansions (or recessions), it is first necessary for investors to reduce

(or increase) their required rates of return. For debt investors a reduction (or increase) in their

required rate of return implies by equation (4) a downward (or upward) shift of the dd schedule

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in Figure 2, while for equity investors it would imply by equation (7) a leftward (or rightward) shift in the ee schedule in Figure 2. It will be assumed in this analysis that only equity investors change their required rate of return in response to some external shock; for example, a change in risk and/or risk aversion. While this assumption is not necessary it will simplify the presentation particularly in subsequent figures. In addition to simplicity it is empirically the case that equity yields fluctuate more than debt yields. It is also the case that equity yields, the Sharpe ratio, and the risk premium follow a countercyclical path as implied in (8) and (9) and observed in the empirical work of Fama and French (1989), Ferson and Harvey (1991), Hardouvelis and Wizman (1992), Harrison and Zhang (1999), and Harvey (2001) among others, and the theoretical work of Campbell and Cochrane (1999), Chan and Kogin (2002), and Bekaert, Engstrom, and Grenadier (2004).

The analysis so far suggests that economic fluctuations occur when enterprises change the level and structure of their assets. But in order for enterprises to change the level and structure of their assets, it is first necessary for the required rates of return of investors to change. To develop this idea further we define the nominal price of one debt security/deposit P(d) to be:

10. $$P(d) \; = \; \frac{\overline{X}(d)}{R(d, RR)} \; \bullet \; \frac{1}{N(d)}$$

where

$R(d, RR)$ = The required rate of return of debt/deposit investors.

$N(d)$ = Number of debt securities/deposits.

Multiplying the numerator of the rhs of (10) by A(D)/A(D) and defining $R(d, ER) = \overline{X}(d)/A(D)$ to be the expected rate of return (returns delivered to investors by the operating and financing decisions of firms) on debt securities enables us to rewrite (10) as:

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11. $\quad P(d) \; = \; \dfrac{R(d, \, ER)}{R(d, \, RR)} \; \bullet \; \dfrac{A(D)}{N(d)}$

Equation (11) says the market value of debt is the book value of one unit of debt scaled by the

ratio R(d, ER)/R(d, RR). Similarly for equity we can write the market price of one share of stock

P(e) as:

12. $\quad P(e) \; = \; \dfrac{\overline{X}(e)}{R(e, \, RR)} \; \bullet \; \dfrac{1}{N(e)}$

    where

        R(e, RR) =   The required rate of return for equity investors.

        N(e)   =   Number of shares.

Again multiplying the numerator on the rhs of (12) by A(E)/A(E) and defining R(e, ER) =

$\overline{X}$ (e)/A(E) to be the expected rate of return on equity shares enables us to rewrite (12) as:

13. $\quad P(e) = \dfrac{\overline{X}(e)/A(E)}{R(e, \, RR)} \; \bullet \; \dfrac{A(E)}{N(e)} = \dfrac{R(e, \, ER)}{R(e, \, RR)} \; \bullet \; \dfrac{A(E)}{N(e)}$

The first term on the rhs of (13), R(e, ER)/R(e, RR), is a Q - ratio for equity, while the second

term, A(E)/N(e), is the economic book value of one share of equity stock. In effect the market

price of one share of stock is the economic book value (replacement cost of the assets minus the

book value of debt) of one share of equity stock scaled by an equity Q-ratio.

       To see the link between the capital market and general economic activity, consider some

initial position where the market value of debt and equity securities equals their respective book

values. Now suppose there is a positive external shock that reduces the risk aversion of equity

investors that in turn reduces R(e, RR). (Suppose also there is no change in R(d, RR).) The

reduction in R(e, RR) in equation (13) will drive up equity share prices above their economic

book value. Managers in this model then respond to this stock market signal by increasing their

investments in risky assets such as inventories, plant, and equipment. Bank managers respond to their stock market signal by increasing their investment in risky loans which in turn helps finance the investments of nonfinancial enterprises. Since the expected returns of the firm/economy $\overline{X}$ are increasing at a decreasing rate by equation (8), eventually the expected rate of return on equity, $\overline{X}$(e)/A(E) = R(e, ER), is driven down to the shock-induced required rate of return on equity R(e, RR) at which point the equity Q-ratio in (13) is again unity and market valuations equal economic book values for equity shares. For nonfinancial enterprises the resulting operating decisions to increase investment in risky assets—that in turn increases the operating risk of firms by equation (9)—causes a business cycle expansion. For financial enterprises such as banks the resulting decision to shift their portfolios towards risky business loans—in response to the shock induced reduction in risk aversion that increases the market value of bank shares— helps finance the business cycle expansion caused by the increased risky investments of nonfinancial enterprises. The opposite sequence of events would result in an economic contraction. A negative external shock increases risk aversion and the required yield on equity driving share prices below economic book values. Managers in this model respond to the decline in share prices by reducing production and their investments in risky assets, which in turn causes a recession. The reduction in bank share prices causes a "flight to safety" as banks reduce their loans to nonfinancial enterprises and shift their portfolios towards the safe securities issued by government.[4]

The discussion so far indicates that a business cycle expansion is characterized by an increase in the operating risk of nonfinancial enterprises and a shift towards more speculative business loans by financial enterprises. From the perspective of equity investors the resulting speculative asset adjustments by nonfinancial and financial enterprises that created the business cycle expansion are optimal since it was a reduction in their required rate of return that triggered

these investment decisions. But what about the debt/depositor investors? They surely are worse

off as a result of the production-investment-portfolio decisions of these nonfinancial and

financial enterprises. All they can gain is their up-front promised payment on their debt/deposit

investments in the firm if the speculative investments turn out to be successful, but potentially

they could lose everything if the speculative investments turn out to be a complete failure.[5] Can

anything be done for debt/depositor investors that ameliorates the effect of the speculative

investment decisions that cause and enable business cycle expansions? It has been shown in

Krainer (1985, 1992, 1996, 2000, and 2003) that if production-investment-portfolio decisions are

made to conform to the risk aversion of equity investors in the firm, then investor rationality

requires that the financing decisions should be made to preserve the valuation of the debt/deposit

securities in the nonfinancial and financial enterprises. In other words, if managers make

operating or portfolio decisions in the interest of their shareholders, then a rational debt/deposit

contract (or regulation) would require managers to make financing decisions in the interest of

their debt/depositor investors. In this way the welfare of both types of investors would be

coalesced over the business cycle, and both types of investors would be more confident in

investing in the firm. For a business cycle expansion resulting from the implementation of

speculative investment decisions, the optimal financing decision from the perspective of

debt/depositor investors is to increasingly finance the asset acquisitions of the nonfinancial and

financial enterprises with equity. The end result is that debt/depositor investors offset increases

in the operating risk of the enterprise with financing decisions that reduce the financial risk. In

the case of a recession resulting from a flight to safety by both nonfinancial and financial

enterprises, the financing constraint in the debt/deposit contract is relaxed and both types of

enterprises can rely more heavily on debt and deposit finance. For banks it will be immediately

recognized that this model contract between depositors and equity investors takes the form of the Basle Accord regulations on risk-based capital requirements.

Insert Figure 3 here

A geometric description of a business cycle expansion is presented in Figure 3. The intersection of the dd schedule and the ee schedule at point z represents some initial product market and capital market equilibrium where R(d, ER) = R(d, RR) and R(e, ER) = R(e, RR) and the capital market value of the firm/economy equals the economic book value of the assets employed by the firm/economy. Now suppose an external shock reduces the risk and/or risk aversion of equity investors which in turn reduces R(e, RR) and increases equity share prices. As mentioned before, we assume for simplicity the shock has no effect on R(d, RR). The reduction in the required yield on equity shifts the ee schedule to e″e″ and a new equilibrium emerges at z″ in the figure. When the firm/economy is at point z in terms of generating the expected rate of return R(e, ER) but at point z″ in terms of the investor's required yield R″(e, RR), the capital market value of the firm/economy by equation 13 rises above the book value of its productive resources. Managers of enterprises react to this arbitrage opportunity by increasing production and investments in risky assets. These decisions increase the level of productive assets in the economy but at the same time change the composition of assets with more being invested in the risky category. These decisions by nonfinancial enterprises also cause an expansion in economic activity, which in part is financed by banks that at the same time are shifting the composition of their portfolios towards risky loans to nonfinancial enterprises. The increased investment in risky assets increase expected returns but at a decreasing rate by equation (8). Eventually these decisions deliver the expected rate of return R″(e, ER) now required by equity investors as a result of the shock that reduced risk perceptions and/or risk

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aversion. When that occurs the market value of equity shares equals the economic book value of shares. In the new equilibrium at z″ in Figure 3 the firm/economy generates more expected income $\overline{X}$, but also (by equation 9) more operating risk σ. To offset the negative effect this increased operating risk would have on debt valuations, the optimal contract that brings debt investors and equity investors together in the same enterprise requires managers to finance the economic expansion with equity. The same is true with banks. The shift in their portfolios towards risky business loans, which helped finance the economic expansion, must now by negotiated contract or Basle-like regulation be followed up with a safe and conservative financial strategy that reduces financial leverage. This can be seen in the figure as a leftward movement in financial leverage A(D)/A(E). In the expansion equilibrium at z″ both debt investors and equity investors earn their required rate of return and no further arbitrage opportunities between the capital market and product market exist. While there is more operating/portfolio risk in the expansion equilibrium at z″, it has been offset with the contract/regulation induced decision to lower financial risk. A recession induced by an increase in the risk aversion and required yield of equity investors can also be described with a similar geometry but is omitted here in the interest of conserving space.

