# NOTES D'ÉTUDES

# ET DE RECHERCHE

**PORTFOLIO AND FINANCING ADJUSTMENTS**

**FOR U.S. BANKS:**

**SOME EMPIRICAL EVIDENCE**

Robert Krainer

July 2008

**NER - R # 217**

## BANQUE DE FRANCE

### EUROSYSTÈME

# PORTFOLIO AND FINANCING ADJUSTMENTS

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# SOME EMPIRICAL EVIDENCE

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# Portfolio and Financing Adjustments for U.S. Banks:
## Some Empirical Evidence

Robert E. Krainer[1] [2]

**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.

KEY WORDS: Banks, Business Cycles, Basle Accord, Finance

JEL Classification: E3, G2, L2

RÉSUMÉ

Le papier propose un modèle de choix et de financement de portefeuille des banques américaines au cours du cycle d'activité. Au cœur du modèle réside un problème d'aléa moral entre déposants/régulateurs bancaires et actionnaires. La solution prend la forme d'une gestion partagée de la banque : les actionnaires s'occupent de la gestion du portefeuille et le régulateur de son financement. Le modèle prédit que les ajustements de portefeuille sont opérés en concordance avec l'aversion pour le risque des actionnaires et que les ajustements financiers neutralisent leur incidence sur le risque de portefeuille. L'analyse économétrique sur les années 1955-2000 ne permet pas de rejeter ces conclusions.

Mots-clés : Banque, cycle d'affaires, accords de Bâle, finance
Codes JEL : E3, G2, L2

**Non-technical summary**


This paper presents a theoretical and empirical analysis of the portfolio adjustments and financing adjustments of U.S. banks over the business cycle. The model describes a representative bank whose portfolio is financed with deposits and equity claims. At the core of the model is a moral hazard problem between relatively more risk averse depositors and relatively less risk averse equity investors. The solution to this moral hazard problem takes the form of shared management of the representative bank between depositors (or the deposit insuring regulator) and equity investors. This shared management has the bank making portfolio adjustment decisions to conform to the risk aversion and/or risk perceptions of their equity shareholders. To keep the investment quality of deposits intact, financing decisions are then made so as to offset any changes in portfolio risk caused by the portfolio adjustment decision. In this model portfolio adjustments are initiated by an outside shock that changes the risk aversion and/or perception of risk of equity investors and therefore their required rate of return. Changes in the required yield of equity investors change the market valuation of their equity shares. Bank managers observe the signal of a change in equity share valuations and respond by changing the composition of the bank's portfolio. When there is a positive shock that lowers the required yield of shareholders and raises the market valuations of bank stock, bank managers respond by shifting the bank's portfolio towards risky loans and away from relatively safe securities. This portfolio decision can initiate and/or prolongs economic expansions. To protect depositors (or the deposit insurance fund) the bank then matches that portfolio decision with a financing decision that relies more heavily on equity finance. The end result is that more portfolio risk is matched with less financial risk. A negative outside shock, that causes shareholders to charge a higher price for bearing risk that in turn drives down equity share prices, will then have the opposite effect on portfolio adjustment and financing adjustment. This shock-induced re-pricing of risk causes banks to shift their portfolio away from risky loans and into safe securities. With a less risky portfolio banks then shift their financing mix more towards deposits. The "flight to quality" portfolio decision can sometime initiate and/or prolong economic recessions. For nonfinancial enterprises this matching of financial adjustments to asset adjustments is implemented with protective covenants in bond contracts. For financial enterprises like banks this matching is achieved by regulating minimum capital requirements such as those contained in various versions of the Basle Accord.

The model predicts that: i) the risky loan component of a bank's portfolio is positively related to lagged changes in bank stock prices; and ii) changes in the equity leverage ratio varies directly with the bank's loan to asset ratio. The first prediction is tested in Tables 2-5 using three different measures of lagged real bank share valuations over two different time periods to account for regime shifts. The results of the regression tests in these tables failed to reject this prediction of the model that lagged changes in real bank share prices precede changes in private loans relative to total assets. In addition non-nested hypothesis tests were carried out in Table 5 against an alternative specification of bank lending based on interest rate differentials between rates on loans and rates on short-term Treasury securities. In these tests we were able to reject the alternative hypothesis of bank lending based on interest rate differentials, but unable to reject the specification based on lagged bank stock valuations. Our results here are consistent with the hypothesis that volatility in bank share valuations induces volatility in bank lending that in turn

can have an amplifying effect on business cycles. The second prediction concerns the financing of bank portfolios. This prediction was tested in Tables 6 and 7 and endnote 11 using two measures of bank capital (tier 1 and tier 2) and over three different time periods. The OLS and 2SLS regression tests in these two tables and endnote did not reject the prediction that U.S. banks rely more (or less) heavily on equity finance when they take on more portfolio risk in the form of private loans. Our regression coefficients estimated over the 1956-2000 sample time period indicate that a one dollar increase in private loans is associated with a $.05-$.06 increase in tier 1 capital and an $.08-$.09 increase in (tier 1 + tier 2) capital, both of which are in line with the Basle I/FDIC Improvement Act capital requirement at that time. Furthermore Granger causality tests for a lag of one year do not reject the hypothesis that changes in portfolio composition Granger causes changes in the equity leverage ratio, but we can reject the hypothesis that changes in the equity leverage ratio Granger causes changes in the portfolio composition of the U.S. banks.

In what way does this research further our understanding of the banking system and the link between the banking system and the real economy? In this model managers respond to stock price signals. Instability in the market for speculative assets like stocks caused by investors re-pricing risk induces instability in real aggregates such as employment, investment, and output. Part of the financing that supports employment, investment, and output is provided by banks. Our results suggest further studies as to whether Central banks might want to consider innovative ways of stabilizing the prices of speculative assets. Prior to the summer of 2007 this was rather low on the agenda of most Central banks. However the sub-prime crisis that now in 2007/2008 engulfs many developed countries' financial systems may move it further up the policy agenda. This will be the subject matter of our future research.

**Résumé non-technique**

Le présent article rend compte d'une analyse théorique et empirique des choix de portefeuille et de la gestion actif-passif des banques américaines au cours du cycle d'activité. Le modèle décrit une banque représentative dont le portefeuille est financé par des dépôts et des fonds propres. Au cœur du modèle se trouve un problème d'aléa moral entre des déposants dont l'aversion au risque est relativement forte et des actionnaires dont l'aversion au risque est moindre. La solution à ce problème d'aléa moral prend la forme d'une gestion partagée de la banque entre les déposants (ou l'autorité en charge de l'assurance des dépôts) et les actionnaires. Cette gestion partagée contraint la banque à adopter des choix de portefeuille reflétant l'aversion au risque et/ou la perception du risque des actionnaires. Pour préserver la qualité des dépôts, les décisions de financement sont alors prises de façon à compenser toute modification du risque de portefeuille induite par les choix de portefeuille. Dans ce modèle, ces choix résultent d'un choc extérieur qui modifie l'aversion au risque et/ou la perception du risque des actionnaires et, partant, le taux de rendement qu'ils exigent, ce qui entraîne une modification de la valeur de marché de leurs portefeuilles d'actions. Les dirigeants de la banque, qui observent avec attention les signaux d'une modification de la valeur de la banque, réagissent alors en modifiant la structure du portefeuille de la banque. Lorsque se produit un choc positif qui abaisse le rendement exigé par les actionnaires et augmente la valeur de marché de la banque, les dirigeants réorientent la structure du portefeuille de la banque en faveur de prêts risqués et au détriment de titres sûrs. Cette décision peut déclencher et/ou prolonger des phases d'expansion économique. Pour protéger les déposants (ou le fonds d'assurance des dépôts), la banque décide dans le cadre de sa gestion actif-passif de faire davantage appel aux fonds propres. Au final, un risque de portefeuille plus important a pour corollaire un risque financier moindre. Un choc extérieur négatif, qui pousse les actionnaires à exiger un prix élevé pour supporter un risque susceptible de faire baisser les cours, aura un effet inverse sur les choix de portefeuille et l'ajustement du passif. Cette réévaluation du risque conduit les banques à effectuer des choix de portefeuille qui se détournent des prêts risqués et privilégient les titres sûrs. Détenant à l'actif un portefeuille moins risqué, les banques modifient également leur passif, en favorisant davantage les dépôts. Cette décision de « report sur les valeurs sûres » peut parfois déclencher et/ou prolonger des phases de récession économique. Pour les sociétés non financières, cet alignement des choix de passif sur les décisions d'actifs est mis en œuvre en attachant des clauses protectrices aux contrats obligataires. Pour des entreprises financières comme les banques, ce lien est assuré par la réglementation des exigences minimales de fonds propres telles que celles contenues dans les différentes versions de l'Accord de Bâle.

