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REPO MARKET, ITS DYNAMIC RELATIONSHIPS TO OTHER FINANCIAL MARKETS AND ITS ROLE AS ECONOMIC INDICATORS: THE CASE OF THAILAND.

by

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A dissertation submitted to the Graduate Faculty in Economics in partial fulfillment of the requirements for the degree of Doctor of Philosophy, The City University of New York

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ABSTRACT

REPO MARKET, ITS DYNAMIC RELATIONSHIPS TO OTHER FINANCIAL MARKETS AND ITS ROLE AS ECONOMIC INDICATORS: THE CASE OF THAILAND.

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Prisadarng Skolpadungket

Adviser: Professor Salih N. Neftci

Repos are essentially secured loans. Securities are put as collateral by contracts of sale attached with repurchased agreements. Repo markets provide low cost of funds for financial institutions in taking investment positions on government securities, and for security lending. Central banks use Repo markets for their Open Market Operation (OMO) mostly for the short-run purposes. However, the Bank of Thailand heavily relies on Thai Repo market for its OMO because there is virtually no secondary market for government securities. By using Vector Autoregressive Methodology (VAR) to investigate dynamic relationship among Thai domestic financial markets, this study found that there are unidirectional influences from Thai interbank market and the Repo market to Thai stock market but not to Thai baht/US. dollar exchange rate. For dynamic linkage among major international money markets namely, US. federal fund market; London Euro-dollar market (LIBOR); Singapore Asian dollar market (SIBOR) and the both of Thai money markets, this study found that there are unidirectional transmissions from the outside to domestic markets including the foreign exchange market. Studies of economic

indicators found that interest rates and their yield curves contain some information about future real and monetary variables. For the case of Thailand, this study found that Repo rates and interbank rate in overall can be a good economic indicators. Spread between 30-day Repo rate and 1-day Repo rate as a proxy for the shape of yield curve is found to Granger cause growth in narrow money (M1), growth in board money (M2), return on the stock market index and the change in prime rate. While 30-day Repo rate exhibits Granger cause the prime rate and the stock index. By using Repo rates to forecast future inflation rates, the model that uses the spread of Repo rates performs best but fails to capture seasonality and has a wrong sign. The model that based on theoretical relation of inflation, nominal interest rate and real interest rate with rational expectation assumptions performs slightly better that that based on univariate time series (Autoregressive Moving Average-ARMA) of inflation rate.

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I. Introduction

The Repo market refers to the overall market for lending and borrowing fixed income securities which includes repurchase agreements, collateralized loans, buy and sell agreements as well as securities loans (Miller 1997.)

The term "Repos" is abbreviated for repurchase agreements, literally mean contracts involving simultaneous sale and future repurchase of assets. In practice, assets "the objects" of Repos are normally fixed income securities (recently, there are some equity Repos but still small compare to those of fixed income) , most often government debt instruments (Treasury securities for the US. dollar market.) Generally speaking, Repos are reciprocal contracts involve at least two parties, the first party surrenders securities and the counter party surrenders cash in exchange attached with a promise to re-exchange the same securities and an amount of cash in a specific time in the future. Effectively, Repos are contracts of lending and borrowing securities versus cash (may be securities versus securities in case of the true security lending.)

The markets define "Repo" from a dealer's point of view. Whenever the dealer lends securities and borrows cash the trade is a "Repo". On the other hand, if the dealer borrows securities and lends cash, it is called a "Reverse Repo" or just simply a "Reverse".

1.1.1| Origins

Even though, the practices of security lending can be traced back to the seventeenth century but Repos as what we call today was originated by the Federal Reserve System in 1910's. By the Federal Reserve Act 1913, one of the three paramount objectives of the Fed was to facilitate the development of US. domestic Banker's Acceptance (BA) market. At the time of its existence, the Fed found that BA dealers needed supplementary financing. In 1918, it provided such financing by creating a Repo (at that time was called "Resale Agreement") against BA(s) at a public quoted discount rate.

In 1920, after the Fed had created a discount window, in which banks might borrow at their will, it abandoned the outright buying short term notes. The practice was aimed to created bank reserves at the Fed.'s volition, as it deemed necessary. But to outright buy the notes had it short coming, the Fed had to muddle with collecting money from private borrowers that is a tedious business, so it decided to cease the practice and switched to influence bank reserves through the lending windows. Without the outright purchase, however, the Fed had no mean to create bank reserve at its will (Banks borrow

from the window at their will), it found itself in need of a tool at its volition. Consequently, in 1923, the Fed found the way. It began to use short term Repos against government securities (may be called governments) as a mean of temporary altering bank reserves. (The reason that it did not use the outright buy/sell of governments in the first place was it feared that frequent outright buy/sell would jeopardize fixed income markets.)

At the end of 1929, the Fed.'s Repos against governments outstanding was $23 million (Stigum 1989, Ch.7.) In 1930's, due to the Great Depression, demand for credit declined and the Fed.'s Repo tailed off. During the wartime, the Fed adopted a pegged rate policy for treasury bills (from April 1942 to July 1947, the official rate was 0.375%) to prevent interest rates driving up by the large sales of treasury securities in the need of war financing. Under this policy, the Fed was standing ready to buy T-bills at the official rate at any amount as banks needed. Because of this policy and its commitment to maintain a fixed pattern on treasury coupons, the Fed did no Repo against governments during the time.

After the 1951 Accord with the Department of Treasury, which made the pegged rate policy to an end, the Fed revived the use of Repo in order to make temporary adjustment in bank reserves. Initially, it was permitted to do a Repo for maximum of 15 days and only against short term treasury securities. Up to now, Repos and Reverses are a key part of the Fed.'s Open Market Operation. At the end of 1986, for instance, the Fed had on its book $ 16 billion of Repos (Stigum 1989, Ch.8)

1.1.2] Private Repos

Tight regulation of US. domestic market attributed to the birth and development of private Repo markets in the early 1950's. The Banking Act 1933 prohibited banks from paying interest rate on demand deposits. The act also gave the Fed to impose ceiling on its banks might pay on time deposits, known as Regulation Q. Under Regulation Q, large money market banks were gradually losing deposits to smaller suburban banks. While large banks became deposit poor banks, they faced a raising demand for medium term loans from rapidly expanding major US. corporations. At the same time, the smaller country banks became deposit rich (they were not affected by the regulation) but lacked of an efficient mean to utilize these funds. Although the suburban banks could sell their unused funds through Fed Wire (called Fed Fund same as interbank markets in many countries, the market term "sell" means "lend" and "buy" or "purchase" means "borrow" from the Fed Fund market) to the big banks, selling Fed Funds are considered as making unsecured loans. All nationally chartered banks are not permitted to lend to any single borrower loans more than 10% of their capital, known as "bank lending limit". By this restriction, a small suburban bank has to distribute its unused funds to many fund needed banks. But no restriction has ever existed on the amount of treasury securities a nationally chartered bank can buy. Repo was a right answer to evade this restriction and it has made the domestic money markets function in a more efficient way. Not only those big and

small banks but also corporate investors, municipal bodies as well as dealers rapidly engaged in the innovative Repo markets.

1.1.3] Non US. dollar Repo Markets

The way that the Fed has been utilized Repo as a Open Market Operation tool is dated back to the late 1910's. Following the Fed, central banks in many countries have adopted the uses of Repo for their own monetary policy implementation as soon as their domestic financial market fundamentals could provide such an opportunity. However, private non US. dollar Repo markets are mostly existed only in OECD countries. Some active private Repo markets with a considerable volume include those in Germany, France, the UK., Italy, Spain, the Netherlands, Belgium, Denmark, Sweden, Canada and Japan as well as the market for the European Currency Unit (ECU) (D'Amario 1997.)

The non-dollar Repo markets are based in London because major participants have developed the market in London first and by the fact that the city has a role as the financial center of Europe. Comparing with US. private Repo markets, the non-dollar markets are quite new, they were launched in London in the late 1980's.

Two important factors that attributed to the creation of the non-dollar Repo markets were the demand for low cost financing of taking position in non-dollar government bonds and the demand for security borrowing. Before the launch of the Repo

markets, the large US. broker/dealer firms which operated in London funded their position in non-dollar government bonds as a significant part of their portfolios by their internal funds or by bank loans. They found that to fund their positions this way was excessively expensive, so they desperately tried to find a new way to live with. To establish a non-dollar Repo market in London was a conceivable way to solve the problem, given the experience of using Repo to fund their treasury positions in the US markets. The demand for security borrowing was also crucial. A fine for a dealer who is unable to deliver bonds on the settlement date is roughly 400-600 basis points and if the dealer try to borrow bonds through clearing houses, the cost of doing so is up to 350 basis points. The non dollar Repo markets provide a lot less expensive cost for a security borrower to the cover short positions.

II. Types of Repo

Repos may be categorized by their settlement and custodial arrangements. These operational choices affect lender's credit risk as well as Repo rates.

1.2.1] Hold-in-Custody-Repo

This kind of Repo, some time, is called "letter Repo", from the fact that the lender of money gets only a letter from the dealer, who borrowed the money and pledged securities, stated that the securities have been assigned to the lender's account within the

dealer's firm (and in the dealer's discretion.) Although this kind of Repo may offer a higher rate than other kinds, the lender may assume an unexpected high credit risk, especially in the case of fraud. The fraudulent collateralization actions by the borrowing dealer did happen occasionally, some dealers pledged securities that did not exist or that having been pledged to another counter-party. Such a fraud results the Repo effectively become an unsecured loan. Dealers like this kind of Repo because it is almost costless to them to make settlements and flexible to manage their positions, thus results a higher offer rate. Because the credit risk depends heavily on the dealer's fidelity, sometime, this type of Repo is called "trust me" Repo.

1.2.2| Deliver-Out Repo

In a deliver-out Repo, the pledged securities are sent to the lender's custodian in exchange for cash. This kind of Repo is, sometime, costly because of the delivery cost, especially if the transaction involves small size securities versus a large sum of loan.

1.2.3| Tri-Party Repo

A tri-party Repo is a compromised way to do Repo. It provides a safe and economical transaction. In this type of Repo, the collateral is held by an independent custodian who is an entity other than borrower of the cash (in practice, the custodian is paid by the dealer.) The custodian normally has a duty to verify the collateral securities

according to the lender's requirements as well as to value and reprise them daily, in order to execute margin calls. For the US domestic Repo market, tri-party Repos have dominated the other kinds of Repo, especially by the primary dealers (mostly, large investment banking firms.)

1.2.4] Four Party Repo

In this type of Repo, there are two custodians in the settlement, one for the lender and one for the borrower. A four party Repo gives a little additional safety comparing with the typical tri-party Repo. However, some states or municipal bodies have a legal requirement to employ only financial institutions located in those particular states or cities. Practically, the main custodian who has the duties and responsibilities as same as the tri-party custodian is the borrowing dealer's custodian. While the lender's custodian bank, called as "sub-custodian", merely oversees the process and pays or receives the cash.

1.2.5] Buy/Sells and Sell/Buys

A buy/sell is a Repo without entering a standard Repo agreement. It involves a contract of sale and a forward agreement to buy the same securities. Because its operational and legal simplicity, it has been the dominating form in underdeveloped markets. However, this type of Repo has some problems which a standard Repo

agreement do not, mainly, a buy/sell does not allow a mark to the market thus the margin call. Moreover, the sale of securities may be taxable.

1.2.6] Security Lending

A security lending is similar to a Reverse but it has a different arrangement. A dealer may do a Reverse to arbitrage (called matched book) or to cover a short position of previously established short (he has sold securities in his possession which he obligate to make a delivery, then by the time to make delivery, he does a Reverse to get the same securities to fill his obligation.) The latter is almost an act of security lending. But in the true security lending, the lender of securities does not get money (as in the case of a Reverse) instead, he gets securities (of different kinds) valued equal to the lent securities (as collateral) plus a margin and also a fee, usually called a rebate (usually, around 50 basis points.) In the US markets, custodian banks are the largest and best organized security lenders, while dealers of securities play a major role as borrowers.

III. Mechanics and Practices

Repos, in the economic sense, can be said to be collateralized loans, however, in the legal perspective, they are hybrids between collateralized loans and security transactions. The latter is, especially, true in the cases of Reverses to cover short and Reverses to maturity. (Someone's Repo is always his counter party's Reverse and vice

versa but by the market convention, the contract is called a Repo when a dealer borrows money and called a Reverse when a dealer lend money.) In a Reverse to cover short, a dealer lends cash and takes pledged securities to cover his short position. In a Reverse to maturity, a dealer lends money and take collateral securities then, immediately, sell the securities to get money to reinvest. (The Repo will mature at the same time as the pledged securities mature.) When the Reverse is mature, the dealer will write a check to the borrower of cash in an amount of redeem value (normally face value) plus accrued interests minus the actual amount of borrowed cash (Repo value) including the Repo interests.

In ordinary Repo and Reverse agreements, they are normally attached with an arrangement called Pass-Through of Coupon Interest. This provision is that any coupon interests coming to due on the pledged securities will be paid by the buyer (lender of money) to the seller (borrower of money.) This means that the borrower of cash still gets interest dividend on the security he has repoed out. Moreover, most of Repo agreements are included a provision that gives dealers (borrowers of cash) right of substitution. The right enables the dealers to replace collateral securities with other securities of equal value and quality whenever they need. These two characteristics of Repo agreements make them look closer to collateralized loans than security transactions.

1.3.1] Fed.'s Repo

The Fed is very active in doing Repos for its monetary policy implementation (by the so-called "Open Market Operation".) It is also active in doing Reverses but insists to call the transactions as "matched sale/purchase agreements" because Congress do not authorize it to do any collateralized borrowing from bank and non bank dealers. Normally, the Fed requires more margin than the most of dealers do, due to its concern about credit risk. Because it actually do Repos for monetary policy purposes. The Fed has no interest in any control over the collateral and never do either a Reverse to maturity or a Reverse to cover short, it just holds the securities until the Repos reach their maturity.

1.3.2] Repo Rates

Repo rates of various maturity are always closely tied to top quality money market rates of the same maturity. However, Repo rates, in the most of time, is slightly below those of other money market instruments (i.e. Fed Funds, CDs, BAs, etc.) The result is from the fact that Repos are short term loans that are, normally, collateralized by government securities, thus the safest of all classes of securities. The behavior of Repo rates supports the view that Repos are collateralized loans rather than security transactions. If they were closer to security transactions, the Repo rates would be tied to market yield to maturity of the collateral securities. But this does not mean that the kind of the collateral securities does not matter. In fact, there are several Repo rates depend on

the credit quality as well as liquidity of the collateral. For instance, an overnight Repo rate on treasuries is the lowest, then some spread must be added if the collateral is of BAs or CDs (approximately 15 basis points.) For US dollar Repos, the Repo rates are quoted on a computer screen with bid and ask rates that represent Reverse and Repo rates accordingly. The bid-ask spread results from the market practice of matched-book trading. The Repo rates are equal to annualized the difference between the Repo price and the repurchase price (to be normalized to $100.) In the most of other countries, Repo rates are quoted by telephone.

1.3.3| Margin and Mark to the Market

A margin on a Repo is a market practice to protect the lender of money against any possible decline in market value of the collateral securities. As same as in a security transaction, the collateral is priced as its market price plus accrued interest. However, the amount of cash which is paid by the counter party is slightly less than the price of collateral. The excess value of collateral is the margin or in the street's jargon as "a hair cut." In a term Repo, the maturity is longer than one day (over night) its collateral is also subject to mark to the market, in the other words, the collateral is reprised in accordance with the end of the day closing market price. If the market price of the collateral falls, a margin call may follow. In this case, the borrower of the money is subject to pay back an amount of cash or deliver additional securities to cover the margin call.

1.3.4] Clearing

In a delivery-out Repo, mostly there are four parties involve in the clearing process who are the lender of money (buyer of securities), the borrower of money (seller of securities), the lender's clearing bank and the borrower's clearing bank. After the transaction is concluded, the borrower will instruct his custodian to deliver the collateral to the lender's custodian, this is the sell side (first leg) settlement, typically is done on the trade date. For the buy side, when the Repo's term is mature, normally, the settlement is executed a day or more later (depend on the Repo's maturity.) Repos (and Reverses) are done in both book-entry and physical securities. In the US, security transferring are made through an electronic clearing system called Fed Wire, since the Federal Reserves acts as the registrar of treasury securities. From a clearing bank's perspective, buys and sells generated by Repos are not different from outright buys and sells, the both clearing processes are the same.

For a hold-in-custody Repo, the transaction is internal, the dealer (and also the borrower of money) just moves the assigned securities to another account created for the lender within the dealer's firm. Thus, Fed Wire is not necessary.

For tri-party Repos and most of four-party Repos, the borrower of money will instruct the custodian bank (the third party as a middle man) to hand over the control of the collateral to the lender of money. However, in four party Repos, the process is

overseen by the lender's custodian as the fourth party. As the hold-in-custody Repos, no Fed Wire transfer is needed.

Even though, Repos are economically collateralized loans but legally, the control over the collateral is some what different. The control over Repo collateral securities is established by a contract of sale, thus, by the laws, the ownership is transferred immediately, constitutes absolute control of the collateral. The holder of collateral (the lender of money) has a full legal right to sell, to hypothecate it or to lend it out. The only thing he has to concern is that he has an obligation to sell it back at the expiration of the Repo. However, in an ordinary collateralized loan, the holder of collateral has only a right to hold the collateral against the loan, except in the case of default.

1.3.5] Arbitrage

The term "arbitrage" as used in money markets is quite misleading. The true meaning as acceptable to economists is an action to render a riskless profit. But in money markets, the term means an action of simultaneously buy and sell securities or borrow and lend money to create a profit in which, sometime, may involve a bet on future events. Money market trader refers to this kind of arbitrage as "risk arbitrage" or shorten as "risk arb."

Repo dealers usually do risk arbitrages. At first, they repoed only to borrow money in order to finance their inventory (securities which the dealers hold as market makers.) However, soon they realized that Repos can be used in a more profitable way. For instance, if an dealer looks at the shape of treasury yield curve and find that the curve is slope up with 60 day maturity rate below that of 90 day maturity, he will be able to put himself into a risk arb by buying the 90 day treasuries in the auction, finance with a 30 day Repo (the Repo rate is below the 90 day treasury rate and the auctioned treasuries will be used as Repo collateral.) When the term expire, given the yield curve will not significantly change in 30 days, he will sell the securities with a handsome profit. (He will get a capital gain on the treasuries because 60 day treasury is discounted at a lower rate than those of 60 day.) However, the risk arb is a bet on the shape of the yield curve in the next 30 days. If the yield curve substantially unfavorably changes, the dealer will take a loss. The different between the maturity of the term Repo and the maturity of the security being financed is called "tail", in this case, the "tail" is 60 days. Not only dealers but also Repo investors practice this kind of arbitrage. Some poor risk arbs did suffer apparently severe losses, especially, when the arbs created very long tails such as taking a position on 5 year bonds and finance them by a 30 day Repo.

1.3.6] Matched Book

A matched book refers to an offsetting position in Repos and Reverses that a dealer makes by reversing in securities (lend money) and simultaneously Repos them out

to another customer (borrow money.) The dealer gains a profit by an amount of bid-ask spread, normally around 10-20 basis points. The Reverse side of a matched book is always deliver out Repos (the dealer always gets the securities physically) while the Repo side may be hold-in-custody, tri-party or four-party Repos. Sometime, a dealer can bet on his matched book operation, similar to risk arb practice, by "mismatch" the book. If he is convinced that Repo rates in the market is likely to decline, he may mismatch his book by taking a long position in collateral and repoing out with a shorter term than that is reversed in (if he makes a right guess!) On the contrary, if he is bearish about the market (being convinced that Repo rates will rise in the near future) he may mismatch the book by taking a short position in collateral, repos them out with the right of substitution. By repoing with a longer term than that is reversed in, and then he excises the right of substitution while rolling the Repo over to get a handsome profit. The matched book operation makes Repo dealer's look similar to financial intermediaries.

1.3.7] Recent Development:

In the US, Repo markets like other financial markets, have been innovated into more exotic more "hybrid" products to serve particular needs of their participants. In the same time, non-dollar Repo markets become active and well organized. Non-dollar Repo trades have been wild spread under a general uniform agreement named Global Master Repurchase Agreement (GMRA) created by International Securities Market Association (ISMA), Public Securities Association (PSA) and the London law firm of Clifford Chance.