The model in this section yields two important predictions. The first prediction is that changes in the market valuation of bank stock sends a cost of capital signal to bank managers to adjust their holdings of risky loans and relatively safe cash and securities. In this model procyclicality in bank lending is driven by the stock market reflecting investor risk perceptions and/or risk aversion, and not countercyclical movements in agency costs of bank customers or the systematic mis-judgements of bank managers and regulators. The second and related prediction is that portfolio adjustments that change portfolio risk, induce bank managers to make

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financial adjustments that change financial risk in an offsetting way. These predictions from the theory will be empirically tested in the next section.

III. ASSET ADJUSTMENTS AND FINANCING ADJUSTMENTS FOR U.S. BANKS: SOME EMPIRICAL EVIDENCE

A. Data

The main objective of this section will be to test the two recursive balance sheet relationships between: 1) asset allocation decisions and lagged equity share valuations; and 2) financing decisions and asset allocation decisions implied by the model in Section II for U.S. banks over the business cycle. The data that will be used to measure the portfolio adjustments and matched financing adjustments of U.S. banks comes from the aggregate balance sheets and income statements of all FDIC insured commercial banks. Aggregate time series data is used in this study since the focus of this research is on the macroeconomic relationships between the stock market, the banking system, and the business cycle. The FDIC makes this data available on the Web under the heading of Historical Statistics on Banking.[6] The empirical question that will be studied below is what factors determine how much of the year to year marginal change in total bank assets will be invested in relatively risky private loans and how much in relatively safe assets like cash and securities. On the financing side the empirical question is what factors determine how much of a given change in total bank assets will be financed with equity and how much with deposits and other forms of debt. Since the denominator in the portfolio adjustment variable and the financial adjustment variable is the change in total assets, it is important to note up front that this variable is positive for every year over the sample time period. Moreover, there are statistical advantages associated with this specification in that the Q-statistic indicates there is no significant autocorrelations up to order twenty in the regression residuals reported below, and the CUSUM test fails to reject the hypothesis that the parameter estimates are stable over the

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sample time period. The specific balance sheet variables representing the portfolio allocation

decisions that will be used in various figures and regressions presented below are as follows.

$$\left(\frac{\Delta \text{Loans}}{\Delta \text{A}}\right) =$$ The ratio of the change in Net Loans and Leases (net of allowance for losses in loans and leases) to the change in Total Assets, a *proxy for a risky investment strategy.*

$$\frac{\Delta(\text{Cash} + \text{Securities})}{\Delta \text{A}} =$$ The ratio of the change in the sum of Cash and Investment Securities to the change in Total Assets, *a proxy for a safe investment strategy.*

The financing decisions are measured in the following way.

$$\left(\frac{\Delta \text{Equity}}{\Delta \text{A}}\right) =$$ The ratio of the change in Total Equity Capital to the change in Total Assets. *This is a proxy for the change in Tier 1 Capital relative to the change in bank assets.*

$$\left(\frac{\Delta(\text{Tier}1 + \text{Tier}2)}{\Delta \text{A}}\right) =$$ The ratio of the change in the sum of Total Equity Capital, the Allowance for Losses in Loans and Leases, and Subordinated Notes to the Change in Total Assets. *The latter two items are a proxy for Tier 2 capital.*

Bank share valuations play a key role in the model presented in Section II. They are an

advanced signal for a change in the portfolios of banks. The share valuation measures used in

this study are based on the Standard & Poor index of 26 major regional banks.[7] Specific bank

share price variables used in the regressions presented below are as follows.

$\Delta \text{SP}_{t-1} =$ The Change in lagged real (i.e., nominal share prices deflated by the consumer price index) share prices of banks.

$$\Delta\left[\frac{\text{SP}_{t-1}}{(\text{Div} + \text{RE})_t}\right] =$$ The change in the ratio of lagged real bank share prices to the sum of cash dividends declared and retained earnings. Retained earnings is the difference between net income and total cash dividends declared. This variable is one measure of a price-earnings ratio.

$\text{SP}_{t-1}^{\text{Cyc}} =$ The deviation in lagged real bank share prices from their computed Hodrick-Prescott trend.

B.   Results

The presentation of the empirical results begins in Figure 4 with a time series plot of the risky loan variable, (ΔLoans/ΔA) and relatively safe investments in cash and securities, Δ(cash + securities)/ΔA. As can be seen there are three large spikes for these two portfolio allocation variables over the sample time period. One spike occurs in 1959 when loans grew more than twice as much as the total assets of U.S. banks. In this year the variable (ΔLoans/ΔA) took on its highest value (more than three standard deviations above the mean) over the sample time period. According to the Federal Reserve this sharp increase in bank loans was the result of an attempt by nonfinancial enterprises (particularly metal fabricating companies) to build up their inventories of steel in anticipation of a well-publicized steel strike scheduled for mid-1959.[8] Much of this speculative inventory accumulation was financed with bank loans. The Federal Reserve also noted that there was a sharp increase in charge card and credit card debt by consumers in response to a heavy promotional campaign by the card companies in this relatively new financial service business.[9]

Insert Figure 4 here

The second and third large spikes occurred in 1991 and 1992. These are the only two years in the entire sample for which the change in bank loans is negative, namely, −$57 billion in 1991 and −$20.1 billion in 1992. What were the reasons for this sharp decline in bank loans for these two years? One important reason for the decline in bank loans was the implementation of government mandated risk-based capital requirements.[10] The FDIC Improvement Act of 1991 (which became fully effective at year end 1992) with its "prompt corrective action" linked the financing of a bank's portfolio to the risk classification of the various categories of assets within the portfolio. The more (or less) risky the asset category, the more (or less) bank equity capital

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was required by the FDIC Improvement Act to finance the portfolio. Loans were classified in the most risky category and therefore required the largest amount of equity finance. Cash and government securities were classified in the least risky category and required the least amount of equity finance. Thus a bank in 1991 and 1992 not in compliance with the new capital requirements could achieve compliance in one or both of two ways. One way is that it could raise more equity capital through earnings retention and/or by issuing new shares on the capital market. The second way would be for banks to reduce their investments in loans that carry a higher equity capital requirement, and increase their investments in cash and government securities that carry a relatively low equity capital requirement. Figures 4 and 5 indicate that U.S. banks adjusted to the new Basle/FDIC capital standards in the early 1990's in both ways. Figure 4 presents time series plots for both (ΔLoans/ΔA) and Δ(Cash + Securities)/ΔA. As can be seen in the figure there is a strong negative relationship between these two components of bank portfolios over the entire sample period. For the years 1991 and 1992 U.S. banks sharply reduced the loan component of their portfolios and correspondingly increased the cash and securities component. On balance this portfolio adjustment reduces the required equity finance mandated by the FDIC. But this was not the only adjustment U.S. banks made to meet the new equity capital standard. Figure 5 indicates that U.S. banks also sharply increased their equity finance in 1991 and 1992. To account for these external factors two dummy variables (one each for the years 1959, and 1991 and 1992) that take on the value of unity in the year(s) in which the event occurred and zero elsewhere will be used in the regression tests presented below.

Insert Figure 5 here

With this brief description of the relevant data over the sample time period of 1956-2000, we now move on to test some of the predictions of the model presented in Section II. That model implies that changes in bank share valuations are a cost of capital signal for bank managers to change their portfolio strategy so that it conforms to the risk in the environment and the risk aversion of their equity investors. Table 1 presents the results of the regression tests on asset adjustments by U.S. commercial banks over various sample time periods. Column (1) presents the three different lagged stock market variables used in the regressions. Column (2) presents the two different sample times periods for each of the stock market variables used in the regression tests. Column (3) presents the estimated coefficients on the three stock market variables over the two different sample times periods. Columns (4) and (5) present the Newey-West corrected t-scores and P-values. Column (6) presents the partial correlation coefficient between (ΔLoan/ΔA) and the three different stock market variables over the two different sample time periods. Finally, Column (7) presents the various dummy variables (all of which were statistically significant) used in each of the six regressions. The regressions are carried out over two different sample time periods: 1) 1956-2000, the entire sample period; and 2) 1956-90, the sample period before the enactment of the FDIC Improvement Act of 1991. The reason for carrying out the regressions over these two time periods is to see whether the capital requirements imposed by Basle/FDIC altered the relationship between the three stock market variables and the bank portfolio allocation variable (ΔLoans/ΔA). The model presented in Section II above predicts that in the absence of bank capital regulations the risky loan component of bank portfolios is positively related to the lagged stock market valuations of banks.