Le modèle prédit que : (1) la composante des prêts à risque d'un portefeuille bancaire est positivement corrélée aux variations retardées du cours boursier de la banque ; et (2) le ratio de fonds propres sur endettement évolue en phase avec le ratio prêts sur actif total de la banque. La première prédiction est testée dans les tableaux 2 à 5 en utilisant trois mesures différentes des valorisations retardées des actions bancaires sur deux horizons temporels différents pour tenir compte des changements de régime. Les résultats des tests de régression de ces tableaux n'ont pas permis de rejeter la prédiction du modèle selon laquelle des variations retardées des cours effectifs des actions de la banque précèdent les variations des prêts au secteur privé rapportés à l'actif total. En outre, des tests d'hypothèses non imbriquées ont été effectués dans le tableau 5

par rapport à une spécification alternative des prêts bancaires reposant sur les écarts de taux d'intérêt entre les taux appliqués aux prêts et ceux des bons du Trésor à court terme. Dans ces tests, nous avons pu rejeter l'hypothèse alternative des prêts bancaires reposant sur les écarts de taux d'intérêt, mais pas l'hypothèse reposant sur les valorisations retardées des actions bancaires. Ici, nos résultats sont conformes à l'hypothèse selon laquelle la volatilité de la valorisation des actions bancaires entraîne la volatilité des prêts bancaires, laquelle peut exercer un effet d'amplification des cycles d'activité. La seconde prédiction concerne le financement des portefeuilles bancaires. Cette prédiction a été testée dans les tableaux 6 et 7 et la note de fin n°11 en utilisant deux mesures des fonds propres des banques (le niveau 1 et le niveau 2) et trois horizons temporels différents. Les tests de régression OLS et 2SLS de ces deux tableaux et de cette note de fin n'ont pas rejeté l'estimation selon laquelle les banques américaines recourent plus (ou moins) fortement au financement en fonds propres lorsqu'ils accroissent leur risque de portefeuille sous la forme de prêts au secteur privé. Nos coefficients de régression estimés sur la période d'échantillonnage (1956-2000) indiquent qu'une hausse de un dollar des prêts au secteur privé entraîne une augmentation de 0,5 à 0,6 dollar des fonds propres de niveau 1 et de 0,8 à 0,9 dollar de la somme des fond propres de niveau 1 et de niveau 2, conforme alors, dans les deux cas, aux exigences en fonds propres de Bâle I et du *FDIC Improvement Act*. De plus, les tests de causalité de Granger sur un retard d'un an ne démentent pas l'hypothèse selon laquelle les modifications de la composition du portefeuille entraînent, au sens de Granger, des modifications du ratio de fonds propres sur endettement, mais nous pouvons rejeter l'hypothèse selon laquelle les modifications du ratio de fonds propres sur endettement entraînent, au sens de Granger, des modifications de la composition du portefeuille des banques américaines.

Dans quelle mesure ces recherches font-elles avancer notre compréhension du système bancaire et du lien entre ce système et l'économie réelle ? Dans ce modèle, les responsables répondent aux signaux émis par les cours des actions. L'instabilité du marché d'actifs spéculatifs comme les actions qui résulte de la réappréciation du risque par les investisseurs entraîne une instabilité des variables réelles telles que l'emploi, l'investissement et la production. Le financement qui soutient l'emploi, l'investissement et la production est fourni en partie par les banques. Au vu de nos résultats, de nouvelles études doivent être menées pour déterminer si les banques centrales pourraient envisager des méthodes innovantes de stabilisation des prix des actifs spéculatifs. Avant l'été 2007, la plupart des banques centrales accordaient une assez faible priorité à ces travaux. Toutefois, la crise des *subprime* qui affecte aujourd'hui la plupart des systèmes financiers des pays développés pourrait les mettre à l'ordre du jour. Ce sera la matière de nos travaux de recherche à venir.

# 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)[1].  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 and flexible 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), Panageas (2003), Gilchrist, Himmelberg, and Huberman (2005), Chirinko and Schaller (2007), 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 theoretical and some empirical  research indicating that bank lending is procyclical and amplifies 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.

What are these other factors that cause banks to both under fund and over fund real corporate investments thereby prolonging and amplifying the business cycle?  These other factors can be subdivided into regulatory and non-regulatory factors.  In this connection there is a large literature that attributes the procyclicality  of bank lending to Basle type regulations on bank capital.  The argument is that during recessions loan losses increase resulting in direct charges on bank equity capital.  Since bank investments in risky loans are by regulation tied to capital adequacy, the volume of bank lending will decrease during recessions.  The opposite occurs in cyclical expansions.  A sample of this large literature on the regulatory induced procyclicality of bank lending and it's relevance for the real economy includes Bernanke and Lown (1991), Lang and Nakamura (1995), Berger and Udell (1994), Hancock and Wilcox (1994), Peek and Rosengren (1995), Shrives and Dahl (1995), Stanton (1998), Wagster (1999), Borio, Furfine, and Lowe (2001), Estrella (2004), Pennacchi (2005), and Catarineu-Rabell, Jackson, and Tsomocos (2005) among many others.  A parallel literature that incorporates capital adequacy requirements in the theory of stabilization policy includes Blum and Hellwig (1995), Chami and Cosimano (2001), and Cecchetti and Li (2005).  One conclusion that emerges from this literature is that capital adequacy requirements and stabilization policy often work at cross purposes thereby making the goal of economic stabilization more difficult to achieve.

While we have learned much from this literature on bank capital regulation, this paper will focus on the non-regulatory factors that cause banks to over fund and under fund real corporate investment.  In this strand of research Bernanke and Gertler (1989), Bernanke, Gertler,

and Gilchrist (1996), and Kiyotaki and Moore (1997) develop non-regulatory 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. Outside lenders like banks therefore 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 its 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. Rajan (1994), on the other hand, developed a non-regulatory 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 non-regulatory arguments laid 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 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 who 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 non-financial 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? Stock market valuations provide information on the risk perceptions and risk aversion of investors. It would therefore seem that this information would be useful to managers of banks and non-financial 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 non-financial enterprises. For these reasons financial and non-financial 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 comparative static 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 remarkably similar. In previous work (Krainer; 1985, 1992, and 2003) we have described and measured these asset adjustments and financing adjustments for non-financial enterprises. This research indicates that shock-induced changes in equity valuations initiate asset adjustments of non-financial enterprises. Rising (or falling) equity share valuations cause non-financial 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 non-financial 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, the increased real investments occurring during economic expansions are increasingly financed at the margin with equity, while more of the representative firm's downsized assets in recessions are financed with debt. Long-term financial leverage and financial risk are 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 (FDICIA) 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.