The agreements are governed by English Laws by the fact that London is the center of non-dollar Repo markets. The non-dollar trades may be cross currency Repo trades that may not accommodate collateral delivery (for delivery-out Repos) in all currencies, and may require high margins because the marks to the markets are more volatile than those of dollar Repos.

An examples of innovation in Repo markets is the floating-rate-Reverse-Repo or "floater" in which the Repo rate varies in accordance with some important money market rates such as LIBOR or Fed Fund rates but the lender (security purchaser) can withdraw the principle in part at any time when he need the fund by leaving the rest in the same term and at the same rate.

IV. Uses

Essentially, a Repo is a collateralized loan but in the eye of the laws, the agreement is a series of contracts and promises thus it is not just a simple collateralized loan. As it was created to evade the laws and regulations, a Repo is usually under the "don't ask don't tell policy." No one wants to make it clear about its legal nature. The Fed, for instance, has no authority to borrow with collateral, it officially calls its Reverse Repos (effectively collateralized borrowing money) as "matched sale/purchase agreements" to insist that it is not doing something *ultra vires*. For banks, dealers, corporate investors, as

mentioned before, involve in Repo markets for different reasons but in the most cases, it would be difficult or costly, if not inconceivable for them to fulfill the same objectives through ordinary collateralized loan markets.

1.4.1] Uses of Monetary Authorities

To implement monetary policy, central banks and monetary authorities usually have four major ways, called monetary policy instruments. First, by varying percentage of bank reserve requirement against deposits, this instrument would has a deep and wild spread impact to the financial sectors. Because of its severe impact, most of central banks are rarely use it. Second, by adjusting the last resort lending at the loan window, most of central banks put some restrictions on their member banks' lending to ensure that the banks will use the window only in necessity as the last priority. Third, by varying the rediscount rate, a central bank may buy at discount some certain type of commercial papers such as BA, B/E or P/N from its member banks, through this channel, the central bank can injects money supply to the financial sector. But by using the rediscount channel, the central bank faces some disadvantages, namely, it is at its member banks volition, the central bank has no full control over the money supply, and the central bank has to muddle with collecting due payments from its member banks' customers. Most of central banks do not want to involve such a tedious business. Fourth, by the so-called Open Market Operation (OMO), a central bank trades government securities that will cause bank reserves be (thus the money supply) drained out or pour into the system as it

sells or buys the securities accordingly. OMO is the most convenient way to implement monetary policy for central banks given suitable economic circumstances that includes an adequate amount of government securities as well as a certain level of development in the financial sector. Most of central banks in developed countries use OMO as a main monetary policy instrument.

The true Open Market Operation involves outright buy and sell of government securities in domestic financial markets. The amount to buy or sell is up to the calculated amount of money supply necessary to accommodate the projected level of economic activity, and to fight inflation. Practically, the US Federal Reserve for instance, uses the true OMO as a tool to achieve the long term predetermined level of money supply.

For short term unexpected shocks in the money supply (caused by such as strikes, stock market panics etc.) the Fed relies on Repos as its "temporary" OMO. Repos have some advantages in those situations comparing with the out right sells and buys of securities. First, doing the outright sells and buys too often will jeopardize the markets and may cause the term structure of interest rates look "diffuse". But Repo markets are separated from the government security markets and closed to money markets (short-term debt markets) thus variations in Repo markets normally do not affect those of the long - term debt markets. Second, Repos and matched sell/purchases (the Fed.'s Reverses) are self liquidating that are suitable for correcting of the short-term temporary shocks. The Fed can decide that how long the shock is going to last and thus does Repos with an

appropriate term to maturity. Third, Repo market operation is auto error-correcting, the Fed normally does a Repo with a right to withdraw collateral (to terminate the Repo) at any time during the term of the Repo. If the Fed miscalculates the appropriate amount of the money supply to fight the previous shock, let us say that it is doing too much Repos (that causes an excessive injection of the money supply), it will eventually cause the overall money market rates in the economy to fall. The dealers who are currently doing Repos with the Fed (they are borrowing money), while they try to minimize the costs, will withdraw the collateral and return the money then go to cheaper sources of money. Thus the amount of the money supply will decrease to the appropriate level automatically. Fourth, doing Repos is much more versatile than the true OMO in which the Fed.'s officer have to go through a tedious book building process (called "go-round") that is quite time consuming. But for doing Repos the Fed normally makes an offer call to make a deal, if the dealer accepts the offer, the deal is done one by one (Stigum 1989, Ch. 8.)

1.4.2] Uses of Private Sector

The uses of Repo in private sectors are due to, of course, economic rationales that are minimizing costs and maximizing profits. Repo markets provide dealers and investors low-cost funds, yield enhancements and profit opportunities. And as mentioned before, the private Repo markets were emerged to counter the tight regulated money markets of those days. It is still useful, even in a comparatively loose regulated markets nowadays, to exploit their legal ambiguous nature.

The private uses of global Repo markets may be categorized into five primary functions. First, Repos are used extensively to fund dealer's trading and inventory positions as well as to do the risk arbs. Second, Repo markets provide a secure and flexible investment opportunity to an investor who can not take longer term investments or is prohibited to make a collateralized loan. Third, Repo markets facilitate security lending to enhance portfolio yields for passive long position security holders. Fourth, on the other hand, the markets provide an efficient way to borrow securities against short positions at reasonable prices. Fifth, Repo the matched book operation generates a considerable income for a dealer (Miller, 1997.)

Chapter 2: Repo Market in Thailand.

I. Introduction

The most active debt instrument market in Thailand is Thai baht Repo market. Due to the fact that both government bond market as well as corporate secondary bond market are mostly inactive. The only Repo market in Thailand has been monopolized by the Bank of Thailand as it is the sole dealer in the market. Since 1986, the Bank of Thailand has been active in the Repo market for its intention to use the market as a de facto Open Market Operation Channel. The terms of Repo are ranged from 1 day to 6 months (180 days) but those of shorter terms are much more active than those of longer term. (before 1994, Repos in terms longer than 30 days were not active.)

The Repo market is one of a few main channels for Thai financial institutions to manage their liquidity along side with the interbank market. As the Repo market is a channel to conduct monetary policy, a channel for short term funding of the financial institutions (the fund in need) and for their short term speculative purposes as well. Thus, it is possible that Repo rates may contain some information about future economic variables, reflects from market expectations as well as monetary policy implementation as the treasury rates and yield curve do for the US variables.

II. Mechanics

The Bank of Thailand operates the only Repo market in Thailand twice a day,(must be a banking day not banking holiday which does not always coincide with a national holiday) one hour in the morning and one hour in the afternoon. The participants must be financial institutions that are permitted to operate under Thai law and they must maintain a current account and have deposited some Repo eligible bonds (not in the reserve requirement accounts) with the Bank of Thailand.

The prospective lenders and borrowers can offer bid and ask rates during the time of operation by telephone to the Repo desk (under the Banking Department,) the desk will arrange book building until the closing time (one hour after the opening.) Normally, the Bank of Thailand acts as a dealer so the desk just only matches bid and ask rates according to market demand and supply until the so-called stopping rate that is the rate everyone will pay. If the Bank of Thailand is willing to intervene the market in order to implement its monetary policies, it will bid or ask in the name of its own account, of course, no one except its employees would have any direct knowledge about this.

The Bank of Thailand is not only the sole Repo dealer in Thai Repo market but also the only counter party in all Repo/Reverse contacts in the market due to the fact that under the Laws, the Bank of Thailand is prohibited to involve in any brokerage business. Because the Bank of Thailand is always the counter party of any Repo, thus it legally and actually do take responsibility in any event of default and it is always honor the

agreements. On the other-hand, the Bank of Thailand incurs a substantial fine on the financial institution if they default.

The Bank of Thailand is the registrar of all government securities, thus it is convenient to also act as the Repo custodian. According to the classification of types of Repo in the previous chapter, we can view all Repos in Thailand as hold-in-custody Repos since the Bank of Thailand is always the counter party in any Repos.

There are no margining in doing Repo with the Bank of Thailand, thus the Repo's proceed is always equal to the face value of the bonds (without accrued interests,) since all of the financial institutions have to maintain most of their liquid assets with the bank that are more than enough as guarantees in cases of default. And also, as mentioned before, there are virtually no government bond secondary market in Thailand, so mark to the market is useless, if not impossible.

III. Uses

Before the repurchase market was established in April 1979, commercial Banks had relied solely on the interbank market for their liquidity adjustments. Up to now, the interbank market is still oligopolistic, where small banks and foreign banks must depend on a few big domestic banks for short-term funds.

During the first seven years, the Repo market was merely an alternative channel for commercial banks to manage their liquidity. The Bank of Thailand merely acted as a broker, although all transaction have been made by the Bank as a contracting party to comply with the Laws that prohibit it from involving in brokerage business (Sondysuvan and Bavorada 1988.) Terms of the Repo agreements are ranged from 1 day to 180 day maturity but most of the concluded transactions were 1 day and 7 days maturity (about 90% in 1988.)

2.3.1] Repo in Monetary Policy Implementation

The Bank of Thailand has been active in the repurchase market since 1986, by the motivation to use it for an "approximate" Open Market Operation. At the same time, the Bank also introduced its short-term debt instrument called Bank of Thailand Bond (BoT Bond) which have been regularly sold to the public. Both were parts of the financial liberalization program for Thai financial market development and monetary policy reform program.

Up to now, there are virtually no well developed secondary market for government and government guaranteed bonds thus performing the true and efficient Open Market Operation is impossible. Under Thai Laws and regulations, commercial banks are forced to hold the government securities for two main purposes, namely, as a

part of reserve requirement against deposits and as a condition for a new branch opening to maintain 16 percent of the new branch deposit liability in government debt instruments (included most of state enterprise bonds which are eligible to use as collateral in the Repo agreement.) Thus, a considerable amount of government securities is held by commercial banks, indeed, facilitates the development of the Repo market in the term of liquidity. Banks are eligible to use their government securities as collateral in Repo agreements and in some certain transactions with the Bank of Thailand.

The Bank of Thailand primarily uses the monetary aggregate, namely, M1, M2 and domestic bank credit as intermediate monetary targets. To affect those variables, the Bank has to control bank reserve and monetary base. To control the reserve money, the Bank focuses on its lending to commercial banks and other financial institutions, which can be easily steered by its day to day operations.

The Bank's lending to the financial institutions is made through three channels, first, which are loan window as the last resort facility with limitation for emergency uses; second, the refinance facility for commercial banks' lending to priority sectors which is not for a general control purpose; and third, the Repo market where government bonds (including state-enterprise bonds) are traded with Repo agreements. The Bank of Thailand assumes the role of the sole dealer and operator in the market. Since the late 1980's, the Repo market has been a main channel through which the bank adjusts it

lending to commercial banks and finance companies in line with its reserve money targets. (Sondysuvan and Bavorada 1988.)

2.3.2] Uses of Banks and Financial Institutions

Since the Repo rates are usually below interbank rates with the same maturity, an in need financial institution tend to borrow from the Repo market before the other sources (the Bank Rate for the loan window borrowing is always set higher than average interbank rate.) For the lender of cash's perspective, investment in Repo is riskless because the counter party in the eye of Laws is the Bank of Thailand and if the undisclosed borrower is default, the Bank will take all responsibilities.

Commercial banks and other financial institutions in Thailand often have liquidity problem, especially for the smaller institutions. Most of the liability side of Thai financial intermediaries is short-term such as time deposits (most of them in less than 1 year term,) saving accounts and checking accounts. While the asset side is dominated by long-term loans, even though some of them are legally revocable, and the lending rates are floating, but the loans are not practically callable. Because of this kind of balance sheets, the intermediaries have to rely on short term funds at their volition, since the deposit money is fluctuated and virtually not in their control. The Repo market provides the cheapest and the most accessible source of funds in the money markets. Beside the Repo market, there

is interbank market at a more expensive rate, and the loan window facility at the Bank of Thailand but it is not quite accessible as the Bank set some restrictions upon it.

Most of commercial banks and finance companies normally have some portfolio investments in Thai stock market, and some of them invest in corporate bond secondary market (known as Bond Dealer's Club) even though it is thin and quite inactive. Moreover, some banks especially large banks speculatively involve in the foreign exchange market even this kind of activity has been prohibited by the Bank of Thailand but there are some evading ways to do it. The mentioned activities are sometime speculative, especially when the markets move fast due to some expected eminent events or changing in policies or regulations. Beside internal funds, bullish (institutional) investors can leverage their bets by borrow from either the interbank market or the Repo market in which the Repo market provide cheaper rates. At the same time, bearish investors may sell the securities and invest the proceeds in both the interbank and the Repo markets. (The stock market and the Bond Dealer's Club are not allowed short-sell.)

Chapter 3: Dynamic Relationships of Thai Repo Market to Other Domestic Financial Markets and to International Money Markets.

I. Introduction

Since the Repo market is one of the most important financial markets in Thailand, it is worth to examine its relationship to other domestic financial markets as well as to address the existence of international transmission of money market fluctuations, its linkage to some important international money markets. During the period of study Thailand was considered as an emerging market, it experienced very volatile capital movements, attributed from short-term speculative indirect investments. This caused Thai money markets as well as the equity market (the Stock Exchange of Thailand - SET) unpredictably fluctuated. An exception was the foreign exchange market which was under the basket-of -currencies pegged regime. The monetary authority tried to smooth the market as much as possible.

Both the Repo market and the Interbank market are money markets. And they are closely substitute. We would expects a strong relationship between them. There are evidences of closed relationships between Repo markets and other money markets in

many countries (Happ, 1984; Stigum, 1989 for the US. case.) The relationships make most economists consider Repo markets as money markets.

Stock markets are evidently sensitive to interest rates. In financial communities, there is common credence that any central bank discount rate changes or reasonable expectations of the changes have strong and immediate effects on stock markets. Some studies point out that the real sources of such influence are in money markets. If such a change originates in money markets and then monetary authorities adjust the discount rates accordingly, the discount rate adjustments will not significantly affect stock markets. But if the changes originate from the discount rates, such as in the countries that use active monetary policies, the changes will hit money market rates and then pass to equity markets (Bonomo, Ferris, and Lamy, 1991.)

The relaxation of restrictions on international capital movements of the 1980's has made world financial markets become more integrated. There are many studies to support that there are international linkages among the world major stock markets (Eun and Shim, 1989; Shachmorove, 1995.) The international transmission does exist for money markets as well. A study found that there are some degrees of integration among national money markets of the OECD countries with the US. market plays a leading role. The degree of integration is somewhat lesser than that of the stock markets (Ahmad and Sarver, 1994.) There are also evidences of linkages between domestic US. dollar money markets and off-shore US. dollar (Eurodollar) money markets. An empirical Investigation concludes that

the linkages are unidirectional from the domestic market to the Eurodollar markets and sometime there are feedback between those markets (Kaen and Hachey, 1983.)

This chapter will investigate the dynamic as well as contemporaneous relationships of Thai Repo rates to other financial market rates, both in domestic setting and international setting. The methodology will be relied on, is the Vector Auto Regressive (VAR) model developed by Christopher A. Sims (Sims 1980.) The chapter will be organized as follows, Part II will address the methodology. Part III will be the results of the dynamic relationship among Thai domestic financial markets that compose of the Repo market, the interbank market, the stock market and the US. dollar/ Thai baht foreign exchange market detected by VAR. Part IV will be the evidences of international transmission of money market Fluctuations to Thai money markets. The last part, V, will be the conclusion and remark.

II. The Methodology: the Vector Autoregressive (VAR) Analysis

The Vector Autoregressive modeling was developed out of skepticism about the nature of restrictions which economic theories put on econometric models. As a result, the VAR models attempt to impose restrictions as least as possible, and instead, to describe the dynamic interactions of the data.

The VAR methodology can address the following questions. First, How long does it take for the (rate or variable) movements in one market to be transmitted to other markets? Second, If there are transmissions, what are the magnitudes of the effects. Third, How much of the movements in one market can be explained by innovations in the other markets? Fourth, Are there any orders of such transmissions and which market does play a leading role? Fifth, Are there any group of markets in which the markets are more closely tied to each other than to those outside of the group? (Ahmad and Server, 1994.)

3.2.1] The Model

A VAR model is a system of equations called a vector process. A k-dimensional with p-lag length VAR system can be stated as

$$\mathbf{X}_t = \mathbf{C} + \mathbf{A}_1\mathbf{X}_{t-1} + \mathbf{A}_2\mathbf{X}_{t-2} + \ldots + \mathbf{A}_p\mathbf{X}_{t-p} + \mathbf{u}_t \qquad (1)$$

where $\mathbf{X}t$ is a k x 1 column vector of the variables of interest (market rates,) $\mathbf{C}$ is a k x 1 column vector of constants, $\mathbf{A}t \ldots \mathbf{A}p$ are k x k matrices of coefficients, p is the lag length and $\mathbf{u}_t$ is the k x 1 column vector of forecast errors of the best linear predictor of $\mathbf{X}_t$ by using its all past values, and is white noise. Thus,

$$\begin{aligned} E(\mathbf{u}_t) &= \mathbf{0}, \\ E(\mathbf{u}_t\,\mathbf{u}'_s) &= \Sigma_{\mathbf{u}} \quad \text{for } t = s \\ &= \mathbf{0}, \quad \text{otherwise.} \end{aligned} \qquad (2)$$

where Σ_u is positive definite. The *ij*th element of A_l (for l = 1, 2, . . . p) represents the direct effect on the variable *i*th of a one-percentage-point change in the variable *j*th in period *l*th (Hamilton, 1994, p.257-290 ; Ahmad and Sarver, 1994.)

3.2.2] Choosing the Lag Length

To choose the lag length, the Likelihood Ratio Test modified by Sims (Sims, 1980) will be used. Comparing to the other criteria, namely, the Akaike Information Criterion (Akaike, 1973) and the Schwarz Criterion (Scwarz, 1978) which are basically single-equation tests. Both tests tend to choose lag length fewer than it should be in a multi-equation system such as in a VAR model (Shachmurove, 1995.) The Likelihood Ratio Test is based on multi-equation residuals as follows:

$$LR = (T - C)\,(\ln|\Sigma_R| - \ln|\Sigma_U|) \qquad (3)$$

where T is the number of usable observations, C is the correction for the number of parameter in order to improve small sample properties as $C = (k \times p) + 1$. $|\Sigma_R|$ and $|\Sigma_U|$ are the restricted and the unrestricted determinants of covariance matrices of residuals. The Likelihood Ratio (LR) is asymptotically distributed as a Chi-sq. with degrees of freedom equal to the number of restrictions.

Since there are scarcity of data, especially in a long lag length model, the parsimonious policy will be enforced strictly. A shorter lag length model will be preferred to any longer length models unless it can be rejected at least one percent level of statistical significance.

3.2.3] Granger-Causality Tests

The question that how useful some variables are to forecast others can be addressed by Granger-Causality tests developed by Granger, (Granger, 1969.) To implement the test, for a two variable system, one assumes an autoregressive model with lag length p and estimates

$$X_t = C_1 + \alpha_1 X_{t-1} + \alpha_2 X_{t-2} + \ldots + \alpha_p X_{t-p} + \beta_1 Y_{t-1} + \beta_2 Y_{t-2} + \ldots + \beta_p Y_{t-p} + u_t \quad (4)$$

by OLS and then conducts an F-test of the null hypothesis

$$H_0: \beta_1 = \beta_2 = \ldots = \beta p = 0.$$

If the null hypothesis is rejected, one can conclude that Y does Granger-cause X.

However, the test should be interpreted with cautions. Causality in the test means only there are movements in a variable precedes movements in another variable, nothing

more and nothing less. It is inadequate to jump to the conclusion that there are really a mechanical causality between those variables. A prudent interpretation is the movements of a variable contain some information concerning the movements of another variable in the next somewhat periods. This is especially true in any researches involve with expectations and market efficiency (Hamilton 1994, p. 302-309.)

