Geographic and Product-Line Bank Expansions: Effects on Bondholders' and Shareholders' Wealth

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Abstract

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This study develops and test hypotheses concerning the effects of three types of bank expansions on the wealth of the bank bondholders and the shareholders of the firm(s) involved. The three types of expansions examined are: interstate bank expansions in the United States, the formation of export trading companies by American banks, and the purchase of investment dealers by Canadian banks.

The hypotheses are derived by examining truncated portions of the cash flows to the bank in Sealey's [1983] model. Cost and risk motivated reasons for expansion are suggested. The hypotheses are tested using the standard market model approach to event studies, as well as intervention analysis and ARCH estimation.

The results indicate that the shareholders of expanding banks do not benefit from expansion. Furthermore, there is no significant benefit to the bondholders of expanding banks. Therefore, neither the diversification or the economies of scope and scale hypotheses are supported. Shareholders of target firms are found to benefit from takeover announcements. Considerations for event study procedures and financial sector reform are presented.

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List of Symbols

i) English Alphabet Letter Symbols

A_1 = the assets held initially by a bank
A_2 = the assets into which a bank diversifies
AC = autocorrelation
AR = abnormal return
AAR = average abnormal return
b_{ij} = investor i's holdings of the bonds of bank j
B_j = the value of the bonds of bank j
BL = the Box-Ljung test statistic for autocorrelation
BP = the Breusch-Pagan test statistic for heteroscedasticity
BR = the Bierwag-Roberts bond pricing model
C_A = the cost of managing bank assets
C_D = resource costs of servicing deposits
CAR = cumulative abnormal return
CAAR = cumulative average abnormal return
cov = the covariance operator
D_j = the value of the deposits of bank j
D_M = the total value of the deposits of all banks
D_1,D_2 = dummy variables
E = the expectations operator
e = an error term (main body)
the investor's expected cashflow (Appendix 1)
G = the cumulative normal distribution
g = a bank's borrowing or lending in the interbank liquidity market (main body)
= the normal distribution (Appendix 1)
i = bank input prices (Chapter 3)
= an interest rate proxy (Chapter 4)
IA = intervention analysis
JB = the Jarque-Bera test statistic for normality
ln = natural logarithm
m = the risk free asset
M = the value of the market portfolio
N = number of observations
P = the face value of a bank's bonds
p = the borrowing and lending rate in the interbank liquidity market
q = the penalty rate charged on overdrawn accounts
R = the rate of return on a security
R_D = 1 + the rate of return on bank deposits
R_f = 1 + the risk free rate
R_k, R_q = bond returns
S_j = the value of the equity of bank j
SFM = single factor market (model)
SSR = the sum of squares explained by a regression
U = utility
V_j = the value of bank j
w_i = the proportion of total bank assets invested in asset type i

x_B = the portion of a bank's cash flow which accrues to bondholders
x_j = the cash flow accruing to the bondholders and shareholders of a bank
x_M = the cash flow of the market
x_S = the portion of a bank's cash flow accruing to shareholders

ii) Greek Alphabet Letter Symbols

α_{ij} = investor i's holdings of the equity of the jth bank
α = the constant term of a regression model
β_{ij} = investor i's holding of the deposits of the jth bank
β = systematic risk; in Chapters 4 on, it is the coefficient of the market return in a regression model
Γ = the market price of risk
δ = the partial derivative operator (Chapter 3) the coefficient of the event dummy (Chapter 4 on)
ϵ = a dummy variable representing the event in question
Θ = a vector of integers representing the sequence of takeovers of Canadian investment dealers
Σ = the summation operator
σ = the standard deviation operator; the covariance operator when used with two unequal subscripts
σ^2 = the variance operator
μ_i = random payment flow experienced by investors (Chapter 3) the i^{th} moment about the mean of an error term (Chapter 4)
Φ = a step function
ϕ = penalty when outflows exceed deposit balance

Note: Symbols for the sample firms are given in Appendix 4.

Chapter 1

Introduction

Banking is currently undergoing great change. In the United States, banks are no longer localized institutions profiting almost exclusively from the spread between deposit and loan rates. In response to the removal of regulatory restrictions, interstate (geographic) bank expansion has occurred, and banks have added new lines of business such as the operation of export trading companies and discount brokerage.[1] These new lines of business represent significant new opportunities for banks, which have traditionally been prohibited from engaging in commercial activities and investment banking.

The issues of geographic and line-of-business bank expansion are also of current interest in Canada. The recent failures of two Canadian banks have been attributed, in part, to the banks' lack of geographic diversification [Estey, 1987], and Canadian banks have recently been permitted to purchase investment dealers. Furthermore, proposals exist to allow Canadian banks to enter currently-forbidden lines of business such as fiduciary services [Hockin, 1986]. The Free-Trade Agreement between Canada and the United States also has the potential to enlarge expansion opportunities for banks in North America [Canada, External Affairs, 1987]. Under the agreement, banks are given national status in the other country.

Other countries are also undertaking reforms of their financial systems. Japan plans to abolish existing barriers between banking and the securities industry in 1993, and European countries are currently formulating a new regulatory structure for their financial services industry.[2]

The existing evidence on the effect of interstate expansion on bank stakeholders is contradictory. Born, Eisenbeis and Harris [1988] found no benefit to the shareholders of expanding banks. Trifts and Scanlon [1987] found significant negative abnormal returns to the shareholders of banks which expand interstate. Cornett and De [1988] found significant positive results. Little evidence exists regarding the effects of recent types of line-of-business expansion.[3] In the only empirical study of a bank acquisition of a discount brokerage firm, Saunders and Smirlock [1987] failed to find significant benefits to the acquiring bank's shareholders.

Reasons stated by bank executives for undertaking expansion include the desire to achieve economies of scale and/or scope or the reduction of risk through diversification.[4] Others (see Kareken and Wallace [1978]) have noted that, given the prevailing fixed premium of deposit insurance, banks can profit at the expense of the insuring institution by expanding into higher risk ventures. However, most existing studies of bank expansion are strictly empirical in nature and fail to develop a theory or model of motives for expansion. Cornett and De discuss some motives for expansion, but ultimately their tests are unable to distinguish between the two motives they consider. Clearly, as Eisenbeis, Harris and Lakonishok [1984, p. 892] state: "further research on the benefits of geographic and product diversification in the present environment is warranted."

1.1 Purpose of the Thesis

In view of the limited amount and conflicting conclusions of the existing research on bank expansion, the purpose of this thesis is to identify the effects of bank expansion by:

1. developing a theoretical bank model from which motives for bank expansion may be derived; and
2. empirically testing hypotheses derived from the model, regarding the motives for expansion and the effects of expansion on bondholders' and stockholders' wealth.

1.2 Contributions of the Thesis

The contributions of the thesis over existing research are as follows:

1. The thesis introduces the use of truncated distributions in the modelling of banks' security values.[5] The use of this approach has several benefits:

   i) It incorporates, within the valuation model, institutional details which are often overlooked in financial modelling. Such details include: multiple classes of securities, priority in payment of different security classes, and limited liability.

   ii) It allows wealth transfers (or co-insurance) to be modelled within a mean-variance framework Wealth transfers permit distinctions between diversification motivated and cost-motivated expansions to be drawn.

2. The study also provides several empirical contributions:

   i) It provides the first empirical evidence on the security price effects of US banks' formation of export trading companies and Canadian banks' takeovers of investment dealers and the first evidence of the effect on bondholders of US banks' inter-state expansions.

   ii) It provides further findings on the effect on bank shareholders of US banks' inter-state expansions.

   iii) It contains the first use of The Bierwag-Roberts bond pricing model in an event study and the first use of the model on non-government bonds.

1.3 Applications and Significance of the Research

The findings of this research will provide evidence on the extent to which bank management can increase shareholders' wealth by expansion, and the extent to which diversification and economies of scale and scope can be achieved. Investors may be able to use the findings to formulate investment strategies to maximize the value of their bank holdings. The results regarding diversification and economies of scale and scope may be of interest to consumers who wish to participate in any cost savings or risk reduction resulting from expansion. Because expansions have potential effects on bank customers and investors, the results will be useful in the process of formulating bank regulation. Finally, the approach taken to modelling bank value may be of interest to other financial researchers, as it provides a way of incorporating priority of payment into mean variance valuation models.

1.4 Organization of the Thesis

The remainder of the dissertation is organized as follows: In Chapter Two, the relevant literature is reviewed. In Chapter Three, the theoretical model and hypotheses are developed. In Chapter Four, the effects of interstate expansion are tested. In Chapter Five, the formation of export trading companies is studied. In Chapter Six, takeovers of investment dealers by Canadian banks are investigated. In Chapter Seven, conclusions and suggestions for further study are presented.

Notes to Chapter 1

1. Throughout the dissertation, the term "bank" is used to refer to both individual banks and bank holding companies.

2. For further details on the reforms in Japan, Europe, the United States and Canada, see Japan [1990], Schaefer [1989], Kaufman [1988] and Hockin [1986].

3. Earlier studies concentrated on the bank stock-price effects of the 1970 Amendment to the Bank Holding Company Act, which redefined the activities in which bank holding companies could participate. Saunders and Smirlock [1987] are the first to empirically test stock price reactions to line-of-business type bank expansions which occurred after the activities associated with the 1970 Bank Holding Company Act Amendment. Other activities which have to date gone unstudied include the operation of export trading firms, which banks were permitted to operate following the passage of the 1980 Depository Institutions Deregulation and Monetary Control Act (DIDMCA).

4. For example, Willard C. Butcher, Chairman and Chief Executive Officer of the Chase Manhattan Bank said in a 1981 interview with United States Banker magazine:

> The industry is faced with many challenges. We are going to have to try to whittle at fixed costs. Fortunately there are some technological advances that will help. Electronic banking is one. The old concept of bricks and mortar, which are expensive, will have to give way to a supermarket approach. ... I will say this: there are system savings that can be developed and the banking industry will have to undergo change. We talk about national banking. We will by some amalgamation of our system over time become more efficient.

5. Castanias' [1983] approach to testing the tax shelter/ bankruptcy cost explanation of capital structure in retail and manufacturing firms is similar in concept.

Chapter 2

Review of the Literature

Three areas of literature are relevant to this study of bank geographic and product line expansion. These are:

1. Existing studies of bank interstate and product line expansions;
2. Studies of economies of scale and/or scope in banking and studies of diversification (i.e., of the two expansion motives which will be considered here); and
3. The literature on bank models; that is, the framework in which the present study must be conducted.

A brief summary of each of these areas follows.

2.1 Literature on Interstate and Product Line Bank Expansion

The existing empirical evidence on the wealth effects of interstate expansion is inconclusive. Born, Eisenbeis and Harris [1988] examined the impact of banks' interstate expansion announcements on the returns to bank stockholders using a market model residual technique. They found marginally significant negative abnormal returns. However, their sample size was small, consisting of the 21 banks, which had, at that point in time, announced plans for interstate expansion. Using a similar technique and sample size, Trifts and Scanlon [1987] found significant negative abnormal returns. Cornett and De [1988] studied a much larger sample of interstate expansions. Although they used the same methodology as Trifts and Scanlon and Born, Eisenbeis and Harris, Cornett and De found significant positive abnormal returns to the shares of banks which announced interstate expansions. Cornett and De were the only authors to attempt to determine the source of the wealth effects of expansion. They hypothesized two possible sources: benefits of diversification and signalling. However, their research design did not allow them to distinguish between these two hypotheses.

A large body of work exists on bank product line expansions associated with the 1970 amendment to the Bank Holding Company Act. However, only one study examines the effect of product line expansions which have taken place in response to more recent regulation. Specifically, Saunders and Smirlock [1987] studied the stock price response to:

1. BankAmerica's 1981 announcement of its intention to acquire a discount brokerage firm, and

2. the (subsequent) approval by the Federal Reserve Board of bank holding company discount brokerage activity.

They found neither BankAmerica nor any of the other 18 banks studied had significant stock price or risk reactions to the events, although the nine securities firms studied had a negative stock price reaction to BankAmerica's takeover announcement.

Thus, to date, empirical studies have failed to find a clear benefit arising from geographic or product-line bank expansions. Thus, the motives for such expansions remain unclear.

2.2 Literature on Scale and Scope Economies and Diversification

2.2.1 Economies of Scale and Scope

There is a large literature on economies of scale in banking. Benston [1972] provides an overview of the early work. Generally, early studies found no significant economies beyond a small bank size (approximately $50 million in deposits). This implies there is no cost-based motive for banks, other than the very smallest, to expand. Furthermore, these studies usually found that diseconomies associated with branching (a necessity for interstate expansion) nullified any bank economies of scale. However, these studies may have failed to find economies in larger banks due to the data source used. Most of the studies used data from the Federal Reserve's Functional Cost Analysis Program. There are two problems with this source. First, the large banks (which are the potential possessors of economies of scale) are significantly under-represented in this sample. Second, the banks participating in this voluntary Federal Reserve Program may be more likely to be banks experiencing problems with costs, and are thus less likely to display economies.

More recent studies of economies of scale have corrected another shortcoming of early studies. Instead of the Cobb-Douglas type of production functions assumed in early studies, recent studies have employed more flexible functional forms of production functions, such as Constant Elasticity of Substitution (CES), Variable Elasticity of Subsistution (VES), and translog forms. The advantage of such forms is that they permit both increases and decreases in unit costs as volume changes. In contrast, the Cobb-Douglas form assumes that costs are either monotonically increasing or decreasing.

However, even with such improvements, the evidence of most existing studies of economies of scale is irrelevant for the present study. The reason is that most studies have not considered interstate expansions which offer the opportunity of much greater firm size and thus significant economies.

Recently, attention has focused on economies of "super-scale". Shaffer and David [1986] postulate, and indeed find, that significant economies may be associated with the very large size of, for example, interstate banks. Hunter and Timme [1986, 1987] hypothesize that some technological innovations in banking could increase banks' operating efficiency and thus reduce costs. However, because such innovations may require large capital outlays, they can only be implemented by very large banks. Their empirical results are also consistent with the existence of economies of superscale.

The question of economies of scope in banking has also begun to receive attention in the literature. It is of interest due to banks' new-found ability to diversify[1] their product lines. Gilligan and Smirlock [1984] find economies of scope for commercial banks, and Murray and White [1983] find scope economies in credit unions. However, Mester [1986] has noted the failure to report levels of significance for the measures of scope economies in these studies (as well as other weaknesses). Her own empirical results indicate no significant economies of scope among common commercial bank activities. All of these studies have examined only traditional bank products such as mortgage and other loans, demand and time deposits and investments. Thus, they give no direct evidence on economies of scope which may exist between traditional bank activities and new lines of business such as export trading company operations and/or discount brokerage.

2.2.2 Diversification

Much of the discussion of the effect of diversification on the values of firms' securities has occurred within the literature on conglomerate merger. The use of such literature is not inappropriate for the present study, because many bank expansions are accomplished by means of merger. Even those expansions which are not accomplished by means of merger may display effects similar to mergers.

Galai and Masulis [1976] combined a multi-period capital asset pricing model with an option pricing model to demonstrate that for an unexpected fall in the firm's variance of percentage returns due to a non-synergistic merger, there will be a rise in the value of the bonds and a fall in the value of the stock. (The reverse is true for the case where the merger causes an unanticipated rise in the firm's variance of percentage returns.) These results depend upon the assumption that no side payments are allowed between different classes of investors and that no perfectly enforceable "me-first" rules exist.

The results are due to the fact that bondholders receive more protection because, after merger, the stockholders of each firm back the claims of the bondholders of each company. The stockholders lose because their limited liability is weakened. The result has thus been termed "co-insurance". In mathematical terms, under this combined CAPM-OPM approach, security prices change because the systematic risk (which determines their prices) is a function of the variance of the firm's percentage returns.

Kim and McConnell [1977] derive similar co-insurance results in a simpler, comparative-static state-preference framework.

Both of these approaches to modelling the security-price effects of diversification would be difficult to integrate into the mean-variance market valuation bank models discussed in the next section. A new approach to modelling diversification will be developed in Chapter 3.

2.3 Literature on Bank Models

Relatively few bank valuation models exist. Baltensperger [1980] notes that most bank models deal with only one facet of banks' operations (e.g., reserve management, Orr and Mellon [1961]) and do not determine, for example, the optimal size (value) of the bank. To derive complete models, Baltensperger notes that researchers have usually incorporated one of the following considerations into their models:

1. monopoly power,
2. risk aversion, or
3. the real resource costs of producing bank services.

Though he noted that monopoly power may play a role in bank decision making, Baltensperger rejected as too simplistic Klein's [1971] bank model in which monopolistic powers play a paramount role.

Similarly, though the inclusion of uncertainty in Pyle's [1971] model is an improvement over deterministic models, Pyle provides no reason why depositors should choose to hold assets through banks rather than independently.[2]

Another criticism of bank models is the form of objective function used. Most of these models have as an objective function the maximization of expected bank profit or bank utility, and not (as is more common in modern corporate finance), the maximization of investors' utility. As Santomero [1984] notes:

> In fact, if one views the investors function as the relevant one for bank choice, a more appropriate approach would be one in which the bank portfolio decisions are determined by global utility maximization of the owners. In this case [the usual objective function] would be replaced by the risk-averse utility function of the equity holder. ... This idea, however, has never been incorporated into bank modelling.

In fact, Sealey [1983] has developed a bank valuation model based on investors' utility maximization. The result is an equilibrium bank valuation model with a market determined price of risk.

Sealey's model also incorporates the real-resource costs of providing bank services, and, by assuming that banks have access to production technologies not available to individuals, he provides the reason for the existence of banks which is lacking in Pyle's model. The inclusion of these production technologies makes the model suitable for studying the cost motive for bank expansion.[3]

Thus, the model has a number of attractive features. However, it must be modified to study the expansion decisions of interest in the present investigation. First, the focus of the research will be on the banks' earning asset portfolio and not on the capital decision as in Sealey [1983]. Multiple earning assets (as opposed to the single asset assumed by Sealey), three classes of bank security holders, and the modelling of limited liability via truncated normal cash flows comprise the other changes to Sealey's model which will be incorporated in the present study to permit the examination of the diversification hypothesis of bank expansion. The model is discussed in detail in the next chapter.

Notes to Chapter 2

1. The term "diversification" is used to include expanding into new lines of business such as offering brokerage services, as well as expanding the product offering among the traditional bank products and services.

2. In fact, in Pyle's [1971] model, everyone will be an intermediary. This is clearly unrepresentative of reality, and may be remedied by incorporating resource costs, as in Sealey [1983].

3. Sealey [1983] assumes that the deposit rate is exogenously determined and he avoids modelling the liquidity concerns of the bank by assuming that the bank has unrestricted borrowing power in the Federal Funds market. Borrowing and lending rates are assumed to be equal in this market.

Chapter 3

Model and Hypotheses

3.1 The Bank Valuation Model[1]

Consider a one period economy in which individuals hold initial endowments of risky bank bonds[2] and shares plus a risk free asset, m.[3] All of these assets are assumed to be illiquid; that is, some expense is incurred in converting these assets to a medium of exchange. Individuals in this economy maximize their expected utility of wealth by choosing optimal values of these illiquid assets, plus a fourth asset, bank deposits (D). Bank deposits are assumed to be riskless[4] and perfectly liquid. Cheques drawn against bank deposits form the medium of exchange in this economy. Liquidity is important in this economy because, immediately after having chosen an optimal portfolio, individuals experience random payments flows, μ_i.[5] If μ_i is an outflow, the individual may make payment by costlessly drawing down his or her deposit balance, to the extent that the payment does not exceed the deposit. If the required payment exceeds the individual's deposit balance, a penalty of q% is charged on the unpaid amount. The rationale for the existence of banks in this model is the presumed superiority of banks at producing the medium of exchange. Banks are assumed to have access to a technology for producing this medium of exchange which is not available to individuals.

Other assumptions of the model are:

- there are no taxes[6] or corporate bankruptcy costs
- individuals have homogeneous expectations about the returns on risky assets
- the return on bank deposits (R_D) is exogenously given
- individuals have quadratic utility functions
- individuals' cash outflows, μ_i, are never great enough to cause bankruptcy
- the operating income of the bank is normally distributed.

Security prices are established by the portfolio choices of individuals. An equilibrium bank valuation model may be derived by solving the investor's constrained portfolio choice problem (as is done in Appendix 1). The resulting model is as follows:

$$V_j = (1/R_F)\ \{E(x_j) + R_D D_j + (R_F - R_D)D_j - \Gamma[\mathrm{cov}(x_j, x_M)/\sigma^2(x_M)]\} \quad (3.1)$$

or

$$V_j = (1/R_F)\ \{\underbrace{E(x_j) + R_D D_j + (R_F - R_D)D_j}_{\text{certainty equivalent cash flow}}\ \underbrace{-\Gamma\beta_j}_{\text{risk premium}}\}$$

where $\Gamma = E(x_M) + R_D D_M + (R_F - R_D)D_M - R_F M$

which is the market price of risk, and

V_j = the value of bank j

R_F = 1 + the risk free rate

E = the expectations operator

x_j = cash flows to the bondholders and shareholders of bank j

R_D = 1 + the deposit rate

D_j = the deposits of bank j

x_M = the cash flows of the market

cov = the covariance operator

σ^2 = the variance operator

β = systematic risk

M = the value of the market.

The market price of risk is a function of market wide variables only, and is therefore assumed to be invariant to changes occurring in a single banking firm.

In general terms, the model is like other mean-variance models of firm valuation; namely, a certainty equivalent cash flow less a risk premium is discounted at the risk free rate. However, the specifics of the bank model are different from those for non-bank firms. The certainty equivalent cash flow of the bank valuation equation (3.1) contains a premium, $(R_f-R_D)D_j$, not found in the valuation equations for non-bank firms. This premium represents, in Santomero's [1984] terms, seigniorage earned by the bank as a provider of liquidity or a medium of exchange. There is also a liquidity premium term in the market price of risk, which does not appear in asset pricing models which do not consider liquidity concerns and the presence of financial intermediaries.

Investors will consider the covariance between their payment flows and possible portfolio returns when forming portfolios. This will cause investors to weight assets with low covariance with their non-marketable flows more heavily in their portfolios. This implies that all investors will not hold the same portfolio.

The diversity of portfolio holdings implies that changes in the values of different classes of bank securities (which may occur following diversification-type expansions) may have wealth implications for bank security holders.

The investor-specific payment flows of the model are similar to the non-marketable assets of Mayers' [1972] model. As noted by Copeland and Weston [1988, p. 210], such models are not especially problematic:

> the market equilibrium price of risky assets may still be determined independently of the shape of individuals' indifference curves. This implies that the separation principle still holds. There is still an objectively determined market price of risk that is independent of individuals' attitudes toward risk. No variable in [the valuation equation] is subscripted for the preferences of the ith individual.

Asset pricing models which incorporate investor-specific assets are usually plagued with difficulties in the testing and implementation stage, due to the inability to observe returns on these assets and to calculate the covariances in the terms representing systematic risk and the market price of risk. However, when aggegating across investors (Line 27 of

Appendix 1), the individual payment flow term of this model drops out. As Sealey [1983, p. 868] notes, in an economy with no exogenous payment flows, the aggregate of individuals' payment flows, and the covariance of the aggregate of individuals' payment flows with the aggregate cash flow of firms, will be zero. Thus, the unobservable covariance term does not appear in the price relationship, and the model can be implemented.

In this setting, it is not only important (due to the diverse holdings of investors and the possibility of wealth transfer), but also feasible to study the effects of expansion on the prices of different classes of bank securities. In Section 3.3, expressions for the value of different classes of bank securities will be derived. First, the expansion decision will be discussed.

3.2 The Expansion Decision

Following the establishment of the bank via the purchase of its shares and bonds by investors, the management of the bank will make decisions regarding the bank's operations. The type of decision which is of interest here is the expansion decision; i.e., the decision to operate in markets which differ in terms of product or geographic location from the bank's initial operations. In the context of the present one-period model, the distinction between initial operations and expansion is somewhat forced. However, in reality, a bank may decide to undertake one of the aforementioned types of expansion long after its initial establishment, when its bonds are at mid-maturity and at a time when it has long been performing only the traditional banking functions of accepting deposits and making loans.

It is commonly recognized that such changes in operations may change the risk profile of the firm, and that changes in risk may have effects on the value of the firm's bonds and stock.[7] The precise method in which such changes occur in the present model is described in Section 3.4. Before proceeding to that discussion, the relevant assumptions regarding expansion must be clarified.

First, it is assumed that such expansions may be unanticipated by investors. If the possibility of such expansions were anticipated by investors, then rational investors would be expected to take the probability of such expansions, and their effect on security prices into account when purchasing bank securities. If investors were not systematically biased in their assessments of expansion effects, this would mean that no security price changes would occur upon the announcement of expansion, because all effects had been anticipated at the time of price setting. This assumption of unanticipated events is inherent in all studies where wealth transfers are permitted to occur (e.g., Galai and

Masulis [1976], Kim and McConnell [1977], and Asquith and Kim [1982]). Although unanticipated wealth transfers are assumed to be possible, they are not assumed to occur. The existence of unanticipated expansions will be tested in the hypothesis testing stage. If changes in security prices are observed to occur, events were obviously not fully anticipated by investors. However, if no price changes occur, events may either have been anticipated by investors or judged to have no economic impact.

Second, some comments on the motives of bank management are required. If expansions which transfer wealth from shareholders to bondholders are to be considered, then obviously the possibility that managers do not act in the interests of shareholders is admitted. For example, management may seek diversification at shareholders' expense because imperfections in labour markets make it difficult for managers of failed firms to find re-employment, and because diversification reduces the risk of such corporate failure. There is substantial evidence of agency costs in banking.[8] Although the existence of agency costs does not conflict with the model's assumptions, no explicit assumption regarding managerial motives is made in this study.[9] The results of the hypothesis testing may provide evidence on the existence of agency costs. If wealth is transferred from stockholders to bondholders, the results would be consistent with the existence of agency costs.