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# 2. II.Asset Adjustments and Financing Adjustments for Non-financial 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 a representative 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 of this enterprise in the form of a box diagram. 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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Figure 1
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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 for small variations in A(D) around Z we have:

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).  For convenience 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.

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Figure 2
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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 for small changes in A(E) around Z we have:

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

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 the small neighborhood of 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. One interesting question is what happens to the length and height of the box in Figure 1 during cyclical expansions and recessions 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, $\sigma$, 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 on 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 the 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 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 all 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 changes in economic activity 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.    $P(d) = \dfrac{\overline{X}(d)}{R(d, RR)} \bullet \dfrac{1}{N(d)}$

   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:

$$11. \qquad P(d) \ = \ \frac{R(d, ER)}{R(d, RR)} \ \bullet \ \frac{A(D)}{N(d)}$$

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:

$$12. \qquad P(e) \ = \ \frac{\overline{X}(e)}{R(e, RR)} \ \bullet \ \frac{1}{N(e)}$$

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:

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

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 perceptions and/or risk aversion of equity investors that in turn reduces $R(e, RR)$. (Suppose also for convenience 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 of non-financial firms 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 real investments of non-financial 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 non-financial enterprises the resulting operating decisions to increase investment in risky assets—that in turn increases the operating risk of firms by equation (9)—causes an 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 perceptions and risk aversion that increases the market value of bank shares— helps finance the expansion caused by the increased risky investments of non-financial enterprises. The opposite sequence of events would result in a flight to safety and an economic contraction[4].

The discussion so far indicates that an expansion is characterized by an increase in the operating risk of non-financial enterprises and a shift towards more speculative business loans by

financial enterprises. From the perspective of equity investors the resulting speculative asset adjustments by non-financial and financial enterprises that created the 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 asset adjustment decisions of these non-financial 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 prolong business cycle expansions? It has been shown in Krainer (1985, 1992, and 2003) that if asset adjustment decisions are made to conform to the risk perceptions and/or risk aversion of equity investors in the firm, then bondholder rationality requires that the financing decisions should be made to preserve the valuation of the debt/deposit securities of the non-financial and financial enterprises. In other words, if managers make investment 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 adjustment period, and both types of investors would be more confident in investing in the firm. For an 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 non-financial and financial enterprises with equity. The end result is that debt/depositor investors offset increases in the operating/portfolio 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 non-financial 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.

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Figure 3
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A geometric description of an 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 market value of the firm/economy by equation 13 rises above the book value of its assets. Managers of enterprises react to this arbitrage opportunity by increasing investments in risky assets. The decision to increase investment results in more assets being invested in the risky category by (9). These decisions by non-financial enterprises 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 non-financial enterprises. The increased investment in risky assets also increases 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 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 caused 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 representative bank model in this section yields two important macroeconomic predictions.[6] The first prediction is that changes in the market valuation of bank stocks send 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 misjudgments of bank managers and regulators. The second and related prediction is that portfolio adjustments that change portfolio risk induce bank managers to make financial adjustments that change financial risk in an offsetting way. These predictions from the theory will be empirically tested in the next section.

# 3. 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 above model 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 rather than firm-level data are 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 (Ramey, 1993, p.8). The FDIC makes this data available on the Web (http://www2.fdic.gov/hsob/hsobRpt.asp) under the heading of Historical Statistics on Banking. 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 Breusch-Godfrey serial correlation LM test indicates there is no significant autocorrelations up to order five in the regression residuals reported below, and the CUSUM test fails to reject the hypothesis that the parameter estimates are stable over the 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.

$\left(\dfrac{\Delta \text{Loans}}{\Delta \text{A}}\right)$ = 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.*

$\dfrac{\Delta(\text{Cash} + \text{Securities})}{\Delta \text{A}}$ = 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.

$\left(\dfrac{\Delta \text{Equity}}{\Delta \text{A}}\right)$ = 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.*

$\left(\dfrac{\Delta(\text{Tier}1 + \text{Tier}2)}{\Delta \text{A}}\right)$ = 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:

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

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

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

Table 1 presents certain descriptive statistics of the main variables used in this study.

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Table 1
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## 3.1. B.    Results

    The presentation of the empirical results begins in Figure 4 with a time series plot of the risky loan variable, ($\Delta$Loans/$\Delta$A) and relatively safe investments in cash and securities, $\Delta$(cash + securities)/$\Delta$A).  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 ($\Delta$Loans/$\Delta$A) 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 non-financial enterprises (particularly metal fabricating companies) to build up their inventories of steel in anticipation of a national 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]

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Figure 4
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    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 reason is that in 1991 there was a relatively mild recession (GDP growth was -.002) and that contributed to some of the decline in bank loans.  However it is doubtful that the recession of 1991 was the only reason for the sharp decline in bank loans in 1991 and 1992. A recession of the same magnitude occurred in 1980, and in that year bank loans grew by \$70.9 billion.  A more 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 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

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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/FDICIA capital standards in the early 1990's in both ways.  Figure 4 presents time series plots for both ($\Delta$Loans/$\Delta$A) and $\Delta$(Cash + Securities)/$\Delta$A.  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 FDICIA.  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.

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Figure 5
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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 2 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 time 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 time periods.  Column (4) presents the Newey-West corrected t-scores and P-values.  Column (5) presents the Breusch-Godfrey test for serial correlation in the regression residuals.  Column (6) presents the partial correlation coefficient between ($\Delta$Loan/$\Delta$A) 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/FDICIA altered the relationship between the three stock market variables and the bank portfolio allocation variable ($\Delta$Loans/$\Delta$A).  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.

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Table 2
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As can be seen from Table 2 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 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.  Finally, column (5) indicates the Breusch-Godfrey test cannot reject the hypothesis that there is no serial correlation in the regression residuals up to lag 5 indicating that the t-scores are not biased upward.

At this point we present some robustness checks on the empirical test specification presented in Table 2.  To begin with, the specification of the dependent variable in Table 2 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 $\Delta A$ not be negative or zero.  In our sample time period $\Delta A$ was never negative or close to zero.  Bank assets along with deposits grew throughout the sample time period.  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 2.  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 3.

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Table 3
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The results in Table 3 indicate that all of the estimated coefficients on the three stock market variables are positive, and for the $\Delta SP$ 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 2 when $(\Delta Loans/\Delta A)$ was the dependent variable.  The results in Table 3 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), $\Delta SP^{Ind}$, in the regressions of Table 2.  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 4.  As can be seen in the table the estimated coefficients on $(\Delta SP)^{Ind}$ are relatively small and for the most part not significantly different from zero (although in C2 this variable is significantly different from zero at the 3.5 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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          Table 4
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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 2.  In this connection suppose alternatively that ($\Delta$ Loans/$\Delta$A) 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 non-financial 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: $\quad (\Delta \text{ Loans}/\Delta A)_t \, 1 = k_0 + k_1(\Delta SP)_{t-1} + k_2(DV)^{59} + k_3(DV)^{91, 92} + e_1$
and
H2: $\quad (\Delta \text{ Loans}/\Delta A)_t \, 2 = f_0 + f_1(PR\text{-}TBR)_{t-1} + f_2(DV)^{59} + f_3(DV)^{91, 92} + e_2$

To carry out the Davidson-MacKinnon J-test, we take the fitted values from regression H2 and include them as a regressor in H1.  If the estimated coefficient on the fitted values from H2 is statistically significant, we reject the specification in H1.  This procedure is then repeated for H2; namely, we take the fitted values from H1 and include them as a repressor in H2.  If the estimated coefficient on this fitted variable is statistically significant, we reject the specification in H2.  The results for the two sample time periods 1956-2000 and 1956-90 are reported in Table 5.  As can be seen in the table the estimated coefficient on ($\Delta$Loans/$\Delta$A)2 for both sample time periods of 1956-2000 and 1956-1990 is not significantly different from zero, while the estimated coefficient on ($\Delta$Loans/$\Delta$A)1 is significantly different from zero.  Consequently, we reject the specification in H2 and fail to reject the specification in H1.