Insert Table 1 here

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As can be seen from Table 1 the regression evidence is consistent with this prediction from the model. To begin with, the estimated coefficients on the three lagged stock market variables in part A, B, and C are all positive and statistically significant for the two sample periods of 1956-2000 and 1956-90. In addition, it is generally the case that the estimated coefficients (and their associated t-scores) on the stock market variables are larger for the 1956-90 period compared to 1956-2000. The one exception occurs in part B where the stock market variable is the change in the price-earnings ratio for bank stocks, $\Delta[SP_{t-1}/(Div + RE)_t]$. In this case the estimated coefficient and the t-score/P-value are essentially the same between the two samples time periods. The regression evidence for both time periods is consistent with the view that positive (or negative) changes in bank share valuations signal an increase (or decrease) in the risky loan component of bank portfolios as bank managers adjust their portfolios to reflect changes in the risk perception and/or risk aversion of their shareholders.

At this point we present some robustness checks on the empirical test specification presented in Table 1. To begin with, the specification of the dependent variable in Table 1 takes the view that bank managers at the margin respond to stock market signals by changing the volume of loans they make relative to the change in their total assets. For this to be a valid measure of the portfolio choice variable it is necessary that ΔA not be negative or zero. In our sample time period ΔA was never negative or close to zero. Bank assets along with deposits and the monetary base grew throughout the sample time period as a result of Federal Reserve policy. Nevertheless, it might be useful to present some results for an alternative specification of the portfolio choice variable as a check on the results presented in Table 1. One possible choice here is the change in the ratio of loans to total assets, or, $\Delta(Loans/A)$. The results for this alternative specification of the dependent variable for the two sample time periods are presented in Table 2.

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The results in Table 2 indicate that all of the estimated coefficients on the three stock market variables are positive, and for the ΔSP and SP^{cyc} measures the estimated coefficients are statistically significant. Moreover with the exception of the $\Delta[SP_{t-1}/(Div+RE)_t]$ measure of the stock market variable, the estimated coefficients are larger for the sample time period that predates the FDIC Improvement Act. This was also the case in Table 1 when $(\Delta Loans/\Delta A)$ was the dependent variable. The results in Table 2 do not reject the portfolio allocation hypothesis presented in Section II.

So far our analysis of fluctuations in bank lending has emphasized the supply side. But what about demand? As Rajan (1994, p. 399) reminds us:

> "In a rational profit-maximizing world banks should maintain a credit policy of lending if and only if borrowers have positive net present value (NPV) projects. Therefore, a change in the level of bank credit should be a consequence only of a change in the credit quality of borrowers—the demand side."

To test for this possibility in the context of the model in Section II, we include the change in real industrial share prices (the S&P 380 stock index of industrial companies), ΔSP^{Ind}, in the regressions of Table 1. The estimated coefficient on this variable is predicted to be positive since in the model of Section II a change in industrial share prices signals a change in the demand for investment by industrial firms (ie., the loan customers of banks) along with the financing of those investments. The results are presented in Table 3. As can be seen in the table the estimated coefficients on $(\Delta SP)^{Ind}$ are not significantly different from zero (although in C2 this variable is significantly different from zero at the 8 percent level) indicating that this measure of loan demand from bank customers has little effect on the marginal change in the loan component of bank portfolios.

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Finally, we also carried out a non-nested hypothesis test proposed by Davidson and MacKinnon (1981) for an alternative specification of the loan regressions in Table 1. In this connection suppose alternatively that (Δ Loans/ΔA) depends positively on the difference between the rate of interest on prime bank loans and the Treasury bill rate, (PR-TBR), that in turn reflects changes in the demand for loans by nonfinancial firms. Thus higher (or lower) yield differentials on loans induce banks to make more (or fewer) loans relative to total assets. The two specifications then take the following form.

H1: $(\Delta \text{ Loans}/\Delta A)_t 1 = k_0 + k_1(\Delta SP)_{t-1} + k_2(DV)^{59} + k_3(DV)^{91, 92} + e_1$

and

H2: $(\Delta \text{ Loans}/\Delta A)_t 2 = f_0 + f_1(PR-TBR)_{t-1} + f_2(DV)^{59} + f_3(DV)^{91, 92} + e_2$

To carry out the Davidson-MacKinnon J-test, we take the fitted values from regression H2 and include them as a regressor in regression H1. If the estimated coefficient on the fitted values variable from H2 is statistically significant, we reject the specification in H1. This procedure is then repeated for H2; namely, take the fitted values from regression H1 and include them as a regressor in regression H2. If the estimated coefficient on this fitted variable is statistically significant, reject the specification in H2. The results for the two sample time periods 1956-2000 and 1956-90 are reported in Table 4. As can be seen in the table the estimated coefficient on (ΔLoans/ΔA)2 for both sample time periods of 1956-2000 and 1956-1990 is not significantly different from zero, while the estimated coefficient on (ΔLoans/ΔA)1 is not significantly different from one. Consequently, we reject the specification in H2 and fail to reject the specification in H1.

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So far in this section we have empirically examined the link between stock market
fluctuations and the portfolio adjustments of U.S. banks, a link predicted by the model in Section
II. A second prediction of this recursive model is that rational contracting (or regulation)
between shareholders and depositors (or the deposit insuring agency) requires banks to adjust
their financing to any change in the risk of their portfolios induced by changes in bank share
valuations. Thus when banks increase (or decrease) the risk of their portfolios—in response to
rising (or falling) share prices—by investing more heavily in risky loans (or by investing more
heavily in cash and securities), a rational contract requires them to increase (or decrease) their
reliance on equity finance. This is what the Basle Accord attempts to achieve through the
regulation of bank capital. However, would private arrangements between shareholders and
depositors more or less achieve the same result? Table 5 will provide some evidence on this
question.

Towards this end Table 5 presents some regression evidence on how financing decisions
adjust at the margin to the portfolio decisions of U.S. banks. Column (1) presents two popular
measures of adjustment to bank capital. The first is the marginal change in total equity capital
relative to the change in total assets of the U.S. banking system, (ΔEquity/ΔA). Total equity
includes both common equity and perpetual preferred stock, and is a fairly close proxy for what
the Basle Accord defines as Tier 1 capital. The second measure of bank capital adds the loan
loss reserve and subordinated notes of U.S. banks to total equity capital. In the U.S. the sum of
the loan loss reserve and subordinated notes is a close proxy for what the Basle Accord defines

as Tier 2 capital. The second measure of financial adjustment is defined to be the sum of the

change in Tier 1 and Tier 2 capital relative to the change in total assets, Δ(Tier 1 + Tier 2)/ΔA.

Column (2) presents three time period samples. The first two are the same that were used in

Table 1, namely: 1) 1956-2000 and 2) 1956-90. Note that there are two regressions for the two

sample periods of 1956-2000 and 1956-90. The difference in these two regressions for both

sample periods is that the second (i.e., 1b and 2b) includes a dummy variable for the year 1987.

The reason for this is that the loan loss reserve for that year had its largest year to year increase

($21 billion which is more than 5 standard deviations above the mean) in the sample period as

U.S. banks were coming under market and regulatory pressure to recognize the losses on risky

loans made in the earlier years of the 1980's. The third sample time period is 1956-79. This is

the time period in which neither the Basle/FDIC regulations nor its predecessor the so-called

CAMEL rating system were in existence. This was the period of time in our sample in which

there was the least regulation on the adequacy of bank capital. Column (3) presents the

estimated regression coefficient on the risky loan variable, (ΔLoans/ΔA). Column (4) and (5)

present the Newey-West computed t-scores and P-values on the estimated regression coefficients

in Column (3). Column (6) presents the partial correlation (and in some cases the simple

correlation) coefficient between the marginal change in the two measures of bank capital and the

marginal change in risky loans. Finally, Column (7) present the various dummy variables used

in the individual regressions over the various sample time periods.

  The regression/correlation evidence in Column (3)-(6) of Table 5 is broadly consistent

with the financing prediction of the model in Section II. For the sample periods of 1956-2000,

1956-90, and 1956-79 (i.e., regressions 1a, 1b, 2a, 2b, and 3) there is a statistically significant

relationship between the marginal change in the two measures of bank capital in Parts A and B,

and the marginal change in the risky loan component of U.S. bank portfolios (ΔLoans/ΔA).