3.2.4| Impulse Response Functions

A moving average (MA) representation of the VAR model can be obtained by successive substitution on the right hand side of (1):

$$\mathbf{X}_t = \sum_{g=0}^{\infty} \mathbf{B}_g \mathbf{u}_{t-g} \qquad (5)$$

where $\mathbf{B}_0 = \mathbf{I}_k$ is a (k x k) identity matrix and

$$\mathbf{B}_g = \sum_{g=0}^{\infty} \mathbf{B}_{g-j} \mathbf{A}_j, \quad g = 1, 2, \ldots, \qquad (6)$$

and $\mathbf{A}_j = 0$ for $j > p$.

Equation (6) represents $\mathbf{X}_t$ as a linear combination of current and past one step ahead forecast errors, u_t. The elements of $\mathbf{B}_g$ are known as the impulse responses of the VAR which trace out the dynamic responses of each variable to innovation of another variable. The *ij*th component of $\mathbf{B}_g$ is the response of the *i*th variable g period after a unit random shock in the *j*th market setting aside the effect from the other markets. Graphs of the dynamic response pattern will be insightful about the interconnection of the markets.

Since the components of u_t may be contemporaneously correlated, we should orthogonalize them before make an interpretation of the MA representation. A method that can be used is Choleski decomposition (Enders, 1995, p.305-312.) The resulting MA representation of $\mathbf{Y}_t$ is

$$\mathbf{X}_t = \sum_{g=0}^{\infty} \mathbf{C}_g \mathbf{u}_{t-g} \qquad (7)$$

where $\mathbf{C}_g = \mathbf{B}_g\mathbf{P}$, $\mathbf{P}$ is the Cholesky factorization Matrix. The *ij*th element of $\mathbf{C}_g$ shows the impulse response of the *i*th market *g* period after one standard deviation shock in the *j*th market.

3.2.5| Decomposition of Variances

By using the orthogonalized MA representation, the forecast error variance can be decomposed. The proportion of the *h*-step forecast error variance of variable *i*th accounted for by innovations in *j*th variable is

$$\sum_{g=0}^{h-1} (c_{ij.g})^2 \,/\, \text{MSE(h-step forecast of } i\text{th variable}) \qquad (8)$$

where $c_{ij,g}$ is the *ij*th element of C_g. The expression measures the overall relative importance of each market in generating further fluctuations in its own and in other markets. It will help to understand the order of transmission among the markets (Ahmad and Server, 1994.)

III. Repo Market and Other Domestic Financial Markets: The results.

This part attempts to investigate contemporaneous and dynamic relationships among Thai domestic financial markets which include the Repo market, the interbank market, the foreign exchange market and the stock market. During the time, Thailand was under a pegged foreign exchange system that tied its national currency, the Thai Baht to a basket of foreign currencies in which composed of around 80% of US. dollar and 20% of Japanese Yen (all else foreign currencies seemed negligible and the proportion was subject to minor adjustments.) Since it is insightful to make an analysis of money markets versus return on equity market, the stock market variables are included both in level (denoted SET) and in annualized daily capital gain (denoted RMSET.) The VAR model composes of five variables and a constant.

3.3.1] The Data

The data base for this study consists of series of daily closed rate of one-day Repo (REPO1D), overnight interbank (INTBK), exchange rate of US. dollar per Thai Baht (THB), the stock market index (SET) and a transformation of SET to be the annualized daily capital gain on SET index (RMSET.) The data base, roughly contains 2,000 observations in each series, covered the period January 3, 1989 through June 30, 1997, the day that Thailand abandoned the pegged foreign exchange regime and adopted a floating system. The basic statistics of the data are shown in Table 1. While the plots of the series are presented in Figure 1 to Figure 5.

3.3.2] Correlation Matrix

The correlation matrix of the data is presented in Table 2. As we could expect, the Repo market and the interbank are highly correlated (0.86) due to the fact that they both are closely substitute money markets. An interesting point is the negative correlation coefficient between the stock index and the exchange rate, the magnitude is moderately high (0.57). This may suggest that market timing did exist in Thai equity market and some how foreign investors might sensitive to the exchange rate on their investment decisions. Another point is the correlation coefficients between the Repo rate and the stock index as well as the correlation between the interbank rate and the stock index are both negative,

the magnitudes are not high but around 20% (0.19 and 0.2565 respectively.) The results support the supposition that money market rates do influence stock markets.

3.3.3] Unit Roots Test

The results of unit roots tests are presented in Table 3. Two kinds of tests were performed for each data series, namely, the Dickey-Fuller test and the Phillips-Perron test (Dickey and Fuller, 1979 ; Phillips and Perron, 1988.) Most of the series are rejected against the existence of unit roots (indicates that they are stationary time series) with an exception of the stock market index (SET) which can not be rejected the unit root hypothesis at any conventional level. Beside the exchange rate (THB) series which can be rejected only at 10 % level of statistical significance, the rests are rejected at 1% level.

3.3.4] Choosing the Lag Length of the VAR Model

By using the Likelihood Ratio Tests as (3) with the strict parsimonious policy, the Lag Length of 10 is chosen. The details of the Tests are shown in Table 4. Given the sample size, 10-lagged model seem to be the most appropriate.

3.3.5] Granger-Causality Tests

Table 5 presents the block-F test for Granger Causality Tests for the VAR model with 15 lag length. Generally speaking, the tests indicate whether a variable help to forecast another variables at least one step ahead. The rows in Table 5 are the influencing or affecting markets while the columns are the affected markets. Mathematically, each column represents an equation where the dependent variable is in the column's heading and the rows are the independent variables.

The Repo market seems to be most influential in this setting. It significantly affects to all markets except the foreign exchange market. At the same time, the foreign exchange market is the most independent market, it is affected only by its own lags. The interaction between the Repo market and the interbank market seems uni-directional dominated by the former.

The stock market both in level (index) and in differences (yield) Granger causes by both of the money market rates and the relation is uni-directional from those of money markets to the equity market. The results support the view that equity markets are sensitive to money market interest rates. The only feed-back relation is between the stock index and its yield.

3.3.6] Contemporaneous Residual Correlation Coefficients

The contemporaneous correlation of residuals measure the degree to which new information produces an abnormal movement in one market in the same day. The higher correlation between market residuals, the more integrated those markets are. The matrix of residuals is also presented in Table 5. The results are as one would expected, the Repo market and the interbank market are highly correlated, and also for the SET index and its yield.

3.3.7] Decomposition of Forecast Variance

Table 6 to Table 9 present the results of the decomposition of variances in various orders for 5, 10, 15, 20 and 25 day-ahead forecasts. The column heading denotes the market in which the innovations come from. There are two interesting points, first, the variance of the Repo market and of the interbank market are significantly explained by each other depend on the order of decomposition. If the Repo market precedes the interbank market, It will seem that the Repo market explains the interbank market far more than that it is explained. But if the order reverses, the fact will not hold and the interbank market will substantially explain the Repo market. This results tell us to be careful about interpretation of the Granger-Causality Tests. There may be some flaws in

the model or it may be the results of the two variables are highly contemporaneous correlated.

Second, the same pattern occurs between SET index and SET yield as well. The order does matter for the both pair of highly residual correlated series. Only the foreign exchange market has no effect concerning with the order and its remains roughly 95% explained by its own innovations regardless of priority.

3.3.8] The Impulse Response Plotting

Figure 6 to Figure 10 present the plots of responses of the heading variables to the others. And Figure 11 to Figure 15 show the plots of responses to the heading variables by the others. The impulse responses are plotted from different simulations in which a unit standard deviation shock is presumably occurred in one of the markets (variables) then its dynamic effects to the other markets are traced to the next 24 days. The vertical axis measures the deviation from the bench case in standard deviation unit. The horizontal axis represents the days from the day of shock up to 24 consecutive days.

There are some points worth noting, First, the pattern of responses of the Repo rate, and the Interbank rate, to the Repo rate in Figure 6 is almost identical but their magnitudes. And the responses to the interbank rate in Figure 7 of them seem co-integrated, this may suggest that how closely related they are. Second, the stock index as

well as the exchange rate negatively and uniformly responds to the shock in the both money markets, the shock seems to have a delayed but permanent effect, this is consistent with the money-market-rate effect to equity markets proposition (Bonomo, Ferris, and Lamy, 1991.) Third, the effects of a shock either in the stock market or in the foreign exchange market to itself does not die away, it seems hang over entire the horizon.

The transmission between the money markets is almost simultaneously, and after the eighth day, the effect is steady and perpetual. While, the transmissions of those of money markets to the stock market are uni-directional. The index responses by gradual declining over the twenty-four day period. The same pattern is found in that of foreign exchange rate.

IV. Thai Repo Market and International Money Markets: The results.

There are evidences of international transmission of money market fluctuation both among US. dollar money markets and among different dominated currency money markets (Kean and Hachey, 1983; Ahmad and Sarver, 1994.) Economic theories suggest that the fewer restrictions of capital movements, and the more rigid of foreign exchange a country has, the more sensitive to international money markets it becomes. In the case of Thailand, most of its restrictions of capital flows had been eliminated before the end of 1994 but its foreign exchange regime remained comparatively fixed until the mid of 1997.

A few studies that have been conducted to measure the degree of monetary linkage found that Thai monetary system is moderately to highly sensitive to outside monetary environments (Hataiseree 1997.) In this part, we will focus on the order and magnitudes of the international transmission of money market fluctuation from the major US. dollar dominated money markets to Thai money markets by using the VAR methodology.

3.4.1] The Data

The data base for this study is in the same sample period as in part III. The series of one-day Repo rate (REPO1D) and overnight interbank rate (INTBK) remain in the model. The newly introduced series are the US. interbank rates or known as federal fund rates (FEDFUND), the seven-day Euro-dollar interbank rates known as London Interbank Offered Rates (LIBOR1W) and the seven-day Asian-dollar interbank rates or Singapore Interbank Offered Rate (SIBOR1W.) Thus, the model compose of five money markets which are geographically far away from each other. This results differences in their opening and closing times from 6 hours to 12 hours. We have to take the facts in mind in the interpretation of the results.

Since foreign exchange markets can be "buffer" markets to reduce the effects of the international transmission, the foreign exchange rate (THB) will be included in the model as well. Basic statistics of the newly introduced series are presented in Table 10.

Federal fund rate is lowest in mean but most volatile, while SIBOR is highest in mean but least volatile. The graphical representations of the series are shown in Figure 16 to Figure 18. The model will be a six variable system of VAR.

3.4.2| Correlation Matrix

Table 11 presents the correlation matrix of the data. There are very highly correlated among the US. dollar dominated markets (around 0.97 between Federal fund and LIBOR and quite the same for SIBOR, while around 0.999 between LIBOR and SIBOR.) This is not a good news, we are about to face the problem of near multi-collinearity in estimation of the model. The problem may results one variable statistically significant but in the same time make its highly correlated couple not significant at all. Common senses tell us that there are no reason why a variable has a strong effect to the dependent variable but another variable which is very correlated with that effecting variable remain virtually not influential. This is another point we have to take in consideration while we are interpreting the results. However, the results are not beyond expectation, since those markets are the markets of the same product (US. dollar short-term loans,) and are operated in three of the most liberal market economies in the world. The both of Thai money markets have moderately high correlation with those of international money markets (around 0.473 to 0.58.) However, the Thai markets are among the earliest to be open and close in a calendar day (an hour later than that of Singapore but seven hours before that of London and around 12 hours before that of New

York.) This fact results Thai money markets hardly take advantage of the time, thus among the least informed markets. Another interesting point is the foreign exchange market also has moderate correlation with those of international money markets (around 0.33.)

3.4.3] Unit Roots Test

The results for unit root tests for the newly introduced series are presented in Table 12. The series of federal fund rate and LIBOR are rejected against the null hypotheses of the existence of unit roots at 1% level of statistical significance for both of the Dickey-Fuller and the Phillips-Perron tests. While that of SIBOR can only be rejected at 10% level for the Dickey-Fuller test, but cannot be rejected at any conventional level for the Phillips-Perron test.

3.4.4] Choosing the Lag Length of the VAR Model

Table 13 presents the Likelihood Ratio Tests in order to choose the lag length of the VAR model. Since the sample deteriorates as the lag length increases, the parsimonious policy is strictly enforced. It seems that the model of 12 lags is the most appropriate in this setting.

3.4.5] Granger-Causality Tests

Having chosen the lag length of 12 business days, then the VAR model can be estimated. Table 14 presents the block F-test for the Granger-Causality Tests. The rows indicate affecting markets and the columns indicate those are affected.

The results are consistent with the previous study that the US. market is the most influential, and the transmissions from the US. domestic market are uni-directional (Ahmad and Server, 1994; Kean and Hachey, 1983.) Federal fund market is apparently influential to all the money markets in the model but not for the foreign exchange market, while it remain not be affected by any other markets. Between the Euro-dollar and the Asian-dollar markets, the interconnection seems bi-directional. The feed back of information apparently occurs.

In this setting, the Repo market become the least influential and the most sensitive. it is affected by the interbank market, not in another way around. This may suggest the role of the omitted variables in the previous model (the international money markets) or may be the result of the near multi-collinerity of the data. As mentioned earlier, since the Repo market and the interbank market are highly correlated, there is no reason why one markets are affected by some variables while its correlated twin is staying aloof. This is also the case of why Federal fund does not Granger cause the foreign exchange while the both of SIBOR and LIBOR do. However, we can safely draw a conclusion that Thai

money markets are significantly affected by the international money markets, and the effects are uni-directional from the outside.

The foreign exchange market in this model is not independent as in the previous model, it is significantly affected by SIBOR(at 1% level) and LIBOR(at 5% level.) However it remain far more affected by its past values.

3.4.6] Contemporaneous Residual Correlation Coefficients

The correlation matrix of residuals is presented at the bottom of Table 14. The values in the matrix are in overall smaller than those of the previous model. This suggests that the present model is more fitted but be cautious it may be resulted from the near multi-collinearity nature of the data. The residuals of the Repo rates and that of the interbank rates are considerably correlated as in the previous model. The correlation of residuals between SIBOR and LIBOR is also moderately high (0.623.)

3.4.7] Decomposition of Forecast Variance

Table 15 to Table 21 present the decomposition of variances in various orders for 5, 10 , 15 and 25 day-ahead forecasts. The smaller the proportion of variances a market can be explained by itself, the more sensitive or integrated it is. The most sensitive market is SIBOR, it can be explained by itself less than 42 %, (if it is placed behind LIBOR, it is

explained by itself only about 14%.) For LIBOR, the results are slightly higher and depend on whether or not it be placed behind SIBOR (about 50% and 40% respectively.) Federal fund market is explained by itself around 60% regardless of its place.
The priority remains important to the results of the Repo market and the interbank market. But an interesting point is their proportions of variances which are explained by the international money markets are not as high as expected, only about 10% at the highest. This tell us that we might overestimate the transmission effects. Perhaps, the effects are absorbed by the foreign exchange market which seems quite sensitive in this setting in contrast with the previous model.

3.4.8] The Impulse Response Plotting

Figure 19 to Figure 24 show the plots of responses of the heading markets to the others. While Figure 25 to Figure 31 present the plots of responses to the innovations in the heading markets by the others.

The plots agree with the view that the domestic US. dollar market play the leading role. If the shock happen to occur in the Federal fund market, it will transmit to the London market and then the Singapore market in a day to five days to reach its highest effect. The shock will have an temporary effect in the Thai Repo market in the next day but the effect will recur after the seventh day, this may result from the pass through effect

of the Euro-dollar and the Asian-dollar markets. For the foreign exchange market, the shock seem to have a delayed but prolong effect (see Figure 19.)

A shock originated from the LIBOR market impacts its Asian counterpart immediately and quite uniformly (to its own.) It may have a brief response from the Federal fund market in between the fifth day to the eighth day. But a shock from SIBOR market seem to have a smaller effect to LIBOR market (see Figure 20, 21.)

The interbank market seem to have almost uni-directional effect to the Repo market, the impact is immediate and gradually decline beyond the horizon of 24 days. While the responses of the foreign exchange to itself seem perpetual entire the period.

V. Conclusion and Remark

In this chapter, the VAR methodology is used to study the dynamic interrelationships among the Thai domestic financial markets, and among the Thai money markets and the major international money markets. The methodology enables us to investigate the relationships among those markets through space and time, to trace how those markets are linked to each other, and to identify what role does each market play, leading or following.

Amongst the Thai financial markets, the Repo market seems to be the leading market. However, it is highly and simultaneously correlated with the interbank market. The both money markets may share the leading role in the domestic setting. There is no doubt that the stock market is mostly uni-directional affected by both of money markets. The effects are slow but seem perpetual. This result supports the view that money market rates have direct influences to equity markets. The foreign exchange market seem to be the most independent market in this model.

For the global setting, the results are consistent with the previous studies (Ahmad and Server, 1994; Kean and Hachey, 1983.) The US. money market plays the leading role, even if we take the account of the time differences. Its shock is usually transmitted about 5 day period to reach its peak in the Euro-dollar and the Asian-dollar markets, and finally reaches the Thai money markets as well. However, in the long-run, it seems also be affected by the world environment, in the 24-day horizon, it can only explained by itself only around 60% of its forecast variances. For the offshore US. dollar markets, they are far more integrated to each other than to the US. domestic markets. A shock in one market is transmitted almost simultaneously and causes both of them move quite uniformly. However. it may be the size or the time differences that make the Euro market seem to be more influential than the Asian market. For the Thai money markets which are the interbank market and the Repo market as the center of the study, the result is what we can expected. They are sensitive to the international markets. The finding is also consistent with some previous researches (Hataiseree, 1997.) Both of Thai domestic

money markets tend to move together, but in this setting the interbank market plays the leading role within the country. The foreign exchange market is prone to shocks from the outside as well, but not from the inside.

In a board sense, this chapter shows that how interconnected the world financial markets are. In the era of financial globalization, no market can stay aloof, they are all connected, the questions are how much and how long.

In the closing, it should be remarked that the circumstances in the period that generated the data comparing with the succeeding period have been materially changed. From July 1, 1997, Thailand abandoned the basket pegged regime due to its severe casualties in defense of that regime. The Baht, its currency has been floated since. As foreign exchange markets can be buffer markets to adsorb monetary shocks from the outsides, the behaviors of and the relationships among those markets may not be the same. But the period is still too short to produce an adequate amount of data for this kind of study thus it is left for future researches.

Chapter 4: Interest Rates and Economic Cycles.

I. Introduction

Economic Cycles or Business Cycles are defined as follows:

" Business Cycles are a type of fluctuation found in the aggregate economic activity of nations that organize their work mainly in business enterprises: a cycle consists of expansions occurring at about the same time in many economic activities, followed by similarly general recessions, contractions and revivals which merge into the expansion phase of the next cycle; this sequence of changes is recurrent but not periodic: in duration business cycles vary from more than one year to ten or twelve years; they are not devisable into shorter cycles of similar character with amplitudes approximating their own." (Mitchell, 1927; Burn and Mitchell, 1946; Lahiri and Moore, 1991: p.1 ; Niemira and Klein, 1994: p.5.)

Generally, during a business cycle, the following are observable. First, Production output is affected across various sectors. Second, Production and consumption of durable goods are volatile than those of non-durable goods and services. Third, both of interest rates and inflation tend to exhibit declination during recessions and increasing during expansions. Fourth, Employment moves up and down in accordance with the overall phase of the business cycles (Niemira and Klein, 1994: p.4.)

Empirically, there are many cycles which are coincident, leading or lagging with business cycles (or output cycles.) Those include inflation cycles, credit cycles, monetary cycles, interest rate cycles as well as stock market cycles. Some are used as economic indicators to forewarn or to confirm the phases of business cycles. While some are informative in a making of economic decision for their own right.

II. Why Can Yield Curves and Interest Rates Predict Economic Activities?

Up to date, there are more than a score of business cycles theories, ranging from agricultural theories, one of them well known as "the sunspot theory" to new classical theories such as supply side theories and rational expectation theories. In this part, only relevant theories in which dictate or imply that interest rates can be predictors of the economic cycles will be reviewed. Some good reviews of business cycle theories can be found in Niemara and Klein (1994, Ch.2.,) and Zarnowitz (1992, Ch.1 and Ch.2.)