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          Table 5
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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?

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Table 6
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Table 6 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, ($\Delta$Equity/$\Delta$A). 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, $\Delta$(Tier 1 + Tier 2)/$\Delta$A. Column (2) presents three time period samples. The first two are the same that were used in Table 2, 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 ($21 billion which is more than 5 standard deviations above the mean) in the sample period as U.S. banks were coming under market and pre-Basle regulatory pressure to recognize the losses on risky loans made in the earlier years of the 1980's. According to Rajan (1994, p. 428) this herding on providing for loan losses was initiated by Citicorp on May 19, 1987. The third sample time period is 1956-79. This is the time period in which neither the Basle/FDIC regulations nor its predecessor the so-called CAMEL rating system were in existence. This was the period of time in our sample in which there was the least regulation on the adequacy of bank capital. Column (3) presents the estimated regression coefficient on the risky loan variable, ($\Delta$Loans/$\Delta$A). Column (4) presents the Newey-West computed t-scores and P-values on the estimated regression coefficients in Column (3). Column (5) presents the Breusch-Godfrey test for serial correlation. 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) presents the various dummy variables (all of which were statistically significant) used in the individual regressions over the various sample time periods.

The regression/correlation evidence in Column (3)-(6) of Table 6 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 ($\Delta$Loans/$\Delta$A). 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/FDICIA 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/FDICIA 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 ($\Delta$Loans/$\Delta$A) 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 also be noted that the estimated coefficients on ($\Delta$ Loans/$\Delta$ A) in Table 6 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. Finally, the Breusch-Godfrey LM test indicates that we cannot reject the hypothesis of no serial correlation in the regression residuals up to lag 5.

At this point it will again be useful to supplement the results in Table 6 with some robustness checks. According to the theory in Section II, the balance sheet adjustment regressions for banks in Tables 2 and 6 represent a recursive system in that the portfolio adjustment – i.e., ($\Delta$ Loans/$\Delta$ A) – depends on lagged bank share valuations, and the financing adjustment – ($\Delta$ Equity/$\Delta$ A) and $\Delta$(Tier 1 + Tier 2)/$\Delta$ A – then depends on the portfolio adjustment. Under these conditions the OLS estimates of k1 in Table 6 are both consistent and efficient. In analyzing this question further we carried out a Hausman test for simultaneity between: i) the loan variable ($\Delta$ Loans/$\Delta$A) on the one hand, and ii) the two measures of bank capital, ($\Delta$ Equity/$\Delta$A) and $\Delta$(Tier 1 + Tier 2)/$\Delta$A. On the basis of this test we could not reject the null hypothesis of no simultaneity between the loan variable and the two measures of bank capital[11]. 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 ($\Delta SP_{t-1}$), 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 7.

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Table 7
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The results in the table indicate that the 2SLS estimates of the coefficients on ($\Delta$Loans/$\Delta$A) are fairly close to the OLS estimates reported in Table 6. They are marginally higher for the ($\Delta$Equity/$\Delta$A) measure of bank capital, and marginally lower on [$\Delta$(Tier1 + Tier2)/$\Delta$A]. Finally, Table 7 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.[12]

# 4. IV.     Summary and Conclusions

This paper proposes and tests a simple one period comparative static equilibrium model describing both the portfolio adjustments and financing adjustments of all FDIC insured U.S. banks. These portfolio adjustments potentially facilitate and amplify changes in economic activity. 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. 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 that ease the financing constraint of individuals and firms thereby facilitating an increase in the demand for real output. On the other hand when stock prices fall, there is a flight to safety as bank managers turn away from loans and increase their investments in relatively safe assets like cash and securities. When this occurs the financing constraints of firms and individuals are tightened thereby resulting in a reduction in the demand for real output. In this way volatility in the stock market spills over to the real economy. Of course, any portfolio adjustment will have differential effects on depositors (and/or the deposit insuring agency) and shareholders. A risky investment strategy 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 finance speculative real investments and thereby causes an expansion in business activity), 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 non-financial companies and reducing real investment thereby 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 real economy.

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 2-5 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. An increase (or decrease) in lagged bank share valuations is 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 6 and 7 using two measures of bank capital and three different sample time periods. The results of the regression tests in Tables 6 and 7 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. In the end equity investors and regulator/depositor investors finance the investments they want to finance consistent with their perceptions of risk and risk aversion, and this is how a financial system should work.
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## Endnotes

1. The underlying argument is that an advanced and efficient financial system enables non-financial enterprises access to external finance from savers thereby expanding the pool of funds available for growth enhancing real investments.

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 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. It should be noted, however, that there is also an important cost in casting our model in terms of a representative firm in that it precludes an analysis of other important issues in banking.  For example, the representative agent model is not very useful in dealing with issues of bankruptcy of individual banks and the related issues of financial fragility and contagion effects.  For these issues a heterogeneous agent model is required.  For heterogeneous agent models that address financial

fragility and contagion issues see Allen and Gale (2000), Diamond and Rajan (2001), and Goodhart, Sunirand, and Tsomocos (2004)(2006).

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

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

9.  See the Federal Reserve Bulletin, 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 the papers by 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. To carry out a Hausman endogeniety test the first step is to run an auxiliary regression of ($\Delta$Loans/$\Delta$A) on all exogeneous variables (i.e., $\Delta SP_{t-1}$, $DV^{59}$, and $DV^{91,92}$) and instruments (assumed to be the monetary base, capacity utilization in manufacturing, and the inflation rate in consumer prices). The next step is to collect the residuals from the auxiliary regression and include them as regressors for ($\Delta$Equity/$\Delta$A) and $\Delta$(Tier1+Tier 2)/$\Delta$A. If the estimated coefficient on the residuals is not significantly different from zero, then the OLS estimates of $k_1$ will be consistent. The results for ($\Delta$Equity/$\Delta$A) and $\Delta$(Tier 1+Tier 2)/$\Delta$A over the 1956-2000 period are:

$$(\Delta Equity/\Delta A)_t = .042 + .058(\Delta Loans/\Delta A)_t + .377(DV)^{91,92} - .013(Resid)$$
$$(2.44) \ (2.41) \qquad\qquad (8.12) \qquad\qquad (-.35)$$

$$\overline{R}^2 = .70 \qquad DW = 1.95$$

$$\{\Delta(Tier1 + Tier 2)/\Delta A\}_t = .058 + .075(\Delta Loans/\Delta A)_t + .437(DV)^{91,92} \ .042(Resid)$$
$$(2.49) \ (2.30) \qquad\qquad (6.93) \qquad\qquad (.82)$$

$$\overline{R}^2 = .64 \qquad DW = 1.95$$

In both cases the estimated coefficient on (Resid) is not significantly different from zero so that the OLS estimates in Table 6 are consistent and efficient.

12.    We also carried out a Granger causality test between ($\Delta$Loans/$\Delta$A) and the two measures of bank capital, ($\Delta$Equity/$\Delta$A) and $\Delta$(Tier1 + Tier2)/$\Delta$A. At a lag of one year and at a 5 percent significance level, i) we cannot reject the hypothesis that both measures of bank capital do not Granger cause ($\Delta$Loan/$\Delta$A); and ii) we were able to reject the hypothesis that that ($\Delta$Loans/$\Delta$A) does not Granger cause the two measures of bank capital. For the i) null the F-statistic (P-value) were 3.3 (.08) and 2.5(.12); while for the ii) null the F-statistic (P-value) were 7.3 (.01) and 8.7 (.005).