When banks increase the risky loan component of their portfolios, they match that portfolio

adjustment with a financial adjustment that increases their Tier 1 and Tier 2 capital. Moreover

regressions 2a and 2b in Parts A and B indicate that they have matched financing adjustments to

portfolio adjustments before the Basle/FDIC regulation on capital adequacy. Finally, regression

3 reinforces this matching result for the period 1956-79 which in turn is prior to both the

Basle/FDIC capital requirements and the CAMEL rating system. This is the time period of least

government regulation for bank capital, and yet we see that banks adjusted their capital to

changes in their investment portfolio in much the same way as they did in the 1956-2000 and

1956-90 periods. This is indicated by the fact that the estimated coefficients on (ΔLoans/ΔA) are

not too different between the three sample time periods of 1956-2000, 1956-90, and 1956-79 for

which there were varying degrees of government regulation on the adequacy of bank capital. It

should finally be noted that the estimated coefficients on (Δ Loans/Δ A) in Table 5 indicates that

the tier 1 and (tier 1 + tier 2) financing adjustments over the various sample periods are all in line

with the Basle/FDIC Improvement Act capital requirements. A dollar increase in total assets that

is fully invested in loans is matched with a 5-6 percent increase in tier 1 capital and an 8-9

percent increase in (tier 1 + tier 2) capital.

At this point it will again be useful to supplement the results in Table 5 with some

robustness checks. According to the theory in Section II, the balance sheet adjustment

regressions for banks in Tables 1 and 5 represent a recursive system in that the portfolio

adjustment – i.e., (Δ Loans/Δ A) – depends on lagged bank share valuations, and the financing

adjustment – (Δ Equity/Δ A) and Δ(Tier 1 + Tier 2)/Δ A – then depends on the portfolio

adjustment. Under these conditions the OLS estimates of k1 in Table 5 are both consistent and

efficient. In analyzing this question further we carried out a Houseman test for simultaneity

between: i) the loan variable (Δ Loans/ΔA) on the one hand, and ii) the two measures of bank

capital, (Δ Equity/ΔA) and Δ(Tier 1 + Tier 2)/ΔA. On the basis of this test (not reported here) we

could not reject the null hypothesis of no simultaneity between the loan variable and the two

measures of bank capital. An alternative estimation technique would be 2SLS. While 2SLS

estimates of k1 will be consistent, they will not necessarily be efficient. To implement 2SLS our

instrument list will include the monetary base as a measure of Federal Reserve policy and the

predetermined variables in the loan adjustment regressions in Table 1; namely, the lagged change

in bank share prices (ΔSP_{t-1}), the 1959 steel strike (DV^{59}), and the FDIC Improvement Act

($DV^{91, 92}$). The 2SLS parameter estimates for the financial adjustments of banks are presented in

Table 6.

Insert Table 6 here

The results in the table indicate that the 2SLS estimates of the coefficients on (ΔLoans/ΔA) are

fairly close to the OLS estimates reported in Table 5. They are marginally higher for the

(ΔEquity/ΔA) measure of bank capital, and marginally lower on [Δ(Tier1 + Tier2)/ΔA]. Finally,

Table 6 indicates that on average U.S. banks adjusted their capital in response to their portfolio

reallocations over the various time period samples in the way prescribed by the Basle Accord

and the FDIC Improvement Act.[11]

IV.   SUMMARY AND CONCLUSIONS

This paper proposes and tests an equilibrium model describing both the portfolio

adjustments and financing adjustments of U.S. banks. These portfolio adjustments facilitate and

amplify business cycles. The adjustments are triggered by an external shock that in the end

changes the required yield, R(e,RR), of investors in bank equity shares.   This can occur directly

if the shock changes the risk of the underlying economic environment or the risk aversion of

investors.   It can also occur indirectly when the shock is to future cash flows.   In this case

changes in future cash flows when discounted back to the present changes current wealth and via

Arrow-Pratt changes the risk aversion and required yield of investors.   When required yields

change, stock prices change. In this model changes in stock prices are a cost of capital signal for

managers to change the portfolio strategy of their banks. Thus when stock prices are rising, bank

mangers in this model shift the composition of their portfolios towards risky investments like

loans. On the other hand when stock prices fall, there is a flight to safety as managers increase

their investments in relatively safe assets like cash and securities. Of course, any portfolio

adjustment will have differential effects on depositors (and/or the deposit insuring agency) and

shareholders. A risky investment strategy, other things remaining equal, increases the

probability of bank failure with potential losses for depositors and the deposit insurance fund.

For this reason, rational depositors and the deposit-insuring agency will require that banks do

something to offset any change in portfolio risk. That something in this model and the Basle

Accord is some form of a required adjustment in the bank's financial strategy. More

specifically, when banks increase portfolio risk by investing more heavily in increasingly risky

loans that finances a speculative business cycle expansion, they match that portfolio strategy

with a financial strategy that infuses more equity capital into banks. Conversely when banks

reduce portfolio risk by reducing their investments in risky loans—thereby tightening the budget

constraint of nonfinancial companies and causing a recession—and increasing their investments

in relatively safe cash and government securities, the offsetting financial strategy is to rely more

heavily on deposit finance. In this way financial adjustments are linked to portfolio adjustments

and the business cycle.

Section III presented the results of a number of regression/correlation tests for the two main predictions of the model. The first prediction concerned the link between changes in bank share prices and the risk of bank portfolios. This prediction was tested in Tables 1-4 using three different measures of lagged bank share valuations and conducting the tests over two different sample time periods to account for possible regime shifts. The results of the regression tests in these tables did not reject this prediction of the model. Increases (or decreases) in bank share valuations are followed by marginal increases (or decreases) in the risky loan component of bank portfolios. Bank managers act as if they change bank portfolios in response to changes in investor perceptions of risk and/or risk aversion as reflected in movements in share prices. The second prediction concerned the financing of bank portfolios. This prediction was tested in Tables 5 and 6 using two measures of bank capital and three different sample time periods. The results of the regression tests in Tables 5 and 6 did not reject the prediction of the theory that banks rely more (or less) heavily on equity finance when they take on more (or less) portfolio risk. Furthermore banks adjusted the financing of their portfolios in this way long before the Basle/FDIC capital requirements and the CAMEL rating system were part of the regulatory architecture.

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Endnotes

1. Other research reaching similar conclusions comes from the second strand of research in this area dealing with the financing choices of banks. In this literature Basle type capital requirements for banks are partly responsible for credit crunches and their negative affects on the real economy. In this connections see: Berger and Udell (1994), Hancock and Wilcox (1994), Peek and Rosengren (1995), Shrieves and Dahl (1995), Wagster (1999), and Furfine (2001) among others..

2. See also Bannerjee (1992) and Welch (1992) for a further discussion on herding in financial markets. Gorton and He (2005) develop and empirically test an imperfect competition model where banks herd on their investments in information production. In their model credit crunches arise when banks raise their investments in information production and their credit standards for lending. The bank's decision to invest more or less in information production depends on its' performance relative to other banks.

3. Stiglitz (1972, p. 39) used the technology assumption in an analysis of the optimality of investment allocation in a mean-variance economy, but provided no theoretical or empirical justification. Why should risk increase with real investment? One argument is that an expansion in real investment today creates increased supply and competition for sales tomorrow. How individual firms will fare in that increased competition is one source of risk. Moreover if the expansion in real investment is heterogeneous in magnitude across firms and industries, the differential effect on supply in the different sectors of the economy will increase the variability of relative prices which further increases the operating risk of firms. This is because it is more difficult for firms to formulate their production-investment plans when the selling price for their product and the cost price for their inputs are changing at

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different rates. Evidence supporting the procyclical variability of relative prices is presented in Anderson (1994) (2001), Balke and Wynne (2002), Ball and Mankiw (1995), and Parsley (1996) among many others.

Empirical evidence on the cyclical pattern of risk is provided by Brandt and Kang (2003). They use a latent VAR approach to analyze the intertemporal pattern of the variability of stock returns. They find that when the economy is in the trough of a recession (i.e., when real investment is low) the volatility of stock returns is falling. When the economy moves towards a cyclical peak of an expansion (i.e., when real investment is high), the volatility of stock returns is rising. If stock returns reflect the real returns on corporate capital, then this evidence is consistent with the procyclical movement in operating risk assumed in equation (9).

4.   For evidence on the "flight to safety" see Kashyap, Stein, and Wilcox (1993), Gertler and Gilchrist (1993), Berger and Udell (1990), Corcoran (1992), and Peek, Rosengren, and Tootell (2000).

5.   For an analysis of the effect of changes in business risk on the price of risky corporate debt in the option pricing model see Merton (1974) and the numerical example in Krainer (1992, pp. 82-86). Merton (1977) used the put option feature in the option pricing model to show that a fixed risk insensitive premium for deposit insurance induces banks to make excessively risky portfolio and financing decisions.