4.2.1] Over-investment Theories

Monetary over-investment explanations are drawn from works of R. G. Hawtrey (1937), Knut Wicksell (1907) and Friedrich von Hayak (1939.) The essence of those theories is in the operation of the banking system. According to the classical economists' view, the economy is normally in equilibrium, business fluctuations do occasionally occur

but as minor self correcting phenomena. Profit-seeking bankers are the initiators. At a level of interest rate called the natural rate of interest, the supply of savings equal the demand for loanable funds. It ensures that all productions that are not utilized by consumption will be saved and invested, thus the general market clearing is reached. The competition of banking system is to drive the actual rate of interest or the market rate of interest below the natural rate thus makes investors and entrepreneurs increase their lending to expand their activities. As a result, the economy expands to unsustainable levels in which the consumers' demand are less than the entrepreneurs' supply and a recession may follow. Whenever the market rate of interest is driven back to the natural level, the economy will return to the equilibrium and the cycle starts all over again (Niemira and Klein, 1994.)

The implications of the theories about the role of interest rates as economic indicators are as follows: First, the level of interest rates is normally and most of the time in a comparatively stable level called the natural rate of interest. Combining the effect of inflation expectations, any nominal deviation from the natural rate or the real interest rate will be the expected rates of inflation. Second, the decline of the market rate of interest (with extension to include the expectation of inflation, the market rates should be the real rates) will lead to expansion in economic activities.

4.2.2| The Banks' Willingness to Lend Theories

This group of theories also focuses on the practices of the banking and financial system. The theories try to explain why, most of the time, a financial crisis lead to an economic crisis. An influential theory is the financial instability hypothesis (FIH), proposed by Minsky (1982.) In his words, Minsky describes the hypothesis as follows:

" [T]he structural characteristics of the financial system change during periods of prolonged expansion and economic boom and that these changes cumulate to decrease the domain of stability of the system. Thus, after an expansion has been in progress for some time, an event that is not of unusual size or duration can trigger a sharp financial reaction . . . . Once the sharp financial reaction occurs, institutional deficiencies will be evident."

Revell (1986) added to the FIH that competition among financial institutions leads to bad banking practices. To compete with each other, the financial institution not only lowers prices but also attract less creditworthy borrowers, thus adds risk. And as they try to lend to the most lucrative sectors in the economy, the banking industry become to overexposed to the booming sectors, mostly in bubble states. When the fortunes turn upside down, the financial sector is piled up with a huge bad debt (Niemira and Klein, 1994: p.402.) Either before or after, they find themselves in a financial crisis, they reverse their credit policy sharply by restricting credit. As interest rates rise, relatively secure borrowers, who are not willing to pay the higher interest cost curtail their borrowing while the riskier borrowers who are still willing to borrow are denied by the banks. As a result, the economy will accelerate to a recession (Stiglitz and Wiess, 1981.)

The theories imply that before and in an expansion phase, interest rates are comparatively low, the risk premiums, measure by the different between interest rate costs of high credit quality borrowers and low credit quality borrowers, are small. In contrast, as a recession is eminent, interest rates jump up and the risk premiums are large as the gap between the yield curve of A rating bonds and B rating bonds is widen.

4.2.3] The Bank Portfolio Holding Theory

This theory is closely related to the banks' willingness to lend theories but instead of bank credit rationing that causes a recession, the theory's explanation is based on bank portfolio shifting. The theory proposes that during expansions, banks increase their proportion of security holding relative to loans, especially medium to long term government bonds. The reduction of loanable funds that triggers a recession (Bernanke and Blinder, 1987; Wood, 1975; Niemira and Klein 1994: p.402-403.)

The bank portfolio shifting will drive longer term (government) bond prices up comparing with those of shorter term bonds, thus invertly turns (flattens) the yield curves. According to this theory, the slope of yield curves is a good predictor of business cycles.

4.2.4] Credit Crunch Hypothesis

The credit crunch hypothesis is another attempt to link business cycles to financial crises. Wolfson (1989) pointed out his key observations as follows: First, financial crises tend to out brake after a peak of the economic expansion. Second, Debt payment difficulties tend to occur as the peak of corporate profits. Third, debt to equity ratio increases and the debt maturity shortens during the peaks of business cycles. Fourth, at the brink of financial crises, the situation is delicate and vulnerable so the crises can be trigged by a surprise event that causes lenders to fear the loss of their funds. Fifth, The role of central banks as the lender of last resort would relieved the financial crises.

The essence of the hypothesis is that credit bottlenecks are the triggers for recession (Wojnilower, 1980.) A good proposition of the credit crunch hypothesis is found in Sinai (1976) as follows

"[A] period of an intensifying squeeze on liquidity, where the credit demand of households, businesses and governments increasingly outstrip the ability of the financial system to provide sufficient funds. Both internal and external sources of finance slowly, but continuously, diminish for each sector or become available only at a prohibitive cost. The liquidity squeeze takes its toll sector by sector, until eventually all sectors sharply curtail their desired expenditures."

As the hypothesis predicts, the following would be observed: First, stock markets tend to crash late in the boom phase of credit cycle or shortly into the lightening liquidity phase. Second, the ratio of fixed and inventory investment to cash-flow as a measure of the corporate financial gap tend to be coincident with the peak in short term interest rates and the onset of credit crunch. Thus, the rise of short term interest rates is a leading

indicator of recessions that implies the change in the shape of yield curves as well (Niemira and Klein, 1994: p. 407.)

4.2.5] Rational Expectation Hypothesis

The role of the rational expectation hypothesis to explain why interest rates can predict economic activities or business cycles is not in its view about business cycles but in its basic assumptions concerning economic agents (however, it does have an explanation for business cycles, see Lucas (1981.)) The economic agents are assumed to utilized all information at their disposal in an efficient manner. Thus, in the most cases, they can form accurate forecasts about the future including what would central banks and governments act or counteract according to the expected events (Muth, 1961; Lucas, 1981.)

The hypothesis suggests that financial markets are efficient in such a way that they are the best predictors about the future. For instance, if the economy is in a late expansion stage in which interest rates are normally high and a recession is eminent, the market will reflect the consensus that future interest rates will eventually decline due to the central bank intervention to counter the recession (which is the economic agents expects in the near future.) The consensus will twist the interest rate yield curves by pushing down the long maturity ends. And the expectation of high interest rates during the boom stage will push up the long ends of the yield curves before the economy reaches the high gear. Thus, interest rates and their yield curves could be good leading indicators for business cycles.

III. Brief Review of Some Empirical Studies

The search for leading economic indicators to predict the future state of the economy which is represented by a set of successive major economic variables has been undergone for decades, many impressive predictors are found. US Treasury bills/bonds interest rates and yield curve are among those leading indicators.

In the United States, the Treasury rate indicators were found to have some predictive power to future inflation and some real economic variables such as GNP, investment and consumption as well as the probability of economic down turn or up turn in each business cycles (Mishkin 1988, 1990; Frankel and Lown 1994, Estrella and Hardouvelis 1991.) For the power of the yield curve to predict future interest rates, there are not conclusive but in several empirical studies, some evidence of the yield curve's predictive ability has been found (Fama 1984, Fama and Bliss 1987 and Hardouvelis 1988.)

The shape of yield curves are observed that they are different in various stages of business cycles. And the transformations usually occur before the economy enter in the next stages. However, such patterns of the yield curves can be relied on as an economic indicator only when the cyclical forces are powerful (Homer, 1978; Niemira and Klein 1994: p.405.)

In this part, some empirical evidences of interest rate role's as economic indicators will be briefly reviewed.

4.3.1] The Yield Curve Over The Business Cycles

An empirical study about the shapes of the treasury yield curve over the US. business cycles by Niemira and Klein (1994: p.404-405) concluded from 1954 to 1991 averages, in their own words as follows:

"[T]he relationship between the interest rate yield curve and its term maturity, holding all other factors constant, is known as *the term structure of interest rates* or *the yield curve*. The shape of the yield curve varies over the business cycles as expectation of growth and inflation change. Using the business cycle stage framework and cycle averages for U.S. government debt securities . . . . . In Stage I, the yield curve is upward sloping, that is, the yield on longer term government securities are higher than the shorter term maturities. As the economy moves away from the trough in the business cycles, the yield curve ratchets higher (in Stage II) almost uniformly across all maturities. However, as the economy moves into the middle stage of the expansion period (Stage III), the shape of the yield curve begin to change. The yields on the shorter maturities (U.S. government bills and notes) tend to rise while the long end of the yield curve tends to fall slightly. But as the short end of the term structure to move higher (Stage IV), the long end remains relatively stable causing a partial inversion of the yield curve, that is, some of the shorter maturity instruments are yielding a higher rate than the long end of the curve. This process continues through the peak in the business cycles (Stage V). In Stage V, the whole yield

curve tends to be inverted as the short end rises more than the long end, but the long end shows the largest rise of the business cycle during this phase. The long end of the yield curve tends to move higher after the peak in the economy (Stage VI) but maturities less than one year tend to show little change. Then with the recognition of a recession, Federal Reserve policy tends to push down short-term interest rates and in Stage VII. short-term rates drop about 70 basis points on average, while the long end falls about 20 basis point . . . . As Federal Reserve policy become more aggressive in lowering rates and getting the economy moving again, short-term decline by about another 80 basis points while long-term rates drop by about 30 basis points. And with that, the process starts all over again."

4.3.2] Predictive Ability to Future Interest Rates

The so-called term structure hypothesis (TSH) says that the future interest rates implicit in the term structure are optimal and unbiased. For instances, if the yield curve slope is steeply upward, interest rate will rise in the future, in contrary, if the yield curve slope is downward the interest rate will fall in the future (Frankel 1995.)

Under the no arbitrage condition, given there are no liquidity premium and risk premium of any kind, the TSH can be stated mathematically for 6 month and 3 month treasury bills as:

$$R6(t) = [E\{R3(t+3)\} + R3(t)] / 2$$

thus, $$E\{R3(t+3)\} - R3(t) = 2*[R6(t) - R3(t)] \quad (1)$$

where R6(t) is the interest rate of today six months to maturity Treasury bill

R3(t) is the interest rate of today three months to maturity Treasury bill

$E\{R3(t+3)\}$ is the expected interest rate of the next three months a three months to maturity bill (if unbiased, the expected will be realized.)

The results of testing the hypothesis on Treasury bill term structure to predict future short term interest rates are not conclusive. Campbell and Shiller (1987, 1989), Fama (1984), Fama and Bliss (1987) and Hardouvelis (1988) found some degrees of predictive power. While Shiller, Campbell, and Schoenholtz (1983), Mankiw (1986), Froot (1989), Fama (1990) and Evans and Lewis (1984) found no statistically significant in predictive ability. But all of those authors agree on the fact that the predictive ability of the yield curve to forecast short-term interest rates is less than that the TSH states it suppose to be and the results are seem to be sensitive to sample periods (Frankel 1995.)

4.3.3] Predictive Ability to Future Inflation

In 1988, Manuel Johnson, then vice-governor of the Federal Reserve System publicly announced that the term structure of Treasury interest rates was one of three monetary indicators might be helpful to show what kind of monetary policy was in the moment, tight or loose (Frankel and Lown 1994.) Many studies of the yield curve's

predictive ability to future inflation have been done since then. Mishkin(1988,1990,1991) proposed a simple model use only 3 month and 12 month Treasury rates to test the idea as follow:

$$p(12) - p(3) = a + b*[R12 - R3] + u \qquad (2)$$

where p(3), p(12) are future inflation rates over the next 3 month and 12 month respectively.

R3, R12 are the three month and 12 month (to maturity) Treasury bill rates, respectively.

The results from running regression of equation (2) on monthly sample from January 1960 to November 1991 are concluded that the coefficient b is significantly greater than zero implies that the term structure does have some degree of predictive ability to future inflation rate. But in the same time, b is also significantly less than unity thus rejecting the null hypothesis that the real interest is constant.

The later authors such as Frankel and Lown (1994) used more sophisticated models which allow the real interest rates to vary and extend to the longer maturity rates as well as apply non-linear techniques to extract the information that contains along entire length of the yield curve. Their approach has out performed the Mishkin approach (as

equation (2)) and the finding confirms that the yield curve do contain some information about future inflation.

Dasgupta and Lahiri (1991) used a simple random walk model for real interest rate then extracted inflation expectation from nominal interest rates by a complicated, recursively generate method based on a chain rule forecasting. They found that over 1953 to 1986 the inflation expectation predictors perform much like the comprehensive composite leading indicator approaches by Moore, (1983 and 1986) and by Niemira (1986.) And they proposed that to include the interest rate-based inflation predictor would greatly enhance the performance of those indices.

4.3.4] Predictive Ability to Future Real Economic Variables

Estrella and Hardouvelis (1991) proposed that the term structure of interest rates might contain information about future real economic activities as well. The authors had got the idea from many business economists and financial analysts who believe that a flatten followed by an inverse yield curve is a sign of recession in the near future. In order to test the idea, they ran regression on the following equation:

$$Y(t, t+k) = a + b * SPREAD(t) + \Sigma[c_i * X_i(t)] + e(t) \qquad (3)$$

where $Y(t, t+k)$ is the annualized *cumulative* percentage change from current quarter (t) to future quarter (t+k) in the seasonal adjusted finally revised real GNP number based on 1982 dollars, mathematically

$$Y(t, t+k) = [400/k]*[\log\{y(t+k)/y(t)\}] \quad (4)$$

where k is the forecasting horizon in quarters,

y(t+k) is the level of real GNP during quarter t+k

e(t) is the error term

The annualized *marginal* change in real GNP from future quarter (t+k-j) to future quarter (t+k) is also of interest, the marginal change can be defined as

$$Y(t+k-j, t+k) = [400/j]*[\log\{y(t+k)/y(t+k-j)\}] \quad (5)$$

The variable which represents the term structure of interest rates, for simplicity, is the different between the long term rate (10-year Treasury bond rate) and the short term rate (3-month treasury bill rate), mathematically:

$$SPREAD(t) = RL(t) - RS(t) \quad (6)$$

where, RL(t) is the long-term rate at the time (t), particularly, 10-year Treasury bond rate.

RS(t) is the short-term rate at the time (t), particularly, 3-month Treasury bill rate.

$X_i(t)$ is stand for a number of other information variables available in quarter (t).

The results warranted the idea, the model that regresses the GNP change to only SPREAD and the interception was statistical significant. The flatten and reverse yield curves would indicate that the real GNP growth decline or even negative. The cumulative change are more predictable than the marginal change. While the predictive power of the term structure to cumulative change lasts almost 4 years, the predictive power for the marginal change lasts for only 6 to 7 quarters. The forecasting accuracy is highest for 5 to 7 quarters ahead in predicting the cumulative change based on in-sample forecasting (R^2), the SPREAD explains one-third of the variation in future GNP changes. The term structure also has predictive power for all private sector components of real GNP which are consumption, consumer durable, and investment but not for government spending. Those results are based on the second quarter of 1955 to the fourth quarter of 1988.

When supplementary information variables such as the real federal funds rate, the index of leading indicators, the annualized rate of inflation and the lagged of GNP changes (as X_i) are included, the term structure continues to have explanatory power over the entire forecasting horizon. Its in-sample predictive power significantly lasts for about three years in the future. The real fed funds rate is also statistically significant in

predicting about six quarters in the future. For the index of leading indicators, it has a positive relationship with future real GNP but the predictive power lasts only the next three quarters, less than that of the yield curve. The coefficients of lagged rate of inflation show negative signs which are all statistically significant beyond two quarters. Finally, the lagged growth in GNP has a negative relationship with its own, suggesting a slight mean reversion. The out-of-sample forecasting of the model has a smaller root mean square error (RMSE) than that of based on the yield curve alone. While the in-sample forecasting of the yield curve alone is better than that includes all information variables by comparing the R-squares.

In the same article, the authors also compared the forecasting performance of the yield curve with that of the survey forecasts conducted by the NBER and the American Statistical Association since the beginning of 1970. The yield curve also outperforms the survey forecasts both in-sample and out-of-sample while the survey forecasts' predictive power lasts for only two quarters ahead. Although, the yield curve is better than the other predictors in predictive power to the real economic variables in this paper, the absolute size of the out-of-sample RMSE of its forecasts is not so impressive. The RMSE is quite large comparing with the standard deviation of the real GNP growth rate.

Chapter 5: Repo Rates as Economic Indicators: The Case of Thailand.

I. Introduction

The motivation to investigate possibilities of using interest rates in general, and Repo rates in particular as economic indicators comes from their ideal property. Interest rates are promptly available indicators. They are mostly real-time quoted. Comparing with those of commonly used as economic indicators such as money supply, employment, inventory change, etc., which take some time to be available and subject to revise later. Moreover, interest rates have a firm theoretical background and a considerable amount of empirical evidences to support their role as economic indicators. A brief review of the theories and empirical studies is presented in Chapter 4.

This chapter will focus on the investigations of predictive abilities of Repo rates to some important financial variables, the data comes from the Bank of Thailand's Monthly Bulletins, the statistical summery is shown in Table 22. Because all of real variables in Thailand in that period were not monthly available, mostly were yearly available, given less than 10-year period as in our setting, there are statistically insufficient to perform robust

tests for those variables. However, some characteristics of Repo rates and the financial variables during business cycles will be examined in the next part.

This chapter will be proceeded as follows: The next part will address business cycles in Thailand and their relationship to the financial variables and Repo rates during the period of 1989 to 1997. Part III will describe the methodology to investigate and evaluate predictive abilities of Repo rates to those variables. Part IV will report the results. And the last part, Part V will be for the conclusion and remark.

II. Economic Cycles in Thailand

In Thailand, due to a poor collecting and recording system in which many key economic variables are inaccurate and long lag reported, study of economic indicators had been overlooked except in a few governmental agencies which need to have the indicators for policy advises and implementations. The Bank of Thailand, for instance, as Thailand's monetary authority normally relies on Monetary Aggregates (such as Monetary Base, M1, M2, Bank Reserve) as monetary indicators in which it has been convinced that the indicators do have strong and stable relationships with GNP and Inflation (Hataiseree 1996.)

Recently, Department of Business Economic, Ministry of Commerce with technical assistance of the Foundation for International Business and Economic Research, Columbia

University, had performed an empirical study to search for indices for business cycles in Thailand, it concluded that a leading index is composed of six leading economic indicators. Those are Money Supply (M1), stock price index (SET), construction area permitted in Bangkok, authorized capital of newly registered businesses, export value and the number of foreign tourists. The index leads business cycles around 1.75 month before turning points at the trough and around 5.6 months at the peak, thus on average 3.8 months prior to each turning point (Benyasut 1996.)

The Department researched and developed an index as an official reference to states of the business cycle which is composed of five variables as follows: First, Composite Production Index which is calculated from Commercial Vehicle Production, Cement Production, Beer Production and Motorcycle Production. Second, Department Store Sale is added as a single variable. Third, Car (Automobile) Sale is also included. Forth, the government revenue from Business Tax is added. Fifth, Composite Import Index which is made up from Import Value and Import Duty.

From the reference index, the Department set official dates called "Reference Chronology" for the business cycles. Since 1970, Thailand has passed through 5 business cycles and is in the sixth cycle. The official dates for the business cycles are as follows

1) The first cycle was from July 1970 as the first peak via May 1972 (the first trough) to November 1973 as the second peak, lasted for 40 months.

2) The second cycle began at the second peak passed through the second trough in November 1974 and ended at the third peak in May 1979, lasted for 66 months.

3) The third cycle started at the third peak via the third trough in February 1982 and finished in January 1984 as the fourth peak, lasted for 56 months.

4) The fourth cycle was from the fourth peak via the fourth trough in June 1986 to the fifth peak in August 1990, lasted for 79 months.

5) The fifth cycle began at the fifth peak passed through the fifth trough at January 1992 and ended at the sixth peak January 1995, lasted for 53 months.

6) The sixth cycle started at January 1995 (the sixth peak) and has not yet reached the sixth trough at the end of the data set (end at September 1997) (Benyasut 1996.)