Table 1

**Descriptive Statistics**

| | Mean | Median | Maximum | Minimum | Std. Dev |
|---|---|---|---|---|---|
| $\left(\dfrac{\Delta \text{Loans}}{\Delta A}\right)_t$ | .580 | .609 | 2.136 | -1.383 | .451 |
| $\left(\dfrac{\Delta\ Equity}{\Delta A}\right)$ | .092 | .066 | .423 | -.024 | .075 |
| $\left[\dfrac{\Delta(Tier\ 1\ +\ Tier\ 2)}{\Delta A}\right]$ | .120 | .091 | .531 | .030 | .092 |
| $\Delta SP$ | .031 | .024 | .722 | -.647 | .268 |
| $\Delta\left[\dfrac{SP}{(Div\ +\ RE)}\right]$ | -.022 | -.014 | .306 | -.322 | .113 |
| $(SP)^{Cyc}$ | .000 | -.009 | .608 | -.333 | .211 |

**Table 2**

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

**OLS Estimates**

| (1)<br><br>4.1.1.1. Stock Market<br><br>Variable | (2)<br>Time Period | (3)<br>Estimated<br>Coefficient | (4)<br>t-score[1]/P-<br>Value | (5)<br>Breusch-<br>Godfrey<br>Test | (6)<br>Partial[2]<br>Correlation<br>Coefficient | (7)<br>Dummy<br>Variables | |
|---|---|---|---|---|---|---|---|
| A. $\Delta SP_{t-1}$ | 1. 1956-2000<br>2. 1956-90 | .3427<br>.4068 | 2.48/.017<br>2.77/.009 | .55/.74<br>.32/.89 | .3745[a]<br>.4041[a] | $DV^{59}$<br>$DV^{59}$ | $DV^{91,}$<br>$^{92}$ |
| B.<br><br>$\Delta\left[\dfrac{SP_{t-1}}{(\text{Div}\ +\ RE)_t}\right]$ | 1. 1956-2000<br>2. 1956-90 | .7520<br>.7325 | 2.13/.040<br>2.12/.042 | .79/.57<br>.30/.91 | .3098[b]<br>.3607[b] | $DV^{59}$<br>$DV^{59}$ | $DV^{91,}$<br>$^{92}$ |
| C. $(SP)_{t-1}^{Cyc}$ | 1. 1956-2000<br>2. 1956-90 | .4479<br>.7059 | 2.96/.004<br>4.78/.000 | .31/.90<br>.20/.96 | .3750[a]<br>.5371[a] | $DV^{59}$<br>$DV^{59}$ | $DV^{91,}$<br>$^{92}$ |

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.

3. The Breusch-Godfrey LM Test is a test for serial correlation in the regression residuals up to a pre-specified lag. The first number reported in column (5) is the F-statistic and the second is the P-value. The null is that there is no serial correlation in the residuals up to the pre-specified lag; 5 in this and subsequent tables. Low probabilities (e.g., Pr < .01) indicate a rejection of the null.

## Table 3

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

### OLS Estimates

| (1)<br>4.1.1.2. Stock Market<br>Variable | (2)<br>Time Period | (3)<br>Estimated<br>Coefficient | (4)<br>t-score[1]/P-<br>Value | (5)<br>Breusch–<br>Godfrey<br>Test | (6)<br>Partial[2]<br>Correlation<br>Coefficient | (7)<br>Dummy<br>Variables | |
|---|---|---|---|---|---|---|---|
| A. $\Delta SP_{t-1}$ | 3.  1956-2000<br>4.  1956-90 | .0183<br>.0306 | 2.14/.039<br>5.55/.000 | 1.97/.11<br>1.47/.23 | .374[a]<br>.545[a] | DV$^{59}$<br>DV$^{59}$ | DV$^{91,}$<br>$^{92}$ |
| B.<br><br>$\Delta\left[\dfrac{SP_{t-1}}{(\text{Div} + \text{RE})_t}\right]$ | 3.  1956-2000<br>4.  1956-90 | .0338<br>.0350 | 1.63/.109<br>1.69/.100 | 1.72/.15<br>1.10/.39 | .261[c]<br>.287 | DV$^{59}$<br>DV$^{59}$ | DV$^{91,}$<br>$^{92}$ |
| C. $(SP)_{t-1}^{Cyc}$ | 3.  1956-2000<br>4.  1956-90 | .0291<br>.0487 | 2.92/.006<br>8.30/.000 | 2.01/.10<br>1.83/.14 | .457[a]<br>.615[a] | DV$^{59}$<br>DV$^{59}$ | DV$^{91,}$<br>$^{92}$ |

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 $\left(\dfrac{\Delta \text{Loans}}{\Delta \text{A}}\right)$.

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.

3. The Breusch-Godfrey LM Test is a test for serial correlation in the regression residuals up to a pre-specified lag. The first number reported in column (5) is the F-statistic and the second is the P-value. The null is that there is no serial correlation in the residuals up to a pre-specified lag; 5 in this and subsequent tables. Low probabilities (e.g., Pr < .01) indicate a rejection of the null.

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# Table 4

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

## OLS Estimates

| (1) 4.1.1.3. Stock Market Variable | (2) Time Period | (3) Estimated Coefficient $k_1$ (t=score/P-Value)[1] | (4) Estimated Coefficient $k_2$ (t-score/P-Value)[1] | (5) Breusch-Godfrey Test | (6) Dummy Variables | |
|---|---|---|---|---|---|---|
| **A.** $\Delta SP_{t-1}$ and $\Delta SP^{Ind}_{t-1}$ | 1.1956-2000 | .3558 (2.59/.013) | -.0197 (-.33/.738) | .50/.77 | DV[59] | DV[91, 92] |
| | 2.1956-90 | .4181 (2.93/.006) | .1201 (1.40/.171) | .50/.78 | DV[59] | |
| **B.** $\Delta\left[\dfrac{SP_{t-1}}{(Div + RE)_t}\right]$ and $\Delta SP^{Ind}_{t-1}$ | 1.1956-2000 | .7336 (2.07/.045) | .0162 (.39/.70) | .89/.50 | DV[59] | DV[91, 92] |
| | 2.1956-90 | .7256 (2.09/.045) | .0102 (.12/.904) | .37/.86 | DV[59] | |
| **C.** $(SP)^{Cyc}_{t-1}$ and $\Delta SP^{Ind}$ | 1.1956-2000 | .4393 (2.83/.007) | .0298 (.49/.626) | .41/..84 | DV[59] | DV[91, 92] |
| | 2.1956-90 | .8029 (5.12/.000) | .2146 (2.20/.035) | .52/.76 | DV[59] | |

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

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.

3. The Breusch-Godfrey LM Test is a test for serial correlation in the regression residuals up to a pre-specified lag. The first number reported in column (5) is the F-statistic and the second is the P-value. The null is that there is no serial correlation in the residuals up to the pre-specified lag; 5 in this and subsequent tables. Low probabilities (e.g., Pr < .01) indicate a rejection of the null.

**Table 5**

**J-Test Results**

| 1956-2000 |
|---|

A1 $\left(\dfrac{\Delta \text{Loans}}{\Delta A}\right)_t$ = .2991 +.3400$(\Delta SP)_{t\text{-}1}$ +.7399$(DV)^{59}$ $-$.6889$(DV)^{91,\,92}$ +.4980 $\left(\dfrac{\Delta \text{Loans}}{\Delta A}\right)2$
.  (.22)  (2.53)  (.22)  ($-$.21)  (.23)

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

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

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

| 1956-90 |
|---|

A2 $\left(\dfrac{\Delta \text{Loans}}{\Delta A}\right)_t$ = 2.8586 +.4159$(\Delta SP)_{t\text{-}1}$ + 7.0642$(DV)^{59}$ $-$ 3.6653 $\left(\dfrac{\Delta \text{Loans}}{\Delta A}\right)2$
.  (.53)  (2.70)  (.53)  ($-$.42)

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

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

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

**Table 5 (continued)**

<div>

**1956-2000**

B1.