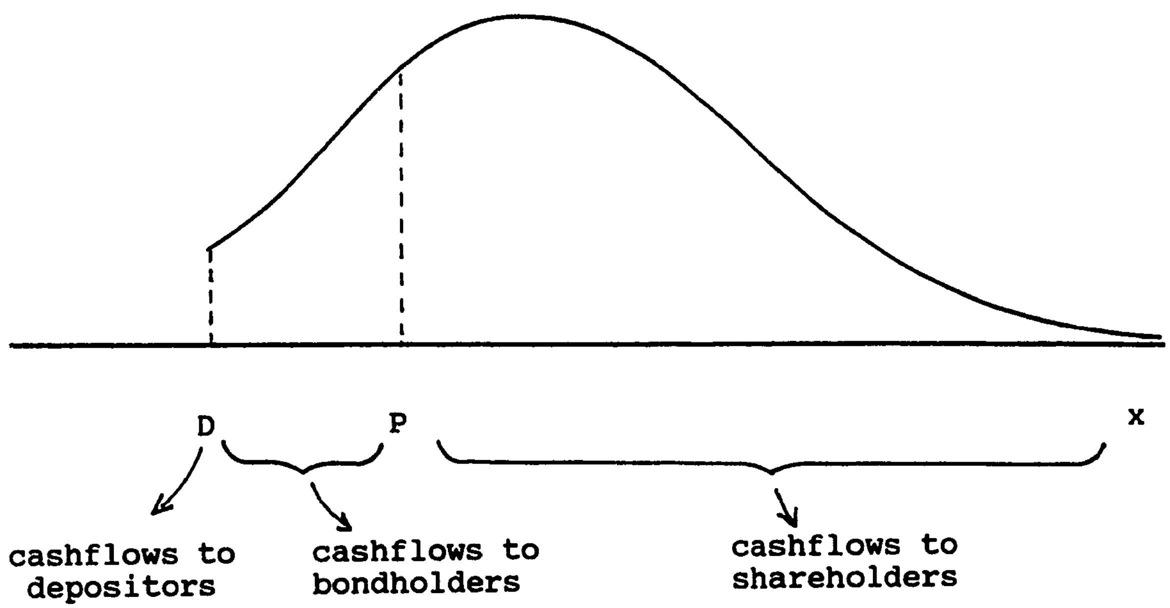
3.3 The Valuation of Shareholder and Bondholder Claims

Equation (3.1) shows that the value of an asset in this economy is equal to the expected cash flow accruing to the asset, less a risk premium (comprised of the covariance of the asset's cash flow with the market's times the market price of risk) all discounted at the risk free rate. The value of different types of bank securities may be derived by specifying the cash flows accruing to the security. The following priority of payment of stakeholders will be assumed:

1. depositors
2. bondholders
3. stockholders.

Deposits have been assumed to be riskless, so that their repayment is guaranteed. It follows that the cashflows accruing to bondholders (x_B) follow a doubly truncated normal distribution, with a lower truncation point of D (the promised payment to depositors) and an upper truncation point of P (the promised return to bondholders). Cash flows available to shareholders (x_S) will be singly truncated, from below, at point P. This ensures the limited liability of security holders. The situation is illustrated in Diagram 3.1.

Diagram 3.1


D
P
x
cashflows to depositors
cashflows to bondholders
cashflows to shareholders

The value of a bank's shareholders' claims is:

$$S_j = (1/R_r)\ [E(x_S)\ - \Gamma\ \beta_S] \tag{3.2}$$

and the value of bondholders' claims is:

$$B_j = (1/R_r)\ [E(x_B) - \Gamma\ \beta_B] \tag{3.3}$$

From Equations (3.2) and (3.3), it is clear that security prices depend on both on the security's expected cash flow and the covariance of the security's cash flow with the market. Lintner [1977] provides equations for the expected value and covariance of truncated normal variables (such as the cash flows of securities) in terms of the variance of the underlying complete distribution. For example, the covariance of bond returns with the market is equal to the standard deviation of the bank's cash flows times the differnce between the area under the curve between the standardized values of P and D in Diagram 3.1 (see Appendix 2 for all the formulae). To determine the effect of an expansion on the value of banks' securities, these formulae can be differentiated with respect to the mean and variance of the bank's cash flow, the firm-level variables which will be affected by expansion. In the following section, the effect of diversifying expansions on the wealth of bank security holders will be examined.

3.4 The Effects of Diversifying Expansions on the Value of Bondholder and Shareholder Claims

Diversifying involves investing in assets (A_2) which are less than perfectly positively correlated with the firm's existing assets (A_1). Given the formula for the variance of a combination of assets:

$$\sigma^2_{A(1+2)}=W^2_{A1}\sigma^2_{A1}+W^2_{A2}\sigma^2_{A2}+2W_{A1}W_{A2}corr(A_1,A_2)\sigma_{A1}\sigma_{A2}$$

where w represents the proportion of total bank value invested in a class of assets

diversification will reduce bank variance (i.e., $\sigma^2_{A(1+2)} < \sigma^2_{A1}$) except for cases where the new assets have high variance and/or represent a large proportion of the bank's assets. It is assumed that diversification results in a reduction in the variance of bank cash flows.

Equations (3.2) and (3.3) show that the effect of expansions on security prices depends on the expansion's effect both on the security's expected cash flow and the covariance of the security's cash flow with the market. Partial derivatives of a security's expected cash flow and covariance with the market, given changes in firm variance (as might arise from expansion) are calculated in Appendix 2. These partials are summarized in Table 3.1.

Table 3.1

Effects of Diversification on Securities' Expected Cash Flow and Covariance with the Market

	Column 1 Effect of Change in Bank's Variance on Security's Expected Cash Flow	Column 2 Effect of Change in Bank's Variance on Security's Covariance with the Market
Bonds	$\frac{\delta E(X_B)}{\delta \sigma_x} < 0$	$\frac{\delta \sigma(B,M)}{\delta \sigma_x} > 0$
Stock	$\frac{\delta E(X_S)}{\delta \sigma_x} > 0$	$\frac{\delta \sigma(S,M)}{\delta \sigma_x} > 0$

The overall effect of a diversifying expansion on a security's value will be given by the entry in Column 1 of Table 3.1 minus $\Gamma/(\sigma^2_M)$ times the entry in Column 2. For bonds, the effect is clearly negative (i.e., Column 1 minus $\Gamma/(\sigma^2_M)$ times Column 2 is negative). In other words, expansions which increase (decrease) the bank's cash flow variance will decrease (increase) bond value.

Although the effect of diversifying expansions on stock values seems to be indeterminant, it can in fact be deduced with some additional information. If the market is assumed to be complete, so that changes in the variance of the bank's cash flows have no effect on the value of the bank as a whole, then the sign of a change in share price, given a change in firm variance, must be opposite to the sign of a change in bond price. The derivative of bond price with respect to changes in firm variance has been demonstrated to be negative. Therefore, the same derivative must be positive for stocks. In other words, expansions which increase (decrease) the variance of the bank's cash flows must increase (decrease) the value of the bank's stock.

Several points are of interest here. First, assuming that diversification reduces risk, the result is consistent with the findings of Born, Eisenbeis and Harris [1988], Trifts and Scanlon [1987] and Saunders and Smirlock [1987] that no benefit accrues to the shareholders of expanding banks. In fact, the results found here suggest that researchers should look at bondholder returns when searching for benefits of diversifying expansions.

Second, the results of this truncated-normal mean variance approach to modelling expansions should be compared with the predictions of other types of models. The standard (i.e. non-truncated) market model mean variance approach used by all empirical studies to date fails to yield predictions of wealth transfer because it does not incorporate relationships between various classes of stakeholders.

Thus, the model developed in this research provides a valuable alternative approach to modelling the effect of diversifying expansions on security prices. This approach integrates contingent claim considerations within a mean-variance framework.

3.5 The Effect of Expansions Yielding Economies of Scope and/or Scale on the Value of Bank Bondholder and Shareholder Claims

The cash flow variable (x) in equations (3.1)-(3.3) may be re-expressed in terms of the revenues and costs of the bank:

$$x = R_{A1}A_1 + R_{A2}A_2 - C_A(A_1+A_2) - C_D(D) - pg \qquad (3.6)$$

where: R_A = the rate of return on the bank's assets (loans and investments);

A_1 = the pre-expansion loans and investments of the bank;

A_2 = the new loans and/or investments into which the bank has expanded;

$C_A(A)$ = a function representing the cost of managing the bank's assets;

$C_D(D)$ = a function representing the resource costs of servicing deposits;

p = the borrowing/lending rate in the inter-bank liquidity market (e.g., the Federal Funds market); and

g = the bank's borrowing ($g>0$) or lending ($g<0$) in the inter-bank liquidity market.

From this expression the effects of economies of scope and scale on the values of bondholder and shareholder claims can be analyzed. The cost function $C_A(A)$ may be represented by a second-order expansion about output quantities (i.e., loans and investments) and input prices (i_m). Taking the natural logarithm of this function yields:

$$\ln C(A) = c_1 + \Sigma_n c_{2n} \ln A_n + \Sigma_m c_{3m} \ln i_m + \tfrac{1}{2}\Sigma_j \Sigma_k c_{4jk} \ln A_j \ln A_k + \tfrac{1}{2}\Sigma_j \Sigma_k c_{5jk} \ln i_j \ln i_k + \Sigma_j \Sigma_k c_{6jk} \ln A_j \ln i_k \quad (3.7)$$

The cost function should be homogeneous of degree one, nondecreasing and concave in input prices. These conditions are met if:

$$\Sigma_n c_{3n} = 1$$

$$\Sigma_{jk} c_{5jk} = 0$$

$$\Sigma_{jk} c_{6jk} = 0$$

The condition which must be met for economies of scale to exist is as follows:

$$\Sigma_j\ c_2 j + \Sigma_j\ \Sigma_k\ c_{jk} \ln\ A_k\ +\ \Sigma_j\ \Sigma_k\ c_{6jk} \ln\ i_k < 1 \qquad (3.8)$$

When condition (3.8) holds, the following holds:

$$\Sigma_i \frac{\delta \ln C}{\delta \ln A_i} < 0 \qquad (3.9)$$

Economies of scope occur when it is cheaper for one firm to produce two outputs than it is for the outputs to be produced separately by two firms. This may occur because of shared inputs in the production of the two goods. For example, the same personnel or computer may be used in loan production in different states, or the expertise developed in loan production may be applicable to export trading. If economies of scope exist, they favour diversification of a firm's production, as opposed to specialization. This concept is formalized in the equations below.

Two conditions have been used in the literature to represent economies of scope. One (see Murray and White [1983]) is that the firm's iso-cost curves are concave to the origin, i.e.:

$$\frac{\delta^2 C}{\delta A_1 \delta A_2} < 0 \qquad (3.10)$$

The second condition used in the literature (see Mester [1987]) to characterize economies of scope is:

$$\frac{C(A_1) + C(A_2) - C(A_1+A_2)}{C(A_1+A_2)} > 0 \qquad (3.11)$$

In words, there is a relative increase in cost if assets are produced in two groups, A_1 and A_2, as opposed to joint production. Clearly, if condition (3.11) holds, then $\delta C/\delta A$ is negative, as with economies of scale.

If $\delta C/\delta A$ is negative, then from equation (3.6) it can be seen that E(x) increases. As with a change in firm variance (analyzed in Section 3.4), a change in expected firm cash flow has potential effects on both the security's expected cash flow and the covariance of the security with the market. The partial derivatives of a security's expected cash flow and covariance with the market are derived in Appendix 2, and are summarized in Table 3.2.

Table 3.2

Effects of Economies of Scope and/or Scale on Securities' Cash Flow and Covariance with the Market

	Column 1 Effect of Change in Bank's Expected Cash Flow on Security's Expected Cash Flow	Column 2 Effect of Change in Bank's Expected Cash Flow on Security's Covariance with the Market
Bonds	$\frac{\delta E(x_B)}{\delta E(x)} > 0$	$\frac{\delta \sigma(B,M)}{\delta E(x)} < 0$
Stock	$\frac{\delta E(x_S)}{\delta E(x)} > 0$	$\frac{\delta \sigma(S,M)}{\delta E(x)} > 0$

The overall effect of a cost-motivated expansion on a security's value will be given by the entry in Column 1 of Table 3.2 minus Γ/σ^2_M times the entry given in Column 2. For bonds, the resulting value will clearly be positive. In other words, expansions which increase (decrease) the bank's expected cash flow will increase (decrease) bond value.

Because both terms in the derivative of stock value with respect to changes in the bank's expected cash flow are positive (i.e., both Columns 1 and 2 of Table 3.2 are positive for stock), the net effect of changes in the bank's expected cash flow on stock value depends critically on the magnitude of Column 1 relative to Γ/σ^2_M times Column 2. Estimates of Γ and σ^2_M are given in Appendix 3. The ratio of these two values is of the order of magnitude of 1×10^{-14}. From Appendix 2, the value in Column 1 can be seen to be of the order of magnitude of the expected cash flow of the firm (perhaps in the range 1×10^7 to 1×10^9). From Appendix 2, the value in Column 2 will be of the order of magnitude of $Cov(x,M)/\sigma(M)$ (perhaps 1×10^{12}). Therefore, it is clear that (Column 1 - Γ/σ^2_M times Column 2) will be positive. In other words, expansions which increase (decrease) the bank's expected cash flow will increase (decrease) stock value.

3.6 Hypotheses

The foregoing analysis yields predictions regarding the effect of bank expansions on bond and share prices. Because the predicted security price effects differ under the two expansion motives considered in the research (namely, diversification and economies of scope and/or scale), inferences about expansion motives can be drawn from observed security price changes.

The hypotheses of diversification and economies of scope and/or scale are not mutually exclusive. Both could take place in a given expansion. In such a case, observing realized security returns would indicate only which effect had been dominant. The hypotheses of diversification and economies of scope and/or scale are also not exhaustive. Other security prices effects could be observed. For example, excess returns to security holders in response to bank expansions may be zero, indicating that investors had fully anticipated the expansion or judged it to have no economic impact. Furthermore, in the case of expansions effected by means of merger, there may be a transfer of wealth to the shareholders of the acquired firm, as observed in many merger studies (see Jensen and Ruback [1983]).

These hypotheses are summarized in Table 3.3. The data and procedures for testing the hypotheses are discussed in the following chapters.

Table 3.3

Hypothesis About Source of Excess Return	Expected Sign of: Expanding Bank's Stock Return	Expected Sign of: Expanding Bank's Bond Return	Expected Sign of: Target's Stock Return
1. Diversification	-	+	
2. Economies of Scope/Scale	+	+	
3. No impact/ Anticipated	0	0	
4. Wealth transfer to target	-		+

Notes to Chapter 3

1. The bank valuation model is based on Sealey [1983].

2. Most bank models do not incorporate bonds. Though bonds are not a large component of the capital structure of banks, their importance is growing (see Roussakis [1984, p. 116], Beighley [1977]). Furthermore, the presence of a security requiring fixed payments results in the possibility of wealth transfers between different classes of security holders, as is discussed in section 3.4.

3. The holding of other assets, including securities of other firms, may also be considered, but would not alter the results concerning bank valuation. To see this, note that the inclusion of, e.g., stock of another firm would result in an another equation similar to equation (6) in the derivation of the bank valuation model (see Appendix 1). Because the stock of other firms is not a component of the bank's value, this new equation would not be added to equations 14-16 at line 17. This would have no impact on the final bank valuation equation (equation (34), Appendix 1).

4. The assumption of riskless deposits is based primarily on the prevalence of Federal Deposit Insurance. In 1980, 98% of commercial banks had Federal Deposit Insurance [Rose and Fraser, p 147]. As Federal Deposit Insurance applies only to the first $100,000 of an account in a federally-insured bank, the realism of this assumption likely depends on the ratio of commercial accounts (which are more likely to exceed the $100,000 limit) to retail accounts.

Alternatively, deposits could be assumed to be risky, and could take the place of bonds in the model as a mechanism for generating possible wealth transfers between classes of bank stakeholders. However, the assumption of fixed required payments (necessary for wealth transfers) is much less reasonable for deposits than for bonds.

5. These payment flows may be due to returns on human capital.

6. This assumption is made for the sake of simplicity. In such a world there is no tax-motivated reason for corporations to issue debt. Debt may be (in the words of Miller [1977, p. 273] a "neutral mutation", or it may be issued for reasons unrelated to taxes (e.g., to avoid diluting shareholders' voting rights and/or claims to residual income). These factors may motivate the use of debt despite the agency problems discussed in Sections 3.3 and 3.4. In reality, given the high level of deposit financing, and the existence of some level of bankruptcy costs, tax motivations are unlikely to be a major reason for the use of bond financing by banks. Instead, as Roussakis [1984, p. 117] notes, debt is likely

issued to provide long-term capital at a lower flotation cost than equity.

7. Smith and Warner [1979] found that only 39% of bond covenants restrict merger (a form of expansion). Thus, many bondholders have no means of protecting against the wealth effects of expansion decisions.

8. Vernon [1971], Edwards [1977], Hannan [1979] and Hannan and Mavinga [1980] all found evidence of agency costs in the banking industry. Smith and Watts [1984] found that straight salaries, and not incentive schemes, are used more frequently in bank compensation plans than in other industries. This would lead one to expect a higher incidence of agency problems. Williamson [1963] stated that agency costs are more likely to occur in regulated industries, such as banking, due to the barriers to entry, and the resulting lower degree of competition.

9. The traditional CAPM, from which the valuation equations used herein are derived, is derived under the assumption of no agency costs. No CAPM incorporating agency costs exists. It will be assumed that any effects of agency costs will be reflected in the banks' cash flows, and do not affect, for example, the market price of risk.

Chapter 4

Interstate Expansions: Sample, Methodology and Empirical Findings

In this chapter, tests are carried out to determine the effects of interstate expansion on the expanding bank's bondholders, and on the shareholders of expanding and target banks. The results of these tests are compared to the findings of existing studies (see Chapter 2) in those instances where other researchers have examined similar events. Several techniques for measuring the effect of interstate expansions were used in the present study in order to judge the sensitivity of the results to the technique employed. The techniques and the data to which they were applied are described in the following sections.

4.1 Sample

Interstate expansions, and the dates of the announcements of such expansions, were identified by searching the Wall Street Journal Index for the years 1980 to 1986. Five interstate expansion announcements involving the takeover of failed or failing banks were not included in the sample. Of the 102 interstate expansions not involving failed firms which were identified, NYSE, AMEX or NASDAQ data was available for 61 expansions. These 61 expansion announcements constitute the interstate sample. Daily return data for 42 of the expansions (by 20 banks) was available on the CRSP tape, and daily prices for 19 additional expansions (by 11 banks) were obtained from the National Association of Securities Dealers (NASD). Returns for 22 acquired banks were also examined. Data for nine of these firms came from CRSP, and for the other 12 from NASD.

Nine banks which expanded interstate (for a total of 22 expansions) had NYSE-traded, non-convertible debt.[1] Returns on this debt were calculated using prices obtained from the Wall Street Journal. For banks with multiple issues of traded, non-convertible debt, choosing the issue whose price is most sensitive to expansions would maximize the power of the tests of hypothesis. However, it is impossible to know which issue will prove most sensitive without examining each series. Therefore, if the firms had multiple issues of traded, non-convertible debt, the issue to be studied was chosen based on:

i) Time to maturity. Longer maturities were selected to avoid the deterministic price movements which bonds experience at maturity, and because one of the bond pricing models used had been found to have higher explanatory power for long duration (as opposed to short duration) bonds. [Bierwag and Roberts, 1989].

ii) Lack of special features such as foreign currency denomination. Flucuating exchange rates could cause price changes in these bonds which might confound the measurement of expansion effects.

iii) Trading frequency. Thin trading has been shown to cause bias in estimates of market model parameters. [Fowler, Rorke and Jog, 1983].

Details of the sample are presented in Appendix 4. Most observations in the sample are from the 1985-86 period, when the bulk of interstate expansions took place. The acquiring banks tend to be either the largest US banks (e.g., BankAmerica and Citicorp) or agressive regional banks (e.g., NCNB and Banc One). On average, an acquiring bank has seven to ten times the assets or equity of a target bank.

4.2 Methodology

4.2.1 For Stock Returns

The first technique employed to estimate abnormal stock returns associated with expansion announcements was a traditional residual analysis where the behaviour of common stock returns surrounding the studied event (namely, the announcement of a bank's intention to expand interstate) was analyzed by examining the residuals from a single factor market (SFM) model. This technique assumes that the returns on a security are given by:

$$R_{in} = \alpha_i + \beta_i R_{Mn} + e_{in} \qquad (4.1)$$

where R_{in} = the return on security i during period n;

R_{Mn} = the return on the market proxy (namely, the equally weighted CRSP index[2]) during period n;

α_i and β_i are parameters; and

e_{in} = an error term which is assumed to have the following properties:

$$E(e_{in}) = 0 \qquad (A1)$$

$$E(e_{in(1)}, e_{in(2)}) = 0 \text{ for } n(1) \neq n(2) \qquad (A2)$$

$$\sigma^2(e_{in}) = \text{a constant.} \qquad (A3)$$

The residual, or abnormal return (AR), is calculated as:

$$AR_{in} = R_{in} - (\alpha_i + \beta_i R_{Mn}) \qquad (4.2)$$

where α_i and β_i are OLS estimates. The AR_i's may be averaged across securities experiencing similar events to obtain an average abnormal return for the group, AAR.

Given the additional assumptions of normally, independently and identically distributed errors, t-tests can be used to test whether the AAR's are significantly different from zero. The test statistic is calculated as follows:

$$t = AAR_n \,/\, \sigma(AAR) \qquad (4.3)$$

where the standard deviation is calculated from a pre-event time series of residuals (-90 days to -30 days in this study). Cumulative AR's and cumulative AAR's are given by:

$$CAR = \sum_{n=1}^{N} AR_{in} \tag{4.4}$$

and

$$CAAR = \sum_{n=1}^{N} AAR_{n} \tag{4.5}$$

The relevant test statistics for the CAAR is given by:

$$t = \sum_{n=1}^{N} AAR_{n} \; / \; (\sigma(AAR) \sqrt{N}) \tag{4.6}$$

Equation (4.1) was estimated for each event using return data for the relevant firm for the period -90 days to -30 days (where day 0 is the announcement date). Substituting the estimated parameters into Equation (4.2), the AR's were calculated for each event for the period from -29 to +30 (i.e., the "event window"). Cross-sectional daily AAR's were also calculated for this event window. The estimation period was chosen to be long enough to yield statistical significance, yet not so long that it would be likely to span different regimes of return generating processes. Estimation ended 30 days prior to the event to insulate the estimation process from the effects of the event.

There are several potential sources of bias and inefficiency in the CAR technique. The methodology has been criticized by Larcker, Gordon and Pinches [1980] due to the fact that biased residuals will be produced when the systematic risk of a firm changes as a result of, or in anticipation of an announcement. Studies by Bar-Yosef and Brown [1977] and Brenner and Smidt [1977] have demonstrated that shifts in beta could be associated with announcement events. Furthermore, the CAR technique, when applied as described above, does not take into account the trading frequency of the sample shares. OLS parameter estimates have been shown to be biased and inconsistent in the presence of non-synchronous trading (Scholes and Williams [1977], Fowler, Rorke and Jog [1983]). Finally, Flannery and James [1984] note that a single-factor market model may be inappropriate for financial institutions, which are highly sensitive to interest rates.

To investigate the impact of these factors, multiple regression models were estimated with intervention variables to represent the announcement event and leading and lagged market return and interest rate indices. The models were of the following form:

$$R_t = \alpha + \sum_{j=-2}^{+2} \beta_j R_{Mj} D_1 + \sum_{k=-2}^{+2} \beta_k R_{Mk} D_2 + \sum_{l=-2}^{+2} \beta_l i_l + \delta\epsilon + e \qquad (4.7)$$

where R_t = the daily return on the security in question;

α = the intercept of the model;

R_M = the daily return on the equally weighted CRSP index;

j and k are indices that indicate the number of days of lag or lead in the market return variable;

l = an index which indicates the number of days of lead or lag in the interest rate variable;

D_1 = a dummy variable with a value of one before the event day and zero after;

D_2 = a dummy variable equal to zero before the event and equal to one on and after the event;

β_j and β_k are, respectively, the pre- and post- announcement betas for the security in question;

i = the interest rate proxy, the Dow Jones daily bond yield average;

β_1 = the sensitivity of the security's return to the interest rate variable;

δ = the coefficient of the event dummy, ϵ, i.e., a measure of the impact of the event;

ϵ = a dummy variable set equal to one on days -1 to +1 relative to the event, zero otherwise;

e = an error term.

Initially, Equation (4.7) was estimated for each event including all leading and lagged variables detailed above. To produce estimates of the impact of expansion, however, the model was estimated for each event using only the leading and/or lagged variables which had been identified as being statistically significant for that event from the initial estimate of Equation (4.7).

Despite the refinements included in the model in Equation (4.7), there is no guarantee that the error term obeys assumptions (A2) and (A3). Violations of (A2) (i.e., autocorrelation) and (A3) (i.e., heteroscedasticity) could lead to inefficient estimates and biased test results. Furthermore, the assumption of normality, invoked in the context of tests of the significance of the parameters of the model, may not hold, thus invalidating the test results.

Accordingly, tests were conducted on the errors of Equation (4.7). The characteristics of the test statistics chosen are described in Appendix 5. The Ljung-Box [1978] portmanteau statistic at lag 15 was used to test for autocorrelation [assumption (A2)].

Breusch and Pagan's [1977] technique was used to check for heteroscedasticity. The technique involves regressing squared residuals from the original model, divided by the estimated residual variance, on the variable which is thought to be the source of the heteroscedasticity. Two possible sources of heteroscedasticity were investigated in the case of interstate expansion: time and the magnitude of the market return. Given these assumptions, one half of the explained sum of squares of the regression involving the squared residuals is asymptotically distributed as a chi-square with 1 degree of freedom. Thus, the statistic BP = 1/2(SSR) may be used to test for the presence of the assumed type of heteroscedasticity.

The statistic developed by Jarque and Bera [1980] was used to test for the normality of the error terms. Assuming homoscedasticity and serial independence, the statistic (which will be referred to as the JB statistic) is given by:

$$JB = N[\mu_3^2/6\mu_2^3 \quad + 1/24(\mu_4/\mu_2^2 - 3)^2] \qquad (4.8)$$

where μ_i represents the ith moment about the mean of the error terms from Equation (4.7).

The first term measures skewness, the second measures kurtosis. JB is asymptotically distributed as a chi-square with 2 degrees of freedom. Thus, once heteroscedasticity and autocorrelation have been eliminated, the hypothesis of normality is rejected if the computed JB statistic exceeds a desired significance point on the chi-square distribution.

Where these tests indicated violations of assumptions (A2), (A3) or the assumption of normality, adjustments were made to the estimation procedure. Where autocorrelation was found, the error term was modelled using ARIMA procedures. Weighting and/or the smoothing of outliers were the initial techniques used to reduce heteroscedasticity. Where smoothing was used, outliers greater or less than three standard deviations from the mean were replaced by linear interpolation (Anscombe [1960]).

The second technique used to deal with heteroscedasticity was the ARCH (autoregressive conditional heteroscedasticity) estimation procedure [Engle, 1982]. This process allows variance to change over time as a function of past errors. The form of the relationship is identified using a Box-Jenkins [1976] procedure and estimated using maximum likelihood. The

Berndt, Hall, Hall and Hausman [1974] algorithm is used to compute the covariance matrix and standard errors for the parameters of convergence.

As in Fama [1965] and others, non-normality of errors was found to be a problem. Where outliers were smoothed to reduce heteroscedasticity, non-normality was often reduced, but seldom eliminated. To deal with this unalterable characteristic of security returns, non-parametric statistics (the Sign test and the Wilcoxon signed-rank test) were used. These statistics require only that the observations are independent and the population is continuous in the vicinity of the median. Zivney and Thompson [1989] have found the sign test to be more powerful than the t test when applied to market- and risk-adjusted return methodologies.

4.2.2 For Bond Returns

Compared to the well-established models for determining abnormal stock returns in event studies, no generally accepted model for abnormal bond returns exists. The few existing event studies which have examined bond returns (e.g., Warner [1977], Kim and McConnell [1977], Asquith and Mullins [1982], Eger [1983], Dennis and McConnell [1986] and Malitz [1989]) have used either a type of single factor "market" model or paired comparison techniques. No theoretical underpinnings underlie either of these techniques. As noted by Alexander [1980], single factor "market" type of models for bonds overlook features of bond returns such as the effect of time to maturity.