Figure 31 to Figure 43 show plots of the financial variables and the business cycles, during our period of study, there were about two business cycles (not completed,) thus two expansions and two recessions. An expansion is defined as a time interval from a trough to the immediate peak. While a recession is a time interval from a peak to the immediate trough. We may say that an expansion represents an "up-turn" half of a business cycle and a recession represents a "down-turn" half of a business cycle. We can see some ostensible patterns during a business cycle in the behaviors of a few variables. M1 in level shows up-turn trends during expansions and horizontal trends during recession, even through the movements are very fluctuated, see Figure 31. Growth in M1 in Figure 34 also exhibits more volatile and more time in the negative zone during recessions than during expansions. Growth in bank credit in Figure 36 shows general

trends similar to those of M1 in level, up-turn during expansions and down-turn during recessions with no less fluctuation. Stock market index (SET) also shows the same pattern but some what less volatile, see Figure 37. MLR (Prime Rate) and 30-day Repo rate in Figure 38 and 39 exhibit quite the same pattern but the latter is more volatile, they are rising in late expansion periods and reach their peak in the mid of recessions. They usually drop before the end of recessions then reach their trough in late of the next expansion period as some economic theories predict (see section 4.2.2, 4.2.3, 4.2.4 in Chapter 4) the rise of interest rates signals the end of expansions (the peak of a business cycle is near,) while the fall of interest rates signals the end of recessions. And the level of interest rates is usually low in the most of expansions, while it is high in the most of recession, this is also consistent with the theories. In contrary with the theories, the yield curve spread (of Repo rates, 1-day and 30-day maturity) shows no distinct pattern, see Figure 40. And the risk premium in Figure 41, the different between the interbank rate (overnight) and 1-day Repo rate does show a rough cyclical pattern, tend to be up in recession and down in expansion but not as the theories predict. It is not a leading indicator but looks rather like a coincident indicator or a lagging indicator. The rest of variables exhibit no obvious trends or any differences between an expansion and a recession.

To further investigate the behavior of those variables, the series are break up into four periods according to the expansions and recessions. Note that the first expansion (E1) and the last recession (R2) are not in full cycles, the study uses data only from

January 1989 to September 1997. Table 23 exhibits a statistical summery of means and variances comparisons among those periods. A number of t-tests for differences in means are shown in Table 24. The tests also include the null hypotheses of indifference in means between the variables in the both expansions (E1 and E2) as well as in the both recessions (R1 and R2.) An interesting result is most of variables are statistically different in means to themselves during the two expansions (E1 and E2.) This may suggest fundamental changes in the economy during the period between the expansions which are resulted from the financial liberalization program. The interbank rate exhibit remarkable differences in mean during the expansions against the recessions for all 3 comparisons. The Repo rates, growth in bank credit and growth in stock market index show 2 out of 3 statistically different in their means during the expansions-versus- recessions. While the risk premium and the yield curve show differently only once. Growth in board money (M2) shows no differences in mean for all the expansions-versus- recessions tests but shows significant differences in mean for the test between the two expansions and for the test between the two recessions.

F-tests for differences in variances are presented in Table 25. The interbank rate notably shows different in all expansion-versus-recession tests while exhibit indifferent during the both expansions and the both recessions. Inflation rate and 1-day repo rate show significant differences for all of the three tests but shows a difference in variance between the two recessions(R1 and R2) too. The 30-day Repo rate exhibits the same 2 out of 3 result as well as for the capital gain on SET and the risk premium. SET index

exhibits different in all test but the E2 against R2 test. While the yield curve spread and the growth in bank credit show the difference only once. Note that more than a half of the variables show significant differences in variance, by comparing between the two recessions, this may also indicate some fundamental differences in the economy between those two periods, indeed the later recession (R2) has been the most serious economic crisis in 50 years for Thailand and has eventually spread to its neighbors.

III. The Methodology

5.3.1| Granger Causality Tests

Granger Causality tests (The technical details are presented in Chapter 3 section 2.3.) will be used to detect predictive abilities of the three following well theoretical ground predictors, SPREAD (the yield curve spread between 30-day Repo rate and 1-day Repo rate,) RKPRM (the risk premium- the difference between overnight interbank rate and 1-day Repo rate,) and 30-day Repo rate (only as a predictor to the MLR-Prime Rate and to SET index, both in level.) The tests for each dependent variable will be conducted in 5 lag lengths; 1 lag, 3 lags, 6 lags, 9 lags and 12 lags to detect up to a year ahead predictive abilities of the predictors. If any model are found the dependent variables significantly Granger caused by the predictors, the estimated model will be shown and analyzed.

5.3.2] Out-of-Sample Performances of Interest-Rate-Based Models of Inflation Forecasts:

Three sets of out-of-sample forecasting error measurements (Mean Error, Absolute Mean Error and Root Mean Square Error-RMSE) from three apparent models will be compared. The first two models are interest-rate-based (Repo-rate-based) models which are the OLS-SPREAD model and a simplified version of Dasgupta-Lahiri's nominal interest rate model (Dasgupta and Lahiri, 1991.) Another one is an AutoRegressive-Moving-Average model (ARMA). in this model, inflation rate is to be predicted by its own lags and residuals. We will use ARMA (12,12) in this study.

The first model is just a simple ordinary least square estimation model with no lag. The rationale of the model is that the spread between short-term interest rates and longer term rates may contain expected inflation and under the rational expectation hypothesis in concert with the efficient market hypothesis, the expectation is the most accurate prediction. The model is mathematically stated as

$$P(t) = a + b*SPREAD(t) + u \qquad (1)$$

where, P(t) is inflation rate of the month t,

SPREAD(t) is the difference between 30-day Repo rate and 1-day Repo rate

This model is similar and based on the same rationale as the model proposed by Mishkin(1988,1990,1991) which is presented in Chapter 4, section 4.3.3, equation 2. However, this model is only one-month-ahead prediction, so we can use monthly inflation rate directly.

The second model is based on the theoretical relationship of nominal interest rate, real interest rate and inflation rate, by using the Repo rate as the interest rate, the model can be stated as

$$P(t) = REPO30D(t) - RLREPO30D(t) \qquad (2)$$

where P(t) is inflation rate over the month t,

REPO30D(t) is nominal 30-day Repo rate (average) on the month t,

RLREPO30D(t) is real 30-day Repo rate on the month t.

Since the inflation rate is not known until the end of the month (at the earliest), the real rate is also not known. We have to estimate the real rate in some ways. Dasgupta and Lahiri (1991) proposed that the real rate is to be predicted by economic agents under the rational expectation hypothesis and known to them in the month of prediction. The economic agents are assumed to know the inflation rate as well, thus the nominal interest rate reflects all information of the market. If we know what is the market (composes of all economic agents) expected about the real interest rate, we will be able to calculate what

the market has expected for the inflation rate, and under the rational expectation hypothesis, the expectations are the most accurate (the best and unbiased.) The authors used a few models to simulate market expectation of the real interest rate such as random walk and AutoRegressive (AR) models. In this study, the ARMA(12, 12) will be used to estimate the market expectation of 30-day real Repo rate (the model uses only past values of realized real 30-day Repo rate and its residuals.) Since we know the estimate of market expectation of the real rate for the month t, the expected inflation rate is easily calculated by using equation (2).

The out-of-sample evaluation is to used only up-to-date available data to estimate (parameters of) the models and to predicted only one step ahead. However, in this study, I will re-estimate the models only for every quarter, not every month.

IV. The Results

5.4.1] Granger Causality Tests for Predictive Power of The Repo Rates

Table 26 presents the tests for the Repo yield spread as a predictor to growth in M1, growth in M2, growth in bank credit, capital gain on SET index and change in Prime Rate (MLR.) The predictor is found to have some predictive powers to growth in M1, growth in M2, capital gain on SET index and to change in MLR. When we closely look at the model of growth in M1 (see Remark 1, Table 26) the predictor is significant in its 5-

month lag and 9-month lag. The two lags of the predictor are all have positive sign coefficients, it means that if the slope of the yield curve is up-ward, we can expect rises in the growth of M1 next 5 months and next 9 months. However, the Granger test is significant only at 10% level and so are the individual lags of the predictor. The Granger causality tests are more favorable for SPREAD's predictive power to growth in board money (M2), the null hypothesis of no Granger caused is rejected at 1% level for the model of 6 lags and rejected at 5% level for the model of 9 lags. For the individual lags' significance, the both models shows that the third lag, the fourth lag and the sixth lag are significant at least at 5% level (see Remark 2 and 3.) We can conclude that the yield spread has predictive power that lasts to the next 6 months for the growth in board money supply (M2.) For the capital gain in SET index, the yield spread is found to Granger cause in the one-lag length model. However, the R^2 is only 0.2002 and the spread significant at only 10% level (see Remark 4.) The predictor SPREAD is also found to have predictive power to the change in Prime Rate for the model of 1 and 3 lags. It seem that the predictor's predictive ability has lasted for 2 months (see Remark 6.) A down-ward slope yield curve tends to follow by an increase in Prime Rate. This seem contrast with the rational expectation hypothesis, but a down-ward slope may indicate a tight monetary environment and Repo rates are more adjustable than the prime rate.

Table 27 presents the Granger causality tests for predictive abilities of the risk premium (defined as the difference between 1-day Repo rate and overnight interbank rate.) The risk premium shows no significant predictive powers to the dependent

variables, with an exception to the growth in M1 at 5% level. The estimated model shows that its predictive power to GM1 may have lasted for 11 months ahead, the significant lags are the second lag, the fourth lag, the fifth lag and the eleventh lag, all significant lags are positive thus not consistent with the theories (the lower the risk premium, the better the economy would become, thus should lead to an increase in the money supply growth.)

Table 28 presents the Granger tests for 30-day Repo rate as a predictor to the Prime Rate (MLR-in level not in difference) and SET index (in level not in capital gain.) We found that the Repo rate strongly Granger causes the MLR in 1, 3 and 6 lag length models in which it is significant in all lag lengths. This is what we can expected from the plots as well. All significant lags in the models have positive sign with an exception of the first lag in the one lag length model. The 30-day Repo rate is also found to Granger cause the stock market index (SET) in the one lag length model, the Repo rate has a negative sign and highly significant. This result is consistent with what we found in Chapter 3 that money market interest rates negatively impact equity prices.

5.4.2] Out-of-Sample Performances of Inflation Forecasts

Table 29 presents the three measurements for out-of-sample forecasting performances of the nominal interest rate model (Dasgupta and Lahiri 1991.) Figure 44 shows the plot between the predicted and the actual inflation. Since in the beginning of the study period, the model may suffer from too few available data, I also evaluate the

out-of-sample prediction for the last 2 years to compare with the full period of 5 years and 6 months (all data series are from 1989/01 to 1997/09.) The conventional measurement, RMSE (13.2264) is quite high compare to the standard error of inflation rate (6.0417,) it is more than twice. However, in the 2-year period the model performance is improved (RMSE reduces from 13.2264 to 9.3604 in the last two year period.)

Table 30 present the performance of the OLS SPREAD model. The model is better than the nominal interest rate model. However, as we see in the plot of Figure 45, the model fails to capture cyclical behavior of the inflation. And if we look at the estimated model, the parameter of SPREAD has a wrong sign with a high significance. It is hard to explain why this happens. An apparent explanation may be that the 1-day Repo rate is much more active than that of 30-day Repo then it can reflect market expectation about inflation rate better than the 30-day Repo rate which is inert to market forces. When the market expects inflation rate to rise, the expectation will have a strong effect to drive up the 1-day Repo rate but have a comparatively weak effect to that of 30-day Repo thus the yield curve is put inverted. This supposition is drown from the fact that in some interval of time during that period (1989/01 to 1997/09), the 30-day Repo was not active.

To investigate further, I run OLS estimations of inflation rate against 1-day Repo rate, and of inflation rate against 30-day Repo rate, the results are

$$P(t) = \underset{(0.021)}{0.3322} + \underset{(3.198)^{***}}{0.5829}\text{REPO1D}(t) \qquad (3)$$

$$R^2 = 0.4855 \qquad \text{F-Stat.} = 10.2293^{***}$$

and $$P(t) = \underset{(-0.0512)}{-0.107} + \underset{(2.694)^{***}}{0.6053}REPO30D(t) \quad (4)$$

$$R^2 = 0.4715 \qquad F\text{-Stat.} = 7.2517^{***}$$

*** Statistically significant at 1% level.

As we can see, the results indicate that the inflation rate is more significantly explained by 1-day Repo rate than that of 30-day Repo. This may support the supposition. I also try to regress inflation rate with the growth in money supply up to 6 lags, those models seem no significant at all.

Table 31 presents the performance of the ARMA model (to predict inflation rate only by its own lags.) Figure 46 shows the plot of the actual and the predicted inflation rate by this model. The model performs no better than the nominal interest model but found slightly more improved in the last two year horizon. The model is better capture the cyclical pattern than the SPREAD model.

V. Conclusion and Remark

The money market interest rates in general, and the Repo rates in particular are found to be good economic indicators for Thailand. This conclusion is drawn from three facts as follows: First, most of interest rates are promptly and real-time available, they are no need to process or to modified. This property is an ideal for economic indicators.

Second, the money market interest rates do behave differently during expansions and during recessions. for instance, their means tend to be higher in expansion than in recessions and their tend to be more volatile during recessions than in expansions thus they are able to use as state indicators for the economy. Third, they do have predictive powers to some important economic variables which are crucial in economic decision makings. Their predictive abilities to the growth in money supply both M1 and M2, make them useful to be informative in monetary policy implementation. And their predictive powers to the stock market index and the Prime Rate make them can be utilized in economic decision making process of the private sector. However, Repo rates as money market interest rates are, by their nature, influenced by monetary factors, some of which are seasonal and unpredictable; such as the overall liquidity of economy, velocity of money and etc.. Those factors make the interest rates highly fluctuated and deteriorate their predict powers. For their performances in forecasting the inflation rate, in term of accuracy, they are not good predictors but do have some predictive powers.

The best way to predict and measure states of business cycle and overall economic activities is not to rely on only a single variable or even a few variables but to make use of indices which are more dependable and more accurate. This study suggests that to include the Repo rates as well as interbank rate in those indices will be enhance their performance thus facilitate better economic decisions.

TABLE 1: STATISTICS OF THE DATA (THAI FINANCIAL MARKETS.) 1989-1997

Series	Obs	Mean	Std Error	Minimum	Maximum
INTER-BANK RATES(INTBK)	2082	9.8428118	3.5022782	1.2500000	30.5000000
1-DAY REPO(REPO1D)	2072	8.3463091	3.2173312	1.0000000	17.2500000
USS / THAI BAHT(THB)	2085	25.3964029	0.3240945	24.4400000	26.1100000
SET INDEX (SET)	2086	960.6187105	298.7598608	391.2300000	1753.7300000
ANNUALIZED DAILY-CAPITAL GAIN OF SET(RMSET)	1977	0.0773723	5.9196624	-31.4242299	33.0314304

TABLE 2: CORRELATION MATRIX OF THAI FINANCIAL MARKETS. 1989-1997

Correlation Matrix Daily(5) Data From 1989:01:04 To 1997:06:30

	INTBK	REPO1D	THB	SET	RMSET
INTBK	1.00000000000	0.85918691148	0.10631691593	-0.25652774464	-0.06313276438
REPO1D	0.85918691148	1.00000000000	0.10015323276	-0.18983111230	-0.04655362040
THB	0.10631691593	0.10015323276	1.00000000000	-0.56823441619	-0.01379810544
SET	-0.25652774464	-0.18983111230	-0.56823441619	1.00000000000	0.00599165299
RMSET	-0.06313276438	-0.04655362040	-0.01379810544	0.00599165299	1.00000000000

TABLE 3: UNIT ROOTS TESTS ON THE DATA.

	DICKEY-FULLER(W/ 0 LAGS)	PHILLIPS-PERRON(W/ 4 LAGS)
INTBK	-153.29290**	-137.85235**
REPO1D	-107.56365**	-87.78537**
THB	-8.00492*	-7.92873*
SET	-4.26784	-5.09603
RMSET	-1575.58690**	-1585.76150**

** The hypothesis for unit roots is rejected at 1% level.
* The hypothesis for unit roots is rejected at 10% level.

TABLE 4: LIKELIHOOD RATIO TESTS FOR LAGS LENGTH OF VAR
(FOR THAI FINANCIAL MARKETS)

TEST AGAINST 2 LAGS	T	C	LOG R	LOG U	CHI.SQ.	D.F.	REJECTED?
W/ 3 LAGS	1632	16	-0.21952	-0.24366	39.01024	25	NO (1%)
W/ 4 LAGS	1539	21	-0.21952	-0.33155	170.0615	50	YES (0.1%)
TEST AGAINST 3 LAGS	**T**	**C**	**LOG R**	**LOG U**	**CHI.SQ.**	**D.F.**	**REJECTED?**
W/ 4 LAGS	1539	21	-0.24366	-0.33155	133.417	25	YES (0.1%)
TEST AGAINST 4 LAGS	**T**	**C**	**LOG R**	**LOG U**	**CHI.SQ.**	**D.F.**	**REJECTED?**
W/ 5 LAGS	1452	26	-0.33155	-0.40198	100.4332	25	YES (0.1%)
TEST AGAINST 5 LAGS	**T**	**C**	**LOG R**	**LOG U**	**CHI.SQ.**	**D.F.**	**REJECTED?**
W/ 7 LAGS	1283	36	-0.40198	-0.69606	366.7178	50	YES (0.1%)
TEST AGAINST 7 LAGS	**T**	**C**	**LOG R**	**LOG U**	**CHI.SQ.**	**D.F.**	**REJECTED?**
W/ 10 LAGS	1049	51	-0.69606	-1.14508	448.122	75	YES (0.1%)
TEST AGAINST 10 LAGS	**T**	**C**	**LOG R**	**LOG U**	**CHI.SQ.**	**D.F.**	**REJECTED?**
W/ 15 LAGS	749	76	-1.14508	-1.24409	66.63373	125	NO
W/ 20 LAGS	515	101	-1.14508	-1.56861	175.3414	250	NO
W/ 25 LAGS	332	126	-1.14508	-3.21737	426.8917	375	N0 (1%)

Table 4

TABLE 5: F-TESTS FOR GRANGER CAUSALITY VAR WITH 10 LAGS AMONG THAI FINANCIAL MARKETS AND COVARIANCE MATRIX OF RESIDUALS

AFFECTING MARKETS	AFFECTED MARKETS				
	REPO(1 DAY)	INTERBANK	FOREX(US$/THB)	SET(INDEX)	SET(YIELD)
REPO(1 DAY)	255.0478***	10.2102***	1.1949	2.3640***	2.6673**
INTERBANK	1.1281	149.6546***	0.9535	2.0553**	1.7543*
FOREX	0.6839	0.4386	9179.5717**	0.7733	1.0341
SET(INDEX)	0.3412	1.0559	1.1483	21468.6583***	2.2188**
SET(YIELD)	0.7182	1.0575	0.8230	1.9039**	1.18926**

*** Statistically significant at 1% level.
** Statistically significant at 5% level.
* Statistically significant at 10% level.