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

(.63) (2.03) (.55) (−.61) (−.20)

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

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

(−.01) (−.20) (−.02) (.95) (2.03)

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

**1956-90**

B2.

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

(−.62) (2.29) (−.64) (.73)

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

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

(−.00) (−.73) (−.01) (2.29)

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

</div>

**Table 5 (continued)**

**1956-2000**

C1.

$$\left(\frac{\Delta \text{Loans}}{\Delta A}\right)_t = \underset{(.08)}{.1056} + \underset{(2.55)}{.4458(SP)_{t-1}^{Cyc}} + \underset{(.12)}{.4077(DV)^{59}} - \underset{(-.05)}{.1606(DV)^{91,\,92}} + \underset{(.37)}{.8134} \left(\frac{\Delta \text{Loans}}{\Delta A}\right)2$$

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

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

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

**1956-90**

C2.

$$\left(\frac{\Delta \text{Loans}}{\Delta A}\right)_t = \underset{(.21)}{1.0578} + \underset{(3.53)}{.7060(SP)_{t-1}^{Cyc}} + \underset{(.23)}{2.8628(DV)^{59}} \underset{(-.09)}{-.7507} \left(\frac{\Delta \text{Loans}}{\Delta A}\right)2$$

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

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

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

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

DW = Durbin-Watson statistic.

Table 6

# Table 6

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

## OLS Estimates

| (1) Bank Capital | (2) Time Period | (3) Estimated Coefficient | (4) t-score[1]/P-Value | (5) Breusch-Godfrey Test | (6) Partial[2] Correlation Coefficient | (7) Dummy Variables | |
|---|---|---|---|---|---|---|---|
| **A.** $\left(\dfrac{\Delta\,\text{Equity}}{\Delta A}\right)$ | 1a. 1956-2000 | .0528 | 4.78/.000 | .56/.73 | .4059[a] | | DV[91, 92] |
| | 1b. 1956-2000 | .0581 | 6.59/.000 | .92/.48 | .4776[a] | DV[87] | DV[91, 92] |
| | 2a. 1956-90 | .0505 | 3.71/.001 | .36/.87 | .4027[a] | | |
| | 2b. 1956-90 | .0567 | 5.53/.000 | .21/.96 | .4899[a] | DV[87] | |
| | 3   1956-79 | .0603 | 5.86/.000 | .69/.64 | .5473[a] | | |
| **B.** $\dfrac{\Delta(\text{Tier 1} + \text{Tier 2})}{\Delta A}$ | 1a. 1956-2000 | .0928 | 5.07/.000 | 1.22/.32 | .4953[a] | | DV[91, 92] |
| | 1b. 1956-2000 | .0829 | 5.78/.000 | .78/.57 | .5388[a] | DV[87] | DV[91, 92] |
| | 2a. 1956-90 | .0866 | 5.23/.000 | .49/.78 | .4663[a] | | |
| | 2b. 1956-90 | .0799 | 6.85/.000 | .77/.58 | .5207[a] | DV[87] | |
| | 3.  1956-79 | .0799 | 6.61/.000 | .57/.72 | .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.

3.  The Breusch-Godfrey LM Test is a test for serial correlation in the regression residuals up to a pre-specified lag. The first number reported in column (5) is the F-statistic and the second is the P-value. The null is that there is no serial correlation in the residuals up to the pre-specified lag; 5 in this table. Low probabilities (e.g., Pr < .01) indicate a rejection of the null.

## Table 7

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

### 2SLS Estimates

| (1) Bank Capital | (2) Time Period | (3) Estimated Coefficient | (4) t-score[1]/ P-Value | (6) Partial[2] Correlation Coefficient | (7) Dummy Variables | |
|---|---|---|---|---|---|---|
| A. $\left(\dfrac{\Delta\,\text{Equity}}{\Delta A}\right)$ | 1a. 1956-2000 | .0617 | 9.11/.000 | .397[a] | | DV[91, 92] |
| | 1b. 1956-2000 | .0616 | 7.98/.000 | .477[a] | DV[87] | DV[91, 92] |
| | 2a. 1956-90 | .0611 | 9.95/.000 | .396[a] | | |
| | 2b. 1956-90 | .0619 | 10.27/.000 | .489[a] | DV[87] | |
| | 3  1956-79 | .0644 | 9.16/.000 | .547[a] | | |
| B. $\dfrac{\Delta(\text{Tier 1} + \text{Tier 2})}{\Delta A}$ | 1a. 1956-2000 | .0739 | 6.51/.000 | .488[a] | | DV[91, 92] |
| | 1b. 1956-2000 | .0744 | 8.35/.000 | .538[a] | DV[87] | DV[91, 92] |
| | 2a. 1956-90 | .0781 | 5.46/.000 | .461[a] | | |
| | 2b. 1956-90 | .0752 | 10.79/.000 | .521[a] | DV[87] | |
| | 3.  1956-79 | .0828 | 8.24/.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**

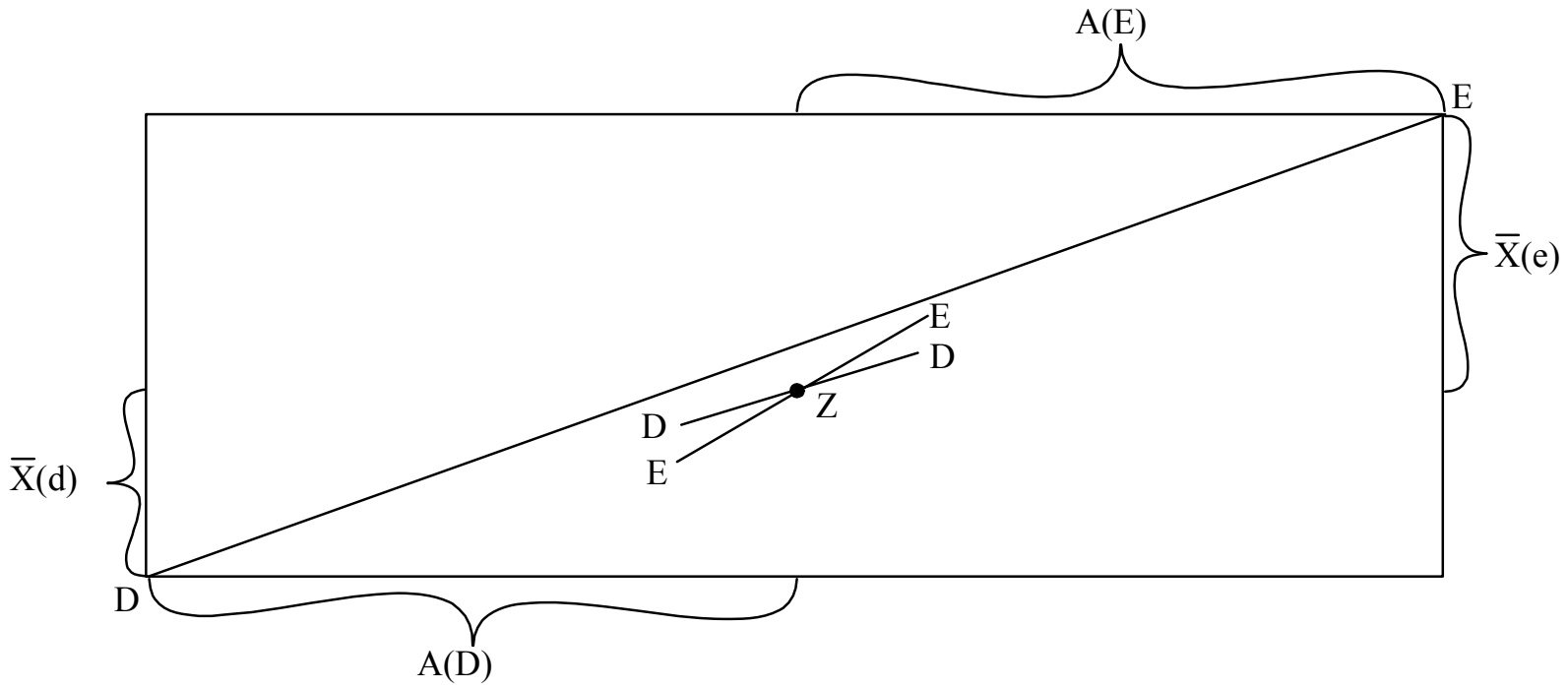**Input and Expected Output Sharing in an Debt and Equity Economy**