6.   The Website is: http://www2.fdic.gov/hsob/hsobRpt.asp

7.   See Standard & Poor's Statistical Service, Security Price Index Record 2000 Edition, p. 285.

8.   See the Federal Reserve Bulletin, February 1960, Vol. 46, Number 2, p. 121.

9. See the <u>Federal Reserve Bulletin</u>, April 1960, Vol. 46, Number 2, p. 360.

10. The literature on bank capital regulation is quite substantial and covers a number of topics including: i) the cross-county competition for banking services; ii) the role regulation plays in safeguarding the banking system; iii) any distortionary effects capital regulations might have on the risk-taking behavior of banks; iv) alternative forms regulation might take, and others. For a useful survey on the theoretical and empirical aspects of this literature see Santos (2000) and Jackson et. al. (1999). For the effects of bank capital regulations on the banking systems in specific countries see Aggarwal and Jacques (2001) for the U.S. and Editz, Michael, and Perraudin (1998) for the U.K.

11. We also carried out a Grainger causality test between (ΔLoans/ΔA) and the two measures of bank capital, (ΔEquity/ΔA) and Δ(Tier1 + Tier2)/ΔA. At a lag of one year and at a 5 percent significance level, we were unable to reject the hypothesis that both measures of bank capital do not Grainger cause (ΔLoan/ΔA). On the other hand, we were able to reject the hypothesis that (ΔLoans/ΔA) does not Grainger cause the two measures of bank capital. On the other hand, for lags of 2 through 7 years we were unable to reject the hypothesis that (ΔLoans/ΔA) causes (ΔEquity/ΔA) and Δ(Tier1 + Tier2)/ΔA and vise-versa.

Table 1

$$\left(\frac{\Delta \text{ Loans}}{\Delta A}\right)_t = k_0 + k_1(\text{StockMarketVariable})_{t-1} + \Sigma_i\ k_i\ (\text{DummyVariable})_t + U_t$$

OLS Estimates

	(1) Stock Market Variable	(2) Time Period	(3) Estimated Coefficient	(4) t-score[1]	(5) P-Value	(6) Partial[2] Correlation Coefficient	(7) Dummy Variables	
A.	ΔSP_{t-1}	1. 1956-2000 2. 1956-90	.3427 .4068	2.48 2.77	.017 .009	.3745[a] .4041[a]	DV[59] DV[59]	DV[91, 92]
B.	$\Delta\left[\dfrac{SP_{t-1}}{(\text{Div} + \text{RE})_t}\right]$	1. 1956-2000 2. 1956-90	.7520 .7325	2.13 2.12	.040 .042	.3098[b] .3607[b]	DV[59] DV[59]	DV[91, 92]
C.	$(SP)_{t-1}^{\text{Cyc}}$	1. 1956-2000 2. 1956-90	.4479 .7059	2.96 4.78	.004 .000	.3750[a] .5371[a]	DV[59] DV[59]	DV[91, 92]

1. The t-scores on the estimated coefficients are computed using the Newey-West heteroskedastic and autocorrelation correction for calculating standard errors.

2. The partial correlation coefficient between the stock market variable and $\left(\dfrac{\Delta \text{Loans}}{\Delta A}\right)$.

a. Indicates that the partial correlation coefficient is significantly different from zero at the 1 percent level.

b. Indicates that the partial correlation coefficient is significantly different from zero at the 2½ percent level.

DV[59] = Dummy variable taking on the value of one in 1959 and zero elsewhere.

DV[91, 92] = Dummy variable taking on the value of one in 1991 and 1992, and zero elsewhere.

Table 2

$$\Delta\left(\frac{\text{Loans}}{\text{A}}\right)_t = k_0 + k_1\,(\text{StockMarketVariable})_{t-1} + \Sigma_1\,k_1\,(\text{DummyVariable})_r + U_1$$

OLS Estimates

(1) Stock Market Variable	(2) Time Period		(3) Estimated Coefficient	(4) t-score[1]	(5) P-Value	(6) Partial[2] Correlation Coefficient	(7) Dummy Variables	
A. ΔSP_{t-1}	3. 4.	1956-2000 1956-90	.0183 .0306	2.58 3.67	.014 .001	.374[a] .545[a]	DV[59] DV[59]	DV[91, 92]
B. $\Delta\left[\dfrac{SP_{t-1}}{(\text{Div} + \text{RE})_t}\right]$	3. 4.	1956-2000 1956-90	.0338 .0350	1.73 1.69	.091 .100	.261[c] .287	DV[59] DV[59]	DV[91, 92]
C. $(SP)_{t-1}^{Cyc}$	3. 4.	1956-2000 1956-90	.0291 .0487	3.29 4.41	.002 .000	.457[a] .615[a]	DV[59] DV[59]	DV[91, 92]

1. The t-scores on the estimated coefficients are computed using the Newey-West heteroskedastic and autocorrelation correction for calculating standard errors.

2. The partial correlation coefficient between the stock market variable and $\left(\dfrac{\Delta\,\text{Loans}}{\Delta A}\right)$.

a. Indicates that the partial correlation coefficient is significantly different from zero at the 1 percent level.

b. Indicates that the partial correlation coefficient is significantly different from zero at the 2½ percent level.

c. Indicates that the partial correlation coefficient is significantly different from zero at the 5 percent level.

DV[59] = Dummy variable taking on the value of one in 1959 and zero elsewhere.

DV[91, 92] = Dummy variable taking on the value of one in 1991 and 1992, and zero elsewhere.

Table 3

$$\left(\frac{\Delta \text{Loans}}{\Delta A}\right)_t = k_0 + k_1 \, (\text{Bank Stock Market Variable})_{t-1} + k_2 \, (\text{Industrial Stock Market Variable})_{t-1} \ \Sigma_i \, k_i \ (\text{Dummy Variable})_r + U_t$$

OLS Estimates

(1) Stock Market Variable	(2) Time Period	(3) Estimated Coefficient k_1 (t=score/P-Value)	(4) Estimated Coefficient k_2 (t-score/P-Value)	(7) Dummy Variables	
A. ΔSP_{t-1} and ΔSP^{Ind}_{t-1}	1. 1956-2000	.3558 (2.47/.018)	-.0197 (-.25/.806)	DV[59]	DV[91, 92]
	2. 1956-90	.4181 (2.79/.009)	.1201 (.95/.348)	DV[59]	
B. $\Delta\left[\dfrac{SP_{t-1}}{(\text{Div} + \text{RE})_t}\right]$ and ΔSP^{Ind}_{t-1}	1. 1956-2000	.7336 (1.96/.058)	.0162 (.21/.84)	DV[59]	DV[91, 92]
	2. 1956-90	.7256 (2.05/.048)	.0102 (.08/.941)	DV[59]	
C. $(SP)^{Cyc}_{t-1}$ and ΔSP^{Ind}	1. 1956-2000	.4393 (2.50/.017)	.0298 (.40/.692)	DV[59]	DV[91, 92]
	2. 1956-90	.8029 (4.08/.000)	.2146 (1.82/.078)	DV[59]	

Table 4

J-Test Results

<table>
<tr><td colspan="2">1956-2000</td></tr>
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A1.
$$\left(\frac{\Delta \text{Loans}}{\Delta A}\right)_t = \underset{(.22)}{.2991} \underset{(2.53)}{+.3400(\Delta SP)_{t-1}} \underset{(.22)}{+.7399(DV)^{59}} \underset{(-.21)}{-.6889(DV)^{91,\,92}} \underset{(.23)}{+.4980} \left(\frac{\Delta \text{Loans}}{\Delta A}\right)_2$$

$$\overline{R}^2 = .729 \qquad DW = 2.03$$

$$\left(\frac{\Delta \text{Loans}}{\Delta A}\right)_t = \underset{(-.05)}{-.0129} \underset{(.23)}{+.8241(PR-TBR)_{t-1}} \underset{(-.04)}{-.0237(DV)^{59}} \underset{(-.03)}{-.0167(DV)^{91,\,92}} \underset{(2.53)}{+.9921} \left(\frac{\Delta \text{Loans}}{\Delta A}\right)_1$$

$$\overline{R}^2 = .729 \qquad DW = 2.03$$

<table>
<tr><td colspan="2">1956-90</td></tr>
</table>

A2.
$$\left(\frac{\Delta \text{Loans}}{\Delta A}\right)_t = \underset{(.53)}{2.8586} \underset{(2.70)}{+.4159(\Delta SP)_{t-1}} \underset{(.53)}{+7.0642(DV)^{59}} \underset{(-.42)}{-3.6653} \left(\frac{\Delta \text{Loans}}{\Delta A}\right)_2$$

$$\overline{R}^2 = .609 \qquad DW = 1.86$$

$$\left(\frac{\Delta \text{Loans}}{\Delta A}\right)_t = \underset{(-.19)}{-.0510} \underset{(.42)}{+1.6534(PR-TBR)_{t-1}} \underset{(-.18)}{-.1235(DV)^{59}} \underset{(2.70)}{+1.0314} \left(\frac{\Delta \text{Loans}}{\Delta A}\right)_1$$

$$\overline{R}^2 = .609 \qquad DW = 1.86$$

Table 4 (continued)