In this study, two models will be used for measuring abnormal bond returns. The first is a single factor "market" model, which is nearly identical in all respects to the traditional SFM model used for stocks. For bonds, the dependent variable in Equation (4.1) is replaced by the daily price change for the bond under study, and the independent variable is replaced by the yield on the Dow Jones daily bond index (obtained from FRI). The SFM model for bonds is given by:

$$R_B = \alpha + \beta R_M + e_B \qquad (4.9)$$

where R_B = the price change for bond B;

R_M = the yield on the Dow Jones bond index;

α and β are parameters to be estimated; and

e_B = is the error term.

The parameters of the equation are estimated using data from days -90 to -30 relative to the event. Using the estimates of α and β, AR's are calculated for days -29 to +30. AAR's, CAAR's and their respective test statistics are all calculated as for the stocks. The rationale for selecting these periods is the same as that described in section 4.2.1 for stocks.

The second model employed to estimate abnormal bond returns is based on a duration-type model developed by Bierwag and Roberts [1989]. Although single-factor duration (SFD) models for pricing debt have been used extensively in finance, and such models have considerable empirical support, they have been criticized for their lack of a solid theoretical foundation. The Bierwag and Roberts model is based on the principle of no riskless arbitrage. Therefore, it is more soundly based than either the other SFD models or the ad-hoc "market" models discussed above.

Bierwag and Roberts develop a one-period single factor bond pricing model where the underlying stochastic process is based on the fluctuations in the term structure of interest rates. Using an arbitrage argument, they show that the excess return of a given bond over a reference bond is proportional to the excess return of an arbitrarily chosen third bond over the reference bond. The proportionality factor (a measure of volatility, called ß) is shown to be a function of the durations of the bonds in question.

The empirical specification of the Bierwag and Roberts model, when ß is assumed to be stable over time, is:

$$R_i - R_q = \beta_i(R_k - R_q) + e \qquad (4.10)$$

where R_i = the return on the bond under investigation;

R_q = the return on a reference bond;

R_k = the return on a third bond; and

e = a random disturbance term reflecting either a specification error, a measurement error, or a random disequilibrium disturbance.

The Bierwag-Roberts approach was used in an intervention model, by estimating the following equation:

$$R_i - R_q = \alpha + \sum_{g=-2}^{+2} \beta_{1g}(R_k-R_q)D_1 + \sum_{h=-2}^{+2} \beta_{1h}(R_k-R_q)D_2 + \delta\epsilon + e \qquad (4.11)$$

where, in addition to the variables previously defined,

D_1 = a dummy variable with a value of one before the event and zero after;

D_2 = a dummy variable equal to zero before the event and equal to one on and after the event;

β_1 and β_2 are, respectively, the pre- and post- announcement betas for the bond under investigation (bond i);

δ = the coefficient of the event dummy, a measure of the impact of the event;

ϵ = a dummy variable set equal to one for the day preceding, the day of and the day following the event, zero otherwise;

g and h are indices that indicate the number of days lead or lag in (R_k-R_q).

The securities used as the two reference bonds were other bonds from the bond sample, which were chosen so that they did not experience an expansion announcement over the estimation period of the bond under investigation. Procedures identical to those used for stocks were employed to correct for autocorrelation, heteroscedasticity, and non-normality.

4.3 Empirical Findings

4.3.1 For the Shares of the Expanding Banks

The AAR's, CAAR's and t statistics generated by the SFM residual technique for the shares of banks announcing interstate expansion are given in Table 4.1. The AAR on the announcement day is -0.0066, which is significantly different from zero at the 1% level. This is the only one-day AAR which is significantly different from zero. All of the multi-day AAR's reported in Table 1 are also negative, with those for the cumulation periods [-5,0] and [-1,+1] being significantly different from zero at the 5% and 10% levels, respectively. Thus, the SFM residual technique indicates that, on average, the share prices of banks undertaking expansion decline at the time of the expansion announcement.

Table 4.1
Interstate Bank Expansion
Acquiring Bank Stock Sample
SFM Model AAR's, CAAR's and Respective t Statistics

Day Relative to Announcement	AAR	t
-10	-.00073	-0.37
- 9	.00010	0.05
- 8	-.00025	-0.13
- 7	-.00289	-1.45
- 6	.00261	1.31
- 5	-.00197	-0.99
- 4	.00031	0.15
- 3	.00221	1.11
- 2	-.00250	-1.25
- 1	-.00162	-0.81
0	-.00663	-3.32***
1	.00230	1.15
2	.00128	0.64
3	-.00108	-0.54
4	-.00225	-1.13
5	-.00051	-0.25
6	-.00302	-1.51
7	.00080	0.40
8	.00220	1.10
9	.00015	0.08
10	.00387	1.94

Cumulation Period	CAAR	t
[-5,0]	-.01020	-2.11**
[-5,+5]	-.01046	-1.60
[-2,+2]	-.00717	-1.62
[-1,+1]	-.00595	-1.74*
[0,+5]	-.00689	-1.42

*** significant at the 1% level
** significant at the 5% level
* significant at the 10% level

Diagnostic statistics for the estimate of Equation (4.7) for shares of banks expanding interstate are given in Table 4.2. The statistics indicate whether leading or lagged market returns or leading, lagged, or contemporaneous interest rate variables were significant factors affecting the stock returns of interstate expanding banks; whether the banks' betas shifted significantly at the time of the expansion announcement; and whether the stock return series for expanding banks were autocorrelated or displayed heteroscedasticity with respect to time or the level of the market return. None of these features is taken into account by the SFM residual technique, and to the extent that any of these factors are significant, the findings of the SFM residual technique may be biased and/or inefficient. Jarque-Bera Statistics for testing the normality of the interstate expanding banks' stock returns are also shown in Table 4.2. The t statistics reported for the significance of the AR's of the SFM residual technique are based on the assumption that the residuals are normally distributed. To the extent that the normality assumption is violated, the t-tests are invalid.

The statistics in Table 4.2 show that leading and/or lagged market returns were a significant factor affecting the stock returns of 13 of 61 (21%) interstate-expanding banks. Interest rates had a significant effect on the stock returns of 9 of 61 (15%) of interstate expanding banks. Beta shifted significantly at announcement for five of 61 (8%) of the banks. Three of the five shifts were positive, two were negative. The residuals of eight of 61 series (13%) exhibited significant heteroscedasticity with respect to time, and four of 61 series (7%) exhibited significant heteroscedasticity with respect to market returns. Over all, 29 of 61 (48%) return series for the interstate expanding banks displayed one or more of these violations of the assumptions of the SFM residual technique. Furthermore, 51 of 61 (84%) of the return series of the interstate expanding banks were significantly non-normal, implying that t-tests for the significance of the abnormal returns associated with interstate expansion are invalid.

Techniques to correct for heteroscedasticity and autocorrelation were applied to the stock return series of those banks which exhibited these problems. Scatterplots of residuals were examined to assess the best correction procedures to employ for heteroscedasticity. In the cases where residual variance appeared to be a function of time, observations were weighted by a trend variable. Where heteroscedasticity appeared to be caused by outliers, the observations with residuals more than three standard deviations from the mean were smoothed with linear interpolation. Where autocorrelation existed, graphs of autocorrelation and partial autocorrelation functions were examined to determine the appropriate type of ARIMA model to fit.

Table 4.2
Interstate Bank Expansion
Acquiring Bank Stock Sample
Diagnostic Statistics - Initial IA Estimate of Equation 4.7
(column headings are explained on next page)

Bank	Lead /Lag R(M)	Signif. Int. Var.	Chow t $\beta1=\beta2$	BL (AC)	JB (Norm)	BP $\sigma(t)$	BP $\sigma(M)$
BAC1			0.49	17.11	34.80*	3.64	2.48
BAC2		-2	1.90	24.29	39.61*	10.00*	4.80
INT1			0.08	17.74	11.65*	2.94	1.12
INT2			0.17	8.33	28.03*	1.49	1.17
BKB1	+2		0.97	20.41	32.33*	4.98	0.10
BKB2			0.94	15.51	11.32*	13.18*	3.06
BKB3			0.88	22.13	12.11*	1.49	1.71
NOR			0.43	30.26*	40.66*	6.33	0.86
MM			0.10	16.57	23.42*	5.03	1.77
SUN			0.04	31.14*	1.49	11.60*	6.06
BBF			1.23	10.27	46.25*	0.14	4.28
ONE1			1.10	15.27	44.72*	7.90	14.04*
ONE2			0.79	7.44	33.46*	3.67	0.00
ONE3		1	0.30	23.61	12.39*	15.86*	0.02
ONE4			0.41	24.13	22.63*	3.37	1.42
ONE5			1.00	30.16*	22.92*	4.04	0.13
FVB			3.34*	12.32	48.62*	0.01	0.76
MFC			0.54	9.30	39.60*	2.20	0.17
FLT1	+2	-1	0.84	24.31	1.92	0.54	0.02
FLT2		-1	1.96	9.74	-3.74	37.27*	18.46*
SPC			0.75	7.58	32.08*	2.22	1.53
GBS1		0,-1	-2.18*	12.63	333.69*	9.71	0.00
GBS2		0,-1	-4.65*	8.64	371.89*	12.52*	0.11
BKNY			0.87	13.67	14.45*	2.51	1.51
KEY1	-2		0.25	14.56	17.90*	1.00	1.18
KEY2		-1	0.51	10.69	-1.48	9.24*	11.24*
KEY3			0.41	24.85	224.84*	3.47	0.26
MEL			1.26	14.12	39.60*	0.22	1.71
NCNB1	+2		0.12	30.23*	25.30*	4.51	0.91
NCNB2		0	1.25	20.47	37.67*	2.19	1.22
NCNB3			0.78	21.87	32.00*	2.33	0.23
NCNB4			0.23	12.82	26.19*	0.17	2.30
CHL1			0.77	19.01	24.28*	3.27	4.71
CHL2			2.51*	23.08	35.81*	3.38	0.08
CHL3			0.85	24.33	21.13*	4.06	0.75
CCI1	-2		0.56	11.42	53.32*	2.28	5.85
CCI2			0.85	11.15	26.87*	0.21	0.94
CMB1			1.66	30.17*	37.77*	2.66	2.32
CMB2		-1	0.36	19.17	24.27*	0.09	0.91
NBD			1.02	12.20	26.76*	0.74	0.27

Table 4.2 (continued)

Bank	Lead /Lag R(M)	Signif. Int. Var.	Chow t $\beta 1=\beta 2$	BL (AC)	JB (Norm)	BP $\sigma(t)$	BP $\sigma(M)$
WAC			0.70	7.75	-2.23	3.66	2.22
BNE	-1		1.91	22.74	14.78*	23.62*	8.39
ZION	-1		0.35	31.77*	288.15*	15.65	7.88
CSG	-1		0.74	7.82	22627.6*	10.71*	54.09*
FTU1			0.24	16.01	34.97*	5.99	0.11
FTU2	-2		1.16	21.49	163.04*	2.81	1.90
FTU3	-2		0.67	16.49	127.06*	11.60	1.68
FTU4			0.64	9.02	8.37	1.61	2.24
FTU5			0.83	11.05	8.06	1.52	2.41
FTU6			0.18	19.50	17.20*	3.15	1.06
FTU7	-1		3.28*	30.50*	49.41*	0.32	0.89
FTh			1.30	8.20	18.83*	0.00	6.42
SOVN1	-1		0.14	30.87*	-9.74	14.71*	4.06
SOVN2	-2		0.51	22.08	-1.50	0.95	0.76
HBAN			1.29	20.13	0.92	0.07	2.82
VNCP			0.75	30.47	319.63*	0.07	0.05
CORE			0.65	16.32	70.27*	5.17	1.76
RIGS			1.44	22.48	15.03*	9.97	1.32
PNC			1.29	18.21	22.14*	1.90	0.00

* significant at 1%

Explanation of Column Headings:

Bank - Symbol for bank expansion. See Appendix 2.

Lead/Lag R(M) - Indicates whether leading or lagged market returns were significant variables in Equation (4.7). -1 represents market returns lagged one day, +1 represents market returns leading by one day, etc.

Signif. Int. Var. - Indicates whether the interest rate variable was significant in Equation (4.7). 0 represents contemporaneous interest rates, -1 interest rates lagged one day, and so on.

Chow t($\beta 1=\beta 2$) - Chow t statistic for the hypothesis that the β before the announcement equals the β after the announcement. At 1%, the critical value is 2.66.

BL (AC) - Box-Ljung portmanteau statistic for the presence of autocorrelation. At 1%, the critical value is 31.52.

JB (Norm) - Jarque-Bera statistic to test for normality. At 1% the critical value is 9.21.

BP $\sigma(t)$ and $\sigma(M)$ - Breusch-Pagan statistic to test for heteroscedasticity with respect to time (t) and market returns (M). At 1%, the critical value is 9.21.

The adjustment employed, and the resulting diagnostic statistics for autocorrelation, heteroscedasticity and non-normality are shown in Table 4.3. Five of the eight series with autocorrelation required differencing. Autocorrelation took the form of autoregression in seven of the eight auto-correlated series. Three of the seven had first-order autoregression, one had second-order, two fourth-order and one fifth-order. One of the series was an autoregressive integrated moving average process, with seventh-order autoregression and a first-order moving average term. Heteroscedasticity was corrected in six of the 12 affected series by weighting by a trend variable. In the remaining series, the heteroscedasticity was removed by smoothing one to three outliers.

An ARCH procedure for estimating Equation (4.7) was also employed for those stock return series displaying heteroscedasticity. An ARCH (0) model was used for eight of the 12 (67%) heteroscedastic series, an ARCH (1) model for three of the 12 (25%) of the series and an ARCH (3) model for one of the 12 (8%) of the series.

A summary of the abnormal return estimates associated with the announcement of an interstate expansion, as generated by the various techniques employed is given in Table 4.4. The abnormal returns shown for the residual method are one third of the [-1,+1] cumulation period AAR's, in order to facilitate comparison with the findings of the IA techniques, in which this three day event period was used. Results are shown for

Table 4.3
Interstate Bank Expansion
Acquiring Bank Stock Sample
Diagnostic Statistics - Adjusted IA Estimate of Equation 4.7

Bank	BL (AC)	JB (Norm)	BP σ(t)	BP σ(M)	adjustment[a]
BKB2	18.06	8.43	0.34	4.10	weighted by time
BAC1	10.46	17.66*	2.05	5.07	weighted by time
FLT2	22.23	2.10	0.52	0.43	weighted by time
ONE3	25.90	39.69*	0.30	0.15	smoothed 3 outliers
ONE1	10.17	29.27*	0.10	0.01	smoothed 2 outliers
GBS1	14.22	16.88*	0.40	0.02	smoothed 1 outlier
GBS2	11.81	15.83*	0.41	2.99	smoothed 1 outlier
KEY2	12.69	38.77*	1.48	0.18	smoothed 2 outliers
BNE	17.83	3.28	0.28	2.66	weighted by time
CSG	29.94	7.33*	4.26	0.29	smoothed 1 outlier
FTU3	10.55	12.49*	2.81	0.17	weighted by time
RIGS	12.69	14.40*	1.07	0.26	weighted by time
NOR	13.41	43.41*	2.72	0.20	(7,1,1)
SUN	25.33	3.64	2.54	0.42	(1,0,0)
ONE5	24.12	13.91*	2.98	3.60	(5,1,0)
NCNB1	23.23	28.61*	8.60*	2.34	(4,1,0)
CMB1	19.80	31.42*	2.86	4.20	(1,0,0)
ZION	11.80	37.26*	4.36	0.62	(4,1,0)
SOVN1	25.63	32.93*	2.31	4.40	(1,1,0)
VNCP	14.89	44.46*	0.14	0.31	(2,1,0)

* significant at the 1% level

[a] The bracketed figures in the adjustment column refer to the type of ARIMA model used. The first number indicates the order of the autoregressive process; the second number indicates the degree of differencing; and the third number indicates the order of the moving average process.

For an explanation of column headings, see Table 4.2.

estimation of the IA model (Equation 4.7) unadjusted, adjusted for autocorrelation and for heteroscedasticity using weighting or smoothing, and adjusted for heteroscedasticity using ARCH estimation.

The summarized distributions for different estimation methods do not differ greatly from one another. There are several reasons for this. First, adjusted estimates were only made for series which displayed heteroscedasticity or autocorrelation. Thus, if, for example, the series yielding the minimum AR associated with expansion was not heteroscedastic or autocorrelated, the AR would not be re-estimated and the same AR would appear in the columns of Table 4.4 for all estimation methods. Second, AR estimates proved to be quite robust with respect to the estimation adjustment employed, perhaps due to the non-significant nature of many of the AR estimates.

In summary, 49% of the abnormal return estimates generated by the residual technique were negative, as were 41% of the abnormal return estimates generated by the unadjusted IA technique, and 43 and 44% of the abnormal return estimates generated by the adjusted and ARCH adjusted IA techniques, respectively.

Because non-normality remained a significant problem, non-parametric Sign and Wilcoxon significance tests, which do not depend on the assumption of normality, were performed in addition to t-tests.

The average residual abnormal return over the three day period surrounding the announcement is -.0022, which is not significant by either the t, Sign or Wilcoxon tests. The t-test insignificance of this result, in contrast with the significance of the CAAR [-1,+1] result in Table 4.1 is due to the use of a different method of calculating the standard deviation. The standard deviation in Table 4.4 is calculated using the cross-section of 1/3 of the banks' [-1,+1] AAR's. The standard deviation used in the t-tests in Table 4.1 is calculated from the banks' 60 day estimation period residuals. It is thus a pooled time series-cross sectional estimate. The Table 4.1 method is more powerful, but it assumes that the estimation period variance is applicable to the event period.

The techniques which adjust for the specification errors of the residual method yield estimates of the abnormal stock return associated with an interstate expansion announcement which are even closer to zero than those generated by the residual method. The mean estimate of the abnormal return generated by the unadjusted IA technique is -0.0005; that of the adjusted IA method is -0.0007 and that of the ARCH adjusted IA method is -0.0012. None of these mean estimates is significantly different from zero using any of the significance tests employed: the t-test, the Sign test or the Wilcoxon Signed Rank Test.

Table 4.4
Interstate Bank Expansion
Acquiring Bank Stock Sample
Comparison of Findings of Different Techniques

Panel A: Summary of Abnormal Returns

	SFM residual	--Intervention Analysis Eq. 4.7-- Unadj.	Adj.	ARCH adj
minimum	-0.0332	-0.0234	-0.0234	-0.0235
1st quartile	-0.0077	-0.0079	-0.0085	-0.0076
median	-0.0004	0.0001	0.0000	0.0000
3rd quartile	0.0043	0.0064	0.0051	0.0060
maximum	0.0158	0.0188	0.0188	0.0188
mean	-0.0022	-0.0005	-0.0007	-0.0012
std. dev.	0.0101	0.0101	0.0102	0.0103
sample size	61	61	61	61

Panel B: Tests of Statistical Significance

t test	-1.62	-0.39	-0.54	-0.91
Sign Test:				
no. pos.	30	32	30	29
no. neg.	30	25	26	27
ties	1	4	5	5
p value	1.0000	0.4185	0.6831	0.8918
Wilcoxon p value	0.2925	0.8570	0.8531	0.5846

These results are consistent with the findings of Born, Eisenbeis and Harris [1988], who also found statistically insignificant negative abnormal returns to the shares of banks announcing interstate expansion. The significant, negative day 0, day [-1,+1] and day [-5,0] residual results reported in Table 4.1 are consistent with the results of Trifts and Scanlon [1987].

No evidence of significant positive average AR's associated with banks' interstate expansion announcements, as found by Cornett and De [1988], was found in this study.

The abnormal returns of the expanding banks shares' were tested to see if they were related to the sizes of the banks involved in the expansion. The AR's were regressed against: 1) the value of the expanding bank's assets; 2) the value of the expanding banks' equity; 3) the value of the target banks' assets; 4) the value of the target banks' equity; 5) the ratio of the expanding banks' assets to the target banks' assets; and 6) The ratio of the expanding banks' equity to the equity of the target bank. The coefficient of the independent variable was insignificantly different from zero in each of these six regressions. Thus, size effects cannot explain the small negative abnormal returns accruing to the shares of banks announcing interstate expansions.

4.3.2 For the Bonds of Expanding Banks

The issue of trading frequency was of concern for the bond sample. The percentage of days and weeks during the period under investigation on which the sample banks' bonds traded are given in Table 4.5. Because some banks' bonds traded infrequently on a daily basis, both daily and weekly bond returns were used for empirical tests. Tests based on weekly data were carried out in exactly the same manner as those based on daily data, with the exception that the observations used were taken weekly (i.e., observations beginning at week -90 were used for estimation) and that the intervention dummy variable in Equation (4.11) was set equal to 1 only for the week of the announcement, and not for the weeks preceding and following the announcement.

Daily and weekly AAR's, CAAR's and t statistics for the bonds of interstate-expanding banks, as generated by a "market" type residual model (where the yield on the daily Dow-Jones 30 bond index is used as the market index) are given in Table 4.6. None of the AAR's or CAAR's is significantly different from zero. The only exception is the AAR of -0.0071 for week -2, which is significantly different from zero at the 5% level. Thus, on the basis of the residual technique, on average, the bond prices of banks undertaking interstate expansion do not change in response to expansion announcements.

Table 4.5
Interstate Bank Expansions
Acquiring Bank Bond Sample
Bond Trading Frequencies

Bond	Trading Frequency Daily(%)	Weekly(%)
BkB	27	81
BAC	50	94
CMB	86	100
CHL	34	75
CCI	97	100
KEY	25	77
NCB	38	77
SPC	67	100
a	53	88

Table 4.6
Interstate Bank Expansion
Acquiring Bank Bond Sample
Market Model AAR's, CAAR's and t Statistics

Period Rel. to Announce.	Daily AAR	Daily t	Weekly AAR	Weekly t
-10	.0010	0.50	-.00061	-0.17
-9	-.0010	-0.50	-.00295	-0.84
-8	-.0011	-0.55	.00288	0.82
-7	-.0032	-1.60	.00148	0.42
-6	-.0011	-0.55	.00035	0.10
-5	-.0019	-0.95	.00465	1.33
-4	.0017	0.85	-.00372	-1.06
-3	-.0005	-0.25	.00235	0.67
-2	-.0002	-0.10	-.00708*	-2.02*
-1	-.0020	-1.00	.00452	1.29
0	.0015	0.75	-.00387	-1.11
1	.0008	0.40	.00054	0.15
2	.0030	1.50	.00267	0.76
3	-.0027	-1.35	.00337	0.96
4	-.0006	-0.30	.00133	0.38
5	-.0003	-0.15	-.00056	-0.16
6	-.0011	-0.55	.00260	0.74
7	.0013	0.65	-.00268	-0.77
8	.0025	1.25	.00014	0.04
9	.0015	0.75	.00157	0.45
10	-.0008	-0.40	-.00643	-1.84

Cumulation Period	Daily CAAR	Daily t	Weekly CAAR	Weekly t
[-5,0]	-.0014	-0.29	-.0032	-0.37
[-5,+5]	-.0012	-0.18	.0042	0.36
[-2,+2]	.0031	0.28	-.0032	-0.41
[-1,+1]	.0003	0.09	.0012	0.20
[0,+5]	.0017	0.35	.0035	0.41

* significant at the 5% level

An intervention model based on the Bierwag-Roberts (BR) approach was also used to estimate abnormal bond returns [Equation (4.11)]. The BR approach is based on constant duration bond portfolios. This condition was not met precisely in the current study. The durations of the sample bonds of banks undertaking interstate expansion are given in Table 4.7. The average change in duration between the beginning of the estimation period and the event date is slight (0.259 years or 5.91% of the initial duration) when daily bond returns are used. Thus the assumptions of the BR approach are well approximated under these conditions. Bond durations change more (on average 0.643 years or 13.22%) when weekly returns are used (as can be seen from Panel B of Table 4.7). Thus, the assumptions of the BR approach are less well met when weekly data are used.

The BR model is formulated for default free bonds. Although an adjustment should be made when the model is used for risky bonds (as in this study), it was beyond the scope of this research to estimate default risk and adjust the model accordingly.