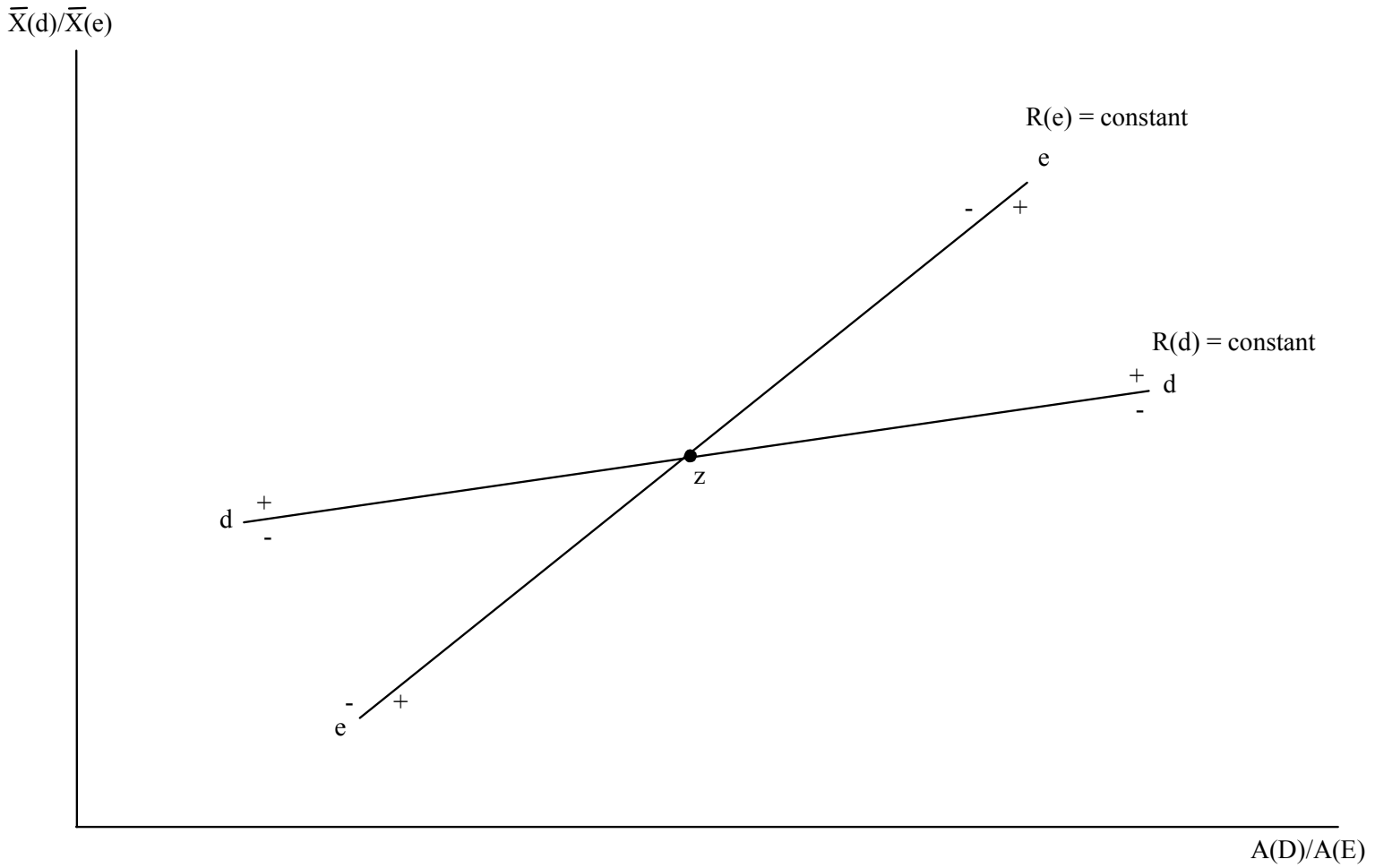# Figure 2

## Financial Markets and Equilibrium

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

R(e) = constant

e

- +

R(d) = constant

+ d
-

d +
-

z

- +

e

A(D)/A(E)

*FIGURE 3*

**A Business Cycle Expansion in a Debt and Equity Financed Economy**
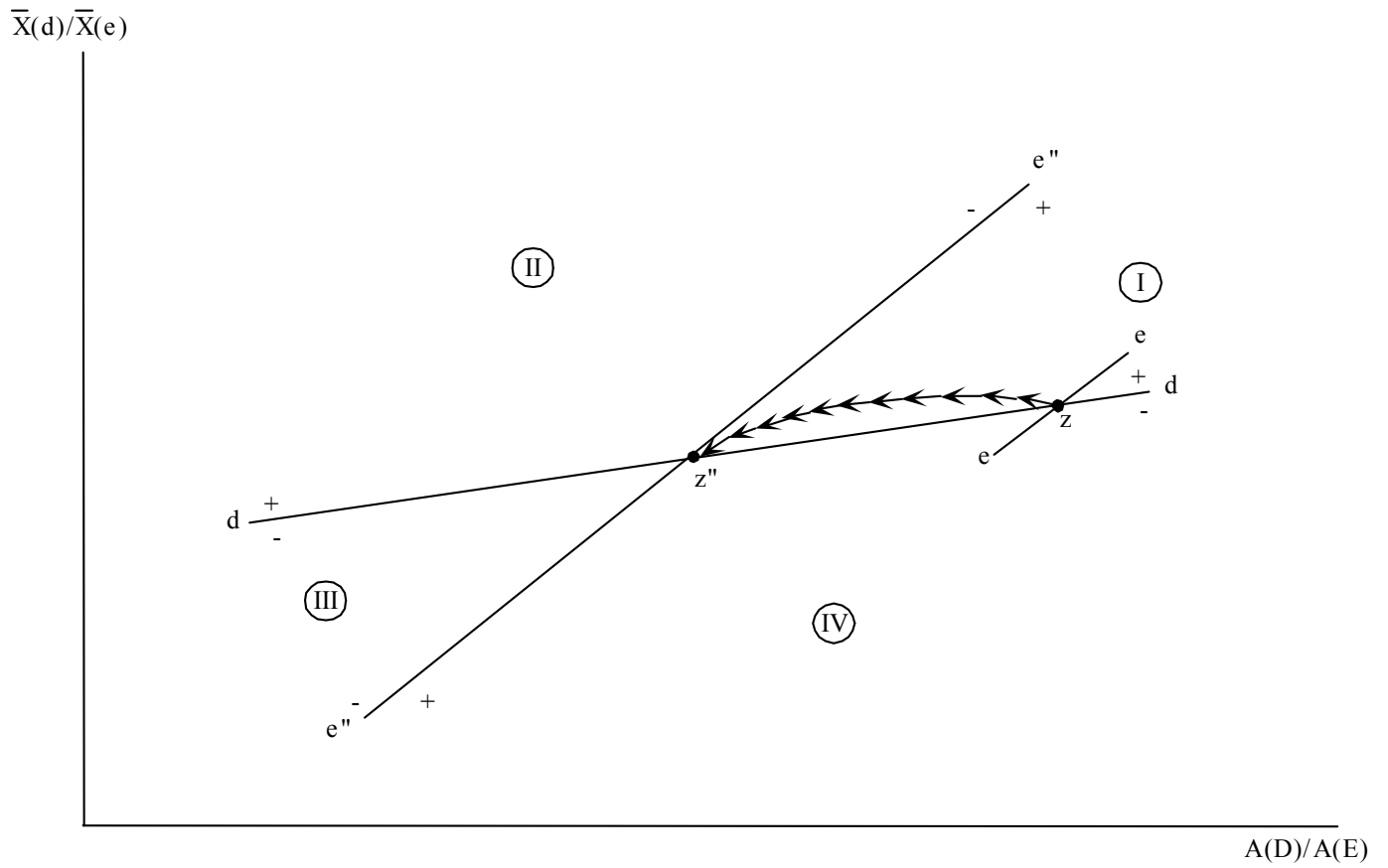
$\overline{X}(d)/\overline{X}(e)$