1956-2000

B1.

$$\left(\frac{\Delta \text{Loans}}{\Delta A}\right)_t = .9400 \quad +.7754\,\Delta\left[\frac{SP_{t-1}}{(\text{Div}+\text{RE})_t}\right] \quad + \quad 1.9762(DV)^{59} - \quad 2.1440(DV)^{91,\,92} \quad -.4736 \quad \left(\frac{\Delta \text{Loans}}{\Delta A}\right)2$$

$$\quad\quad (.63) \quad\quad (2.03) \quad\quad\quad\quad\quad\quad\quad\quad (.55) \quad\quad\quad (-.61) \quad\quad\quad (-.20)$$

$$\overline{R}^2 = .715 \quad\quad DW = 2.15$$

$$\left(\frac{\Delta \text{Loans}}{\Delta A}\right)_t = -.0024 \quad -.7837(\text{PR}-\text{TBR})_{t-1} \quad -.0131(DV)^{59} \quad +.0501(DV)^{91,\,92} \quad + \quad 1.0311 \quad \left(\frac{\Delta \text{Loans}}{\Delta A}\right)1$$

$$\quad\quad (-.01) \quad\quad (-.20) \quad\quad\quad\quad\quad (-.02) \quad\quad\quad (.95) \quad\quad\quad\quad (2.03)$$

$$\overline{R}^2 = .715 \quad\quad DW = 2.15$$

1956-90

B2.

$$\left(\frac{\Delta \text{Loans}}{\Delta A}\right)_t = -3.4873 \quad +.8028\,\Delta\left[\frac{SP_{t-1}}{(\text{Div}+\text{RE})_t}\right] \quad - \quad 9.0320(DV)^{59} + \quad 6.7503 \quad \left(\frac{\Delta \text{Loans}}{\Delta A}\right)2$$

$$\quad\quad (-.62) \quad\quad (2.29) \quad\quad\quad\quad\quad\quad\quad (-.64) \quad\quad\quad\quad (.73)$$

$$\overline{R}^2 = .587 \quad\quad DW = 1.80$$

$$\left(\frac{\Delta \text{Loans}}{\Delta A}\right)_t = -.0002 \quad - \quad 3.0450(\text{PR}-\text{TBR})_{t-1} \quad -.0070(DV)^{59} \quad + \quad 1.0961 \quad \left(\frac{\Delta \text{Loans}}{\Delta A}\right)1$$

$$\quad\quad (-.00) \quad (-.73) \quad\quad\quad\quad\quad\quad (-.01) \quad\quad\quad\quad (2.29)$$

$$\overline{R}^2 = .587 \quad\quad DW = 1.80$$

Table 4 (continued)

1956-2000

C1. $\left(\dfrac{\Delta \text{Loans}}{\Delta A}\right)_t = \underset{(.08)}{.1056} + \underset{(2.55)}{.4458(\text{SP})_{t\text{-}1}^{\text{Cyc}}} + \underset{(.12)}{.4077(\text{DV})^{59}} - \underset{(-.05)}{.1606(\text{DV})^{91,\,92}} + \underset{(.37)}{.8134} \left(\dfrac{\Delta \text{Loans}}{\Delta A}\right)_2$

$$\overline{R}^2 = .730 \qquad DW = 2.02$$

$\left(\dfrac{\Delta \text{Loans}}{\Delta A}\right)_t = \underset{(-.10)}{-.0262} + \underset{(.37)}{1.3459(\text{PR}-\text{TBR})_{t\text{-}1}} - \underset{(-.08)}{.0511(\text{DV})^{59}} - \underset{(-.03)}{.0155(\text{DV})^{91,\,92}} + \underset{(2.55)}{.9952} \left(\dfrac{\Delta \text{Loans}}{\Delta A}\right)_1$

$$\overline{R}^2 = .730 \qquad DW = 2.02$$

1956-90

C2. $\left(\dfrac{\Delta \text{Loans}}{\Delta A}\right)_t = \underset{(.21)}{1.0578} + \underset{(3.53)}{.7060(\text{SP})_{t\text{-}1}^{\text{Cyc}}} + \underset{(.23)}{2.8628(\text{DV})^{59}} - \underset{(-.09)}{.7507} \left(\dfrac{\Delta \text{Loans}}{\Delta A}\right)_2$

$$\overline{R}^2 = .656 \qquad DW = 1.85$$

$\left(\dfrac{\Delta \text{Loans}}{\Delta A}\right)_t = \underset{(-.04)}{-.0075} + \underset{(.09)}{.3386(\text{PR}-\text{TBR})_{t\text{-}1}} - \underset{(-.03)}{.0180(\text{DV})^{59}} + \underset{(3.53)}{1.0016} \left(\dfrac{\Delta \text{Loans}}{\Delta A}\right)_1$

$$\overline{R}^2 = .656 \qquad DW = 1.85$$

$\overline{R}^2$ = Adjusted coefficient of determination.

DW = Durbin-Watson statistic.

Table 5

$$(\text{Banking Capital})_t = k_o + k_1 \left(\frac{\Delta \text{Loans}}{\Delta A} \right)_t + \Sigma_i \, k_i \, (\text{Dummy Variable})_t + V_t$$

OLS Estimates

(1) Bank Capital		(2) Time Period	(3) Estimated Coefficient	(4) t-score[1]	(5) P-Value	(6) Partial[2] Correlation Coefficient	(7) Dummy Variables	
A. $\left(\dfrac{\Delta \text{Equity}}{\Delta A} \right)$	1a.	1956-2000	.0528	4.78	.000	.4059[a]		DV[91, 92]
	1b.	1956-2000	.0581	6.59	.000	.4776[a]	DV[87]	DV[91, 92]
	2a.	1956-90	.0505	3.71	.008	.4027[a]		
	2b.	1956-90	.0567	5.53	.000	.4899[a]	DV[87]	
	3	1956-79	.0603	5.86	.000	.5473[a]		
B. $\dfrac{\Delta(\text{Tier 1} + \text{Tier 2})}{\Delta A}$	1a.	1956-2000	.0928	5.07	.000	.4953[a]		DV[91, 92]
	1b.	1956-2000	.0829	5.78	.000	.5388[a]	DV[87]	DV[91, 92]
	2a.	1956-90	.0866	5.23	.000	.4663[a]		
	2b.	1956-90	.0799	6.85	.000	.5207[a]	DV[87]	
	3.	1956-79	.0799	6.61	.000	.6061[a]		

1. The t-scores on the estimated coefficients are computed using the Newey-West heteroskedastic and autocorrelation correction for calculating standard errors.

2. The partial correlation coefficient between the bank capital variable and $\left(\dfrac{\Delta \text{Loans}}{\Delta A} \right)$.

a. Significance level of .01.

DV[87] = Dummy variable; 1 in 1987, 0 elsewhere.

DV[91, 92] = Dummy variable; 1 in 1991 and 1992, 0 elsewhere.

Table 6

$$(\text{Banking Capital})_t \; = \; k_0 + k_1 \left(\frac{\Delta \text{Loans}}{\Delta A} \right)_t \; + \; \Sigma_i \, k_i \; (\text{DummyVariable})_t + V_t$$

2SLS Estimates

(1) Bank Capital	(2) Time Period		(3) Estimated Coefficient	(4) t-score[1]	(5) P-Value	(6) Partial[2] Correlation Coefficient	(7) Dummy Variables	
A. $\left(\dfrac{\Delta \text{Equity}}{\Delta A} \right)$	1a.	1956-2000	.0621	7.86	.000	.397[a]		DV[91, 92]
	1b.	1956-2000	.0614	7.44	.000	.477[a]	DV[87]	DV[91, 92]
	2a.	1956-90	.0570	5.81	.000	.396[a]		
	2b.	1956-90	.0590	6.86	.000	.489[a]	DV[87]	
	3	1956-79	.0577	6.87	.000	.547[a]		
B. $\dfrac{\Delta(\text{Tier 1} + \text{Tier 2})}{\Delta A}$	1a.	1956-2000	.0769	5.51	.000	.488[a]		DV[91, 92]
	1b.	1956-2000	.0779	6.42	.000	.538[a]	DV[87]	DV[91, 92]
	2a.	1956-90	.0789	4.87	.000	.461[a]		
	2b.	1956-90	.0744	7.68	.000	.521[a]	DV[87]	
	3.	1956-79	.0723	9.17	.000	.604[a]		

1. The t-scores on the estimated coefficients are computed using the Newey-West heteroskedastic and autocorrelation correction for calculating standard errors.