Diagnostic statistics for the intervention analysis (IA) estimate of the Bierwag-Roberts model for the bonds of banks expanding interstate are given in Table 4.8. Lagged values of (R_k - R_q) were significant in four of 20 (20%) weekly bond return series. No lagged variables were significant in the daily sample, and leading values of (R_k - R_q) were not

Table 4.7
Interstate Bank Expansions
Acquiring Bank Bond Sample
Bond Durations

Panel A: Daily Data

(A) Bond	(B) Duration at Beginning of Estimation Period	(C) Duration on Event Date	(D) (B)-(C)	(E) Percent Change (B) to (C)
BkB1	3.789	3.652	0.137	3.62
BAC1	8.744	8.680	0.064	0.73
NCNB1	7.845	7.561	0.284	3.62
BKB2	3.515	3.265	0.250	7.11
BkB3	3.398	3.168	0.230	6.77
Key1	7.340	7.779	-.439	-5.98
CHL1	7.138	7.610	-.472	-6.61
CCI1	8.129	8.215	-.086	-1.06
CMB1	1.889	1.582	0.307	16.25
CHL2	7.594	7.450	0.144	1.90
NCNB2	7.395	7.597	-.202	-2.73
Key2	7.873	8.387	-.514	-6.53
SPC	5.968	5.920	0.048	0.80
CCI2	8.827	8.804	0.023	0.26
CMB2	1.003	0.658	0.345	34.40
Key3	8.260	8.660	-.400	-4.84
CHL3	8.515	9.011	-.496	-5.83
NCNB3	7.700	7.920	-.220	-3.86
BAC2	8.505	9.000	-.495	-5.82
NCNB4	7.780	7.811	-.031	-0.40
avg of abs. values	6.560	6.637	0.259	5.91

Table 4.7 (con't)
Interstate Bank Expansions
Acquiring Bank Bond Sample
Bond Durations

Panel A: Weekly Data

(A) Bond	(B) Duration at Beginning of Estimation Period	(C) Duration on Event Date	(D) (B)-(C)	(E) Percent Change (B) to (C)
BkB1	4.516	3.652	0.864	19.13
BAC1	8.324	8.680	-0.356	-4.28
NCNB1	7.102	7.561	-0.459	-6.46
BKB2	4.167	3.265	0.902	21.65
BkB3	4.116	3.168	0.948	23.03
Key1	8.009	7.779	0.230	2.87
CHL1	7.873	7.610	0.263	3.34
CCI1	8.798	8.215	0.583	6.63
CMB1	2.691	1.582	1.109	41.21
CHL2	7.685	7.450	0.235	3.06
NCNB2	7.771	7.597	0.174	2.24
Key2	7.978	8.387	-0.409	-5.13
SPC	6.312	5.920	0.392	6.21
CCI2	8.509	8.804	-0.295	-3.47
CMB2	1.300	0.658	0.642	49.38
Key3	7.411	8.660	-1.249	-16.85
CHL3	7.677	9.011	-1.334	-17.38
NCNB3	7.118	7.920	-0.802	-11.27
BAC2	7.909	9.000	-1.091	-13.79
NCNB4	7.295	7.811	-0.516	-7.07
avg of abs. values	6.628	6.637	0.643	13.22

significant factors for either daily or weekly series. One (5%) of the daily bond return series experienced a significant beta shift at the time of the expansion announcement. The shift was negative, that is, towards a lower beta post-announcement. No significant beta shifts were observed in the daily data. Similarly, no series of either daily or weekly bond returns displayed evidence of autocorrelation. As was the case for stock returns, non-normality was a problem for the bond returns. Thirteen of twenty (65%) of the weekly series and 12 of 17 (71%) of the daily-series exhibited non-normal distributions. Seven (35%) of the weekly series displayed heteroscedasticity with respect to time, and seven with respect to the level of (R_k-R_q). Among the daily series, three (18%) displayed heteroscedasticity with respect to time, and seven (41%) with respect to the level of the market yield. Overall, 18 of 20 (90%) weekly series and 16 of 17 (94%) daily return series exhibited characteristics which violate the assumptions of the residual technique and/or invalidate t-tests. The R^2 values were significantly lower for the daily data.[3]

Adjustments to the estimation procedure were again made to correct for heteroscedasticity. The diagnostic statistics for the estimates adjusted by weighting or by smoothing outliers are given in Table 4.9. Two (18%) of the heteroscedastic weekly series were corrected by weighting by a trend variable. The remaining nine (82%) heteroscedastic

Table 4.8
Interstate Bank Expansions
Acquiring Bank Bond Sample
Diagnostic Statistics: Initial Estimate of BR Model Eq.4.11

Panel A: Weekly Data

	Lag R(k)-R(q)	Chow ß1=ß2	BL (AC)	JB (Norm)	BP σ(t)	BP σ(M)	R^2
BKB1		-.13	19.00	7.34	17.49*	.33	.63
BKB2		-2.17	23.90	-1.34	0.41	3.02	.73
BKB3		.43	24.85	-2.78	332.26*	327.36*	.75
BAC1		-.72	15.21	59.21*	12.80*	3.62	.38
BAC2	-1	.61	13.55	13.83*	3.55	67.74*	.44
CMB1		.00	16.94	35.10*	6.91*	0.41	.02
CMB2	-1	-11.35*	22.15	-2.72	0.10	23.67*	.52
CHL1		-.27	28.94	115.36*	6.70*	20.11*	.50
CHL2		.62	12.05	94.14*	0.15	5.18	.40
CHL3		1.57	9.91	25.56*	1.05	0.52	.51
CCI1		.00	15.70	35.65*	4.61	0.08	.02
CCI2	-1	.49	16.60	-7.84	28.35*	0.29	.02
KEY1		.68	16.68	23.02*	0.10	0.03	.57
KEY2		.73	24.59	3.70	1.76	13.59*	.57
KEY3		-.96	25.76	14164.49*	23.06*	175.20*	.38
NCNB1		1.21	19.46	5.80	0.23	0.00	.54
NCNB2	-1	.14	11.51	133.35*	0.90	0.58	.56
NCNB3		1.15	15.37	16.42*	0.63	0.99	.47
NCNB4		-.16	9.42	178.30*	1.54	5.25	.53
SPC		1.50	27.32	175.86*	1.75	12.43*	.66

Panel B: Daily Data

	Chow ß1=ß2	BL (AC)	JB (Norm)	BP σ(t)	BP σ(M)	R^2
NCNB1	-1.00	18.30	-3.64	0.43	0.00	.01
BkB1	1.75	17.81	118.38*	2.68	2.41	.03
BkB2	-0.26	31.18	2.24	8.50*	2.05	.00
Key1	0.18	20.34	163.44*	4.19	0.02	.01
CHL1	1.14	22.96	111.59*	1.84	30.23*	.02
CCI1	0.49	13.37	27.75*	1.01	0.06	.01
CMB1	0.16	17.66	11.49*	2.59	9.33*	.00
CHL2	-0.92	11.71	95.23*	0.01	12.38*	.05
NCNB2	-0.39	13.02	163.41*	0.79	2.34	.01
Key2	-1.10	31.48	4.69	1.81	14.09*	.03
SPC	-1.25	32.25	128.27*	2.44	8.50*	.02
CCI2	0.02	22.18	2.15	9.25*	0.46	.01
CMB2	-0.95	14.06	27.90*	0.27	1.97	.02
KEY3	1.62	19.80	11003.32*	21.19*	164.11*	.04
CHL3	-1.66	8.56	17.39*	1.51	0.24	.03
BAC	0.55	17.20	3.98	1.09	13.40*	.01
NCNB3	0.62	10.37	117.76*	1.06	4.62	.01

* significant at 1%. Column headings explained in Table 4.2.

series were corrected by smoothing outliers. Two (22%) of the heteroscedastic daily series were corrected by weighting by time. Smoothing one to four outliers removed the apparent heteroscedasticity in the other seven (78%) daily series.

ARCH estimation was also employed for the heteroscedastic series. In six of ten weekly heteroscedastic bond return series, an ARCH (0) model was used. An ARCH (1) model was used in three of ten weekly bond series, and an ARCH (2) model was used in the one remaining heteroscedastic weekly bond series. Among the heteroscedastic daily bond return series, an ARCH (0) model was used for six of eight (75%), an ARCH (1) model was used for one of eight (12.5%), and an ARCH (3) model was used for the one remaining series.

A comparison of the bond AR's generated by all the techniques is presented in Table 4.10. Using weekly data, all four of the methods found 52% of the bond AR's associated with interstate expansion announcements to be negative and 48% to be positive. The AR's based on daily data were also approximately evenly divided between positive and negative. Between 47% and 59% of the daily interstate bond AR's were negative, depending on the method of calculation used.

The average weekly bond AR generated by the residual and ARCH adjusted BR IA methods is .0004. The average weekly bond AR generated by the unadjusted BR IA and by the adjusted BR IA is .0006. t, Sign and Wilcoxon tests all indicate no significance at conventional levels of these results.

Table 4.9
Interstate Bank Expansions
Acquiring Bank Bond Sample
Diagnostic Statistics-Adjusted IA Estimate of Equation 4.11

Panel A: Weekly Data

	BL (AC)	JB (Norm)	BP σ(t)	BP σ(M)	adjustment
Bkb1	7.96	11.48*	5.72	0.47	weighted by time
Bkb3	18.74	29.50*	1.46	2.81	smoothed 3 outliers
BAC1	24.66	7.40	4.88	3.63	weighted by time
BAC2	13.42	31.85*	3.49	0.44	smoothed 2 outliers
CMB1	9.75	12.48*	3.21	6.17	smoothed 1 outlier
CMB2	11.88	35.71*	4.87	0.68	smoothed 3 outliers
CHL1	29.11	32.49*	2.95	4.63	smoothed 3 outliers
CCI2	19.84	4.76	5.99	1.43	smoothed 1 outlier
KEY2	27.34	13.89*	3.41	2.15	smoothed 2 outliers
Key3	21.17	117.48*	6.43	5.20	smoothed 3 outliers
SPC	13.48	32.11*	4.32	1.75	smoothed 2 outliers

Panel B: Daily Data

Bkb2	24.89	16.54	1.72	2.58	weighted by time
CHL1	12.47	13.98*	2.59	1.07	smoothed 2 outliers
CMB1	28.45	17.63*	2.88	3.78	smoothed 1 outlier
CHL2	8.97	21.85*	4.78	5.14	smoothed 2 outliers
KEY2	28.63	3.21	0.78	6.11	smoothed 1 outlier
SPC	26.48	21.05*	3.49	2.11	smoothed 2 outliers
CCI2	14.38	7.19	0.91	4.23	weighted by time
KEY3	29.83	483.71*	4.62	0.34	smoothed 4 outliers
BAC	19.47	31.08*	3.42	5.71	smoothed 1 outlier

* significant at the 1% level
For an explanation of the column headings, see Table 4.2.

The average daily bond AR's generated by the various methods are as follows: residual method: .0001; unadjusted BR IA method: .0007; weighting and smoothing adjusted BR IA: .0010; and ARCH adjusted BR IA: -.0003. Again, the t, Sign and Wilcoxon tests indicate that the results are not significantly different from zero at conventional levels of significance.

Given the insignificance of the bond findings, it is not surprising that no significant statistical correlation exists between the AR's for expanding banks' bonds and stocks. The correlation between the AR's for the two classes of securities based on the residual technique is .24 (t=1.04). Based on the adjusted BR IA technique, the correlation is .20 (t=0.86). The insignificance of the correlation means that it is appropriate to estimate bond and stock AR's separately rather than in a multi-equation framework.

In summary, returns to the shares of banks announcing interstate expansion are insignificantly negative, and returns to the bonds are zero. Because these findings do not correspond to either the diversification or the economies of scope and/or scale hypotheses, returns to the shareholders of target banks were examined to determine if these stakeholders had gained from interstate expansion.

Table 4.10
Interstate Bank Expansions
Acquiring Bank Bond Sample
Comparison of Findings of Different Techniques

Panel A: Weekly Data

		---BR IA Model Eq. (4.11)---		
	SFM	Unadj.	Adj.	ARCH adj.
minimum	-.0133	-.0089	-.0089	-.0089
1st quartile	-.0017	-.0024	-.0021	-.0020
median	.0042	.0001	.0001	.0001
3rd quartile	.0088	.0021	.0022	.0020
maximum	.0160	.0123	.0084	.0063
mean	.0004	.0006	.0006	0004
std. deviation	.0088	.0040	.0038	.0035
sample size	22	22	22	22
t statistic	0.21	0.70	0.74	0.54
Sign Test				
no. pos.	11	11	11	11
no. neg.	11	11	11	11
p value	1.00	1.00	1.00	1.00
Wilcoxon Test				
p value	.73	.72	.70	.64

Panel B: Daily Data

	SFM	Unadj.	Adj.	ARCH adj.
minimum	-.0079	-.0058	-.0058	-.0058
1st quartile	-.0009	-.0019	-.0019	-.0019
median	-.0002	.0014	.0009	.0001
3rd quartile	.0011	.0020	.0019	.0010
maximum	.0109	.0123	.0084	.0047
mean	.0001	.0007	.0010	-.0003
std. deviation	.0036	.0038	.0038	.0025
sample size	17	17	17	17
t statistic	.11	.76	1.09	-.49
Sign Test				
no. pos.	8	9	10	9
no. neg.	9	6	7	8
ties	0	2	0	0
p value	1.00	.61	.63	.63
Wilcoxon Test				
p value	.96	.63	.41	.85

4.3.3 For the Shares of the Target Banks

The AAR's, CAAR's and t statistics for the shares of banks which were targets of interstate expansion are given in Table 4.11. The AAR's become significantly positive two days before the announcement, and remain significantly positive until the day after the announcement. The CAAR for this four day period is 0.0930, which is significant at the 1% level, as are all CAAR's around the announcement as shown in Table 4.11.

Diagnostic statistics for the estimate of Equation (4.7) for banks which are the targets of interstate expansions are given in Table 4.12. Lagged market returns were significant variables in determining the returns of three of the 22 (14%) target banks. Similarly, lagged or contemporaneous interest rates were significant in the return series of three interstate target banks. None of the series displayed significant autocorrelation or beta shifts at the time of announcement. Non-normality occurred in 20 of 22 (91%) of the target banks' return series. Eight of the 22 (36%) target banks displayed heteroscedasticity: three with respect to time, two with respect to market returns, and three with respect to both time and market returns. In all, 12 of 22 (55%) return series violated the assumptions of the SFM residual technique in one or more ways, and 95% of the series violated one or more of these assumptions and/or the normality assumption of the t-tests used with the SFM residuals in Table 4.11.

Table 4.11
Interstate Bank Expansions
Target Bank Stock Sample
SFM Model AAR's, CAAR's and Respective t Statistics

Day Relative to Announcement	AAR	t
-10	-.00505	-1.26
- 9	-.00419	-1.05
- 8	-.00734	0.97
- 7	.00390	0.97
- 6	-.00135	-0.34
- 5	.00357	0.89
- 4	-.00305	-0.76
- 3	.00670	1.67
- 2	.02649	6.62**
- 1	.02577	6.44**
0	.03209	8.02**
1	.00865	2.16**
2	-.00470	-1.18
3	-.00638	-1.59
4	.00150	0.37
5	.00311	0.78
6	-.00511	-1.28
7	.00094	0.24
8	-.00018	-0.05
9	.00109	0.27
10	-.00212	-0.53

Cumulation Period	CAAR	t
[-5,0]	.09157	9.35**
[-5,+5]	.09375	7.07**
[-2,+2]	.08830	9.87**
[-1,+1]	.06651	9.60**
[0,+5]	.03427	3.50**

** significant at the 1% level

Diagnostic statistics for estimates of Equation (4.7) adjusted by weighting or smoothing of outliers are shown in Table 4.13. Heteroscedasticity was removed in seven of the eight heteroscedastic series by smoothing two to five outliers. In the other heteroscedastic series, the heteroscedasticity was eliminated by weighting by time. ARCH estimation was also used for the heteroscedastic return series. Three series required an ARCH (1) model, three an ARCH (2) model, and two an ARCH (3) model.

A summarized comparison of the abnormal return estimates for interstate target banks, as generated by the different empirical techniques is given in Table 4.14. The percentage of positive AR's ranges between 59 and 64%, depending on the technique used. The average measure of the daily impact of the announcement of an interstate bank takeover on the share prices of target banks ranges between 0.79% and 1.33%, depending on the technique used. T-tests show the residual and smoothing and weighting adjusted IA techniques to yield significant results at the 5% level. ARCH results are significant at the 11% level, and unadjusted IA results at the 15% level, based on the t-tests. Similarly, the residual and smoothing and weighting adjusted IA results are significant by Wilcoxon tests at the 2.05% level and the 5.75% level, respectively. Unadjusted IA results and ARCH results are significant at 18% at 14% levels of significance, respectively, according to Wilcoxon tests. None of the

Table 4.12
Interstate Bank Expansions
Target Bank Stock Sample
Diagnostic Statistics for Initial IA Estimate of Equation 4.7

	lead/ lag	int	Chow	BL (AC)	JB Norm	BP $\sigma(t)$	BP $\sigma(M)$
ASKA		-1	1.44	20.49	12.77*	1.21	0.04
ABAN	-1		0.12	11.14	359.59*	109.24*	8.01*
MERB			1.37	12.62	27.22*	1.53	0.68
CBRP			0.72	12.42	43.53*	17.71*	3.60
PWST			0.34	18.11	22.82*	0.14	0.23
SUBC	-1		0.00	10.84	9.15	0.26	0.18
AZBW			0.42	11.94	-6.84	3.07	0.54
UBAZ		0	0.13	14.22	514.25*	0.19	47.08*
STBN			1.15	16.60	22.80*	0.34	0.36
CFDY			0.77	24.49	11.84*	2.10	0.00
NJNB			0.52	7.20	413.44*	15.02*	30.01*
ORBN			0.18	20.90	21.28*	11.19*	0.19
NEB			0.30	15.42	24.78*	64.13*	18.12*
SFC		-2	0.03	10.49	353.54*	0.31	5.54
SUN			1.73	24.03	49.57*	0.14	0.55
LBC			1.52	18.38	32.43*	0.56	12.23*
PAB			0.90	19.81	316.29*	0.05	0.13
MGT			0.75	11.62	261.37*	3.19	0.00
FBF	-2		0.19	19.02	21.27*	1.65	0.00
HZB			0.71	13.65	16.58*	4.75	1.35
BAC			0.46	18.47	500.18*	208.00*	3.50
TCB			0.57	8.58	33.81*	0.02	5.94

* significant at the 1% level

For an explanation of the column headings, see Table 4.2.

Table 4.13
Interstate Bank Expansions
Target Bank Stock Sample
Diagnostic Statistics - Adjusted IA Estimate of Equation 4.7

	BL (AC)	JB (Norm)	BP $\sigma(t)$	BP $\sigma(M)$	adjustment
ABAN	4.71	33.86*	1.63	1.34	smoothed 3 outliers
CBRP	13.00	43.03*	7.00	1.54	weighted by time
UBAZ	12.33	53.39*	1.26	0.05	smoothed 2 outliers
NJNB	10.01	194.12*	2.19	2.25	smoothed 1 outlier
ORBN	12.06	28.38*	2.59	0.61	smoothed 5 outliers
NEB	15.68	37.40*	0.00	0.16	smoothed 4 outliers
BAC	12.45	26.77*	0.03	1.50	smoothed 2 outliers
LBC	21.86	9.77*	2.89	3.28	(1,0,0) smoothed 2 outliers

* significant at the 1% level
For an explanation of the column headings, see Table 4.2.

Table 4.14
Interstate Bank Expansions
Target Bank Stock Sample
Comparison of Findings of Different Techniques

Panel A: Summary of Abnormal Returns

	SFM [-1,+1] CAR ÷ 3	-Intervention Analysis Eq. (4.7)- Unadj.	Adj.	ARCH adj.
minimum	-0.0400	-0.0430	-0.0430	-.0592
1st quartile	-0.0051	-0.0116	-0.0102	-.0114
median	0.0128	0.0111	0.0120	.0120
3rd quartile	0.0265	0.0248	0.0261	.0294
maximum	0.0683	0.0649	0.0649	.0649
mean	0.0133	0.0079	0.0118	.0092
std. dev.	0.0242	0.0263	0.0270	.0290
sample size	22	22	22	22

Panel B: Tests of Statistical Significance

t test	2.58**	1.53	2.05*	1.78*
Sign Test:				
no. pos.	14	13	14	13
no. neg.	8	9	8	9
p value	.2863	.5235	.2863	.5235
Wilcoxon				
p value	.0203	.1832	.0575	.1396

** Significant at the 5% level in a two-tailed t-test.
* Significant at the 10% level in a two-tailed t-test.

techniques' findings were significant according to the Sign test at significance levels lower than 29%.

In summary, the shareholders of banks which are the targets of interstate expansion appear to gain from such expansion announcements.

4.4 Summary of Findings on Interstate Bank Expansions

The insignificant AR's experienced by shareholders and bondholders of banks which announce interstate expansions do not provide clear support for either Hypotheses 1 or 2 of Table 3.1, i.e., the economies of scale and diversification hypotheses. The strongest result is the positive returns found for the shareholders of the target banks. This suggests that expanding banks overbid for targets and that wealth is transferred from the shareholders of the expanding banks to the shareholders of the target banks. This is consistent with the bulk of the results in the merger literature (see Jensen and Ruback [1983] for a summary of this literature).

Notes to Chapter 4

1. Convertible debt was not used because such debt combines features of debt and equity, which would complicate the interpretation of hypothesis tests in this investigation. Furthermore, the Bierwag-Roberts model, which will be used later in this study, requires the identification of the duration of the debt under study. Calculating the duration of convertible debt involves making assumptions about the timing of possible conversion. Such forecasts were beyond the scope of this study.

2. Brown and Warner [1980] found that the returns of portfolios examined in event studies were more closely correlated with returns on equally weighted, rather than value weighted, indices.

3. Low R^2 values also occurred for the weekly series CMB1, CCI1 and CCI2. The low value for the CMB1 series may be due to its short duration. Bierwag and Roberts [1989] found their model had lower explanatory power for short duration bonds. The low values for the CCI series may be due to the lack of a frequently traded reference bond.

Chapter 5

Trading Company Expansions: Sample, Methodology and Empirical Results

In this chapter, tests are performed to determine the effects of a bank's announcement of the formation of an export trading company on the bond and share prices of the bank. Export trading companies are firms which engage in international trade in one or more different forms. Some export trading companies may simply act as advisors to parties involved in trade, whereas others are full participants in trade, actually taking title to the goods being traded. It is this ability to become fully involved in trade which is of most interest, because this represents the first time US banks have been permitted to engage in commercial activities. There has been no previous research on this topic. The method of gathering data and forming a sample is described in the following section.

5.1 Sample

Banks were first allowed to establish export trading companies in October 1982, following passage of the Export Trading Company Act and the Bank Export Services Act. Several sources were consulted in order to determine the dates of announcement of banks' export trading company formations: the Wall Street Journal Index, the Funk and Scott Predicasts Index and the American Banker were all checked for the years 1982-1986. Additionally, banks which formed export trading companies were contacted by mail. If none of these sources revealed the date of an announcement of the intention to form an export trading company, then the date the bank applied to the Federal Reserve Board to form a trading company, or the date of the Board ruling permitting such an expansion was used. Notice of such applications and rulings are given in the Federal Reserve Board's H.2 Releases: "Actions of the Board: Applications and Reports Received". These reports are released weekly, although the information they contain is available, by contacting the Federal Reserve, as soon as an application or ruling is made. Applications, and not only rulings, contain important information. Banks have the right to establish export trading companies if the Federal Reserve Board has not disapproved such an investment within 60 days of receiving a bank's application.[2]

Using these means it was possible to identify announcement dates for the formation of 21 export trading companies for which stock price data was available. Two trading companies were formed by a consortium of three banks, so that 24 series of bank returns are examined. Daily stock returns for twelve of the companies were available on CRSP. The other nine companies' stock returns were calculated from

NASD data. Nine of the companies had non-convertible NYSE traded debt, which was also studied. Full details of the sample are given in Appendix 4.

5.2 Methodology

The models used to estimate the abnormal stock and bond returns of banks announcing the formation of an export trading company were identical to those used in the interstate sample discussed in Chapter 4.

5.3 Empirical Findings

5.3.1 For Stock Returns

The AAR's, CAAR's and t statistics generated by the SFM model residual technique for the shares of banks forming export trading companies are given in Table 5.1. None of the measures of abnormal return in the table are significant at the 5% level. Thus, according to the residual technique, the announcement of the formation of an export trading company appears to have no effect on the wealth of the shareholders of the bank involved.

Table 5.1
Export Trading Company Formation
Stock Sample
SFM Model AAR's, CAAR's and Respective t Statistics

Day Relative to Announcement	AAR	t
-10	-.0011	-.35
- 9	-.0021	-.69
- 8	-.0017	-.56
- 7	.0005	.17
- 6	.0033	1.09
- 5	.0053	1.77
- 4	-.0049	-1.65
- 3	.0013	.42
- 2	-.0022	-.74
- 1	.0015	.49
0	-.0052	-1.75
1	-.0006	-.19
2	-.0015	-.50
3	.0004	.13
4	-.0025	-.82
5	-.0024	-.78
6	.0011	.36
7	-.0028	-.95
8	-.0003	-.11
9	-.0008	-.27
10	.0022	.75

Cumulation Period	CAAR	t
[-5,0]	-.0042	-.57
[-5,+5]	-.0108	-1.09
[-2,+2]	-.0080	-1.19
[-1,+1]	-.0043	-.83
[0,+5]	-.0118	-1.61

Diagnostic statistics for the estimate of Equation (4.7) for the shares of banks which announced the formation of trading companies are given in Table 5.2. Leading and/or lagged market returns were significant factors in the returns of three (12%) of the bank stock return series. Leading and/or lagged interest rates were significant in five (20%) of the series. No series displayed autocorrelation, but 19 of 25 (76%) return series tested were non-normal. Six of 25 (24%) of the series displayed heteroscedasticity. Two series were heteroscedastic with respect to time, two were heteroscedastic with respect to the market, and two were heteroscedastic with respect to both time and the market.

Diagnostic statistics for the adjusted IA estimates of Equation (4.7) are given in Table 5.3. All cases of heteroscedasticity were corrected by smoothing outliers. In one case, the smoothing of outliers resulted in a series becoming autocorrelated. This was corrected with a first order autoregressive model. All re-estimated series remained non-normally distributed. ARCH estimation was also used to correct for heteroscedasticity. Three of the heteroscedastic series were modelled with an ARCH (0) specification, and the other four were modelled with an ARCH (1) specification.

A summary of the AR's for the shares of banks forming export trading companies, as generated by the various models employed, is given in Table 5.4. Panel A shows the results for the full sample. In Panel B only the results for the

Table 5.2
Export Trading Company Formation
Stock Sample
Diagnostic Statistics for Initial IA Estimates of Equation 4.7

Bank	Lead /Lag	Int	Chow	BL AC	JB Norm	BP σ(t)	BP σ(M)
BT			-0.66	23.09	0.05	2.30	1.15
CMB			-2.04	13.59	34.90*	3.01	0.50
CCI			-1.02	18.27	20.95*	0.01	0.90
CSFN			1.01	7.97	35.57*	1.26	3.57
CKN			0.75	9.86	21.91*	3.45	0.44
INT			-1.00	18.32	6.68	5.45	2.18
FNBC			-0.69	23.11	27.33*	0.81	2.18
FKNY		+2	-0.11	9.86	698.48*	86.45*	4.40
FTU			0.83	18.32	-3.69	2.14	0.09
FLT			-1.27	30.01	36.58*	40.29*	42.01*
MHC			-0.45	28.03	31.72*	0.20	1.21
NJNB1			-0.21	27.03	201.50*	8.83	37.83*
NJNB2			1.67	11.75	333.74*	1.82	5.80
RAIN			-0.31	13.60	27.41*	0.81	1.95
RMPO1	+2	-2	1.57	23.10	368.30*	35.71*	226.69*
RMPO2			0.58	16.41	257.07*	0.01	0.65
SECP			0.00	18.28	-2.82	5.96	3.34
SHMA		-2,+2	-0.11	11.70	303.75*	9.83*	0.26
SOCI		+1	1.51	7.97	0.13	10.91*	1.15
ULTB1			-0.83	15.49	302.41*	6.81	5.83
ULTB2			0.97	25.07	92.31*	0.61	7.94
SOVN	-1		1.40	24.07	7.48	2.17	2.16
UBAZ	-1,+2		-0.26	15.47	23.70*	9.03	5.76
IRV		-1	1.03	20.22	25.28*	4.92	0.70
VNCP			0.71	16.43	4402.66*	3.86	39.10*

* significant at the 1% level

For an explanation of the column headings, see Table 4.2.

Table 5.3
Export Trading Company Formation
Stock Sample
Diagnostic Statistics - Adjusted IA Estimates of Equation 4.7

Bank	BL (AC)	JB (Norm)	$\sigma(t)$	$\sigma(m)$	adjustment
FLT	29.08	39.30*	0.16	3.72	(1,0,0) smoothed 2 outliers
FKYN	27.47	34.54*	0.19	0.07	smoothed 2 outliers
NJNB1	23.22	16.49*	3.00	0.97	smoothed 7 outliers
RMPO1	15.76	29.68*	1.62	1.37	smoothed 3 outliers
SHMA	17.94	19.68*	2.97	0.20	smoothed 1 outlier
SOCI	9.79	21.89*	3.65	0.22	smoothed 1 outlier
VNCP	16.57	37.18*	1.84	2.46	smoothed 2 outliers

* significant at the 1% level
For an explanation of the column headings, see Table 4.2.

expansions where newspaper announcements were available are considered.

In the full sample, the mean stock AR associated with forming a trading company ranged between -.0019 and -.0005. As was the case for the interstate expansions, the residual method gave the most extreme results. The mean AR generated by the residual method is significantly negative at levels of significance ranging from 7.5% (for the t test) to 8.2% (for the Wilcoxon test). The mean AR's generated by the other techniques are not significantly different from zero at reasonable levels for any of the tests of significance.

When only expansions with clear public announcement dates are considered, the mean stock AR associated with forming a trading company is found to be signifcantly lower. These values range between -.0035 and -.0028. Although none of the mean AR's for this group are significant according to t-tests, the Sign and Wilcoxon tests find the results of all models except the ARCH adjusted model to be negative at levels of significance ranging from 1.3% to 3.5%.