Covariance\Correlation Matrix of Residuals

	REPO1D	INTBK	SET	RMSET	THB
REPO1D	0.725494107	0.4928931214	0.0076279477	0.0322764151	-0.0759571386
INTBK	0.488861785	1.355915965	-0.0298262161	-0.0113525498	-0.0619874439
SET	0.097001851	-0.518525264	222.900348610	0.9589481570	0.0137795788
RMSET	0.158675531	-0.076298768	82.633895531	33.313130662	0.0087775148
THB	-0.001744994	-0.001946832	0.005548807	0.001366431	0.000727472

TABLE 6: DECOMPOSITION OF VARIANCES FOR THAI FINANCIAL MARKETS ACCORDING TO INFLUENTIAL ORDER.
(THE ORDER IS REPO, INTERBANK, SET INDEX, SET YIELD, FOREX)

Decomposition of Variance for Series REPO1D

Step	Std Error	REPO1D	INTBK	SET	RMSET	THB
1	0.851759418	100.00000	0.00000	0.00000	0.00000	0.00000
5	1.532692269	98.68508	0.76818	0.24827	0.27493	0.02355
10	1.882702417	96.49688	1.94429	0.66507	0.79100	0.10276
15	2.039436069	94.00494	2.61325	1.59224	1.67052	0.11904
20	2.221876119	93.28481	2.97468	1.61239	2.01678	0.11135
24	2.335183635	93.08841	3.16799	1.48433	2.13557	0.12370

Decomposition of Variance for Series INTBK

Step	Std Error	REPO1D	INTBK	SET	RMSET	THB
1	1.164438047	24.29436	75.70564	0.00000	0.00000	0.00000
5	2.085777492	36.16277	62.37375	0.80627	0.39625	0.26096
10	2.437847236	38.12205	58.87455	1.34922	1.06368	0.59051
15	2.567857800	38.95873	56.61351	2.14445	1.62698	0.65633
20	2.712527191	43.16612	52.22458	2.17918	1.81368	0.61643
24	2.799748137	45.84163	49.63299	2.07192	1.87187	0.58159

Decomposition of Variance for Series SET

Step	Std Error	REPO1D	INTBK	SET	RMSET	THB
1	14.92984757	0.00582	0.14900	99.84518	0.00000	0.00000
5	39.91138146	0.03491	0.50865	99.26793	0.14567	0.04283
10	57.75913997	0.24268	0.86859	98.62744	0.09354	0.16775
15	69.32390981	0.87392	0.99696	97.88025	0.07780	0.17107
20	78.81352735	1.35372	1.16190	97.28296	0.06483	0.13658
24	85.55576425	1.74851	1.28684	96.78600	0.05650	0.12216

Decomposition of Variance for Series RMSET

Step	Std Error	REPO1D	INTBK	SET	RMSET	THB
1	5.771752824	0.10418	0.09817	91.82135	7.97630	0.00000
5	5.942489595	0.95853	0.75194	89.24578	8.70573	0.33802
10	6.021443593	1.97305	1.20230	87.50725	8.69684	0.62056
15	6.034329652	2.10547	1.20922	87.29355	8.73618	0.65558
20	6.037157960	2.12215	1.22021	87.21637	8.75102	0.69026
24	6.039412717	2.15694	1.22070	87.16275	8.75239	0.70722

Decomposition of Variance for Series THB

Step	Std Error	REPO1D	INTBK	SET	RMSET	THB
1	0.026971698	0.57695	0.07960	0.01764	0.00710	99.31871
5	0.060621866	0.58998	0.03806	0.13905	0.13087	99.10204
10	0.083498667	0.48072	0.08437	0.18528	1.32089	97.92875
15	0.100858880	0.65863	0.50769	0.13359	2.03840	96.66169
20	0.115690713	0.85722	1.10230	0.11006	2.27234	95.65808
24	0.126195016	0.99363	1.52039	0.09572	2.35077	95.03949

TABLE 7: DECOMPOSITION OF VARIANCES FOR THAI FINANCIAL MARKETS ACCORDING TO REVERSE INFLUENTIAL ORDER.
(THE ORDER IS SET YIELD, SET INDEX, INTERBANK, REPO, FOREX)

Decomposition of Variance for Series RMSET

Step	Std Error	RMSET	SET	INTBK	REPO1D	THB
1	5.771752824	100.00000	0.00000	0.00000	0.00000	0.00000
5	5.942489595	97.21247	1.06167	0.39206	0.99578	0.33802
10	6.021443593	95.35095	1.24772	0.87142	1.90935	0.62056
15	6.034329652	95.13123	1.29762	0.92003	1.99554	0.65558
20	6.037157960	95.04778	1.31892	0.92878	2.01426	0.69026
24	6.039412717	94.98698	1.32594	0.94127	2.03860	0.70722

Decomposition of Variance for Series SET

Step	Std Error	RMSET	SET	INTBK	REPO1D	THB
1	14.92984757	91.95816	8.04184	0.00000	0.00000	0.00000
5	39.91138146	90.44586	9.34309	0.11556	0.05266	0.04283
10	57.75913997	90.88838	8.30776	0.53253	0.10358	0.16775
15	69.32390981	89.72321	8.73862	0.98943	0.37767	0.17107
20	78.81352735	89.01506	8.87071	1.41233	0.56531	0.13658
24	85.55576425	88.62409	8.76867	1.75364	0.73144	0.12216

Decomposition of Variance for Series INTBK

Step	Std Error	RMSET	SET	INTBK	REPO1D	THB
1	1.164438047	0.01289	0.44606	99.54105	0.00000	0.00000
5	2.085777492	0.44679	0.54285	96.12902	2.62039	0.26096
10	2.437847236	0.79380	0.85890	93.89173	3.86506	0.59051
15	2.567857800	2.02055	0.85716	91.91988	4.54608	0.65633
20	2.712527191	2.16443	0.80020	88.54651	7.87242	0.61643
24	2.799748137	2.08127	0.76992	86.45679	10.11043	0.58159

Decomposition of Variance for Series REPO1D

Step	Std Error	RMSET	SET	INTBK	REPO1D	THB
1	0.851759418	0.10418	0.67644	23.90131	75.31807	0.00000
5	1.532692269	0.36040	0.31098	29.90930	69.39577	0.02355
10	1.882702417	0.83416	0.40160	34.03578	64.62570	0.10276
15	2.039436069	2.08844	0.47376	35.53919	61.77958	0.11904
20	2.221876119	2.14168	0.47896	36.86954	60.39847	0.11135
24	2.335183635	1.99396	0.48505	37.64200	59.75530	0.12370

Decomposition of Variance for Series THB

Step	Std Error	RMSET	SET	INTBK	REPO1D	THB
1	0.026971698	0.00770	0.03576	0.36923	0.26860	99.31871
5	0.060621866	0.08355	0.22881	0.19569	0.38991	99.10204
10	0.083498667	0.09773	1.50011	0.19848	0.27494	97.92875
15	0.100858880	0.14327	2.21974	0.77589	0.19942	96.66169
20	0.115690713	0.21185	2.42799	1.54833	0.15374	95.65808
24	0.126195016	0.23290	2.50912	2.08837	0.13012	95.03949

TABLE 8: DECOMPOSITION OF VARIANCES FOR THAI FINANCIAL MARKETS ACCORDING TO INFLUENTIAL ORDER BEGIN WITH FOREX. (THE ORDER IS FOREX, REPO, INTERBANK, SET INDEX, SET YIELD)

Decomposition of Variance for Series THB

Step	Std Error	THB	REPO1D	INTBK	SET	RMSET
1	0.026971698	100.00000	0.00000	0.00000	0.00000	0.00000
5	0.060621866	99.75193	0.01621	0.06814	0.07927	0.08446
10	0.083498667	98.57920	0.04148	0.08322	0.11687	1.17923
15	0.100858880	97.67930	0.05832	0.32893	0.08779	1.84566
20	0.115690713	96.99161	0.09988	0.75815	0.09072	2.05964
24	0.126195016	96.57034	0.13637	1.07546	0.08778	2.13005

Decomposition of Variance for Series REPO1D

Step	Std Error	THB	REPO1D	INTBK	SET	RMSET
1	0.851759418	0.57695	99.42305	0.00000	0.00000	0.00000
5	1.532692269	0.44871	98.25791	0.77195	0.24714	0.27429
10	1.882702417	0.79303	95.81216	1.93410	0.66916	0.79156
15	2.039436069	0.70921	93.41065	2.61182	1.60004	1.66828
20	2.221876119	0.64288	92.74553	2.97789	1.62019	2.01350
24	2.335183635	0.59430	92.60621	3.17626	1.49202	2.13121

Decomposition of Variance for Series INTBK

Step	Std Error	THB	REPO1D	INTBK	SET	RMSET
1	1.164438047	0.38424	23.97073	75.64502	0.00000	0.00000
5	2.085777492	1.05181	35.51567	62.21294	0.81792	0.40166
10	2.437847236	1.69246	37.23932	58.62143	1.37017	1.07662
15	2.567857800	1.83562	38.01871	56.34726	2.15575	1.64266
20	2.712527191	1.81858	42.19154	51.97342	2.18712	1.82934
24	2.799748137	1.75514	44.88286	49.39601	2.07933	1.88666

Decomposition of Variance for Series SET

Step	Std Error	THB	REPO1D	INTBK	SET	RMSET
1	14.92984757	0.01899	0.00757	0.14599	99.82746	0.00000
5	39.91138146	0.12125	0.03638	0.49620	99.20113	0.14504
10	57.75913997	0.33525	0.21369	0.84116	98.51587	0.09404
15	69.32390981	0.37892	0.81132	0.96713	97.76484	0.07779
20	78.81352735	0.32955	1.28635	1.13486	97.18449	0.06475
24	85.55576425	0.28242	1.68922	1.26445	96.70753	0.05638

Decomposition of Variance for Series RMSET

Step	Std Error	THB	REPO1D	INTBK	SET	RMSET
1	5.771752824	0.00770	0.10915	0.09626	91.81115	7.97573
5	5.942489595	0.33807	1.00604	0.73327	89.21782	8.70480
10	6.021443593	0.67168	1.98841	1.16838	87.47793	8.69360
15	6.034329652	0.70137	2.12681	1.17581	87.26271	8.73330
20	6.037157960	0.73550	2.14407	1.18729	87.18545	8.74769
24	6.039412717	0.74979	2.18168	1.18805	87.13159	8.74890

TABLE 9: DECOMPOSITION OF VARIANCES FOR THAI FINANCIAL MARKETS ACCORDING TO REVERSE INFLUENTIAL ORDER BEGIN WITH FOREX.

(THE ORDER IS FOREX , SET YIELD, SET INDEX, INTERBANK, REPO)

Decomposition of Variance for Series THB

Step	Std Error	THB	RMSET	SET	INTBK	REPO1D
1	0.026971698	100.00000	0.00000	0.00000	0.00000	0.00000
5	0.060621866	99.75193	0.06176	0.09417	0.05610	0.03604
10	0.083498667	98.57920	0.09774	1.16049	0.09552	0.06704
15	0.100858880	97.67930	0.17165	1.77192	0.29737	0.07975
20	0.115690713	96.99161	0.26204	1.94062	0.70432	0.10140
24	0.126195016	96.57034	0.29217	2.00455	1.01874	0.11419

Decomposition of Variance for Series RMSET

Step	Std Error	THB	RMSET	SET	INTBK	REPO1D
1	5.771752824	0.00770	99.99230	0.00000	0.00000	0.00000
5	5.942489595	0.33807	97.19381	1.05277	0.38226	1.03309
10	6.021443593	0.67168	95.33288	1.23192	0.82162	1.94190
15	6.034329652	0.70137	95.11220	1.28208	0.87329	2.03106
20	6.037157960	0.73550	95.02884	1.30242	0.88339	2.04985
24	6.039412717	0.74979	94.96796	1.30908	0.89749	2.07569

Decomposition of Variance for Series SET

Step	Std Error	THB	RMSET	SET	INTBK	REPO1D
1	14.92984757	0.01899	91.94204	8.03897	0.00000	0.00000
5	39.91138146	0.12125	90.39689	9.31746	0.10969	0.05472
10	57.75913997	0.33525	90.80639	8.26327	0.49616	0.09894
15	69.32390981	0.37892	89.63403	8.68718	0.93842	0.36145
20	78.81352735	0.32955	88.93321	8.82359	1.36386	0.54979
24	85.55576425	0.28242	88.55254	8.72840	1.71501	0.72162

Decomposition of Variance for Series INTBK

Step	Std Error	THB	RMSET	SET	INTBK	REPO1D
1	1.164438047	0.38424	0.01168	0.43072	99.17336	0.00000
5	2.085777492	1.05181	0.45752	0.54590	95.37701	2.56776
10	2.437847236	1.69246	0.81028	0.88484	92.85675	3.75567
15	2.567857800	1.83562	2.02517	0.88563	90.83902	4.41456
20	2.712527191	1.81858	2.16449	0.82828	87.47628	7.71237
24	2.799748137	1.75514	2.08054	0.79731	85.41705	9.94996

Decomposition of Variance for Series REPO1D

Step	Std Error	THB	RMSET	SET	INTBK	REPO1D
1	0.851759418	0.57695	0.10853	0.65317	23.54642	75.11493
5	1.532692269	0.44871	0.36673	0.30198	29.58389	69.29868
10	1.882702417	0.79303	0.84545	0.39893	33.56242	64.40018
15	2.039436069	0.70921	2.09549	0.47299	35.11492	61.60739
20	2.221876119	0.64288	2.14547	0.48040	36.47053	60.26072
24	2.335183635	0.59430	1.99703	0.48712	37.27143	59.65012

TABLE 10: STATISTICS OF INTERNATIONAL MONEY MARKET RATES 1989-1997

Series	Obs	Mean	Std Error	Minimum	Maximum
FEDFUND (US.DOMESTIC)	2122	5.5822493193	2.0305293929	1.5000000000	13.0000000000
7-DAY LIBOR (EURO-DOLLAR)	2145	5.6780885781	1.9860589192	3.0000000000	14.0000000000
7-DAY SIBOR (ASIAN-DOLLAR)	2129	5.7447651480	1.9742324809	3.0000000000	12.0000000000

TABLE 11: CORRELATION MATRIX OF THE MONEY MARKETS 1989-1997

Correlation Matrix: Daily(5) Data From 1989:01:03 To 1997:06:30

	FEDFUND	LIBOR1W	SIBOR1W	REPO1D	INTBK	THB
FEDFUND	1.000000000000	0.972176799256	0.971504810637	0.566756662044	0.472962287145	0.322901473007
LIBOR1W	0.972176799256	1.000000000000	0.998911113332	0.574938131762	0.476797578534	0.329058914029
SIBOR1W	0.971504810637	0.998911113332	1.000000000000	0.580336147846	0.484298956908	0.332151647733
REPO1D	0.566756662044	0.574938131762	0.580336147846	1.000000000000	0.860791525879	0.096324383953
INTBK	0.472962287145	0.476797578534	0.484298956908	0.860791525879	1.000000000000	0.098406228296
THB	0.322901473007	0.329058914029	0.332151647733	0.096324383953	0.098406228296	1.000000000000

TABLE 12: UNIT ROOTS TESTS ON THE MONEY MARKET RATES

	DICKEY-FULLER(W/ 0 LAGS)	PHILLIPS-PERRON(W/ 4 LAGS)
FEDFUND	-67.41005**	-30.11328**
LIBOR1W	-16.54002**	-17.04225**
SIBOR1W	-5.69461*	-4.42166

** The hypothesis for unit roots is rejected at 1% level.
* The hypothesis for unit roots is rejected at 10% level.

TABLE 13: LIKELIHOOD RATIO TESTS FOR LAGS LENGTH OF VAR
(FOR THE MONEY MARKETS)

TEST AGAINST 1 LAG	T	C	LOG R	LOG U	CHI.SQ.	D.F.	REJECTED?
W/ 2LAGS	1487	13	-17.4307	-17.7536	475.9251	36	YES (0.1%)
TEST AGAINST 2 LAGS	**T**	**C**	**LOG R**	**LOG U**	**CHI.SQ.**	**D.F.**	**REJECTED?**
W/ 3 LAGS	1302	19	-17.7536	-17.7165	-47.5352	36	NO
W/ 4 LAGS	1235	25	-17.7536	-17.7126	-49.5495	72	NO
W/ 5 LAGS	1010	31	-17.7536	-17.7183	-34.5293	108	NO
W/ 7 LAGS	769	43	-17.7536	-17.5073	-178.807	180	NO
W/ 10 LAGS	496	61	-17.7536	-20.2244	1074.828	288	YES (0.1%)
TEST AGAINST 10 LAGS	**T**	**C**	**LOG R**	**LOG U**	**CHI.SQ.**	**D.F.**	**REJECTED?**
W/ 12 LAGS	379	73	-20.2244	-20.9765	230.1487	72	YES (0.1%)
TEST AGAINST 12 LAGS	**T**	**C**	**LOG R**	**LOG U**	**CHI.SQ.**	**D.F.**	**REJECTED?**
W/ 14 LAGS	290	85	-20.9765	-21.3614	78.9004	72	NO
W/ 15 LAGS	255	91	-20.9765	-21.8605	144.9662	108	NO (1%)
W/ 18 LAGS	161	109	-20.9765	-25.8448	253.1495	216	NO (1%)
W/ 20 LAGS	108	121	-20.9765	-218.52	-2568.07	288	NO

TABLE 14: F-TESTS FOR GRANGER CAUSALITY VAR WITH 10 LAGS AMONG DOMESTIC AND INTERNATIONAL MONEY MARKETS AND COVARIANCE MATRIX OF RESIDUALS.

	AFFECTED MARKETS					
AFFECTING MARKETS	FEDFUND	EURO$	ASIAN$	1-DAY REPO	INTBK	FOREX
FEDFUND	2.1298**	3.7176***	2.7118***	5.3506***	1.9811**	1.3263
EURO$ (LIBOR)	0.8929	13.0806***	5.4340***	2.1869**	1.0329	2.1476**
ASIAN$ (SIBOR)	1.8275	2.4600**	5.3049***	2.3318***	0.7858	2.7398***
1-DAY REPO	1.2431	1.3834	1.2923	53.7273***	1.3603	0.4051
INTERBANK	0.2762	0.5685	0.8871	2.7543***	41.1617***	0.6500
FOREX (US$/THB)	0.8525	1.0084	1.4914	0.9409	1.2561	2458.4918***

*** Statistically significant at 1% level.
** Statistically significant at 5% level.
* Statistically significant at 10% level.

Covariance\Correlation Matrix of Residuals

	FEDFUND	LIBOR1W	SIBOR1W	REPO1D	INTBK	THB
FEDFUND	0.09785827266	0.1100961570	0.0452834760	0.0325030043	0.0241806953	-0.0854890765
LIBOR1W	0.00263201155	0.00584028064	0.6230778861	0.0028130838	-0.0649352784	0.0525397890
SIBOR1W	0.00115575514	0.00388495954	0.00665663292	0.0349809586	-0.0076690572	-0.0240667261
REPO1D	0.00786541581	0.00016630256	0.00220779334	0.59840996360	0.4752479753	-0.0523417531
INTBK	0.00809189427	-0.00530860250	-0.00066934793	0.39328041986	1.14436688820	-0.1658812246
THB	-0.00069334589	0.00010409880	-0.00005090786	-0.00104975565	-0.00460066302	0.00067217306

TABLE 15: DECOMPOSITION OF VARIANCES FOR THE MONEY MARKETS ACCORDING TO OPEN TIME.

(THE ORDER IS SIBOR, INTERBANK, FOREX, 1-DAY REPO, LIBOR, FEDFUND)

Decomposition of Variance for Series SIBOR1W

Step	Std Error	SIBOR1W	INTBK	THB	REPO1D	LIBOR1W	FEDFUND
1	0.081588191	100.00000	0.00000	0.00000	0.00000	0.00000	0.00000
5	0.141236698	75.74182	0.18368	0.96375	0.90939	16.46522	5.73614
10	0.152703005	65.74706	1.02032	1.90642	1.87081	16.07493	13.38045
15	0.171658212	53.71203	1.09985	2.28868	3.02975	22.68495	17.18474
20	0.191245752	46.94309	1.33799	2.58772	7.56768	22.72627	18.83725
24	0.206965684	41.26182	1.55767	3.08895	9.89333	24.84314	19.35509

Decomposition of Variance for Series INTBK

Step	Std Error	SIBOR1W	INTBK	THB	REPO1D	LIBOR1W	FEDFUND
1	1.069750853	0.00588	99.99412	0.00000	0.00000	0.00000	0.00000
5	2.177042981	0.57910	96.11538	0.28088	2.34145	0.24987	0.43332
10	2.543450901	1.98181	91.07536	0.75496	2.48993	2.07538	1.62257
15	2.944549700	5.92812	87.34985	0.81386	2.28353	2.34761	1.27703
20	3.071537176	5.51545	87.40303	0.82763	2.29212	2.54384	1.41794
24	3.145277985	5.79698	86.76528	0.80356	2.23188	2.97258	1.42972

Decomposition of Variance for Series THB

Step	Std Error	SIBOR1W	INTBK	THB	REPO1D	LIBOR1W	FEDFUND
1	0.025926300	0.05792	2.75795	97.18413	0.00000	0.00000	0.00000
5	0.049857197	0.39852	5.34183	92.03335	0.31847	0.85000	1.05783
10	0.064323286	1.10702	9.77318	85.24343	0.31673	1.21555	2.34411
15	0.080589069	2.03648	14.73672	72.24889	0.62585	3.89442	6.45764
20	0.097930802	2.41862	22.55004	63.90480	0.58219	3.76463	6.77972
24	0.110033697	2.06829	26.17683	59.41819	0.62591	4.38990	7.32087

Decomposition of Variance for Series REPO1D

Step	Std Error	SIBOR1W	INTBK	THB	REPO1D	LIBOR1W	FEDFUND
1	0.773569624	0.12237	22.61290	0.07766	77.18708	0.00000	0.00000
5	1.667784245	0.66653	37.05005	1.83105	60.00665	0.33999	0.10572
10	2.197507398	1.13137	52.90622	1.14105	43.65568	0.51294	0.65274
15	2.471609590	1.00510	58.53082	1.47425	36.12388	0.55869	2.30726
20	2.698900282	0.89549	62.62434	1.25049	32.13572	0.85739	2.23656
24	2.818534854	0.87866	64.96265	1.16669	29.98803	0.93386	2.07010

TABLE 15: DECOMPOSITION OF VARIANCES FOR THE MONEY MARKETS ACCORDING TO OPEN TIME. (CONTINUE)

Decomposition of Variance for Series LIBOR1W

Step	Std Error	SIBOR1W	INTBK	THB	REPO1D	LIBOR1W	FEDFUND
1	0.076421729	38.82261	0.36191	0.34073	0.00829	60.46647	0.00000
5	0.127036222	44.79121	0.19472	1.37825	0.64235	43.41871	9.57475
10	0.138982407	39.12585	0.29973	1.49991	2.47569	41.61666	14.98216
15	0.160779561	30.31444	0.35979	2.02778	3.49685	43.74795	20.05320
20	0.181740676	26.59212	0.39698	2.42442	8.61715	41.33683	20.63250
24	0.197090514	23.10502	0.62851	2.87615	10.77784	40.59309	22.01940

Decomposition of Variance for Series FEDFUND

Step	Std Error	SIBOR1W	INTBK	THB	REPO1D	LIBOR1W	FEDFUND
1	0.312823069	0.20506	0.06017	0.66392	0.06003	1.27751	97.73332
5	0.326000052	1.37251	0.51601	1.12993	1.20525	2.58971	93.18658
10	0.381118400	14.85984	2.52468	2.67419	3.46060	5.93490	70.54578
15	0.398811875	15.18233	3.21034	2.95978	4.14814	5.91617	68.58324
20	0.414188642	15.01391	3.56040	3.01608	4.97095	7.74236	65.69630
24	0.424167341	15.81634	3.96104	3.12676	5.95683	8.03381	63.10523

TABLE 16: DECOMPOSITION OF VARIANCES FOR THE MONEY MARKETS ACCORDING TO REVERSE OPEN TIME

(THE ORDER IS FEDFUND, LIBOR, 1-DAY REPO, FOREX, INTERBANK, SIBOR.)