2. The partial correlation coefficient between the bank capital variable and $\left(\dfrac{\Delta \text{Loans}}{\Delta A} \right)$.
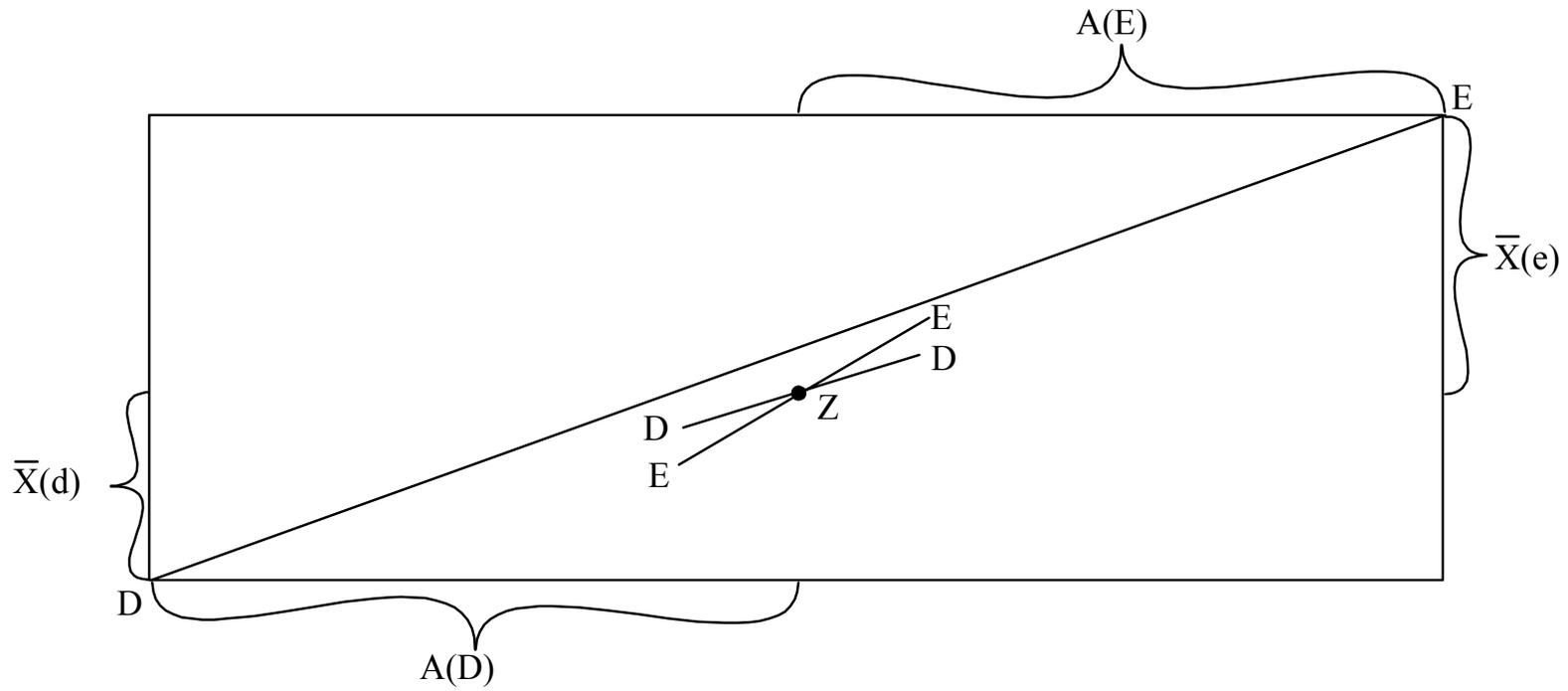
a. Significance level of .01.

DV[87] = Dummy variable; 1 in 1987, 0 elsewhere.

DV[91, 92] = Dummy variable; 1 in 1991 and 1992, 0 elsewhere.