It appears that more information is conveyed by the newspaper announcements than by the Federal Reserve information. Furthermore, when the more informative events are examined, the impact of forming an export trading company on the stockholders of the bank is significantly negative.

Table 5.4
Export Trading Company Formation
Stock Sample
Comparison of Findings of Different Techniques

Panel A: Full Sample

	SFM [-1,+1] CAR ÷ 3	-----IA Model Eq. 4.7----- unadj.	adj.	ARCH adj.
minimum	-.0289	-.0211	-.0211	-.0211
1st quartile	-.0057	-.0056	-.0056	-.0056
median	-.0023	-.0022	-.0015	-.0015
3rd quartile	.0013	.0010	.0001	.0001
maximum	.0196	.0214	.0214	.0214
mean	-.0019	-.0010	-.0007	-.0005
std. deviation	.0088	.0086	.0084	.0084
sample size	24	24	24	24
t test	-1.06	-0.57	-0.41	-0.29
Sign Test				
no. pos.	7	8	8	8
no. neg.	17	15	16	16
ties	0	1	0	0
p value	.0776	.2100	.1516	.1516
Wilcoxon				
p value	.0819	.1909	.2301	.2531

Table 5.4 (continued)
Export Trading Company Formation
Stock Sample
Comparison of Findings of Different Techniques

Panel B: Banks with Newspaper Announcements

	SFM [-1,+1]	-----IA Model Eq. 4.7-----		
	CAR ÷ 3	unadj.	adj.	ARCH adj.
minimum	-.0183	-.0211	-.0211	-.0211
1st quartile	-.0081	-.0086	-.0073	-.0066
median	-.0039	-.0023	-.0019	-.0017
3rd quartile	-.0015	-.0020	-.0001	-.0001
maximum	.0196	.0168	.0168	.0168
mean	-.0035	-.0037	-.0032	-.0028
std. deviation	.0086	.0077	.0076	.0078
sample size	15	15	15	15
t test	-0.41	-0.48	-0.42	-0.36
Sign Test				
no. pos.	3	3	3	4
no. neg.	12	12	12	11
p value	.0129	.0352	.0352	.1185
Wilcoxon				
p value	.0202	.0268	.0332	.0884

5.3.2 For Bond Returns

The percentage of bonds which traded on a daily and on a weekly basis in the sample of bonds of banks which formed export trading companies is given in Table 5.5. As was the case for interstate bank expansions, many sample bonds trade thinly on a daily basis. However, on a weekly basis, the sample bonds traded, on average, on 97% of the weeks studied. Thus, daily and weekly bond AR's will be examined.

The AAR's, CAAR's and t statistics for the bonds of banks forming export trading companies, as generated by the residual method, are shown in Table 5.6. Only one of the measures of abnormal return is significant, that being the day +6 AR of -.0180, which is significant at the 1% level.

The durations of the sample bonds of banks forming export trading companies are given in Table 5.7. The average change in duration between the beginning of the estimation period and the event date is small when daily data is used (.192 years, or 6.52% of the average duration at the beginning of the estimation period). This implies that the constant-duration condition of the BR model is well approximated. However, when weekly data is used, the average change in duration between the beginning of the estimation period and the event date is .834 years, or 19.89% of the average duration at the beginning of the estimation period. This implies that the BR model is less well specified for the sample of weekly bond returns.

Table 5.5
Export Trading Company Formation
Bond Sample
Trading Frequencies

Bond	Trading Frequency Daily(%)	Weekly(%)
BAC	50	94
CMB	86	100
CCI	97	100
FNBC	53	100
MM	26	88
RAIN	31	92
SPAC	67	100
WISC	57	100
avg	58	97

Table 5.6
Export Trading Company Formation
Bond Sample
Residual Method AAR's, CAAR's and t Statistics

Period Relative to Event	Daily AAR	Daily t	Weekly AAR	Weekly t
-10	.0001	0.02	.0050	1.25
-9	.0043	1.15	-.0031	-.78
-8	-.0030	-.81	-.0026	-.65
-7	.0024	0.64	-.0057	-1.42
-6	.0029	0.79	.0032	0.80
-5	.0022	0.60	.0117	2.94
-4	.0037	1.00	.0016	0.40
-3	.0007	0.20	-.0079	-1.98
-2	.0010	0.26	.0012	0.31
-1	.0045	1.22	-.0006	-.14
0	.0044	1.18	.0002	0.05
+1	.0022	0.58	-.0040	-1.01
+2	.0026	0.71	.0058	1.46
+3	.0025	0.67	-.0047	-1.18
+4	-.0018	-.49	-.0017	-.42
+5	.0010	0.27	-.0004	-.10
+6	-.0180	-4.88**	-.0030	-.74
+7	.0029	0.79	.0018	0.44
+8	.0036	0.98	.0006	0.15
+9	.0054	1.46	-.0046	-1.15
+10	.0012	0.32	-.0008	-.19

Cumulation Period	Daily CAAR	Daily t	Weekly CAAR	Weekly t
[-5,0]	.0165	1.82	.0062	0.63
[-5,+5]	.0230	1.87	.0012	0.09
[-2,+2]	.0147	1.78	.0026	0.29
[-1,+1]	.0092	1.44	-.0044	-.64
[0,+5]	.0109	1.20	-.0048	-.49

** significant at 1% in a two-tail t-test.

Table 5.7
Export Trading Company Sample
Bond Durations

Panel A: Daily Data

(A) Bond	(B) Duration at Beginning of Estimation Period	(C) Duration on Event Date	(D) (B)-(C)	(E) Percent Change (B) to (C)
BAC	8.318	8.254	0.064	0.77
CMB	2.601	2.308	0.293	11.26
CCI	8.700	8.831	-.131	-1.51
Chic	3.106	2.830	0.276	8.89
Wisc	6.785	6.826	-.041	-.60
SPac	6.398	6.512	-.114	-1.78
MM	8.004	8.284	-.280	-3.50
Rain	1.421	1.082	0.339	23.86
avg of abs. values	5.667	5.616	0.192	6.52

Panel B: Weekly Data

Bond	Duration at Beginning of Estimation Period	Duration on Event Date	(B)-(C)	Percent Change (B) to (C)
BAC	7.499	8.254	-0.755	-10.07
CMB	3.523	2.308	1.215	34.49
CCI	7.164	8.831	-1.667	-23.27
FNBC	3.773	2.830	0.943	24.99
Wisc	7.054	6.826	0.228	3.23
SPC	6.913	6.512	0.401	5.80
MM	8.322	8.284	0.038	0.46
Rain	2.504	1.082	1.422	56.79
avg of abs. values	5.844	5.616	0.834	19.89

Diagnostic statistics for the initial estimates of the BR model for the bonds of banks which form export trading companies are given in Table 5.8. Non-contemporaneous values of $(R_k - R_q)$ are significant variables in three of eight (37.5%) of weekly bond return series, but are never significant for daily series. None of the series (daily or weekly) was auto- correlated or exhibited significant parameter shifts on the event date. Three of the eight weekly series, and one of the eight daily series displayed heteroscedasticity. All of the heteroscedastic series were heteroscedastic with respect to time, and one was also heteroscedastic with respect to the level of $(R_k - R_q)$. Six out of eight (75%) of each of the daily and weekly series were non-normal.

The diagnostic statistics for the adjusted estimates of Equation (4.11) for the bonds of banks forming export trading companies are given in Table 5.9. Heteroscedasticity was corrected by weighting by time for the daily and weekly CMB series. The other two heteroscedastic weekly series were adjusted by removing one outlier from each. These two series remained non-normal. ARCH estimation was also employed for the heteroscedastic series. One series was modelled as an ARCH (3) process, two were modelled as ARCH (1) processes and one was modelled as an ARCH (0) process.

Table 5.8
Export Trading Company Formation
Bond Sample
Diagnostic Statistics - Initial Estimation of Equation 4.11

Panel A: Weekly Data

Bank	Signif. lead/lag	Chow	BL (AC)	JB (Norm)	BP $\sigma(t)$	BP $\sigma(M)$	R^2
CMB	+1,+2,-1	0.02	21.31	-.27	11.40*	0.35	.87
CCI		1.41	18.90	27.73*	8.33	1.02	.01
FNBC		0.07	26.43	22.56*	3.25	0.49	.61
MM		0.03	28.41	159.49*	0.06	5.32	.22
RAIN	-1	0.13	30.55	140.19*	19.73*	7.46*	.67
SECP		0.25	21.17	0.82	2.61	0.70	.26
BAC	-1,-2	0.24	30.28	108.97*	9.68*	1.85	.53
1stWisc		-1.13	13.21	167.51*	3.12	0.75	.40

Panel B: Daily Data

Bank	Signif. lead/lag	Chow	BL (AC)	JB (Norm)	BP $\sigma(t)$	BP $\sigma(M)$	R^2
BAC		0.00	23.48	188.16*	5.75	4.99	.00
CMB		0.38	31.02	10.96*	18.40*	1.22	.01
CCI		-.16	17.41	23.21*	6.35	1.62	.02
Chic		-.05	16.48	22.90*	2.37	0.45	.00
Wisc		1.77	15.15	214.65*	0.36	0.51	.08
MM		0.91	24.20	173.37*	0.15	6.31	.06
RAIN		0.04	14.27	5.36	2.76	5.50	.02
SPac		1.23	22.04	5.91	0.65	2.72	.02

* significant at the 1% level
For an explanation of the column headings, see Table 4.2.

Table 5.9
Export Trading Company Formation
Bond Sample
Diagnostic Statistics - Adjusted Estimate of Equation 4.11

Panel A: Weekly Data

Bank	BL (AC)	JB (Norm)	BP $\sigma(t)$	BP $\sigma(M)$	adjustment
CMB	9.47	2.13	6.19	3.02	weighted by time
RAIN	25.88	35.18*	4.51	3.21	removed 1 outlier
BAC	21.04	96.35*	2.76	0.50	removed 1 outlier

Panel B: Daily Data

Bank	BL (AC)	JB (Norm)	BP $\sigma(t)$	BP $\sigma(M)$	adjustment
CMB	29.38	8.76	3.14	2.79	weighted by time

* significant at the 1% level

A summary comparison of the bond AR's for banks forming export trading companies, as generated by all the techniques employed, is given in Table 5.10. Based on weekly data, approximately as many bond prices rose as fell on the event date. For daily data, all techniques (except the residual technique) indicate that 75% of the AR's were negative. For the residual technique, only 37.5% of the AR's were negative. The mean bond AR associated with the formation of an export trading company ranges between -.0017 and .0011 when weekly data is used, and between .0008 and .0031 when daily data is used. None of these values are significant using any of the three statistical tests of significance. Furthermore, all techniques yielded insignificant results when only expansions announced in the newspaper were analyzed.

5.4 Summary of Findings on Export Trading Company Formation

The shares of banks forming export trading companies were found to experience negative abnormal returns. The mean stock return was significantly negative when the sample was restricted to banks with newspaper announcements of export trading company formation. No significant abnormal bond return associated with the formation of export trading companies was found. These results are not consistent with either Hypotheses 1 or 2 of Table 3.1, i.e., there is no evidence of diversification or economies of scope or scale related to the formation of an export trading company. Hypotheses 4 (gains captured by target firms) is not applicable in this instance, as the trading companies were formed de novo. The no information hypothesis (Hypothesis 3) is ruled out, as stock returns were found to react significantly. It is likely that the negative stock returns experienced by banks forming export trading companies simply reflect investors' perceptions that these were negative net present value projects.

Table 5.10
Export Trading Company Formations
Bond Sample
Comparison of Findings of Different Methods

Panel A: Weekly Data

	SFM CAR's	------Equation 4.11-------- Unadj.	Adj.	ARCH Adj.
minimum[a]	-.0105	-.0069	-.0069	-.0069
	-.0083	-.0060	-.0060	-.0068
	-.0054	-.0030	-.0015	-.0060
	-.0022	-.0001	-.0001	-.0001
	.0015	.0000	.0000	.0000
	.0057	.0017	.0003	.0007
	.0087	.0025	.0025	.0025
maximum	.0198	.0035	.0037	.0029
mean	.0011	-.0001	-.0001	-.0017
std. deviation	.0094	.0073	.0035	.0039
sample size	8	8	8	8
t statistic	0.33	0.00	-0.08	-1.23
Sign Test				
no. pos.	4	4	4	4
no. neg.	4	3	4	4
ties	0	1	0	0
p value	1.00	1.00	1.00	1.00
Wilcoxon Test				
p value	0.89	0.50	0.50	0.40

[a] All values are listed.

Table 5.10 (con't)
Export Trading Company Formations
Bond Sample
Comparison of Findings of Different Methods

Panel B: Daily Data

	SFM [-1,+1] CAR's ÷3	------Equation 4.11--------		
		Unadj.	Adj.	ARCH Adj.
minimum[a]	-.0035	-.0056	-.0056	-.0056
	-.0022	-.0028	-.0028	-.0028
	-.0020	-.0024	-.0024	-.0024
	.0002	-.0023	-.0023	-.0023
	.0006	-.0018	-.0018	-.0018
	.0018	-.0001	-.0001	-.0001
	.0041	.0021	.0044	.0021
maximum	.0255	.0194	.0194	.0194
mean	.0031	.0008	.0010	.0008
std. deviation	.0088	.0073	.0074	.0073
sample size	8	8	8	8
t statistic	1.00	0.31	0.38	0.31
Sign Test				
no. pos.	5	2	2	2
no. neg.	3	6	6	6
ties	0	0	0	0
p value	0.73	0.29	0.29	0.29
Wilcoxon Test				
p value	0.67	0.33	0.58	0.33

[a] All values are listed.

Notes to Chapter 5

1. Only H.2's from 1984, 1985 and 1986 were available for investigation.

2. No cases of disapproval were found while conducting this investigation.

Chapter 6

Investment Dealer Takeovers: Sample, Methodology and Empirical Findings

In this chapter, the effect on bondholders and shareholders of announcements by Canadian banks of their intention to purchase an investment dealer are examined. The only published study related to this topic analyzes BankAmerica's takeover of the discount broker Charles Schwab and Co. The topic is of substantial current interest because several countries are currently undertaking reforms of their financial services industries to permit the integration of commercial banks and investment dealers. For example, the Securities Industry Association in the US has recently decided to terminate its long fight to preserve the Glass-Steagall Act of 1933 which has effectively kept commercial banks out of all but the discount brokerage segment of the securities business. Also, the Finance Ministry of Japan has announced that in 1993 barriers existing in that country between banking and the securities business will be removed. European countries are currently reforming their financial services sector. The Canadian experience examined herein may provide some insight into the likely impact of financial sector reforms in the US, Japan and Europe, and has the advantage of minimizing "data snooping". This is the term used by Lakonishok and Smidt [1988] for the over-use of standard data sets.

6.1 Sample

Canadian banks were first permitted to purchase Canadian investment dealers effective June 30, 1987. Announcements by banks of their intentions to proceed with such takeovers were identified by searching Canadian newspapers and the Canadian Business Index for the years 1987-1989. Nine such takeovers were announced during this period, and return data was available for all nine. These nine takeovers form the event group for the investment dealer takeover analysis.

Share price and return data were obtained from the Toronto Stock Exchange/University of Western Ontario (TSE/UWO) tape and from the Financial Research Institute's (FRI's) on-line data base. The TSE 300 index (including dividends) was used as a proxy for the market return. The 90 day treasury bill rate was used as the interest rate variable.[1]

Bond prices were obtained from FRI's Bondata data base. The particular issue of a bank's bonds chosen for study was selected according to the criteria discussed in Chapter 4, i.e., time to maturity, trading frequency and lack of special features. Because bond quotes were only available on a weekly basis, much of the analysis in this chapter will be based on weekly observations. However, because the shares of Canadian banks are heavily traded, the weekly analysis will be supplemented with daily analysis for stock returns.[2]

It should be noted that not all of the bond quotes in

FRI's bond database are prices at which actual trades have taken place. Rather, the data is a mixture of actual trading prices and bond traders estimates of market values when no trades occurred. Nunn, Hill and Schneeweis [1986] have found that such data sources can provide better results than databases comprised solely of actual trading prices.

6.2 Methodology

The methodologies used for calculating bond and stock AR's were identical to those used in Chapters 4 and 5. However, the methodologies were applied to weekly data for bonds, and to both daily and weekly data in the case of stocks. In addition to the analysis performed in Chapters 4 and 5, some further tests were conducted on the Canadian data used in this chapter. The new analyses were as follows:

1. Cusum and Quandt ratio tests for structural change;
2. A study of the reaction of the share prices of rival brokerage firms to takeover announcements;
3. A study of the effect on abnormal returns of the timing of the takeover announcement, relative to the 1987 market crash and the announcement of other investment dealer takeovers; and
4. A test of the efficiency of the market in reacting to the takeover announcements, using the Latham [1986] definition of efficiency.

These analyses are described below.

Unal [1989] and Kane and Unal [1988] demonstrate the changing sensitivities of returns on US bank stocks to market returns and interest rates and conclude that it is inappropriate to restrict parameter shifts to the event date (as is done in Equation (4.7)). Parameter shifts at any time over the period examined (i.e., days -90 to +30 relative to the event) were tested by examining the Quandt log likelihood ratio and by using the cusum test. This latter test uses recursive residuals derived by both forward and backward recursive regressions. Both of these tests are described in Brown, Durbin and Evans [1975]. Although no test exists for the significance of the Quandt log likelihood ratio, the minimum values of the ratio indicate points with the greatest likelihood of a parameter shift. Chow tests were performed at these points to check if the shift was significant.

The ability to examine returns to rival investment dealers, which exists with the Canadian sample, permits additional hypotheses about the source of potential AR's to be examined. For example, negative returns to rival brokers would indicate greater competition in brokerage markets due to the entry of the large banks. Positive returns to rival brokers would result if competition in the brokerage market decreased due to some banks' purchase of more than one brokerage firm, thus decreasing the number of competitors. However, all rival brokerage firms may not react to takeover announcements in an identical manner, and the brokerage market may not be the relevant market in which to look for competition. Instead, the market for control of brokerage firms may be where the relevant competition exists. If this were the case, then "in-play" rival brokers (those still eligible to be acquired) may be expected to earn positive AR's upon the announcement of the takeover of a rival, whereas "out-of-play" brokers (those already acquired) would be expected to earn no abnormal return. In this scenario, any positive abnormal return which acquiring banks might have earned due to economies of scope or scale would be lost through competition with other banks for ownership of the target security dealer. The price paid to acquire an investment dealer would be such that each acquisition would be a zero net present value investment for the bank. If the bank's motives for undertaking the expansion were not shareholder value-maximizing (for example, if the motive were diversification), then AR's to acquiring banks would remain negative given control market competition. Thus, the following hypotheses could be added to the ones described in Table 3.3:

Table 6.1
Additional Hypotheses for Sample of Investment Dealer Takeovers

#	Assumption Regarding		Expected Sign of			
#	Expansion Motive	Competition	Acquirer's AR	Target's AR	In-play Rival's AR	Out-of-play Rival's AR
1	sh.holder value max	increased brokerage competition	+	+	-	-
2	sh.holder value max	decreased brokerage competition	+	+	+	+
3	sh.holder value max	control competition	0	+	+	0
4	non share - holder value max	increased brokerage competition	-	+	-	-
5	non share -holder value max	decreased brokerage competition	-	+	+	+
6	non share -holder value max	control competition	-	+	+	0

These hypotheses will be tested by examining the returns to rival brokers.

Because of the timing of the Canadian takeovers and the oligopolistic structure of the financial industry in Canada, the Canadian market reaction may be dependent upon the timing of the takeover announcements relative to the October 1987 market crash and to previous takeover announcements of Canadian investment dealers by Canadian banks. Market observers (see Galt and Lush [1987]) have argued that the Canadian banks which announced acquisitions of investment dealers prior to the October 1987 market crash overpaid for their acquisitions. If investors felt that takeovers announced after the crash were able to be negotiated on terms more favourable to the acquiring banks, then the abnormal returns of banks which announced acquisitions after the crash would be expected to exceed those for banks which preceded the crash. Thus, the null hypothesis for this test of announcement timing is that the abnormal returns to the acquiring Canadian banks were unaffected by the crash, and the alternative hypothesis is that the abnormal returns to the acquiring banks follow an upward step function centred on the crash.

The market structure of Canadian banking has been described as follows:

> In Canadian markets the major Canadian banks compete with one another as

> oligopolists. That is, as sellers having a large share of a market with relatively few competitors, they must take into account the effect of their actions on their competitors' reactions. At the retail level and to a lesser extent in wholesale transactions, banks normally emphasize competition in the services they provide and in other non-price factors. (Royal Commission [1978, p. 244])

Given these market characteristics, other banks could be expected to announce investment dealer acquisitions, once the initial announcement of a takeover was made. However, as more banks acquired investment dealers, the takeover potential and attractiveness of the remaining "in-play" investment dealers increasingly diminished. Any abnormal returns to these investment dealers would be expected to decline as successive acquisitions were consummated. Thus, the null hypothesis for this test of announcement timing is that the abnormal returns of "in-play" investment dealers do not change over time, and the alternative hypothesis is that the abnormal returns of "in-play" investment dealers are a negative function of the number of Canadian investment dealer acquisitions previously announced.

To test if the AR's of the acquiring banks were affected by the market crash of October 1987, the following regression was estimated using Ordinary Least Squares:[3]

$$AAR_i = \alpha_0 + \alpha_1\Phi + u_i \qquad (6.1)$$

where AAR_i = the abnormal return of the acquiring bank over the period from day 0 to day +5 relative to the announcement;

Φ = a step function with an upward step after the October 1987 market crash;

α_0, α_1 = are parameters; and

u_i = an error term which is assumed to have the standard properties.

Under the null hypothesis, the estimated value of α_1 would not be expected to differ significantly from zero. Under the alternative hypothesis, the estimated value of α_1 would be expected to be significantly positive, reflecting higher AR's for acquiring banks after the crash.

To test if the AAR's of the "in-play" investment dealers were affected by successive acquisitions of their rivals, the following regression equation was estimated using OLS:

$$AAR_j = \alpha_0 + \alpha_1\Theta + v_j \qquad (6.2)$$

where: AAR_j = the average abnormal return across "in play" investment dealers over days 0 to +5 relative to the announcement;

Θ = a vector of integers representing the sequence of the takeovers (e.g., 1 for the Canadian Imperial Bank of Commerce's takeover of Gordon Capital, 2 for the Bank of Montreal's takeover of Nesbitt Thomson, etc.);

α_0, α_1 are parameters; and

v_j = an error term which is assumed to have the standard properties.

Under the null hypothesis, the estimated value of α_1 would not be expected to differ significantly from zero, whereas under the alternate hypothesis it would be expected to be significantly negative as AR's to "in-play" investment dealers should decline with successive takeovers.

The traditional definition of informational market efficiency (see Fama [1970]) requires that any abnormal returns which occur due to an event do not persist after the event takes place. This may be tested by observing AR's after the event. Latham [1986] has proposed a definition of informational market efficiency which requires that the revealing of information changes neither equilibrium prices nor portfolio compositions. Thus, if markets are efficient according to this definition, no abnormal trading volume should be observed in shares of companies due to the announcement of a takeover. The following ratio was used to test this hypothesis for the shares of the Canadian banks and investment dealers in this study:

$$\tau_d = \log \frac{\text{Trading volume i}}{\text{Trading volume TSE}} \text{ on day d}$$

where i refers to bank or investment dealer i.

Dividing by the exchange trading volume is designed to remove the day-of-the-week and other seasonal factors in trading volumes. Taking logarithms helps to normalize the volume figures, which are otherwise highly non-normal (see Richardson et al [1986]). The following t-test was computed to test if a specific trading volume within the event window was statistically significant:

$$t = \frac{\tau_d - avg(\tau_d)}{\sigma(\tau_d)} \qquad (6.3)$$

where d is the day relative to the announcement day within the event window, -10 to +10; and avg. and σ are the mean and standard deviation, respectively, which were calculated for the estimation period, -90 to -30.

6.3 Empirical Findings

6.3.1 For the Shares of Acquiring Banks

Daily and weekly SFM model AAR's and CAAR's are given in Table 6.2. The results are reported both including and excluding the Toronto Dominion Bank's acquisition, because the 1987 stock market crash occurred the day after the TD's announcement and thus announcement effects and crash effects may be confounded when the TD's acquisition is considered.

The daily SFM residual results are more sensitive than the weekly findings. Several daily AAR's and one daily CAAR are significantly different from zero whereas no weekly AAR's or CAAR's are significant. The day +1 AAR excluding TD is -.0106, which is significant at the 1% level. (The AAR for the same day including TD is -.0105, which is also significant at

Table 6.2
Investment Dealer Acquisitions
Acquiring Stock Sample
SFM Residual Technique AAR's, CAAR's and t's

	Weekly AAR's		Daily AAR's	
	Incl. TD	Excl. TD	Incl. TD	Excl. TD
-10			.0018	.0018
-9			-.0014	.0004
-8			-.0018	.0011
-7			-.0005	.0013
-6			.0043	.0057
-5	-.0026	-.0017	-.0027	-.0026
-4	-.0063	.0069	.0026	.0010
-3	-.0039	-.0003	-.0027	.0003
-2	.0015	.0034	.0054	.0049
-1	-.0044	-.0008	.0004	-.0033
0	.0002	-.0059	.0010	-.0001
1	-.0025	-.0106	-.0105**	-.0106**
2	.0116	.0125	.0090*	.0013
3	.0087	.0063	-.0026	-.0067
4	-.0054	-.0015	.0017	.0076
5	.0083	.0037	-.0037	-.0074
6			.0065	.0072
7			.0095*	.0023
8			-.0080*	-.0067
9			.0068	.0078*
10			-.0086*	.0019

	Weekly CAAR's		Daily CAAR's	
	Incl. TD	Excl. TD	Incl. TD	Excl. TD
-5,0	-.0155	.0016	.0040	.0002
-5,+5	.0052	.0120	-.0021	-.0156
-2,+2	.0064	-.0014	.0053	-.0078
-1,+1	-.0067	-.0173	-.0091	-.0140*
0,+5	.0209	.0045	-.0051	-.0159

* significant at 5% in a two-tailed t-test
** significant at 1% in a two-tailed t-test

the 1% level.) The [-1, +1] CAAR excluding TD is -.0400, which is significant at the 5% level. No CAAR including TD is significant, although several AAR's in the +2 to +10 period are. These are evenly divided between positive and negative values, and perhaps reflect volatility following the market crash, as only one AAR excluding TD is significant in this period. On balance, the SFM residual results seem to indicate a significant negative bank share price reaction to the announcement of the takeover of an investment dealer.

Diagnostic statistics for the daily and weekly estimates of Equation (4.7) for the shares of banks acquiring investment dealers are given in Table 6.3. Variables other than contemporaneous market returns were only significant in one return series. Both lagged market returns and interest rates were significant factors in the CIBC2 daily series. According to the Chow statistics, no significant beta shifts occurred in the daily series, although one weekly series showed a significant decline in beta at the time of announcement. Cusum and Quandt ratio tests on daily data also showed no significant parameter shifts. Two daily series displayed significant autocorrelation. None of the weekly series was autocorrelated. All of the series, both daily and weekly, were significantly non-normal. Two daily series and no weekly series displayed significant heteroscedasticity. One case of heteroscedasticity appeared to be related to time whereas the other appeared to be related to market returns.