Decomposition of Variance for Series FEDFUND

Step	Std Error	FEDFUND	LIBOR1W	REPO1D	THB	INTBK	SIBOR1W
1	0.312823069	100.00000	0.00000	0.00000	0.00000	0.00000	0.00000
5	0.326000052	95.99975	1.39952	1.44993	0.50162	0.02795	0.62123
10	0.381118400	73.42809	9.78281	5.13195	2.19590	0.92651	8.53475
15	0.398811875	71.09684	9.74011	5.20282	2.54128	2.24107	9.17788
20	0.414188642	68.64552	11.37329	6.14381	2.65068	2.39410	8.79259
24	0.424167341	65.98624	12.61237	7.58311	2.68518	2.45029	8.68281

Decomposition of Variance for Series LIBOR1W

Step	Std Error	FEDFUND	LIBOR1W	REPO1D	THB	INTBK	SIBOR1W
1	0.076421729	1.21212	98.78788	0.00000	0.00000	0.00000	0.00000
5	0.127036222	14.25357	81.79198	0.55016	0.85887	0.05034	2.49509
10	0.138982407	20.39336	73.77514	1.67943	1.14493	0.51905	2.48810
15	0.160779561	26.30045	64.89182	2.12526	2.06055	0.79104	3.83087
20	0.181740676	27.15204	59.19875	6.84494	2.55361	1.00652	3.24413
24	0.197090514	28.70561	54.44599	9.28638	3.09370	0.88564	3.58268

Decomposition of Variance for Series REPO1D

Step	Std Error	FEDFUND	LIBOR1W	REPO1D	THB	INTBK	SIBOR1W
1	0.773569624	0.10564	0.00006	99.89430	0.00000	0.00000	0.00000
5	1.667784245	0.18844	0.18808	93.47800	0.67909	4.65573	0.81066
10	2.197507398	0.86774	0.63130	81.86243	0.76550	14.70874	1.16429
15	2.471609590	3.01876	0.61141	73.67843	1.63100	19.99966	1.06074
20	2.698900282	3.04291	0.63187	70.27460	1.48273	23.52843	1.03947
24	2.818534854	2.84977	0.65779	68.19050	1.42967	25.89907	0.97320

Decomposition of Variance for Series THB

Step	Std Error	FEDFUND	LIBOR1W	REPO1D	THB	INTBK	SIBOR1W
1	0.025926300	0.73084	0.38851	0.24543	98.63522	0.00000	0.00000
5	0.049857197	2.61632	0.81522	0.17587	94.67852	1.18672	0.52736
10	0.064323286	4.95237	0.68972	0.78510	89.13768	3.18156	1.25356
15	0.080589069	10.76931	0.85717	3.23038	75.77589	5.11106	4.25618
20	0.097930802	11.33531	1.04685	5.48097	68.37358	9.08734	4.67595
24	0.110033697	12.27821	0.90918	6.76883	64.36354	10.95540	4.72483

TABLE 16: DECOMPOSITION OF VARIANCES FOR THE MONEY MARKETS ACCORDING TO REVERSE OPEN TIME (CONTINUE.)

Decomposition of Variance for Series INTBK

Step	Std Error	FEDFUND	LIBOR1W	REPO1D	THB	INTBK	SIBOR1W
1	1.069750853	0.05847	0.46255	22.53027	1.87684	75.07188	0.00000
5	2.177042981	0.32369	0.32361	34.55731	2.74464	61.44126	0.60949
10	2.543450901	1.44662	0.61024	33.48718	3.29480	57.54435	3.61679
15	2.944549700	1.10424	3.24937	31.20435	3.98756	56.35082	4.10366
20	3.071537176	1.26129	3.49874	30.69045	3.78227	56.92988	3.83737
24	3.145277985	1.22452	4.17471	30.25681	3.80762	56.82553	3.71081

Decomposition of Variance for Series SIBOR1W

Step	Std Error	FEDFUND	LIBOR1W	REPO1D	THB	INTBK	SIBOR1W
1	0.081588191	0.20506	38.67257	0.11564	0.33255	0.01199	60.66218
5	0.141236698	9.41205	61.14168	1.29603	0.53083	0.19828	27.42112
10	0.152703005	17.26330	54.13613	1.42701	1.72737	1.57680	23.86938
15	0.171658212	22.07084	51.73365	1.92310	2.38072	1.95335	19.93834
20	0.191245752	24.12326	48.57395	6.08401	2.80679	2.25843	16.15356
24	0.206965684	24.92065	46.64318	8.90574	3.29095	1.93850	14.30098

TABLE 17: DECOMPOSITION OF VARIANCES FOR THE MONEY MARKETS ACCORDING TO INFLUENCE.
(THE ORDER IS FEDFUND, LIROR, SIBOR, INTERBANK, FOREX, 1-DAY REPO.)

Decomposition of Variance for Series FEDFUND

Step	Std Error	FEDFUND	LIBOR1W	SIBOR1W	INTBK	THB	REPO1D
1	0.312823069	100.00000	0.00000	0.00000	0.00000	0.00000	0.00000
5	0.326000052	95.99975	1.39952	0.62652	0.45126	0.45124	1.07170
10	0.381118400	73.42809	9.78281	9.01675	2.49826	2.01588	3.25821
15	0.398811875	71.09684	9.74011	9.56779	3.10178	2.49616	3.99733
20	0.414188642	68.64552	11.37329	9.14849	3.50610	2.57150	4.75509
24	0.424167341	65.98624	12.61237	9.05172	3.95521	2.67327	5.72119

Decomposition of Variance for Series LIBOR1W

Step	Std Error	FEDFUND	LIBOR1W	SIBOR1W	INTBK	THB	REPO1D
1	0.076421729	1.21212	98.78788	0.00000	0.00000	0.00000	0.00000
5	0.127036222	14.25357	81.79198	2.36080	0.05335	1.04037	0.49993
10	0.138982407	20.39336	73.77514	2.38935	0.12442	1.18799	2.12974
15	0.160779561	26.30045	64.89182	3.88097	0.15268	1.77149	3.00258
20	0.181740676	27.15204	59.19875	3.26686	0.33121	2.21748	7.83366
24	0.197090514	28.70561	54.44599	3.58277	0.70981	2.72529	9.83053

Decomposition of Variance for Series SIBOR1W

Step	Std Error	FEDFUND	LIBOR1W	SIBOR1W	INTBK	THB	REPO1D
1	0.081588191	0.20506	38.67257	61.12237	0.00000	0.00000	0.00000
5	0.141236698	9.41205	61.14168	27.53288	0.36395	0.75534	0.79409
10	0.152703005	17.26330	54.13613	24.02104	1.16736	1.79214	1.62001
15	0.171658212	22.07084	51.73365	20.14217	1.20005	2.20861	2.64468
20	0.191245752	24.12326	48.57395	16.31318	1.47670	2.59497	6.91794
24	0.206965684	24.92065	46.64318	14.43041	1.84834	3.07212	9.08530

Decomposition of Variance for Series INTBK

Step	Std Error	FEDFUND	LIBOR1W	SIBOR1W	INTBK	THB	REPO1D
1	1.069750853	0.05847	0.46255	0.18394	99.29504	0.00000	0.00000
5	2.177042981	0.32369	0.32361	1.50993	95.15664	0.30344	2.38270
10	2.543450901	1.44662	0.61024	5.05013	89.66654	0.65182	2.57464
15	2.944549700	1.10424	3.24937	5.79710	86.70510	0.80177	2.34242
20	3.071537176	1.26129	3.49874	5.44858	86.63613	0.80844	2.34681
24	3.145277985	1.22452	4.17471	5.28193	86.23100	0.80566	2.28218

TABLE 17: DECOMPOSITION OF VARIANCES FOR THE MONEY MARKETS ACCORDING TO INFLUENCE (CONTINUE.)

Decomposition of Variance for Series THB

Step	Std Error	FEDFUND	LIBOR1W	SIBOR1W	INTBK	THB	REPO1D
1	0.025926300	0.73084	0.38851	0.56869	2.46159	95.85037	0.00000
5	0.049857197	2.61632	0.81522	1.77229	4.81603	89.63467	0.34548
10	0.064323286	4.95237	0.68972	2.54175	9.09143	82.37383	0.35090
15	0.080589069	10.76931	0.85717	3.74995	14.37079	69.68046	0.57231
20	0.097930802	11.33531	1.04685	3.41814	22.18309	61.50339	0.51323
24	0.110033697	12.27821	0.90918	3.16662	25.93425	57.17353	0.53821

Decomposition of Variance for Series REPO1D

Step	Std Error	FEDFUND	LIBOR1W	SIBOR1W	INTBK	THB	REPO1D
1	0.773569624	0.10564	0.00006	0.18900	22.48843	0.08277	77.13411
5	1.667784245	0.18844	0.18808	0.61106	37.40633	1.70533	59.90075
10	2.197507398	0.86774	0.63130	1.12592	52.72246	1.05610	43.59647
15	2.471609590	3.01876	0.61141	0.98954	58.09583	1.29041	35.99406
20	2.698900282	3.04291	0.63187	0.89400	62.35773	1.09866	31.97483
24	2.818534854	2.84977	0.65779	0.83747	64.79790	1.02666	29.83041

TABLE 18: DECOMPOSITION OF VARIANCES FOR THE MONEY MARKETS ACCORDING TO SENSITIVITY (REVERSE INFLUENCE.)

(THE ORDER IS 1-DAY REPO,FOREX. INTERBANK. SIBOR. LIBOR. FEDFUND.)

Decomposition of Variance for Series REPO1D

Step	Std Error	REPO1D	THB	INTBK	SIBOR1W	LIBOR1W	FEDFUND
1	0.773569624	100.00000	0.00000	0.00000	0.00000	0.00000	0.00000
5	1.667784245	93.53802	0.69778	4.65262	0.66586	0.33999	0.10572
10	2.197507398	81.95894	0.83959	14.86107	1.17471	0.51294	0.65274
15	2.471609590	74.03066	1.95839	20.09737	1.04764	0.55869	2.30726
20	2.698900282	70.69381	1.78422	23.49713	0.93088	0.85739	2.23656
24	2.818534854	68.59975	1.70458	25.78441	0.90730	0.93386	2.07010

Decomposition of Variance for Series THB

Step	Std Error	REPO1D	THB	INTBK	SIBOR1W	LIBOR1W	FEDFUND
1	0.025926300	0.27397	99.72603	0.00000	0.00000	0.00000	0.00000
5	0.049857197	0.20937	96.53212	1.14650	0.20418	0.85000	1.05783
10	0.064323286	0.90052	91.63967	3.05462	0.84554	1.21555	2.34411
15	0.080589069	3.59844	79.03985	4.95433	2.05533	3.89442	6.45764
20	0.097930802	5.96510	71.94498	8.96947	2.57610	3.76463	6.77972
24	0.110033697	7.33521	67.97468	10.73475	2.24458	4.38990	7.32087

Decomposition of Variance for Series INTBK

Step	Std Error	REPO1D	THB	INTBK	SIBOR1W	LIBOR1W	FEDFUND
1	1.069750853	22.58606	1.99373	75.42021	0.00000	0.00000	0.00000
5	2.177042981	34.50882	2.71429	61.52926	0.56444	0.24987	0.43332
10	2.543450901	33.26525	3.23863	57.82119	1.97699	2.07538	1.62257
15	2.944549700	31.04289	3.70898	55.68564	5.93785	2.34761	1.27703
20	3.071537176	30.49951	3.52855	56.49231	5.51784	2.54384	1.41794
24	3.145277985	30.06760	3.51109	56.21297	5.80604	2.97258	1.42972

Decomposition of Variance for Series SIBOR1W

Step	Std Error	REPO1D	THB	INTBK	SIBOR1W	LIBOR1W	FEDFUND
1	0.081588191	0.12237	0.04958	0.09982	99.72824	0.00000	0.00000
5	0.141236698	1.43951	0.70526	0.18435	75.46951	16.46522	5.73614
10	0.152703005	1.66112	1.72506	1.69099	65.46744	16.07493	13.38045
15	0.171658212	2.25855	2.24177	2.22445	53.40554	22.68495	17.18474
20	0.191245752	6.68047	2.61275	2.74780	46.39546	22.72627	18.83725
24	0.206965684	9.66538	3.05466	2.40347	40.67827	24.84314	19.35509

TABLE 18: DECOMPOSITION OF VARIANCES FOR THE MONEY MARKETS ACCORDING TO SENSITIVITY (CONTINUE.)

Decomposition of Variance for Series LIBOR1W

Step	Std Error	REPO1D	THB	INTBK	SIBOR1W	LIBOR1W	FEDFUND
1	0.076421729	0.00079	0.27835	0.45878	38.79561	60.46647	0.00000
5	0.127036222	0.67796	1.20572	0.45970	44.66315	43.41871	9.57475
10	0.138982407	1.99061	1.42196	1.09240	38.89622	41.61666	14.98216
15	0.160779561	2.53541	2.11191	1.47481	30.07673	43.74795	20.05320
20	0.181740676	7.53075	2.53580	1.82918	26.13494	41.33683	20.63250
24	0.197090514	10.15162	2.94295	1.65203	22.64090	40.59309	22.01940

Decomposition of Variance for Series FEDFUND

Step	Std Error	REPO1D	THB	INTBK	SIBOR1W	LIBOR1W	FEDFUND
1	0.312823069	0.10564	0.70397	0.00129	0.17827	1.27751	97.73332
5	0.326000052	1.66304	1.22192	0.03361	1.30514	2.58971	93.18658
10	0.381118400	5.44169	2.75694	0.79736	14.52333	5.93490	70.54578
15	0.398811875	5.49072	2.96952	2.13213	14.90822	5.91617	68.58324
20	0.414188642	6.50421	3.05898	2.29215	14.70600	7.74236	65.69630
24	0.424167341	7.95856	3.11954	2.34033	15.44254	8.03381	63.10523

TABLE 19: DECOMPOSITION OF VARIANCES FOR THE MONEY MARKETS ACCORDING TO VOLATILITY.

(THE ORDER IS INTERBANK, 1-DAY REPO, FEDFUND, LIBOR, SIBOR, FOREX.)

Decomposition of Variance for Series INTBK

Step	Std Error	INTBK	REPO1D	FEDFUND	LIBOR1W	SIBOR1W	THB
1	1.069750853	100.00000	0.00000	0.00000	0.00000	0.00000	0.00000
5	2.177042981	96.01598	2.41063	0.41253	0.16421	0.65699	0.33967
10	2.543450901	90.93827	2.56854	1.77410	0.25461	3.79584	0.66864
15	2.944549700	87.10442	2.40541	1.33629	3.98757	4.34116	0.82515
20	3.071537176	87.18339	2.41158	1.54302	3.98456	4.05328	0.82417
24	3.145277985	86.53545	2.35377	1.50308	4.86517	3.92065	0.82188

Decomposition of Variance for Series REPO1D

Step	Std Error	INTBK	REPO1D	FEDFUND	LIBOR1W	SIBOR1W	THB
1	0.773569624	22.58606	77.41394	0.00000	0.00000	0.00000	0.00000
5	1.667784245	37.05570	60.49231	0.13295	0.20834	0.92287	1.18784
10	2.197507398	52.91350	43.89096	0.76700	0.45094	1.23432	0.74328
15	2.471609590	58.53516	36.27654	2.58377	0.44336	1.08902	1.07214
20	2.698900282	62.62429	32.27378	2.52225	0.60537	1.06453	0.90978
24	2.818534854	64.95397	30.13260	2.34018	0.72794	0.99542	0.84990

Decomposition of Variance for Series FEDFUND

Step	Std Error	INTBK	REPO1D	FEDFUND	LIBOR1W	SIBOR1W	THB
1	0.312823069	0.05847	0.05703	99.88450	0.00000	0.00000	0.00000
5	0.326000052	0.51314	1.20380	95.77509	1.41075	0.64719	0.45004
10	0.381118400	2.46665	3.82688	73.09175	9.92075	8.70926	1.98471
15	0.398811875	3.16097	4.43366	70.75838	9.84120	9.30596	2.49983
20	0.414188642	3.50911	5.31604	68.23277	11.45967	8.92662	2.55579
24	0.424167341	3.90013	6.43763	65.55368	12.69736	8.78294	2.62825

Decomposition of Variance for Series LIBOR1W

Step	Std Error	INTBK	REPO1D	FEDFUND	LIBOR1W	SIBOR1W	THB
1	0.076421729	0.42166	0.14647	1.22803	98.20384	0.00000	0.00000
5	0.127036222	0.23399	1.13203	14.17303	81.14841	2.31291	0.99962
10	0.138982407	0.33527	3.05081	20.16093	72.96032	2.37041	1.12226
15	0.160779561	0.39158	4.10427	26.00072	63.92556	3.92381	1.65407
20	0.181740676	0.41510	9.57410	26.59005	58.06747	3.36133	1.99195
24	0.197090514	0.63847	11.79845	27.96046	53.37049	3.80059	2.43153

TABLE 19: DECOMPOSITION OF VARIANCES FOR THE MONEY MARKETS ACCORDING TO VOLATILITY (CONTINUE.)

Decomposition of Variance for Series SIBOR1W

Step	Std Error	INTBK	REPO1D	FEDFUND	LIBOR1W	SIBOR1W	THB
1	0.081588191	0.00588	0.19272	0.19755	38.63642	60.96743	0.00000
5	0.141236698	0.16442	1.48911	9.27942	61.06749	27.28402	0.71553
10	0.152703005	1.00700	2.45246	17.09353	53.91997	23.80385	1.72320
15	0.171658212	1.09232	3.65346	21.82289	51.31102	20.01354	2.10677
20	0.191245752	1.32754	8.56663	23.63764	47.88690	16.19101	2.39027
24	0.206965684	1.53836	11.01474	24.26436	45.96068	14.42535	2.79651

Decomposition of Variance for Series THB

Step	Std Error	INTBK	REPO1D	FEDFUND	LIBOR1W	SIBOR1W	THB
1	0.025926300	2.75166	0.09067	0.67642	0.25183	0.48180	95.74763
5	0.049857197	5.32119	0.60878	2.51397	0.65293	1.61264	89.29048
10	0.064323286	9.73314	0.58992	4.70982	0.62622	2.31352	82.02738
15	0.080589069	14.75499	0.63638	10.19416	0.83310	3.99630	69.58507
20	0.097930802	22.60701	0.50542	10.59676	0.90651	3.88135	61.50295
24	0.110033697	26.23702	0.49530	11.42634	0.88727	3.72526	57.22882

TABLE 20: DECOMPOSITION OF VARIANCES FOR THE MONEY MARKETS ACCORDING TO CALMNESS (REVERSE VOLATILITY.)
(THE ORDER IS FOREX, SIBOR, LIBOR, FEDFUND, 1-DAY REPO, INTERBANK.)