A(D)/A(E)

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



| | |
|---|---|
| —— | Δ(loans)/ΔA |
| - - - - | Δ(cash + securities)/ΔA |
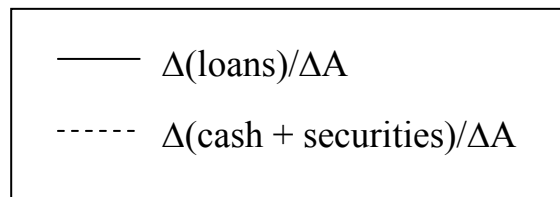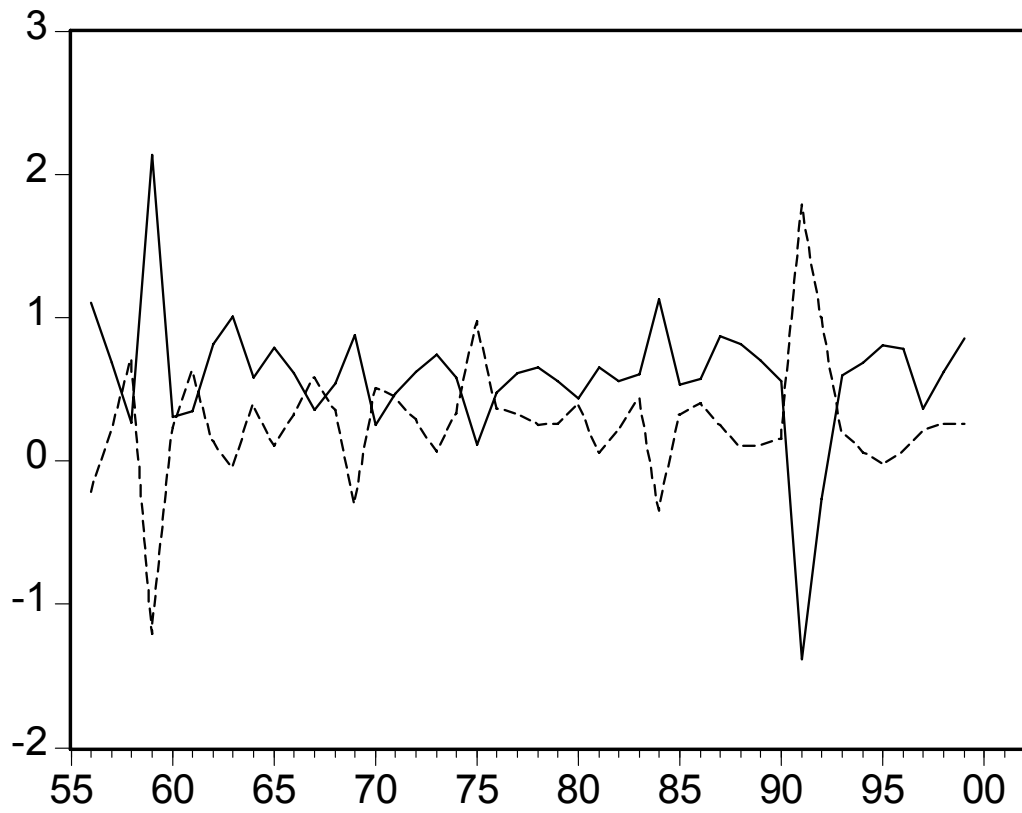
**Figure 5**
**Δ(Equity)/ΔA**
**1956-1999**
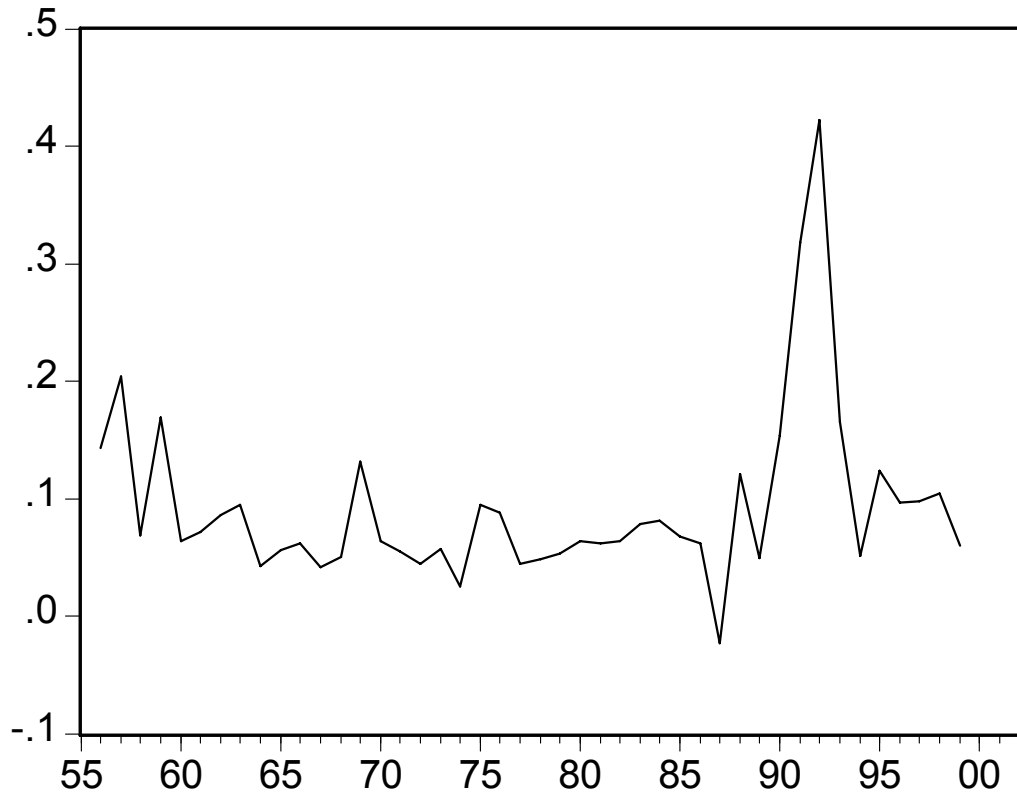


Δ(Equity)/ΔA

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