Table 6.3
Investment Dealer Acquisitions
Acquiring Stock Sample
Diagnostic Statistics - Initial Estimate of Equation 4.7

Panel A: Daily Data

Bank	Lead /lag R(M)	Int.	Chow	Cusum	BL (AC)	JB Norm	BP $\sigma(t)$	BP $\sigma(m)$
CIBC1			-1.12	.2989	20.61	30.0*	1.22	0.00
BMO			0.81	.6062	33.33*	13.2*	1.46	0.01
BNS			-1.56	.3711	26.23	21.6*	2.65	1.25
TD			-0.95	.4273	13.52	44.4*	7.01*	0.01
ROY1			1.99	.2663	20.76	21.6*	0.46	0.05
CIBC2	-1	-1,-2	1.01	.6679	11.35	37.5*	5.66	2.07
NAT1			-0.15	.3154	19.62	26.4*	1.61	3.91
NAT2			-0.87	.4032	31.79*	32.5*	0.09	1.98
ROY2			1.17	.4031	21.52	7.2*	1.22	7.10*

Panel B: Weekly Data

Bank	Lead /lag R(M)	Int.	Chow	Cusum	BL (AC)	JB Norm	BP $\sigma(t)$	BP $\sigma(m)$
CIBC1			-1.06		11.75	20.1*	0.14	0.05
BMO			-3.61*		13.57	20.9*	4.03	0.02
BNS			-1.28		19.06	40.6*	0.24	0.64
TD			-1.19		21.21	44.3*	0.08	0.07
ROY1			1.48		14.07	35.4*	0.09	0.51
CIBC2			1.96		22.98	19.2*	0.68	0.35
NAT1			0.98		20.65	52.0*	0.30	0.10
NAT2			1.58		17.76	45.6*	1.53	0.46
ROY2			0.49		14.11	8.7*	0.02	0.50

* significant at the 1% level
For an explanation of the column headings, see Table 4.2.
The critical value of the Cusum test at 1% is 1.143.

The adjustment made to correct for these violations of the SFM model assumptions, and the resulting diagnostic statistics, are given in Table 6.4. Both cases of autocorrelation were corrected with first order autoregressive models, and both cases of heteroscedasticity were corrected by smoothing outliers. An ARCH procedure was also applied to the heteroscedastic series. ARCH (0) models were fit to both heteroscedastic series.

A summary of the abnormal return estimates associated with the announcement of an investment dealer purchase, as generated by the various techniques employed, is given in Table 6.5. On a weekly basis the AR's are .0002 and .0013 including TD and -.0059 and -.0025 excluding TD. The AR's are approximately evenly distributed between negative and positive values, and are insignificantly different from zero according to all tests for all techniques.

On a daily basis, the mean AR ranges from -.0028 to -.0022 including TD, and from -.0051 and -.0027 excluding TD. Four to five of the observations are negative, depending on the technique used. (There are eight observations excluding TD and nine including it.) The only technique to yield statistically significant results is the SFM model excluding TD. The results of this technique are significantly negative at the 5% level according to the t test and at the 9% level according to the Wilcoxon test. The findings of the other

Table 6.4
Investment Dealer Acquisitions
Acquiring Stock Sample
Diagnostic Statistics for Adjusted Estimates of Equation 4.7

Daily Data

Bank	BL (AC)	JB (Norm)	BP $\sigma(t)$	BP $\sigma(m)$	adjustment
BMO	26.18	18.69*	4.01	0.00	(1,0,0)
TD	14.21	53.14*	4.13	0.00	removed 1 outlier
NAT2	22.88	25.37*	0.27	2.65	(1,0,0)
ROY2	22.98	16.73*	5.73	5.88	removed 3 outliers

* significant at the 1% level
For an explanation of the column headings, see Table 4.2.

Table 6.5
Investment Dealer Acquisitions
Acquiring Stock Sample
Comparison of Different Techniques

A: Daily

	SFM [-1,+1]	--Intervention Analysis Eq 4.7--		
	CAR ÷3	unadj.	adj.	ARCH adj.
minimum[a]	-.0121	-.0123	-.0123	-.0123
	-.0118	-.0120	-.0120	-.0120
	-.0104	-.0082	-.0082	-.0082
	-.0072	-.0061	-.0050	-.0050
median	-.0037	.0000	.0001	.0021
	.0006	.0020	.0027	.0022
	.0013	.0032	.0032	.0032
	.0021	.0048	.0048	.0048
maximum	.0161	.0072	.0056	.0056
mean				
incl. TD	-.0028	-.0024	-.0023	-.0022
excl. TD	-.0051	-.0029	-.0030	-.0027
std. dev.				
incl. TD	.0085	.0098	.0067	.0068
excl. TD	.0056	.0072	.0069	.0070
no. obs.				
incl. TD	9	9	9	9
excl. TD	8	8	8	8
t test				
incl TD	-.99	-.73	-1.04	-.97
excl TD	-2.58*	-1.14	-1.22	-1.09
Sign test p values				
incl TD	1.00	1.00	1.00	1.00
excl TD	0.72	1.00	1.00	1.00
Wilcoxon p values				
incl TD	0.37	0.33	0.44	0.44
excl TD	0.09	0.24	0.33	0.33

* significant at the 5% level in a two-tailed t-test
[a] all values are shown

Table 6.5 (continued)
Investment Dealer Acquisitions
Acquiring Share Sample
Comparison of Different Techniques

B: Weekly

	SFM [-1,+1] CAR ÷3	(Equation 4.7) unadj.	(Equation 4.7) adj.	(Equation 4.7) ARCH adj.
minimum[a]	-.0569	-.0563		
	-.0510	-.0488		
	-.0296	-.0061		
	-.0007	-.0017	no adjustments necessary	
median	.0042	.0053		
	.0055	.0155		
	.0220	.0223		
	.0492	.0314		
maximum	.0593	.0502		
incl. TD				
mean	.0002	.0013		
std dev	.0383	.0331		
no obs	9	9		
excl. TD				
mean	-.0059	-.0025		
std dev	.0362	.0332		
no obs	8	8		
t-test				
incl TD	.02	0.12		
excl TD	-.46	-.21		
Sign test p values				
incl TD	1.00	1.00		
excl TD	1.00	1.00		
Wilcoxon p values				
incl TD	0.86	0.68		
excl TD	0.89	1.00		

[a] all values are shown

techniques are consistent with the Saunders and Smirlock finding that banks do not earn abnormal returns in response to the announcement of the takeover of an investment dealer.

6.3.2 For the Bonds of Acquiring Banks

Weekly AAR's, CAAR's and t statistics for the bonds of banks acquiring investment dealers, as generated by the "market" model residual technique are given in Table 6.6. None of the AAR's or CAAR's are significantly different from zero. Thus, bank bond prices do not appear to change upon the announcement of the acquisition of an investment dealer.

The durations of the sample bonds at the beginning of the estimation period, and on the event date are shown in Table 6.7. The use of weekly data again results in a substantial change in duration between the two dates. On average, this change is 1.098 years, or 25.5% of the duration of the bonds at the beginning of the estimation periods. This may pose some difficulty for the BR technique, which is based on constant duration bond portfolios.

Diagnostic statistics for the initial estimates of the BR model (Equation (4.11)) for Canadian bank bonds are given in Table 6.8. No lagged returns were significant, and Chow statistics indicated a significant parameter shift in only one series (that of CIBC2). The direction of the shift was positive. One series was autocorrelated, three displayed

Table 6.6
Investment Dealer Acquisitions
Acquiring Bank Bond Sample
Market Model Residuals

Week Relative to Event	AAR	t
-5	-.0017	-.50
-4	-.0004	-.12
-3	.0003	.09
-2	.0007	.21
-1	-.0005	-.15
0	.0008	.24
1	.0003	.09
2	-.0010	-.30
3	.0007	.21
4	.0021	.63
5	.0007	.21
	CAAR	**t**
[-5,0]	-.0008	-.10
[-5,+5]	.0020	.18
[-2,+2]	.0013	.04
[-1,+1]	.0006	.10
[0,+5]	.0036	.43

Table 6.7
Investment Dealer Acquisitions
Acquiring Bank Bond Sample
Bond Durations

(A)	(B)	(C)	(D)	(E)
Bond	Duration at Beginning of Estimation Period	Duration on Event Day	B - C	Change
BMO	4.378 yrs	3.063 yrs	1.315	30.04
BNS	6.972 yrs	6.270 yrs	0.702	10.07
CIBC1	5.674 yrs	4.917 yrs	0.757	13.34
CIBC2	5.453 yrs	4.587 yrs	0.866	15.88
NAT1	4.846 yrs	3.254 yrs	1.592	32.85
NAT2	4.452 yrs	2.127 yrs	2.325	52.22
ROY1	3.059 yrs	1.836 yrs	1.223	39.98
ROY2	6.385 yrs	6.081 yrs	0.304	4.76
TD	2.655 yrs	1.855 yrs	0.800	30.14
avg	4.875 yrs	3.777 yrs	1.098	25.48

Table 6.8
Investment Dealer Acquisitions
Acquiring Bank Bond Sample
Diagnostic Statistics for Initial Estimate of Eq. 4.11

Bank	Chow	BL (AC)	JB (Norm)	BP σ(m)	BP σ(t)
BMO	1.22	12.37	0.96	3.66	0.21
BNS	0.59	17.00	-0.54	1.02	7.31*
CIBC1	1.40	11.15	20.94*	0.96	0.29
CIBC2	2.91*	11.43	16.44*	5.92	0.15
NAT1	1.47	38.26*	56.91*	2.46	27.28*
NAT2	0.55	13.22	20.88*	0.49	0.81
ROY1	0.70	6.72	3.87	6.84*	0.04
ROY2	1.24	14.55	15.19*	0.02	0.43
TD	1.96	9.62	0.07	1.51	0.15

* significant at the 1% level
For an explanation of the column headings, see Table 4.2.

heteroscedasticity (one with respect to (R_k - R_q), and two with respect to time), and five of the nine series were non-normally distributed.

Diagnostic statistics for adjusted BR estimates are given in Table 6.9. The autocorrelated series was corrected by modelling the residuals as a first order autoregressive process, and the two heteroscedastic series were adjusted by removing one outlier from each series. ARCH estimation was also employed for the heteroscedastic series. An ARCH (0) model was fitted for one heteroscedastic series, and an ARCH (1) model was fitted to the other.

A comparison of the bond AR's generated by all the techniques is given in Table 6.10. The mean estimates of the bond AR's associated with the purchase of an investment dealer range from .0008 to .0016, with 6 of 9 (67%) of the AR's being non-negative for each technique. The only technique to yield a significant result was the adjusted BR technique, which was significantly positive at the 5% level in a t test. Thus bondholders of banks which acquire investment dealers appear to be unaffected.

Table 6.9
Investment Dealer Acquisitions
Acquiring Bank Bond Sample
Diagnostic Statistics for Adjusted Estimate of Eq. 4.11

Bank	BL (AC)	JB (Norm)	BP $\sigma(m)$	BP $\sigma(t)$	adjustment
BNS	14.31	3.78	2.95	4.29	removed 1 outlier
NAT1	9.05	38.06*	1.53	6.32	(1,0,0)
ROY1	8.76	1.32	4.97	3.60	removed 1 outlier

* significant at the 1% level
For an explanation of the column headings, see Table 4.2.

Table 6.10
Investment Dealer Acquisitions
Acquiring Bank Bond Sample
Comparison of Findings of Different Techniques

	SFM resid.	Intervention Analysis Eq. 4.11 BR unadj	BR adj	ARCH
minimum•	-.0034	-.0044	-.0004	-.0010
	-.0028	-.0026	-.0001	-.0004
	-.0016	-.0001	-.0001	-.0001
	.0001	.0000	.0000	.0000
median	.0009	.0001	.0001	.0001
	.0022	.0014	.0014	.0014
	.0034	.0021	.0021	.0016
	.0034	.0044	.0053	.0021
maximum	.0050	.0053	.0063	.0053
mean	.0008	.0012	.0016	.0010
std. dev.	.0028	.0034	.0024	.0018
no. obs.	9	9	9	9
t stat	0.86	1.06	2.00*	1.67
Sign test				
no neg	6	5	5	3
no pos	3	3	3	5
ties	0	1	1	1
p value	0.51	0.73	0.73	0.73
Wilcoxon				
p value	0.37	0.33	0.16	0.89

• All values are shown.
* Significant at the 5% level.

6.3.3 For the Shares of the Target Dealers

Daily and weekly AAR's, CAAR's and t statistics for the target investment dealers are given in Table 6.11. AAR's are reported for the period -20 to +5, because significant abnormal returns were found to occur well before the announcement date. Most of the AAR's are positive, and they are often of considerable magnitude (e.g., .1036 in one day, or .1526 in a week). All of the CAAR's examined in Table 6.11 are positive and significant at the 1% level. Clearly, according to the results produced by the residual method, the shareholders of target firms benefit from the takeover of their firms by banks.

Diagnostic statistics for the initial estimates of Equation (4.7) for the shares of target investment dealers are given in Table 6.12. No variables other than the contemporaneous market returns are significant in explaining the daily returns. However, lagged market returns are a significant factor affecting the weekly return series of two target dealers. On a daily basis, one dealer shows a significant increase in beta at the time of announcement. Chow tests for parameter shifts were not performed on the weekly data series, as these series contained only 5-15 observations after the announcement due to the delisting of the firms upon takeover. Three of the five daily series were autocorrelated; none of the weekly series were. All series (daily and weekly) were non-normally distributed. Two of the five daily series and

Table 6.11
Investment Dealer Acquisitions
Target Stock Sample
Market Model AAR's

	Weekly Data		Daily Data	
	AAR	t	AAR	t
-20			-.0015	-.12
-19			.0375**	2.88
-18			.0058	0.45
-17			.0408**	3.14
-16			.0082	0.63
-15			.0298*	2.29
-14			.0151	1.16
-13			-.0038	-.29
-12			-.0296*	-2.28
-11			.0130	1.00
-10			.0105	0.81
-9			-.0027	-.21
-8			.0121	0.93
-7			.0157	1.21
-6			-.0089	-.68
-5	-.0057	-.16	.0308*	2.37
-4	.1526**	4.26	.0660**	5.08
-3	.0117	0.33	.0378**	2.91
-2	.0856*	2.39	.0152	1.17
-1	-.0189	0.53	.0315*	2.42
0	.3291**	9.19	.1036**	7.97
1	-.0062	-.17	-.0158	-1.22
2	.0144	0.40	.0060	0.46
3	.0075	0.21	.0107	0.82
4	.0095	0.27	.0012	0.09
5	.0093	0.27	-.0060	-.46

	CAAR	t	CAAR	t
[-5,0]	.5544	6.34**	.2849	9.05**
[-5,+5]	.5889	4.98**	.2810	6.59**
[-2,+2]	.4040	5.07**	.1405	4.89**
[-1,+1]	.3040	4.92**	.1193	5.36**
[0,+5]	.3636	4.16**	.0997	3.17**

* significant at the 5% level in a two tailed t test
** significant at the 1% level in a two tailed t test

Table 6.12
Investment Dealer Acquisitions
Target Stock Sample
Diagnostic Statistics for Initial Estimation of Eq. 4.11

Panel A: Daily Data

	Significant Lead/Lag Var.	Chow	BL	JB	σ(t)	σ(m)
NT	none	0.92	23.03	176.4*	0.05	2.91
DS	none	2.11*	58.41*	26.6*	0.23	0.14
LB	none	0.46	20.11	549.9*	23.79*	0.52
GL	none	1.49	32.69*	17.7*	8.86*	7.84*
PEM	none	1.07	32.06*	1023.1*	6.08	4.55

Panel B: Weekly Data

	Significant lead/Lag Var.	Chow[a]	BL	JB	σ(t)	σ(m)
NT			9.97	993.4*	9.72*	0.00
DS			24.25	16.2*	0.53	8.61*
LB	-1 mkt		15.67	143.8*	8.27*	12.01*
GL	-1 mkt		28.68	634.6*	3.90	0.31
PEM			11.24	41.3*	2.05	8.34*

* significant at the 1% level

For an explanation of the column headings, see Table 4.2.

[a] Not computed. (Only 5 to 15 observations exist after the announcement.)

four of the five weekly series displayed heteroscedasticity. Three series were heteroscedastic with respect to time, two with respect to the level of the market return, and two series were heteroscedastic with respect to both of these variables.

Diagnostic statistics for the adjusted estimates of Equation (4.7) for the target investment dealers are shown in Table 6.13. The autocorrelation in the three daily series was removed using first order autoregressive processes. The heteroscedasticity in the weekly series was removed by smoothing outliers. ARCH estimation was also used to deal with heteroscedasticity. Two of the weekly series were modelled with an ARCH (0) process, one with an ARCH (1) process, and one with an ARCH (2) process. For the heteroscedastic daily series, one ARCH (0) process was used, and one ARCH (2) process.

A summary of the AR's for the shares of target investment dealers, as generated by all the techniques employed in the study, is given in Table 6.14. Because the period examined is day [-1,+1] for daily data, and week 0 for weekly data, and because AR's were seen to occur well before takeover, the AR's in Table 6.14 are comparatively low. Mean AR estimates using daily data range from .0351 to .0458. Because of the small sample size, none of these values is significantly different from zero. For weekly data, the mean AR estimates range from .1137 for the ARCH adjusted IA technique to .3291 for the residual technique. All but the ARCH adjusted estimate are

Table 6.13
Investment Dealer Acquisitions
Target Stock Sample
Diagnostic Statistics for Adjusted Estimate of Eq. 4.11

Panel A: Daily Data[a]

	Chow	BL	JB	σ(t)	σ(m)	adjustment
DS	-1.67	19.86	28.8*	0.13	0.01	(1,0,0)
GL	-1.02	12.98	18.2*	7.66*	7.45*	(1,0,0)
PEM	0.69	11.08	287.9*	0.74	0.15	(1,0,0)

Panel B: Weekly Data[b]

	BL	JB	σ(t)	σ(m)	adjustment
NT	8.63	10.2*	3.10	2.78	smoothed 1 outlier
DS	18.76	14.0*	0.00	2.80	smoothed 1 outlier
LB	13.59	17.8*	0.03	0.98	smoothed 4 outliers
PEM	22.65	38.7*	2.09	0.74	smoothed 3 outliers

*significant at the 1% level

For an explanation of the column headings, see Table 4.2.

[a] No leading or lagged variables were significant

[b] Chow statistics were not calculated because only 5 to 15 observations exist after the announcement.

Table 6.14
Investment Dealer Acquisitions
Target Stock Sample
Comparison of Findings of Different Techniques

Panel A: Daily Data

	SFM [-1,+1]	-------Equation (4.11)--------		
	CAR ÷3	unadj.	adj.	ARCH adj.
minimum[a]	-.0239	-.0276	-.0262	-.0054
	.0043	.0094	.0094	.0094
	.0141	.0178	.0130	.0130
maximum	.1459	.1372	.1662	.1662
mean	.0351	.0341	.0406	.0458
std. dev.	.0655	.0619	.0741	.0699
no. obs.	4	4	4	4
t stat.	1.07	1.10	1.10	1.31
Sign Test				
no. pos.	3	3	3	3
no. neg.	1	1	1	1
ties	0	0	0	0
p. value	0.63	0.63	0.63	0.63
Wilcoxon Test				
p value	0.47	0.47	0.47	0.14

[a] All values are listed.

Panel B: Weekly Data

	SFM CAR	-------Equation (4.11)-------- unadj.	adj.	ARCH adj.
minimum[a]	-.0171	-.0175	-.0150	-.0361
	.0994	.0785	.0409	.0344
median	.3108	.1205	.1466	.0423
	.4865	.4537	.4582	.1466
maximum	.7661	.4844	.4918	.3811
mean	.3291	.2239	.2245	.1137
std. dev.	.2788	.2053	.2113	.1459
no. obs.	5	5	5	5
t Test	2.64**	2.44*	2.38*	1.74
Sign Test				
no. pos.	4	4	4	4
no. neg.	1	1	1	1
ties	0	0	0	0
p value	0.38	0.38	0.38	0.38
Wilcoxon Test				
p value	0.08	0.08	0.08	0.14

* significant at the 10% level
** significant at the 5% level

significantly positive at 5% by the t test, and at 8% by the Wilcoxon test. Again the sign test has low power and does not indicate significance for the findings of any of the techniques. The ARCH results are not significant according to any of the tests of statistical significance.

6.3.4 For the Shares of Rival Dealers

AAR's and CAAR's for non-target (rival) investment dealers, as generated by the residual technique for three of the takeovers are given in Table 6.15. Rival dealers are divided into two groups in the table. The first group contains those rival dealers which are still available for acquisition (i.e., "in-play"). The second group contains those dealers that are "out-of-play" (that is, ineligible for acquisition, because they have already been acquired by a bank). The impact upon an investment dealer of the announcement of a rival's takeover appears to depend on the status of the non-target dealer. As shown in Table 6.15, investment dealers which were eligible for acquisition generally experienced significant positive CAAR's over the two multi-day cumulation periods around the announcement of the takeover of rivals. Investment dealers for which takeover announcements had already been made experienced, on average, no significant AR's.

Table 6.15
Investment Dealer Takeovers
Rival Dealers Sample
Residual Method AAR's and CAAR's

Dealer[a]	[-5,+5]	[-1,+1]	[-1]	[0]	[+1]
	-------Day(s) Relative to Announcement------				
Panel A: Reaction to the Takeover of Nesbitt Thomson					
In play	.1321**	.1101**	.0324*	.0734**	.0043
Out of play	.0070	.0078	-.0006	-.0016	.0100
Panel B: Reaction to the Takeover of McLeod, Young, Weir					
In play	.0947*	.0557*	-.0069	.0158	.0468**
Out of play	.0328	.0324	.0122	.0018	.0184
Panel C: Reaction to the Takeover of Dominion Securities					
In play	-.0013	.0640*	-.0105	.0109	.0636**
Out of play	-.0150	.0134	.0177	.0037	-.0080

* significant at the 5% level for a two-tailed t-test

** significant at the 1% level for a two-tailed t-test.

These findings differ from the Saunders and Smirlock [1987] findings that rival firms suffer significant negative AR's when the purchase of another investment dealer was announced. Together with the earlier findings for the shares of banks and target dealers, the findings are consistent with Hypotheses 3 and 6 of this chapter. Both of these hypotheses postulate that the source of the impact upon returns of rival brokers is not something which affects all brokerage firms (e.g., increased or decreased competition in the brokerage industry), but rather something which affects "in-play" firms only (namely, competition in the market for corporate control). This implies that such takeovers will not lead to increased brokerage fees and thus will not have a negative impact on consumers of brokerage services. The reason is that the gains experienced by target firms are not due to monopolization.

These findings for rival dealers differ from the findings for takeovers of Canadian investment dealers by foreign banks. For example, the August 1987 announcement by Security Pacific Corp. of its intention to purchase Burns Fry, and the July 1987 announcement by Deutsche Bank of its intention to buy McLean McCarthy produced no significant AR's for the rival Canadian investment dealers. The reason for this may be that the 50% ownership ceiling on investment dealers placed on foreign banks until July 1988 was perceived to make takeovers by foreign banks relatively unattractive and therefore unlikely. The positive AR's found for "in-play" rival dealers also differ from the insignificant AR's found by Saunders and Smirlock [1987]. A possible explanation is that the smaller number of investment dealers in Canada as compared to the US might have created positive price pressure for dealers remaining as takeover targets. The Canadian government's departure from its policy of requiring expanding financial institutions to create subsidiaries to offer new services (Hockin [1986, p.7]) did nothing to ease this pressure.

6.3.5 The Effects of the Timing of the Takeover Announcements

Equations (6.1) and (6.2) are the equations used to test the hypotheses that the magnitude of the AR's in bank acquisitions of investment dealers are related to the timing of the announcement relative to the market crash of 1987, and announcements of other investment dealer takeovers. The results of estimating these equations are summarized in Table 6.16. The slope estimates in both equations are of the sign predicted by the alternative hypothesis, and both are significant at the 5% level in a one-tailed t test. Based on the r^2 statistics, approximately 40% of the variance in the AR's of the sample firms is explained by the timing variables alone. These results indicate that banks did earn higher AR's for investment dealer takeover announcements made after the market crash, and that the AAR's of "in-play" investment dealers did decrease as more takeovers were announced.

Table 6.16
Investment Dealer Acquisitions
Tests of Timing Hypotheses

Eq.	Sample	Estimated Slope	t	R^2
6.1	Acquiring banks	0.0475	1.91*	0.38
6.2	"In-play" investment dealers	-0.0117	-2.16*	0.44

* Significant at the 5% level in a one-tailed t test.

6.3.6 Market Efficiency

The AAR's in Tables 6.2, 6.6, and 6.11 generally support the traditional notion of market efficiency; that is, that any abnormal returns associated with the event do not persist after announcement. To test Latham's [1986] definition (that the revealing of information changes neither share prices nor trading volumes), the values of Equation (6.3) (the t statistics for the relative trading volumes) must be calculated and analyzed. These t statistics are shown in Table 6.17.

Based on the statistics in Table 6.17, two of the acquiring banks display abnormally high relative trading volume on their takeover announcement dates. The TD's volume was relatively low, but this was due to the abnormally high volume exhibited by the TSE at the time of the TD announcement. This was due primarily to the volatility around the 1987 stock market crash. Whereas the other acquiring banks experienced no abnormal relative volumes within the [-1,+1] event window, all four acquired investment dealers did. Thus, according to Latham's definition, the market would not be considered to be efficient.