Figure 1

Input and Expected Output Sharing in an Debt and Equity Economy

Figure 2

Financial Markets and Equilibrium

$\overline{X}(d)/\overline{X}(e)$

R(e) = constant

e

- +

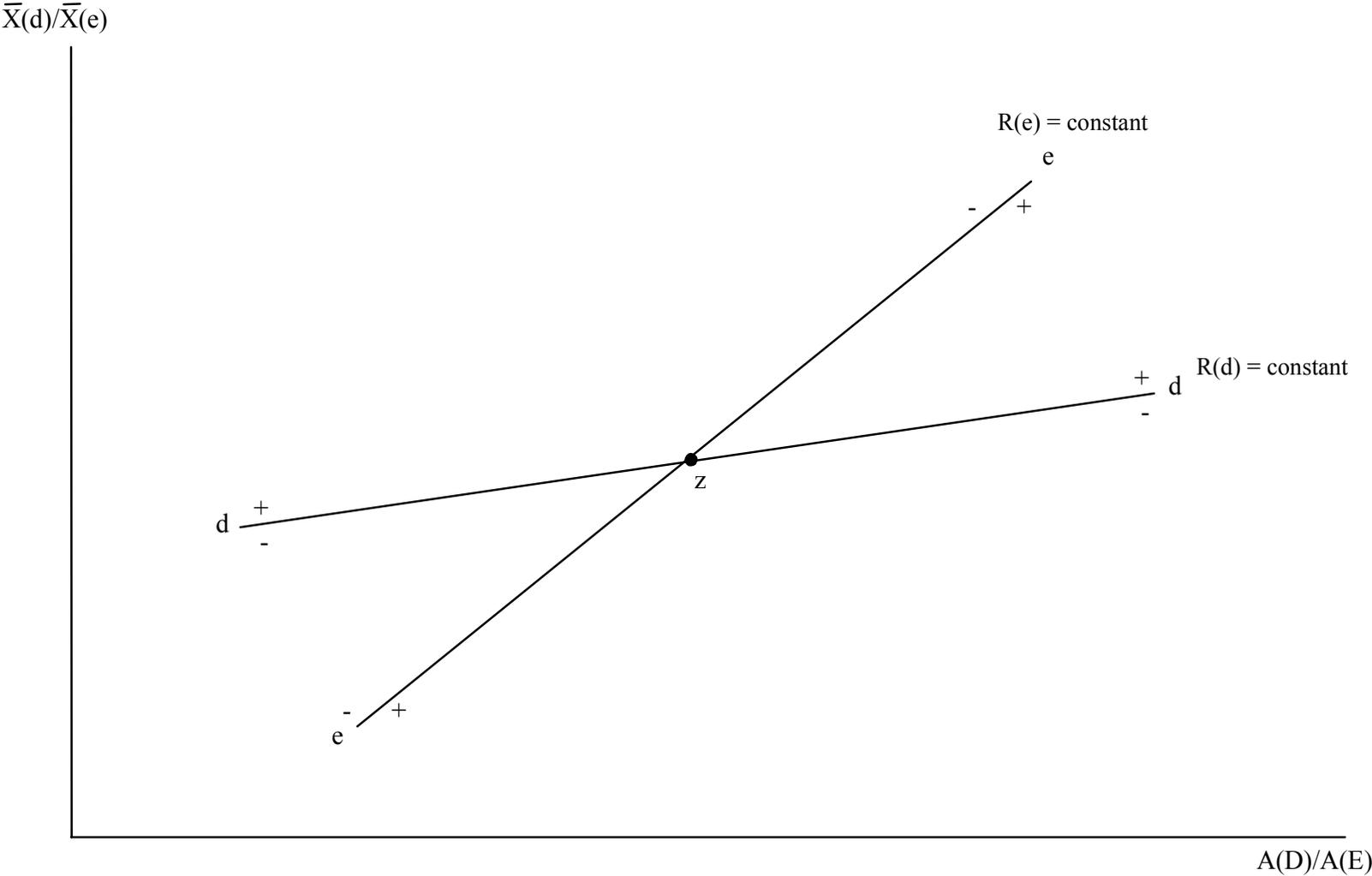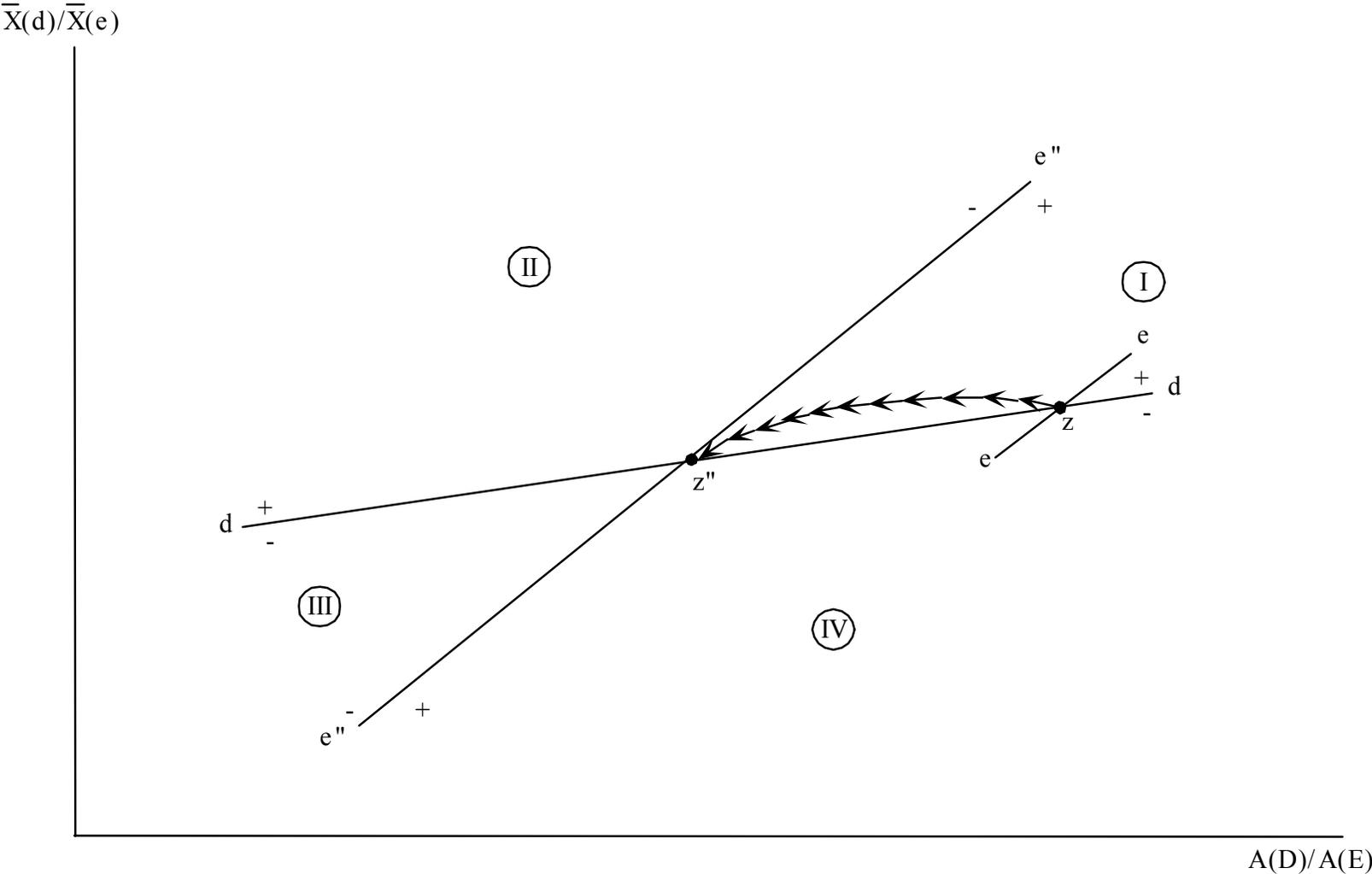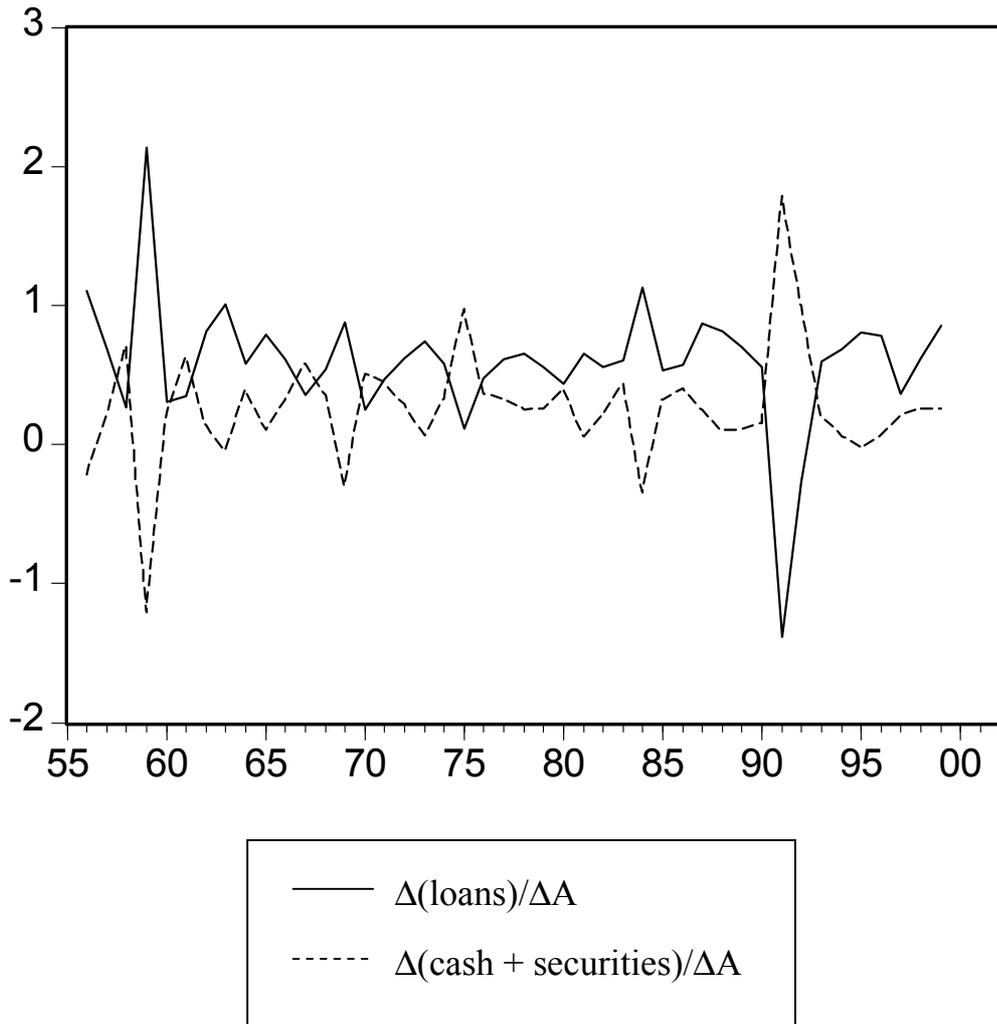+ d R(d) = constant
-

d +
-

z

- +
e

A(D)/A(E)

Figure 3

A Business Cycle Expansion in a Debt and Equity Financed Economy

Figure 4
Δ(Loans)/ΔA and Δ(cash + securities)/ΔA
1956-1999

Figure 5
Δ(Equity)/ΔA
1956-1999
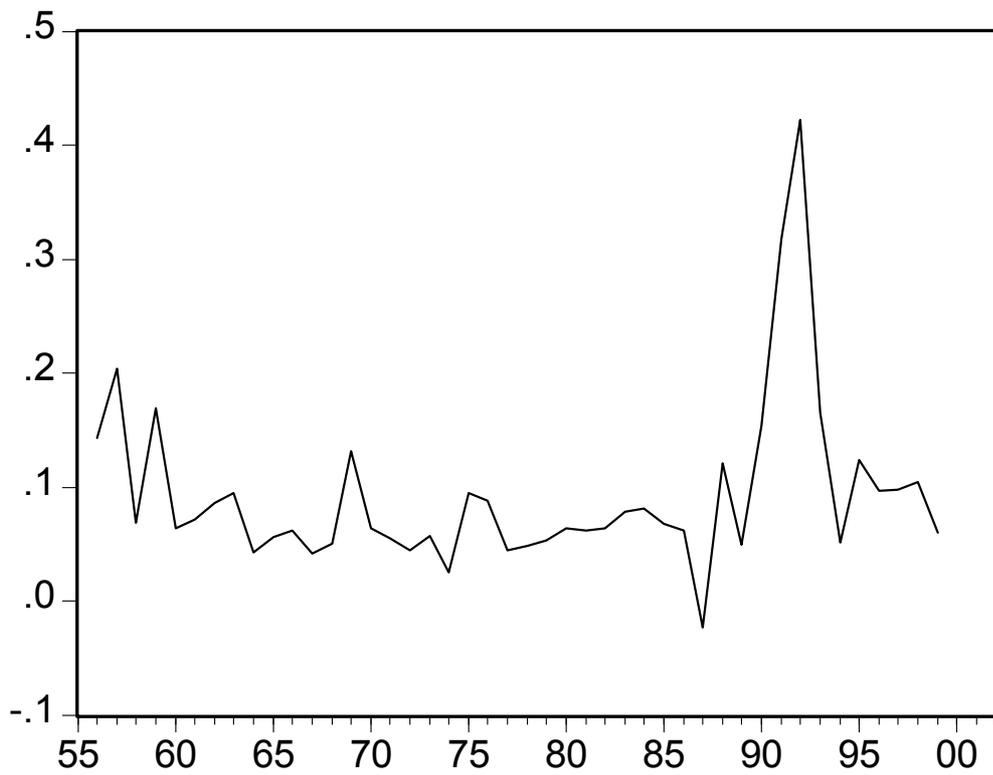
Δ(Equity)/ΔA

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