Table 6.17
Investment Dealer Acquisitions
Tests of Market Efficiency
t statistics for Relative Trading Volumes

Acquiring Bank

Relative Day	CIBC1	BMO	BNS	TD	ROY1	CIBC2	NAT1	NAT2	ROY2
-10	1.08	-0.05	-0.44	-0.60	0.72	-0.39	0.34	-0.30	-1.80
- 9	-0.13	-0.40	2.96**	-0.94	-0.40	-0.48	1.80	-0.31	-0.89
- 8	0.63	1.21	-2.24*	-1.10	-0.34	-1.17	0.41	1.71	-1.19
- 7	-0.70	-0.37	1.08	0.75	0.46	-0.15	1.80	0.43	0.17
- 6	1.12	0.45	2.98	-0.10	0.91	-0.71	0.80	0.72	-1.84
- 5	0.44	-0.91	-0.03	-1.66	1.22	-1.83	2.11*	-0.38	-1.50
- 4	1.18	0.55	-0.60	0.62	-0.03	-0.75	1.34	-0.67	-2.27*
- 3	-1.05	1.04	3.06**	-0.72	0.18	-1.02	1.33	-0.08	-1.78
- 2	-0.51	1.27	1.27	0.25	0.39	-0.01	0.15	0.78	0.19
- 1	-0.46	1.12	3.43**	-0.85	-1.44	0.84	-0.67	0.17	-0.72
0	-0.21	-0.06	3.55*	-2.01*	-0.35	0.06	0.13	0.07	0.53
1	0.03	0.05	1.83	-0.30	0.47	0.36	1.77	0.63	1.58
2	0.28	-0.24	3.05**	1.61	0.16	-0.54	0.58	-0.91	1.10
3	-0.44	-0.23	-0.73	0.84	0.27	0.18	-0.29	0.76	-0.02
4	-0.64	2.42*	2.01	1.05	0.96	0.65	1.10	-0.57	0.92
5	-0.20	2.16*	0.88	0.04	0.36	0.63	-1.41	0.96	0.54
6	0.24	0.59	1.65	-0.50	0.90	-0.96	-1.11	0.05	-0.59
7	-0.39	0.98	1.71	0.04	0.26	-1.10	-0.66	2.21*	-0.08
8	-0.58	1.17	1.54	0.75	-0.84	-0.29	-2.00	-0.91	3.04**
9	-0.53	1.01	1.88	0.62	-1.28	0.34	-0.33	0.04	-4.57**
10	-0.24	0.93	-0.42	0.59	-0.46	0.03	1.21	-0.16	2.65*

Target Investment Dealer

NT	DS	LB	GL	PEM
-0.69	0.93	0.66	0.78	0.17
-1.47	-0.45	-0.61	0.61	0.21
-0.09	1.21	0.45	0.59	-0.57
0.50	-0.78	0.90	0.88	-0.81
-1.32	0.23	0.97	0.48	0.84
0.00	0.22	-0.13	1.56	0.26
0.87	0.29	0.68	TS	1.28
-0.24	0.70	1.32	TS	TS
-1.11	-0.30	1.72	TS	TS
-0.16	0.33	2.64*	TS	TS
TS[c]	2.85**	1.60	TS	2.85**
2.61*	1.89	1.25	2.85**	3.30**
3.31**	1.84	1.13	1.84	3.17**
2.66**	1.36	0.12	1.16	2.63*
1.96	1.99	1.58	0.71	2.17*
1.43	1.46	0.54	1.73	2.28*
1.33	-1.17	1.64	0.61	4.02**
1.91	0.87	0.26	1.26	2.44*
2.37*	1.56	0.98	0.01	1.64
2.54*	0.50	0.84	-0.47	0.52
1.87	1.33	1.19	1.00	1.08

**Significant at the 0.01 level
* Significant at the 0.05 level

6.4 Summary of Findings on Investment Dealer Acquisition

Banks which announced acquisitions of investment dealers were found to experience zero stock AR's and bond AR's. The shares of target investment dealers experienced large, positive AR's prior to the takeover announcement. Rival investment dealers which were "in-play" also experienced positive stock AR's, but rival investment dealers which had already been acquired experienced no significant AR's. These findings are consistent with Hypotheses three six of this chapter. Although some banks may have benefitted from economies of scope in joint bank/brokerage activities, they banks appear to have overbid for their investment dealers. This transferred wealth to the shareholders of the target firm. The results for the rival dealers suggest that the gains experienced by target firms are due to competition in the market for corporate control and not monopolization in the brokerage market. This is good news for consumers of Canadian brokerage services.

The market was found to be somewhat inefficient in reacting to takeover announcements according to the Latham definition of market efficiency. The stock AR's resulting from the takeovers were found to be related to the timing of the takeover relative to the 1987 market crash and the takeovers of other investment dealers. Specifically, takeover announcements made after the market crash resulted in higher

AR's for the shares of acquiring banks than those made before the crash, and the earlier takeover announcements generally resulted in higher AR's for the target investment dealers.

Notes to Chapter 6

1. Kane and Unal [1988] use returns on long-term government bonds as an interest rate variable to proxy for changes in interest rates. Because an index of long-term Government of Canada bonds was unavailable on a daily basis over the period of this study, it was necessary to use the yield on 90 day treasury bills.

2. All of the six Canadian banks studied traded daily on the TSE during the period studied. Among the target investment dealers, Nesbitt Thomson and Dominion Securities traded daily during the period studied, Levesque Beaubien traded daily on the Montreal Exchange (ME) and for 84% of the days studied on the TSE. Geoffrion Leclerc (GL) traded thinly on the TSE, but it traded on 97% of the days studied on the ME. Therefore, prices of GL on the ME were used to calculate GL returns. The TSE was retained as the market index for GL, because of the very high correlation (98%) between returns on the TSE and ME over the period of the study.

3. The Toronto Dominion Bank's takeover of the Gardiner Group was dropped from the sample for both types of timing tests because of its proximity to the market crash.

Chapter 7

Conclusions and Suggestions for Further Research

This study attempted to determine the motives for and effects of three types of bank expansions; namely, interstate bank expansions; the formation of export trading companies; and the purchase of investment dealers.

The findings do not strongly support either of the major hypotheses of the thesis. These were that expansions are undertaken for diversification purposes or realize economies of scale and/or scope.

The rather small sample sizes used in some of the tests weakened their power. This was clearly a limitation of the study. One avenue for future research could be to undertake a similar investigation using larger sample sizes which will probably become available over time. This may not be possible for the formation of export trading companies. These ventures proved to be very unprofitable and few, if any, new firms have been (or are likely to be) established after the period examined in this study. Also, a high percentage of existing Canadian investment dealers have already been acquired by banks. Thus, it is unlikely that there will be enough new takeovers to substantially increase this sample size.

The one effect which was clearly demonstrated herein was the gain realized by shareholders of target firms. This is a result which has been achieved by many other studies (see Jensen and Ruback [1983]), but has never been satisfactorily explained. Although Halpern [1983] feels that mergers are each a "special case", the persistence of the gain to target firms suggests that, at least in this respect, each merger is not unique. Possible avenues which could be investigated include theories based on information or signalling, perhaps via the method of payment as suggested by Carleton et al [1983]. Additional investigation of the impact of market structure (which proved to be important in the Canadian sample studied herein) in the returns accruing due to expansion may be fruitful.

The Canadian sample provided the most useful results for participants in financial sector reform. However, some of the findings may not be applicable where financial services markets are not oligopolistic, as they are in Canada. First, the Canadian results suggest that there is some opportunity for realizing economies of scope in removing barriers between different types of financial services firms. Managers must be careful not to nullify these economies by overbidding for target firms. Second, the purchase of investment dealers by Canadian banks did not appear to result in the creation of additional market power, so that consumers of brokerage services should not be harmed by the takeovers. Third, the government may have been able to prevent the wealth transfer from the shareholders of acquiring banks to the shareholders of target investment dealers by requiring banks wishing to enter the securities business to create de novo subsidiaries.

Fourth, Canadian markets were found to be inefficient in reacting to takeovers.

The failure to find clear support for either of the major hypotheses does not invalidate the modelling approach of using truncated distributions. This approach yielded clear hypotheses, which may be better tested with a larger sample in a non-banking sector. Because nonbanks would have lower debt ratios, events could be expected to have a greater impact on returns to the bondholders.

The study yielded interesting evidence on the comparative results and efficacies of the various return models employed. The standard SFM residual model consistently gave the most significant results. However, in many cases (especially when daily data was used), many of the assumptions of the technique were violated. When these violations were addressed, (e.g., by the adjusted intervention model), the mean estimated impact of the event usually diminished from what was found by the SFM technique. Similarly, although t-tests clearly yielded the highest level of significance in testing, their use was almost always unjustified due to the non-normality of the data. These results suggest the reconsideration of the results of past studies which used the standard SFM residual methodology and t-tests.

The significance of the results of the Canadian tests regarding timing indicate that timing is a factor which should be considered in event studies. This is the case when the period studied spans one or more of the major market moves recently experienced, or when the industry under investigation is oligopolistic (as is the Canadian financial industry).

The Bierwag-Roberts bond pricing model had high explanatory power when weekly data was used. The insignificance of the results for the bonds studied may be due to the small samples used or the insignificance of the events studied. Applications using larger data sets are recommended. Daily over-the-counter bid and ask bond prices may have proved more effective than the NYSE traded prices used in the American samples of this study.

In summary, this study failed to find significant support for either of its major hypotheses; namely, that banks expand for diversification purposes, or that banks expand to realize economies of scope and/or scale. The insignificance of the findings may be due to the low power of the tests due to small sample sizes. Nevertheless, the approach to modelling using truncated distributions was found to be useful, and the Bierwag-Roberts bond pricing model was shown to have promise for use in event studies. The Canadian results raised several considerations for participants in financial services reform.

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Appendix 1: Derivation of Bank Valuation Model

(1) $$\max_{\alpha_{ij}, b_{ij}, \beta_{ij}} E[U_i\ (e_i,\ \sigma_i^2)]$$

subject to the budget constraint:

(2) $$\overline{m}_i+\Sigma_j\overline{b}_{ij}\overline{B}_j+\Sigma_j\overline{\alpha}_{ij}\overline{S}_j=m_i+\Sigma_j b_{ij}B_j+\Sigma_j\alpha_{ij}S_j+\Sigma_j\beta_{ij}D_j$$

where bars indicate initial values (i.e., endowments)

(3) $$e_i=\Sigma_j\alpha_{ij}x_j^S+R_f m_i+\Sigma_j\beta_{ij}R_D D_j+\Sigma_j b_{ij}x_j^B+E(\mu_i)$$
$$-P(\mu_i<0\cap|\mu_i|<\Sigma_j\beta_{ij}D_j)q(-\mu_i-\Sigma_j\beta_{ij}D_j)$$

(4) $$\sigma_i^2=\Sigma_j\Sigma_k\alpha_{ij}\alpha_{ik}\mathrm{cov}(x_j^S,x_k^S)+\Sigma_j\Sigma_k\alpha_{ij}b_{ik}\mathrm{cov}(x_j^S,x_k^S)+\Sigma_j\Sigma_k b_k b_j(x_k^b,x_j^b)+\mathrm{var}(\phi)$$
$$-2\mathrm{cov}\Sigma_j\alpha_j\mathrm{cov}(\phi_i,x_j^S)-2\mathrm{cov}\Sigma_j b_j\mathrm{cov}(\phi_i,x_j^B)$$

ϕ = penalty when outflows exceed deposit balance

to solve, form the Lagrangian:

(5) $$\ell=E[U_i(e_i,\sigma_i^2)]+\lambda[\overline{m}_i+\Sigma_j\overline{b}_{ij}\overline{B}_j+\Sigma_j\overline{\alpha}_{ij}\overline{S}_j-m_i-\Sigma_j b_{ij}B_j-\Sigma_j\alpha_{ij}S_j-\Sigma_j\beta_{ij}D_j]$$

where λ = a Lagrange multiplier

(6) $$\frac{\partial\ell}{\partial\alpha_i}=\frac{\partial E(U_i)}{\partial e_i}E(X_j^S)+\frac{\partial E(U_i)}{\partial\sigma_i^2}2[\Sigma_k\alpha_{ik}\mathrm{cov}(x_j^S,x_k^S)+\Sigma_k b_k\mathrm{Cov}(x_j^S,\ x_k^B)-\mathrm{cov}(\phi_i,x_j^S)]$$
$$-\lambda_i S_j=0$$

(7) $$\frac{\partial\ell}{\partial\alpha}=\frac{\partial E(U_i)}{\partial e_i}[R_D D_j+qD_j]+\frac{\partial E(U_i)}{\partial\sigma_i^2}[0]-\lambda_i D_j=0$$

(8) $$\frac{\partial\ell}{\partial m_i}=\frac{\partial E(U_i)}{\partial e_i}[R_f]-\lambda_i=0$$

(9) $$\frac{\partial\ell}{\partial b_i}=\frac{\partial E(U_i)}{\partial e_i}E(x\ \ )+\frac{\partial E(U_i)}{\partial\sigma_i^2}2[\Sigma\alpha_{ij}\mathrm{cov}(x_j^S,x_k^B)+\Sigma b_k\mathrm{cov}(x_k^B,x_j^B)-\mathrm{cov}(\phi_i,x_i^B)]$$
$$-\lambda_i B_j=0$$

from (8):

(10) $\lambda_i = \frac{\partial E(U_i)}{\partial e_i} [R_f]$

Substitute (10) into (6), (7) and (9):

(11) $\frac{\partial E(U_i)}{\partial e_i} E(x_j^S) \frac{\partial E(U_i)}{\partial \sigma_i^2} 2[\Sigma_k \alpha_{ik} cov(x_j^S, x_k^S) + \Sigma_k b_{ik} cov(x_j^S, x_k^B) - cov(\phi, x_j^S)]$
$- \frac{\partial E(U)}{\partial e_i} R_f S_j = 0$

(12) $\frac{\partial E(U_i)}{\partial e_i} [R_D D_j + qD_j] - \frac{\partial E(U_i)}{\partial e_i} R_f D_j = 0$

(13) $\frac{\partial E(U_i)}{\partial e_i} E(x_j^B) + \frac{\partial E(U_i)}{\partial \sigma_i^2} 2[\Sigma_k \alpha_{ij} cov(x_j^S, x_k^B) + \Sigma_k b_{ik} cov(x_k^B, x_j^B) - cov(\phi, x_i^B)]$
$- \frac{\partial E(U_i)}{\partial e_i} R_f B_j = 0$

Rearrange (12):

(13a) $\frac{\partial E(U_i)}{\partial e_i} [R_D D_j + qD_j] = \frac{\partial E(U_i)}{\partial e_i} R_f D_j$

Simplify (13a):

(13b) $R_D + q = R_f$

(13c) $R_D - R_f = q$

Rearrange (11), (12) and (13):

(14) $\frac{\partial E(U_i)}{\partial e_i} E(x_j^S) - R_f S_j = - \frac{\partial E(U_i)}{\partial \sigma^2} 2[\Sigma_k \alpha_{ik} \ cov(x_j^S, x_k^S) + \Sigma_k \ b_{ik} \ cov(x_j^S, x_k^B)$
$- cov(\phi_i, x_j^S)]$

(15) $\frac{\partial E(U_i)}{\partial e_i} [(R_D D_j + qD_j) - R_f D_j] = 0$

(16) $\frac{\partial E(U_i)}{\partial e_i} E(x_j^B) - R_f B_j = - \frac{\partial E(Ui)}{\partial \sigma_i^2} 2[\Sigma_k \alpha_{ij} \ cov(x_j^S, X_k^B) + \Sigma_k b_{ik} cov(x_k^B, x_j^B)$
$- cov(\phi, x_j^B)]$

add equations (14), (15) and (16):

$$(17)\quad \frac{\partial E(U_i)}{\partial e_i}\left[E(x_j^S)+E(x_j^B)+R_D D_j+qD_j-R_f D_j-R_f S_j-R_f B_j\right] = -\frac{\partial E(U_i)}{\partial \sigma_i^2}\, 2\left[\Sigma_j \alpha_{ik}\mathrm{cov}(x_j^S,x_k^S)+\Sigma_k b_{ik}\mathrm{cov}(x_j^S,x_k^B)-\mathrm{cov}(\phi_i,x_i^S)+\Sigma_k \alpha_{ij}\mathrm{cov}(x_j^S,x_k^B)+\Sigma_k b_{ik}\mathrm{cov}(x_k^B,x_j^B)-\mathrm{cov}(\phi_i,x_k^B)\right]$$

Take the ratio of a pair of equation (17)'s for two firms:

$$(18)\quad \frac{E(x_k^S)+E(x_k^B)+R_D D_k+qD_k-R_f D_k-R_f S_k-R_f B_k}{E(x_j^S)+E(x_j^B)+R_D D_j+qD_j-R_f D_j-R_f S_j-R_f B_j} =$$

$$\frac{\Sigma_n \alpha_{in}\mathrm{cov}(x_k^S,x_n^S)+\Sigma_n b_{in}\mathrm{cov}(x_k^S,x_n^B)-\mathrm{cov}(\phi_i,x_k^S)+\Sigma_n \alpha_{in}\mathrm{cov}(x_n^S,x_k^B)+\Sigma_n b_{in}\mathrm{cov}(x_k^B,x_n^B)-\mathrm{cov}(\phi_i,x_k^B)}{\Sigma_n \alpha_{in}\mathrm{cov}(x_j^S,x_n^S)+\Sigma_n b_{in}\mathrm{cov}(x_j^S,x_n^B)-\mathrm{cov}(\phi_i,x_j^S)+\Sigma_n \alpha_{in}\mathrm{cov}(x_n^S,x_j^B)+\Sigma_n b_{in}\mathrm{cov}(x_j^B,x_n^B)-\mathrm{cov}(\phi_i,x_j^B)}$$

In equilibrium, all assets must be held by investors:

$$(19)\quad \Sigma_n \alpha_{in}=1$$

$$(20)\quad \Sigma_n b_{in}=1$$

Sum (18) across all individuals and apply (19) and (20):

$$(21)\quad \frac{E(x_k^S)+E(x_k^B)+R_D D_k+qD_k-R_f D_k-R_f S_k-R_f B_k}{E(x_j^S)+E(x_j^B)+R_D D_j+qD_j-R_f D_j-R_f S_j-R_f B_j} =$$

$$\frac{\Sigma_i\left[\Sigma_n \alpha_{in}\mathrm{cov}(x_k^S,x_n^S)+\Sigma_n b_{in}\mathrm{cov}(x_k^S,x_n^B)-\mathrm{cov}(\phi_i,x_k^S)+\Sigma_n \alpha_{in}\mathrm{cov}(x_n^S,x_k^B)+\Sigma_n b_{in}\mathrm{cov}(x_k^S,x_n^B)-\mathrm{cov}(\phi_i,x_k^B)\right]}{\Sigma_i\left[\Sigma_n \alpha_{in}\mathrm{cov}(x_j^S,x_n^S)+\Sigma_n b_{in}\mathrm{cov}(x_j^S,x_n^B)-\mathrm{cov}(\phi_i,x_j^S)+\Sigma_n \alpha_{in}\mathrm{cov}(x_n^S,x_j^B)+\Sigma_n b_{in}\mathrm{cov}(x_j^S,x_n^B)-\mathrm{cov}(\phi_i,x_j^B)\right]}$$

$$(22)\quad \frac{E(x_k^S)+E(x_k^B)+R_D D_k+qD_k-R_f D_k-R_f S_k-R_f B_k}{E(x_j^S)+E(x_j^B)+R_D D_j+qD_j-R_f D_j-R_f S_j-R_f B_j}$$

$$\frac{\overbrace{\Sigma_n\Sigma_i\alpha_{in}}^{=1}\mathrm{cov}(x_k^S,x_n^S)+\overbrace{\Sigma_n\Sigma_i b_{in}}^{=1}\mathrm{cov}(x_k^S,x_n^B)-\Sigma_i\mathrm{cov}(\phi_i,x_k^S)+\overbrace{\Sigma_n\Sigma_i\alpha_{in}}^{=1}\mathrm{cov}(x_n^S,x_k^B)+\overbrace{\Sigma_n\Sigma_i b_{in}}^{=1}\mathrm{cov}(x_k^B,x_n^B)-\Sigma_i\mathrm{cov}(\phi_i,x_k^B)}{\underbrace{\Sigma_n\Sigma_i\alpha_{in}}_{=1}\mathrm{cov}(x_j^S,x_n^S)+\underbrace{\Sigma_n\Sigma_i b_{in}}_{=1}\mathrm{cov}(x_j^S,x_n^B)-\Sigma_i\mathrm{cov}(\phi_i,x_j^S)+\underbrace{\Sigma_n\Sigma_i\alpha_{in}}_{=1}\mathrm{cov}(x_n^S,x_j^B)+\underbrace{\Sigma_n\Sigma_i b_{in}}_{=1}\mathrm{cov}(x_j^B,x_n^B)-\Sigma_i\mathrm{cov}(\phi_i,x_j^B)}$$

$$(23)\quad = \frac{\Sigma_n\mathrm{cov}(x_k^S,x_n^S)+\Sigma_n\mathrm{cov}(x_k^S,x_n^B)-\Sigma_i\mathrm{cov}(\phi_i,x_k^S)+\Sigma_n\mathrm{cov}(x_n^S,x_k^B)+\Sigma_n\mathrm{cov}(x_k^B,x_n^B)-\Sigma_i\mathrm{cov}(\phi_i,x_k^B)}{\Sigma_n\mathrm{cov}(x_j^S,x_n^S)+\Sigma_n\mathrm{cov}(x_j^S,x_n^B)-\Sigma_i\mathrm{cov}(\phi_i,x_j^S)+\Sigma_n\mathrm{cov}(x_n^S,x_j^B)+\Sigma_n\mathrm{cov}(x_j^B,x_n^B)-\Sigma_i\mathrm{cov}(\phi_i,x_j^B)}$$

$$(24)\quad = \frac{\mathrm{cov}(x_k^S,x_M^S)+\mathrm{cov}(x_k^S,x_M^B)-\Sigma_i\mathrm{cov}(\phi_i,x_k^S)+\mathrm{cov}(x_M^S,x_k^B)+\mathrm{cov}(x_k^B,x_M^B)-\Sigma_i\mathrm{cov}(\phi_i,x_k^B)}{\mathrm{cov}(x_j^S,x_M^S)+\mathrm{cov}(x_j^S,x_M^B)-\Sigma_i\mathrm{cov}(\phi_i,x_j^S)+\mathrm{cov}(x_M^S,x_j^B)+\mathrm{cov}(x_j^B,x_M^B)-\Sigma_i\mathrm{cov}(\phi_i,x_j^B)}$$

$$(25)\quad = \frac{\mathrm{cov}(x_k^S,x_M)-\Sigma_i\mathrm{cov}(\phi_i,x_k^S)+\mathrm{cov}(x_k^B,x_M)-\Sigma_i\mathrm{cov}(\phi_i,x_k^B)}{\mathrm{cov}(x_j^S,x_M)-\Sigma_i\mathrm{cov}(\phi_i,x_j^S)+\mathrm{cov}(x_j^B,x_M)-\Sigma_i\mathrm{cov}(\phi_i,x_j^B)}$$

$$(26)\quad = \frac{\mathrm{cov}(x_k^S+x_k^B,x_M)-\Sigma_i\mathrm{cov}(\phi,x_k^{s+B})}{\mathrm{cov}(x_j^S+x_j^B,x_M)-\Sigma_i\mathrm{cov}(\phi,x_k^{s+B})}$$

When many individuals are considered, $\Sigma_i\phi_i$ will tend toward zero. Thus the term $\Sigma_i\mathrm{cov}(\phi_i,x_n^{s+B})$ will henceforth be omitted.

(27) $$\frac{E(x_k^S)+E(x_k^B)+R_D D_k+qD_k-R_f D_k-R_f S_k-R_f B_k}{E(x_j^S)+E(x_j^B)+R_D D_j+qD_j-R_f D_j-R_f S_j-R_f B_j} = \frac{\mathrm{cov}(x_k^S+x_k^B,x_M)}{\mathrm{cov}(x_j^S+x_j^B,x_M)}$$

(28) $$\frac{E(x_k^S)+E(x_k^B)+R_D D_k+qD_k-R_f D_k-R_f S_k-R_f B_k}{\mathrm{cov}(x_k^S+x_k^B,x_M)} = \frac{E(x_j^S)+E(x_j^B)+R_D D_j+qD_j-R_f D_j-R_f S_j-R_f B_j}{\mathrm{cov}(x_j^S+x_j^B,x_M)} = \Theta$$

where Θ = a common ratio for all firms.

Sum (28) across all firms:

(29) $$\frac{\Sigma_k[E(x_k^S)+E(x_k^B)+R_D D_k+qD_k-R_f D_k-R_f S_k-R_f B_k]}{\Sigma[\mathrm{cov}(x_k^S+x_k^B,x_M)} = \frac{E(x_M)+R_D D_M+qD_M-R_f M}{\mathrm{var}(x_M)}$$

Substitute RHS of (29) into (28). (28) will hold for Σ_k because it holds for all k.

(30) $$\frac{E(x_k^S)+E(x_k^B)+R_D D_k+qD_k-R_f D_k-R_f S_k-R_f B_k}{\mathrm{cov}(x_k^{B+s},x_M)} = \frac{E(x_M)+R_D D_M+qD_M-R_f M}{\mathrm{var}(x_M)}$$

(31) $$[E(x_k^S)+E(x_k^B)+R_D D_k+qD_k-R_f D_k-R_f S_k-R_f B_k][\mathrm{var}(x_M)]=[\mathrm{cov}(x_k^{B+s},x_M)][E(x_M)+R_D D_M+qD_M-R_f M]$$

(32) $$[-R_fD_k-R_fS_k-R_fB_k][\mathrm{var}(x_M)]=-[E(x_k^S)+E(x_k^B)+R_DD_k+qD_k][\mathrm{var}(x_M)]+[\mathrm{cov}(x_k^{B+s},x_M)]\times[E(x_M)+R_DD_M+qD_M-R_fM]$$

(33) $$D_k+S_k+B_k = \frac{1}{R_f}\quad E(x_k^S)+E(x_k^B)+R_DD_k+qD_k-\frac{[\mathrm{cov}(x_k^{B+s},x_M)][E(x_M)+R_DD_M+qD_M-R_fM]}{\mathrm{var}(x_M)}$$

Rearrange, and substitute in (13c) to get the final valuation equation:

(34) $$V_k = \frac{1}{R_f}\quad E(X_k^S)+E(x_k^B)+R_DD_k+(R_f-R_D)D_k-\frac{[\mathrm{cov}(x_k^{B+s},x_M)][E(x_M)+R_DD_M+(R_f-R_D)D_M-R_fM]}{\mathrm{var}(x_M)}$$

Appendix 2: Derivatives of Security Values with respect to E(x) and $\sigma(x)$

Derivative of σ_{BM} with respect to σ_x:

From Lintner [1978] p. 18, eq. 2.17 and 2.12

$$\sigma_{BM} = \sigma_{xM}[G(p)-G(d)] \quad \text{where } p= \frac{P-E(x)}{\sigma} \quad d= \frac{D-E(x)}{\sigma}$$

$$G(p)= \int_{-\infty}^{\frac{P-E(x)}{\sigma}} (1/\sqrt{2\pi})e^{-\frac{x^2}{2}} \qquad G(d)= \int_{-\infty}^{\frac{D-E(x)}{\sigma}} (1/\sqrt{2\pi})e^{-\frac{x^2}{2}}$$

$$\frac{\partial G(p)}{\partial \sigma_x} = -\sigma_x(P-E(x))^{-2} \frac{1}{\sqrt{2\pi}} e^{-\frac{1}{2}\left(\frac{P-E(x)}{\sigma}\right)^2}$$

$$\frac{\partial G(d)}{\partial \sigma_x} = -\sigma_x(D-E(x))^{-2} \frac{1}{\sqrt{2\pi}} e^{-\frac{1}{2}\left(\frac{D-E(x)}{\sigma}\right)^2}$$

$$\left(\frac{D-E(x)}{\sigma}\right)^2 > \left(\frac{P-E(x)}{\sigma}\right)^2 \; ; \; e^{-a} < e^{-b} \text{ when } a > b \therefore \frac{\partial G(p)}{\partial \sigma_x} > \frac{\partial G(d)}{\partial \sigma_x}$$

$$\frac{\partial \sigma_{BM}}{\partial \sigma_x} = \frac{\partial \sigma_{xM}}{\partial \sigma_x}[G(p)-G(d)]+\left(\frac{\partial G(p)}{\partial \sigma_x} - \frac{\partial G(d)}{\partial \sigma_x}\right)\sigma_{xM} \quad > 0$$

Therefore $\frac{\partial \sigma_{BM}}{\partial \sigma_x} > 0$

Derivative of σ_{sM} with respect to E(x):

$$\sigma_{sM} = [1-G(p)]\sigma_{xM} \qquad \text{where } p = \frac{P-E(x)}{\sigma_x}$$

$$G(p) = \int_{-\infty}^{\frac{P-E(x)}{\sigma}} (1/\sqrt{2\pi})\, e^{-\frac{1}{2}\left(\frac{P-E(x)}{\sigma}\right)^2}$$

$$\frac{\partial G(p)}{\partial E(x)} = -\frac{1}{\sigma\sqrt{2\pi}}\, e^{-\frac{1}{2}\left(\frac{P-E(x)}{\sigma}\right)^2} < 0$$

$$\frac{\partial[1-G(p)]}{\partial E(x)} > 0$$

$$\frac{\partial\sigma_{sM}}{\partial E(x)} = \underbrace{\frac{\partial[1-G(p)]}{\partial E(x)}}_{+}\ \underbrace{\sigma_{xM}}_{+} + \underbrace{\frac{\partial\sigma_{xM}}{\partial E(x)}}_{0}\ \underbrace{[1-G(p)]}_{+} > 0$$

$$= +$$

Therefore, $\frac{\partial\sigma_{sM}}{\partial E(x)} > 0$

Derivative of σ_{sM} with respect to σ_x:

From Lintner [1978] p. 19 (eq. 2.23):

$$\sigma_{sM} = [1-G(p)]\sigma_{xM} \quad \text{where } p = \frac{P-E(x)}{\sigma_x}$$

$$G(p) = \int_{-\infty}^{\frac{P-E(x)}{\sigma}} (1/\sqrt{2\pi}) e^{-\frac{x^2}{2}}$$

$$\frac{\partial G(p)}{\partial \sigma_x} = -\sigma_x (P-E(x))^{-2} \frac{1}{\sqrt{2\pi}} e^{-\frac{1}{2}\left(\frac{P-E(x)}{\sigma}\right)^2}$$

$$- \quad + \quad + \quad = -$$

$$\frac{\partial [1-G(p)]}{\partial \sigma_x} > 0$$

$$\frac{\partial \sigma_{sM}}{\partial \sigma_x} = \underbrace{\frac{\partial [1-G(p)]}{\partial \sigma_x}}_{+} \underbrace{\sigma_{xM}}_{+} + \underbrace{\frac{\partial \sigma_{xM}}{\partial \sigma_x}}_{+} \underbrace{[1-G(p)]}_{+}$$

Therefore, $\frac{\partial \sigma_{sM}}{\partial \sigma_x} > 0$

Derivative of σ_{BM} with respect to E(x):

From Lintner[1978], p. 19 (eq. 2.24):

$$\sigma_{BM} = \sigma_{xm}[G(p)-G(d)] \text{ where } p = \frac{P-E(x)}{\sigma_x} \quad d= \frac{D-E(x)}{\sigma_x}$$

$$G(p)= \int_{-\infty}^{\frac{P-E(x)}{\sigma}} (1/\sqrt{2\pi})e^{-\frac{x^2}{2}} \qquad G(d)= \int_{-\infty}^{\frac{D-E(x)}{\sigma}} (1/\sqrt{2\pi})e^{-\frac{x^2}{2}}$$

$$\frac{\partial G(p)}{\partial E(x)} = -\frac{1}{\sigma_x\sqrt{2\pi}} e^{-\frac{1}{2}\left(\frac{P-E(x)}{\sigma}\right)^2} \qquad \frac{\partial G(d)}{\partial E(x)} = -\frac{1}{\sigma_x\sqrt{2\pi}} e^{-\frac{1}{2}\left(\frac{D-E(x)}{\sigma}\right)^2}$$

$$\frac{\partial\sigma_{BM}}{\partial E(x)} = \underbrace{\underbrace{\frac{\partial\sigma_{xM}}{\partial E(x)}}_{0}\underbrace{[G(p)-G(d)]}_{+}}_{0} + \underbrace{\underbrace{\left(\frac{\partial G(p)}{\partial E(x)} - \frac{\partial G(d)}{\partial E(x)}\right)}_{-}\underbrace{\sigma_{xM}}_{+}}_{-}$$

0 + - = -

Therefore $\frac{\partial\sigma_{BM}}{\partial E(x)} < 0.$

Derivative of $E(x_s)$ with respect to $E(x)$:

$E(x_s)=\sigma[g(p)-p(1-G(p))]$ where $p=\frac{P-E(x)}{\sigma}$

$$= \frac{\sigma_x}{\sqrt{2\pi}} e^{-\frac{1}{2}\left(\frac{P-E(x)}{\sigma}\right)^2} - [P-E(x)] - [P-E(x)] \int_{-\infty}^{\frac{P-E(x)}{\sigma}} (1/\sqrt{2\pi}) e^{-\frac{1}{2}}$$

$$\frac{\partial E(x_s)}{\partial E(x)} = \left(\frac{P-E(x)}{\sigma_x}\right) \frac{1}{\sqrt{2\pi}} e^{-\frac{1}{2}\left(\frac{P-E(x)}{\sigma}\right)^2} +1+ \int_{-\infty}^{\frac{P-E(x)}{\sigma}} (1/\sqrt{2\pi}) e^{-\frac{x^2}{2}} +$$

$$E(x)\left(\frac{1}{\sqrt{2\pi}} e^{-\frac{1}{2}\left(\frac{P-E(x)}{\sigma}\right)^2}\right)$$

The terms in the derivative have the following signs:

Term 1	Term 2	Term 3	Term 4
-	+	+	+

The absolute value of term 4 is greater than that of term 1. Therefore, $\frac{\partial E(x_s)}{\partial E(x)} > 0$.

Derivative of $E(x_s)$ with respect to σ_x:

From Lintner [1978], p. 18 (eq. 2.13 and 2.12):

$$E(x_s) = {}_x[g(p)-p(1-G(p))] \qquad \text{where } p= \frac{P-E(x)}{\sigma_x}$$

$$= \frac{\sigma_x}{\sqrt{2\pi}}\, e^{-\frac{1}{2}\left(\frac{P-E(x)}{\sigma_x}\right)^2} - (P-E(x)) - (P-E(x)) \int_{-\infty}^{\frac{P-E(x)}{\sigma}} (1/\sqrt{2\pi})\, e^{-\frac{x^2}{2}}$$

$$\frac{\partial E(x_s)}{\partial \sigma_x} = \frac{1}{\sqrt{2\pi}}\, e^{-\frac{1}{2}\left(\frac{P-E(x)}{\sigma}\right)^2} - \frac{\sigma}{\sqrt{2\pi}}[-(P-E(x))^2\sigma^{-3}]\, e^{-\frac{1}{2}\left(\frac{P-E(x)}{\sigma}\right)^2} -$$

$$(P-E(x))\frac{1}{\sqrt{2\pi}}\, e^{-\frac{1}{2}\left(\frac{P-E(x)}{\sigma}\right)^2}\left(\frac{-P-E(x)}{\sigma}\right)$$

The first term of the derivative is positive. The second and third terms cancel. Therefore, $\frac{\partial E(x_s)}{\partial\, \sigma_x} > 0$.

Derivative of $E(x_B)$ with respect to σ_x:

$$E(x_B)=\sigma_x(g(D)-D(1-G(D))-g(P)+P(1-G(P)))$$

where $d= \frac{D-E(x)}{\sigma}$, $p = \frac{P-E(x)}{\sigma}$

$$E(x_B)=\frac{1}{\sqrt{2\pi}} e^{-\frac{1}{2}\left(\frac{D-E(x)}{\sigma}\right)^2} + [D-E(x)][1- \int_{-\infty}^{\frac{D-E(x)}{\sigma}} (1/\sqrt{2\pi})e^{-\frac{x^2}{2}} - \frac{\sigma_x}{\sqrt{2\pi}} e^{-\frac{1}{2}\left(\frac{P-E(x)}{\sigma}\right)^2}$$

$$-[p-E(x)][1- \int_{-\infty}^{\frac{P-E(x)}{\sigma}} (1/\sqrt{2\pi})e^{-\frac{x^2}{2}}$$

$$\frac{\partial E(x_B)}{\partial \sigma_x} = \frac{1}{\sqrt{2\pi}} e^{-\frac{1}{2}\left(\frac{D-E(x)}{\sigma}\right)^2} + \frac{\sigma}{\sqrt{2\pi}} (-\tfrac{1}{2}[D-E(x)]^2\sigma^{-3})+$$

$$(D-E(x))(D-E(x))\sigma^{-2} \frac{1}{\sqrt{2\pi}}e^{-\frac{1}{2}\left(\frac{D-E(x)}{\sigma}\right)^2} - \frac{1}{\sqrt{2\pi}} e^{-\frac{1}{2}\left(\frac{P-E(x)}{\sigma}\right)^2} -$$

$$\frac{\sigma}{\sqrt{2\pi}}(-\tfrac{1}{2}[P-E(x)]^2\sigma^{-3} - (P-E(x))(P-E(x))\sigma^{-2} \frac{1}{\sqrt{2\pi}}e^{-\frac{1}{2}\left(\frac{P-E(x)}{\sigma}\right)^2}$$

The terms in the derivative have the following signs:

Term 1	Term 2	Term 3	Term 4	Term 5	Term 6
+	-	+	+	-	+

$|\text{term } 4| > |\text{term } 1|$ because $e^{-|a|} > e^{-|b|}$ when $a < b$

$|\text{term } 2| > |\text{term } 5|$ because $|D-E(x)| > |P-E(x)|$

$|\text{term } 3| < |\text{term } 6|$ because $a^2e^{-a} > b^2e^{-b}$ when $a < b$

therefore $\frac{\partial E(x_B)}{\partial \sigma_x} < 0$

Derivative of $E(x_B)$ with respect to $E(x)$:

From Lintner [1978] p. 18, eq. 2.17 and 2.12

$$E(x_B)=\sigma_x[g(d)-d(1-G(d))-g(p)-p(1-G(p))]$$

where $d = \frac{D-E(x)}{\sigma}$ $\quad p= \frac{P-E(x)}{\sigma}$

$$E(x_B)= \frac{\sigma_x}{\sqrt{2\pi}}\, e^{-\frac{1}{2}\left(\frac{D-E(x)}{\sigma_x}\right)} - (D-E(x))\,(1- \int_{-\infty}^{\frac{D-E(x)}{\sigma}} (1/\sqrt{2\pi})\, e^{-\frac{x^2}{2}}$$

$$- \frac{\sigma_x}{\sqrt{2\pi}}\, e^{-\frac{1}{2}\left(\frac{P-E(x)}{\sigma_x}\right)} + (P-E(x)\,(1- \int_{-\infty}^{\frac{P-E(x)}{\sigma}} (1/\sqrt{2\pi})\, e^{-\frac{x^2}{2}}$$

$$\frac{\partial E(x_B)}{\partial E(x)} = \frac{\sigma}{\sqrt{2\pi}}\, (D-E(x))\,\sigma^{-2} e^{-\frac{1}{2}\left(\frac{D-E(x)}{\sigma}\right)^2} - \frac{D}{\sqrt{2\pi}}\, e^{-\frac{1}{2}\left(\frac{D-E(x)}{\sigma}\right)^2}$$

$$- \frac{\sigma}{\sqrt{2\pi}}\, (P-E(x))\,\sigma^{-2} e^{-\frac{1}{2}\left(\frac{P-E(x)}{\sigma}\right)^2} + \frac{P}{\sqrt{2\pi}}\, e^{-\frac{1}{2}\left(\frac{P-E(x)}{\sigma}\right)^2}$$

The terms in the derivative have the following signs:

<u>Term 1</u>	<u>Term 2</u>	<u>Term 3</u>	<u>Term 4</u>
-	+	-	+

The magnitude of the last two terms is greater than that of the first two because $e^{-\frac{1}{2}\left(\frac{P-E(x)}{\sigma}\right)^2} < e^{-\frac{1}{2}\left(\frac{D-E(x)}{\sigma}\right)^2}$,

therefore $\frac{\partial E(x_B)}{\partial E(x)} > 0$.

Appendix 3: Estimation of the Market Price of Risk and Market Variance

The derivation of the bank model in Appendix 1 yields the following expression for the market price of risk:

$$\Gamma = E(x_M) + R_D D_j + (R_F - R_D)D_j - R_F M$$

where all returns are gross amounts (i.e., 1 + net rate of return). An estimate of this value (Using data from the 1980 period) may be obtained as follows:

$$E(x_M) = V_S\,[1+ \text{avg}(P/E \text{ ratio})^{-1}] + V_B(1+ \text{avg coupon rate})$$

$$\$1571B\ [1 + (1/7)^{-1}] \quad + \$1383B\ (1 + 0.13) \quad = \quad \$3358B$$

	↓	↓	↓	↓
from:	Lorie et al. [1985, p. 7]	Sharpe [1981] p. 393	Sharpe [1981] p. 270	Van Horne [1984] p. 82 & 183

$$R_D D_j = (1 + \text{deposit rate})\ D_j$$

$$= (1 + 0.10)\quad \$1192 \text{ Billion} \qquad = \quad \$1311B$$

	↓	↓
from:	est. at 1% below R_F Van Horne [1984] p. 82	Roussakis [1984] p. 148

$$(R_F - R_D)D_j = (1.11 - 1.10)\ \$\ 1192 \text{ Billion} \qquad = \quad \$\ 12B$$

$$-R_F M = (1.11)(\$1571B + \$1383) \qquad = (\$3279B)$$

Total Price of Risk $1402B

Market Variance:

Ibbotson and Sinquefield [1982] report that the average nominal returns and standard deviations of bonds and stocks over the period 1926 - 1981 were as follows:

	Nominal Avg. Return	σ(Nominal Avg. Return)
Long Term Gov't Bonds	3.0%	5.7%
Long Term Corp. Bonds	3.6%	5.6%
Common Stocks	9.1%	21.9%

Weighting stocks and bonds equally (as per their approximate market values), the average standard deviation (13.75%) is approximately 2.2 times the average return (6.2%). Applying this ratio to the net return yields

(1/7) x $1571B + .13 X $1383B = $404B x 2.2 = $890 Billion

as an estimate of the market standard deviation ($\$8.9 \times 10^{12}$).

Therefore, an estimate of market variance would be $\$7.9 \times 10^{25}$

Appendix 4: Samples

1. Interstate Bank Expansion Sample - Stock

Acquiring Bank		Target Bank		Date
Sym.	Name/(State)	Name/(State)	Sym.	
MM	Marine Midland (New York)	Industrial Valley Bk		July 27 81
NOR	Norstar Bancorp (New York)	Northeast Bankshare (Maine)	NEB	Sept 23 82
BKB1	1st Nat'l Boston (Mass.)	Casco-Northern (Maine)		Mar. 11 83
INT1	1st Interstate	Big Stone State (S. Dakota)		Apr. 22 83
BAC1	BankAmerica (Calif.)	Seafirst (Wash)	SFC	Apr. 25 83
GBS1	Gen'l Bancshares (Missouri)	1st Nat Bk Savannah (Tennessee)		June 15 83
GBS2	Gen'l Bancshares (Missouri)	Mid Central B'shares		June 22 83
BKNY	Bank of New York (New York)	Northeast Bancorp (Conn.)		Aug. 3 83
NCB1	NCNB (N. Carolina)	Ellis Bank'g Corp (Florida)		Aug. 17 83
BKB2	Bank of Boston (Mass.)	Colonial Bancorp (Conn.)		Oct. 3 83
MEL	Mellon Corp (Penn.)	Heritage Bank (N.J.)		Oct. 4 83
BKB3	Bank of Boston (Mass.)	RIHT Fin'l Corp (R.I.)		Nov. 23 83
	Trust Co Ga. (Georgia)	Sun Banks (Florida)	SUN	July 3 83
BNE	Bank of New Eng. (Mass.)	Maine Nat'l Corp. (Maine)		Feb. 14 84

ZION	Zions Utah Bncp. (Utah)	Wyoming Nat'l Bank (Penn.)		Aug. 19 84
KEY1	Key Banks (New York)	Alaska Pacific Bncp. (Alaska)	ASKA	Oct. 26 84
CHL1	Chemical (New York)	Florida Nat'l (Florida)		Nov. 27 84
CSG	Cit&S. Ga. (Georgia)	Landmark Banking (Florida)	LBC	Feb. 21 85
CCI1	Citicorp (New York)	de novo (Maryland)		Mar. 8 85
CMB1	Chase Manhattan (New York)	de novo (Maryland)		Mar. 15 85
CHL2	Chemical (New York)	Home State Sav. Bk. (Ohio)		Apr. 3 85
NBD	NBD Bancorp (Michigan)	Midwest Commerce Ind.		May 21 85
WAC	Wachovia (N. Carolina)	First Atlanta Co. (Georgia)		June 18 85
FTU1	Fst. Union Corp. (N. Carolina)	Atlantic Bancorp (Florida)	ABAN	June 18 85
FTH	Fifth Third Bncp (Ohio)	American Bancorp (Kentucky)		July 30 85
SOVN1	Sovran Fin'l (Virginia)	DC Nat'l Bancorp (Wash., DC)		July 2 85
NCB2	NCNB Corp. (N. Carolina)	Pan American Banks (Florida)	PAB	July 25 85
FLT1	Fleet Fin'l (Rhode I.)	First Conn. Bancorp (Conn.)		Aug. 2 85
KEY2	Key Banks (New York)	1st Interstate Alaska (Alaska)		Aug. 8 85
FLT2	Fleet Fin'l (Rhode I)	Merrill Bankshares (Maine)	MERB	Aug. 13 85
SPC	Security Pacific (Calif.)	Arizona Bancwest (Arizona)	AZBW	Aug. 21 85

HBAN	Huntingdon (Ohio)	Commonwealth Trust (Kentucky)		Sept 5 85
	Union Bancorp (Calif.)	United Bancorp (Arizona)	UBAZ	Sept 6 85
ONE1	Banc One (Ohio)	Perdue Nat'l (Indiana)		Sept 17 85
FTU2	First Union (N. Carolina)	Southern Bancorp (S. Carolina)	STBN	Sept 23 85
SOVN2	Sovran (Virginia)	Suburban Bancorp (Wash., DC)	SUBC	Sept 25 85
CCI2	Citicorp (New York)	Great W. Bk&Trust (Arizona)		Sept 27 85
ONE2	Banc One (Ohio)	Money Mgt. Corp. (Indiana)	MGT	Oct. 9 85
FTU3	First Union (N. Carolina)	Citizens DeKalb (Georgia)		Oct. 17 85
CMB2	Chase Manhattan (New York)	Continental Bncp Ariz (Arizona)		Oct. 18 85
FTU4	First Union (N. Carolina)	First Indiana Bncp (Indiana)		Nov. 7 85
FTU5	First Union (N. Carolina)	1st Bankers Florida (Florida)	FBF	Nov. 15 85
FVB	1st Virginia Bks (Virginia)	Commercial Bank (Maryland)		Jan. 8 86
ONE3	Banc One (Ohio)	Spartan Bancorp (Michigan)		Jan. 24 86
	Midatlantic Bks. (New Jersey)	Continental Bncp. (Penn.)	CBRP	Feb. 24 86
ONE4	Banc One (Ohio)	NW Bk of Rensselear (Indiana)		Feb. 27 86
KEY3	Keycorp (New York)	Pacwest Bancorp (Oregon)	PWST	Mar. 12 86
FTU6	First Union (N. Carolina)	Georgia State (Georgia)		Apr. 10 86

CHL3	Chemical NY (New York)	Horizon Bancorp (New Jersey)	HZB	May 2 86
NCB3	NCNB Corp. (N. Carolina)	Centrabank Baltimore (Maryland)		May 2 86
VNCP	Valley Nat'l (Arizona)	Sunwest Fin'l Serv. (New Mexico)		May 16 86
CORE	Corestates Fin'l (Penn.)	New Jersey Nat'l (New Jersey)	NJNB	May 28 86
BAC2	BankAmerica (Calif.)	Orbanco Fin'l Serv. (Oregon)	ORBN	June 9 86
FTU7	First Union (N. Carolina)	1st RR&Bk'g Ga. (Georgia)		June 12 86
RIGS	Riggs Nat'l Corp (Wash., DC)	Guaranty Bk & Trust (Virginia)		June 12 86
ONE5	Banc One (Ohio)	First Nat'l Corp. (N. Dakota)		June 25 86
PNC	PNC Fin'l Corp (Penn.)	Citizens Fidelity (Kentucky)	CFDY	July 1 86
NCB4	NCNB Corp. (N. Carolina)	Ameribanc Investors (Virginia)		July 8 86
MFC	Metropolitan (N. Dakota)	1st Minnesota Saving (Minnesota)		Aug. 29 86
SUN	Suntrust Banks (Florida)	Third Nat'l Corp. (Tennessee)		Sept 3 86
INT2	First Interstate	BankAmerica	BAC	Oct. 10 86
BBF	Barnett Bks Fla (Florida)	First City Bancorp (Texas)		Oct. 27 86
	Chemical NY (New York)	Texas Commerce (Texas)	TCB	Dec. 16 86

Note: The presence of a symbol indicates that the bank is included in the sample.
2. Interstate Bank Expansion Sample - Bonds

Symbol	Bank	Bond Issue
BKB	Bank of Boston	10.65% notes due 1987
BAC	BankAmerica	7 7/8 debentures due 2003
CMB	Chase Manhattan	8 3/4 debentures due 1986
CHL	Chemical NY	8.4% debentures due 1999
CCI	Citicorp	8.45% notes due 2007
KEY	Key Banks	7 3/4 debentures due 2002
NCB	NCNB Corp.	8 3/8 debentures due 1999
SPAC	Security Pacific	10.35% debentures due 1994

3. Export Trading Company Sample - Stock

Sym-bol	Bank	Date	Event
BAC	BankAmerica	Feb. 10 84	News report
BT	Bankers Trust	Feb. 2 84	Fed. Res. Approve
CMB	Chase Manhattan	Dec. 6 83	News Report
CCI	Citicorp	May 25 83	News Report
CSFN	Corestates	Aug. 25 84	Fed. Res. Applic.
CKN	Crocker Nat'l	Sept 27 83	News Report
FNBC	First Chicago	May 6 83	News Report
FKNY	First Kentucky Nat'l	Apr. 18 83	News Report
FTU	First Union	Apr. 7 84	Fed. Res. Applic.
FLT	Fleet Financial	Feb. 8 84	News Report
INT	First Interstate	June 15 83	Fed. Res. Approve
IRV	Irving	Mar. 15 84	Fed. Res. Applic.
MHC	Manufacturers Hanover	Apr. 16 86	News Report
NJNB1	New Jersey National	Aug. 18 83	News Report
NJNB2	New Jersey National	Nov. 10 84	Fed. Res. Applic.
RAIN	Rainier Bancorp	June 5 84	News Report
RMPO1	Ramapo	Aug. 18 83	News Report
RMPO2	Ramapo	Nov. 10 84	Fed. Res. Applic.
SECP	Security Pacific	Jan. 23 83	News Report
SHMA	Shawmut	Oct. 15 83	News Report
SOCI	Society	Oct. 3 83	News Report
SOVN	Sovran	July 7 84	Fed. Res. Applic.
ULTB1	Ultra Bancorp	Aug. 18 83	News Report
ULTB2	Ultra Bancorp	Nov. 10 84	Fed. Res. Applic.
UBAZ	United Bncp Arizona	Mar. 21 84	Fed. Res. Applic.

4. Export Trading Company Sample - Bonds

Symbol	Bank	Bond Issue
BAC	BankAmerica	7 7/8 debentures due 2003
CMB	Chase Manhattan	8 3/4 debentures due 1986
CCI	Citicorp	8.45% notes due 2007
FNBC	First Chicago	7 3/4 debentures due 1986
MM	Marine Midland	7 5/8 debentures due 2003
RAIN	Rainier Bancorp	9 1/2 notes due 1985
SPAC	Security Pacific	10.35 debentures due 1994
WISC	First Wisconsin	8 1/2 debentures due 1996

5. Investment Dealer Takeover Sample - Stock

Acquiring Bank		Target Dealer		Announcement Date
Symbol	Name	Symbol	Name	
CIBC1	Canadian Imperial Bank of Commerce		Gordon Capital	17/07/87
BMO	Bank of Montreal	NT	Nesbitt Thomson	13/08/87
BNS	Bank of Nova Scotia		McLeod,Young,Weir	30/09/87
TD	Toronto Dominion		Gardiner Group	16/10/87
ROY1	Royal Bank	DS	Dominion Sec.	01/12/87
CIBC2	Canadian Imperial Bank of Commerce		Wood Gundy	26/01/88
NAT1	National Bank	LB	Levesque Beaubien	01/07/88
NAT2	National Bank	GL	Geoffrion Leclerc	06/02/89
ROY2	Royal Bank	PEM	Pemberton Sec.	18/04/89

Note: The presence of a symbol indicates that the firm is in the sample

6. Investment Dealer Takeover Sample - Bonds

Symbol	Bank	Bond Issue
BMO	Bank of Montreal	11.75% due 1991
BNS	Bank of Nova Scotia	9.5 % due 1997
CIBC	Canadian Imperial Bank of Commerce	7.5 % due 1993
NAT	National Bank	7.5 % due 1992
ROY1	Royal Bank	10.4 % due 1989
ROY2	Royal Bank	10.8 % due 1998
TD	Toronto Dominion Bank	10.45% due 1989

Appendix 5: Discussion of Diagnostic Statistics Used

The Chow, Ljung-Box, Breusch-Pagan and Jarque-Bera statistics were used on all samples to test for (respectively): parameter shift, autocorrelation, heteroscedasticity, and non-normality. The characteristics of these tests, and the reasons for choosing them, are discussed below.

Chow Statistic

The Chow statistic tests for a structural shift between two regimes in a regression model. The statistic is easily computed from the output of standard statistical packages and is very widely used in finance and economics (see, for example, Brown, Lockwood and Lummer [1985] and Mandelker and Rhee [1984].)

Ljung-Box Statistic

The Ljung-Box is a widely-used (see, for example, Dezhbahsh and Demirgue-Kunt [1990], Fomby and Hayes [1990] and Kawaller, Koch and Koch [1990]) modification of the Box-Pierce statistic. It is generated by the software package (SPSSX-Trends) used in this study. The Ljung-Box statistic is superior to the frequently used Durbin-Watson statistic, in that the Durbin-Watson statistic tests only for first-order autocorrelation.

Breusch-Pagan Statistic

The Breusch-Pagan statistic has the same asymptotic properties of the likelihood ratio test [Breusch and Pagan, 1979, p. 1287], but has the advantage of being able to be computed using the results of two least squares regressions. The iterative calculations necessary to obtain maximum likelihood parameter estimates can therefore be avoided by using the Breusch-Pagan statistic. It is widely used in economic applications (see, for example, Krol and Ohanian [1990] and Krueger and Burton [1990]).

Jarque-Bera Statistic

The Jarque-Bera test is also asymptotically equivalent to the likelihood ratio test, but can be computed using only moments about the mean of the error terms of a least squares regression, thereby avoiding the iterative calculation necessary for the computation of the likelihood ratio. The test has recently been used by Joharsen and Juselius [1990] in an economic context.