Decomposition of Variance for Series THB

Step	Std Error	THB	SIBOR1W	LIBOR1W	FEDFUND	REPO1D	INTBK
1	0.025926300	100.00000	0.00000	0.00000	0.00000	0.00000	0.00000
5	0.049857197	96.72447	0.18005	0.82448	1.06436	0.02432	1.18232
10	0.064323286	92.17481	0.79555	1.13699	2.40308	0.32340	3.16617
15	0.080589069	80.15537	2.04426	3.41261	6.72801	2.46905	5.19069
20	0.097930802	73.49911	2.61028	3.10011	7.14875	4.41385	9.22790
24	0.110033697	69.74181	2.28345	3.53926	7.75897	5.55530	11.12122

Decomposition of Variance for Series SIBOR1W

Step	Std Error	THB	SIBOR1W	LIBOR1W	FEDFUND	REPO1D	INTBK
1	0.081588191	0.05792	99.94208	0.00000	0.00000	0.00000	0.00000
5	0.141236698	0.61329	75.95147	16.27657	5.82991	1.15717	0.17158
10	0.152703005	1.59644	65.94277	16.00188	13.54130	1.37063	1.54697
15	0.171658212	2.06479	53.89939	22.66850	17.43773	2.00681	1.92278
20	0.191245752	2.28905	47.16689	22.71168	19.30229	6.29040	2.23969
24	0.206965684	2.60847	41.48733	24.68254	19.96411	9.33679	1.92077

Decomposition of Variance for Series LIBOR1W

Step	Std Error	THB	SIBOR1W	LIBOR1W	FEDFUND	REPO1D	INTBK
1	0.076421729	0.27604	39.00293	60.72103	0.00000	0.00000	0.00000
5	0.127036222	1.11825	45.12498	43.49443	9.66214	0.54934	0.05086
10	0.138982407	1.30750	39.42552	41.77681	15.21562	1.76589	0.50866
15	0.160779561	1.92265	30.58447	43.97135	20.37796	2.37598	0.76759
20	0.181740676	2.17237	26.87079	41.48676	21.18078	7.30726	0.98204
24	0.197090514	2.46598	23.36562	40.59856	22.72858	9.98022	0.86104

Decomposition of Variance for Series FEDFUND

Step	Std Error	THB	SIBOR1W	LIBOR1W	FEDFUND	REPO1D	INTBK
1	0.312823069	0.73084	0.18696	1.26332	97.81889	0.00000	0.00000
5	0.326000052	1.27199	1.32329	2.55064	93.36352	1.46085	0.02971
10	0.381118400	2.78004	14.79598	5.80777	70.80482	4.91577	0.89561
15	0.398811875	3.01728	15.13763	5.79813	68.83808	4.99643	2.21245
20	0.414188642	3.08292	14.97289	7.56967	66.01243	5.99440	2.36769
24	0.424167341	3.09270	15.79763	7.82609	63.43189	7.42985	2.42184

TABLE 20: DECOMPOSITION OF VARIANCES FOR THE MONEY MARKETS ACCORDING TO CALMNESS (CONTINUE.)

Decomposition of Variance for Series REPO1D

Step	Std Error	THB	SIBOR1W	LIBOR1W	FEDFUND	REPO1D	INTBK
1	0.773569624	0.27397	0.11378	0.03958	0.08483	99.48785	0.00000
5	1.667784245	0.23162	0.65910	0.12831	0.17008	94.10988	4.70102
10	2.197507398	0.95811	1.12284	0.59446	0.74520	81.84895	14.73044
15	2.471609590	2.38013	1.00743	0.52943	2.64391	73.41002	20.02907
20	2.698900282	2.27454	0.89675	0.63819	2.63122	69.98539	23.57390
24	2.818534854	2.21500	0.87691	0.64514	2.45095	67.86818	25.94381

Decomposition of Variance for Series INTBK

Step	Std Error	THB	SIBOR1W	LIBOR1W	FEDFUND	REPO1D	INTBK
1	1.069750853	2.75166	0.01361	0.39437	0.03153	21.75180	75.05704
5	2.177042981	3.78170	0.52410	0.95195	0.34264	33.11250	61.28711
10	2.543450901	4.25015	1.87287	3.32911	1.36538	31.89886	57.28363
15	2.944549700	4.76023	5.72385	2.94886	1.05207	29.48151	56.03347
20	3.071537176	4.52394	5.33183	3.30201	1.16660	29.05218	56.62344
24	3.145277985	4.50116	5.60730	3.55442	1.17363	28.63659	56.52691

TABLE 21: DECOMPOSITION OF VARIANCES FOR THE MONEY MARKETS ACCORDING TO CALMNESS WITH FOREX AT THE LAST.
(THE ORDER IS SIBOR, LIBOR, FEDFUND, 1-DAY REPO, INTERBANK, FOREX.)

Decomposition of Variance for Series SIBOR1W

Step	Std Error	SIBOR1W	LIBOR1W	FEDFUND	REPO1D	INTBK	THB
1	0.081588191	100.00000	0.00000	0.00000	0.00000	0.00000	0.00000
5	0.141236698	75.74182	16.71948	5.62532	1.08757	0.11027	0.71553
10	0.152703005	65.74706	16.56578	13.10764	1.26133	1.59499	1.72320
15	0.171658212	53.71203	23.45258	16.78205	1.85678	2.08979	2.10677
20	0.191245752	46.94309	23.60033	18.46698	6.00265	2.59668	2.39027
24	0.206965684	41.26182	25.72333	19.00908	8.94441	2.26484	2.79651

Decomposition of Variance for Series LIBOR1W

Step	Std Error	SIBOR1W	LIBOR1W	FEDFUND	REPO1D	INTBK	THB
1	0.076421729	38.82261	61.17739	0.00000	0.00000	0.00000	0.00000
5	0.127036222	44.79121	44.38261	9.23252	0.49162	0.10242	0.99962
10	0.138982407	39.12585	42.65933	14.77267	1.67452	0.64537	1.12226
15	0.160779561	30.31444	45.13007	19.62873	2.21982	1.05287	1.65407
20	0.181740676	26.59212	42.73402	20.29150	6.99594	1.39446	1.99195
24	0.197090514	23.10502	41.93353	21.69581	9.56660	1.26751	2.43153

Decomposition of Variance for Series FEDFUND

Step	Std Error	SIBOR1W	LIBOR1W	FEDFUND	REPO1D	INTBK	THB
1	0.312823069	0.20506	1.09591	98.69903	0.00000	0.00000	0.00000
5	0.326000052	1.37251	2.28384	94.36945	1.46915	0.05502	0.45004
10	0.381118400	14.85984	5.82741	71.54040	4.89098	0.89665	1.98471
15	0.398811875	15.18233	5.84197	69.38043	4.99929	2.09615	2.49983
20	0.414188642	15.01391	7.62722	66.52618	5.97713	2.29977	2.55579
24	0.424167341	15.81634	7.92244	63.91155	7.37127	2.35014	2.62825

Decomposition of Variance for Series REPO1D

Step	Std Error	SIBOR1W	LIBOR1W	FEDFUND	REPO1D	INTBK	THB
1	0.773569624	0.12237	0.05890	0.11343	99.70530	0.00000	0.00000
5	1.667784245	0.66653	0.15271	0.16834	93.70611	4.11847	1.18784
10	2.197507398	1.13137	0.66742	0.82618	81.93462	14.69714	0.74328
15	2.471609590	1.00510	0.58098	3.03362	73.73225	20.57591	1.07214
20	2.698900282	0.89549	0.65143	3.02186	70.37023	24.15121	0.90978
24	2.818534854	0.87866	0.64565	2.82073	68.27483	26.53023	0.84990

TABLE 21: DECOMPOSITION OF VARIANCES FOR THE MONEY MARKETS ACCORDING TO CALMNESS WITH FOREX AT THE LAST (CONTINUE.)

Decomposition of Variance for Series INTBK

Step	Std Error	SIBOR1W	LIBOR1W	FEDFUND	REPO1D	INTBK	THB
1	1.069750853	0.00588	0.59153	0.10754	22.39589	76.89915	0.00000
5	2.177042981	0.57910	1.28799	0.29014	34.01628	63.48682	0.33967
10	2.543450901	1.98181	3.87307	1.25211	32.74749	59.47687	0.66864
15	2.944549700	5.92812	3.27138	0.95122	30.37521	58.64893	0.82515
20	3.071537176	5.51545	3.64228	1.05089	29.89868	59.06853	0.82417
24	3.145277985	5.79698	3.83817	1.04600	29.48488	59.01208	0.82188

Decomposition of Variance for Series THB

Step	Std Error	SIBOR1W	LIBOR1W	FEDFUND	REPO1D	INTBK	THB
1	0.025926300	0.05792	0.74554	0.88458	0.21442	2.34992	95.74763
5	0.049857197	0.39852	2.05345	2.75185	0.13670	5.36900	89.29048
10	0.064323286	1.10702	1.96683	5.10999	0.71694	9.07184	82.02738
15	0.080589069	2.03648	2.79055	10.54939	3.39443	11.64407	69.58507
20	0.097930802	2.41862	2.17123	11.21044	5.73544	16.96133	61.50295
24	0.110033697	2.06829	2.27823	12.00750	7.06682	19.35035	57.22882

TABLE 22: STATISTICS OF THE DATA (THAI FINANCIAL VARIABLES.) 1989-1997

Series	Obs	Mean	Std Error	Minimum	Maximum
M1	107	280355.7280	90845.7393	152312.2000	430128.9000
M2	107	2374088.8477	931751.5600	963733.1000	4250145.3000
CRED	106	2712607.7528	1382443.4118	865044.3000	5709310.2000
SET	103	957.1847	298.0727	422.1776	1519.2200
GM1	106	11.1509	46.2863	-104.2809	131.6762
GM2	106	16.7988	11.1808	-18.5610	50.8579
GCRED	105	21.5665	9.9151	-1.5390	55.3559
GSET	102	4.9428	94.1356	-233.6119	258.9732
INTBK	104	9.9769	3.1262	2.3665	18.6607
REPO1D	104	8.5266	3.1518	1.7688	19.6488
REPO30D	104	8.9365	2.5909	2.9423	15.5000
SPREAD	104	0.4099	1.0093	-4.1488	3.4161
RKPRM	104	1.4503	1.3673	-1.9312	6.3026
CPI	108	116.0760	14.9289	91.2000	146.8000
P	107	5.3385	6.0417	-6.8994	31.3024

TABLE 23: MEAN AND VARIANCE COMPARISONS BETWEEN EXPANSIONS AND RECESSIONS

VARIABL	EXPANSION OF (86) TO 90/07 (E1)			RECESSION OF 90/08 TO 91/12 (R1)			EXPANSION OF 92/01 TO 94/12 (E2)			RECESSION OF 95/01 TO...(97) (R2)		
	OBS.(MO)	MEAN	VAR.	OBS.(MO)	MEAN	VAR.	OBS.(MO)	MEAN	VAR.	OBS.(MO)	MEAN	VAR.
SET	19	709.0586	40042.89	17	729.0826	8504.399	36	1069.076	79278.91	30	1119.804	70121.58
GM1	18	13.7676	1945.086	17	12.1436	2269.179	36	14.7737	2212.677	30	5.3883	2044.839
GM2	18	24.945	71.38476	17	18.9444	104.1931	36	14.4815	139.0088	30	13.4281	106.1971
GCRED	18	28.3452	74.92634	17	21.2943	50.20856	36	21.6941	85.5736	30	15.2454	54.0078
GSET	18	63.4202	3853.231	17	-32.4584	15429.89	36	22.0848	5882.062	30	-37.9877	5552.53
INTBK	19	10.9728	2.965973	17	12.3934	8.519977	36	7.0253	2.853228	30	11.1135	5.486838
REPO1D	19	9.82498	2.953586	17	10.5591	11.17899	36	5.5051	3.073009	30	9.5968	1.882658
REPO30D	19	9.9952	1.137636	17	10.9698	7.057524	36	6.3384	1.82304	30	9.8096	1.94742
SPREAD	19	0.1701	0.804161	17	0.4107	1.26405	36	0.8333	0.93838	30	0.2127	0.270269
RKPRM	19	1.14778	0.191494	17	1.8343	0.853406	36	1.5203	1.063786	30	1.5166	4.123905
P	19	5.9771	31.02936	17	5.1973	62.99279	36	4.09	31.13975	30	5.5048	14.43088

TABLE 24: TESTS FOR DIFFERENCES IN MEANS

VARIABL	Ho: MEAN(E1)=MEAN(E2)			Ho: MEAN(R1)=MEAN(R2)			Ho: MEAN(E1)=MEAN(R1)			Ho: MEAN(R1)=MEAN(E2)			Ho: MEAN(E2)=MEAN(R2)		
	t-STAT.	D.F.	SIG.	t-STAT.	D.F.	SIG.	t-STAT.	D.F.	SIG.	t-STAT.	D.F.	SIG.	t-STAT.	D.F.	SIG.
SET	***5.484***	50.594	1E-06	***7.3348***	40.349	6E-09	0.3921	26.818	0.6982	***6.5402***	***48.376***	***4E-08***	0.7529	65.059	0.4542
GM1	0.0773	38.099	0.9388	-0.4757	33.675	0.6374	-0.1045	34.363	0.9174	0.1884	32.803	0.8518	-0.8243	64.684	0.4128
GM2	***-3.74***	47.778	0.0005	***-1.774***	35.528	0.0848	-1.8886	32.963	0.068	-1.412	38.085	0.1661	-0.3872	65.863	0.6999
GCRED	***-2.601***	38.169	0.0132	***-2.774***	36.357	0.0087	***-2.643***	34.259	0.0123	0.1732	42.584	0.8634	***-3.155***	65.83	0.0024
GSET	***-2.128***	43.47	0.0391	-0.1673	23.474	0.8686	***-2.863***	24.116	0.0086	1.6666	22.675	0.1098	***-3.218***	64.483	0.002
INTBK	***-8.137***	37.904	9E-10	-1.5475	29.128	0.1326	***1.7523***	26.473	0.0915	***-7.046***	21.853	6E-07	***7.9847***	53.031	1E-10
REPO1D	***-8.803***	39.269	8E-11	-1.1338	19.486	0.271	0.8142	24.199	0.4236	***-5.863***	20.79	1E-05	***10.632***	65.717	7E-16
REPO30D	***-11***	47.137	1E-14	-1.6745	21.732	0.1089	1.4141	21.134	0.172	***-6.786***	20.496	1E-06	***10.211***	63.06	6E-15
SPREAD	***2.536***	41.336	0.0151	-0.6858	20.435	0.5007	0.7044	32.317	0.4863	1.3336	28.98	0.1931	***-3.314***	56.636	0.0016
RKPRM	***1.8713***	52.759	0.0669	-0.7334	44.985	0.4672	***2.7962***	23.045	0.0103	-1.1119	36.875	0.2736	-0.0091	42.055	0.9928
P	-1.194	38.635	0.2399	0.1503	20.754	0.882	-0.3375	29.803	0.7382	-0.5179	24.677	0.6092	1.2195	63.44	0.2272

N.B. The bold italic numbers indicate that the null hypothesis is significantly rejected at (least) 10% level.

TABLE 25: TESTS FOR DIFFERENCES IN VARIANCES

VARIABLE	Ho: VAR(E1)=VAR(E2)		**Ho: VAR(R1)=VAR(R2)**		Ho: VAR(E1)=VAR(R1)		**Ho: VAR(R1)=VAR(E2)**		Ho: VAR(E2)=VAR(R2)	
	F-STAT.	**SIG.**	**F-STAT.**	**SIG.**	**F-STAT.**	**SIG.**	**F-STAT.**	**SIG.**	**F-STAT.**	**SIG.**
SET	***1.9798497***	0.06243169	***8.2453304***	2.8348E-05	***4.7084915***	0.00155632	***9.3221053***	1.0152E-05	1.13059208	0.37031102
GM1	1.13757276	0.39962117	1.10971014	0.39071117	1.16662136	0.37704118	1.0255356	0.45545983	1.08207861	0.4172423
GM2	***1.9473179***	0.07207893	1.0192344	0.49998719	1.45959813	0.2235092	1.33414664	0.27341568	1.3089694	0.2306017
GCRED	1.1421031	0.39604798	1.07566915	0.45206523	1.49230198	0.21439744	1.70436271	0.12753672	***1.5844674***	0.10378845
GSET	1.52652708	0.17714572	***2.7788932***	0.00812574	***4.0044024***	0.0034969	***2.6232108***	0.00849549	1.05934803	0.44046917
INTBK	1.03951494	0.44518038	1.55280283	0.1473602	***2.8725743***	0.01683433	***2.9860838***	0.00338406	***1.9230283***	0.03283404
REPO1D	1.04043324	0.47951644	***5.937876***	1.7875E-05	***3.7848881***	0.00401491	***3.6378***	0.00069516	***1.6322711***	0.08995992
REPO30D	1.60248159	0.1440968	***3.6240373***	0.00127283	***6.203677***	0.00019232	***3.8712938***	0.00040386	1.06822681	0.42241329
SPREAD	1.16690588	0.37247923	***4.6770092***	0.0001593	1.57188819	0.17696681	1.34705653	0.22485223	***3.4720215***	0.00047383
RKPRM	***5.5551991***	0.0001555	***4.8322871***	0.00086688	***4.4565757***	0.00156407	1.24651738	0.32623802	***3.8766304***	9.2456E-05
P	1.00355766	0.51417444	***4.3651384***	0.0002873	***2.0301032***	0.07481833	***2.0229064***	0.04051815	***2.1578549***	0.01839011

N.B. The bold italic numbers indicate that the null hypothesis is significantly rejected at (least) 10% level.

TABLE 26: GRANGER CAUSALITY TESTS FOR PREDICTOR SPREAD.

	Lag Length				
Dependent Variable	**1 Lag**	**3 Lags**	**6 Lags**	**9 Lags**	**12 Lags**
Growth in M1 (GM1)	0.43172	1.60814	1.80394	1.80266* (1)	1.34001
Growth in M2 (GM2)	0.30027	2.11795	3.87627***(2)	2.49405**(3)	1.13730
Growth in Credit (GCR)	1.34204	0.84864	1.69638	1.04369	1.06174
Capital Gain on SET (GSET)	3.41889*(4)	1.44897	0.77138	0.86754	1.00269
Change in MLR (DMLR)	3.34532*(5)	2.72862**(6)	0.86743	1.26175	1.00696

* F-Statistic is significant at 10% level.
** F-Statistic is significant at 5% level.
*** F-Statistic is significant at 1% level.

(1) The estimated model of monthly data 1989/11 to 1997/09:

$$\underset{(2.23961)^{**}}{18.05544} - \underset{(-1.0205)}{0.1259}GM1(t-1) - \underset{(-0.716)}{0.0896}GM1(t-2) + \underset{(0.6666)}{0.0831}GM1(t-3) - \underset{(-1.2951)}{0.1392}GM1(t-4)$$
$$- \underset{(-0.9414)}{0.1013}GM1(t-5) - \underset{(-3.5261)^{***}}{0.3811}GM1(t-6) - \underset{(-1.5452)}{0.1848}GM1(t-7) - \underset{(-1.5896)}{0.1892}GM1(t-8) + \underset{(1.1639)}{0.1423}GM1(t-9)$$
$$- \underset{(-1.0729)}{5.3465}SPREAD(t-1) + \underset{(1.441)}{7.3843}SPREAD(t-2) - \underset{(-1.3866)}{8.3709}SPREAD(t-3)$$
$$+ \underset{(0.9983)}{6.1536}SPREAD(t-4) + \underset{(1.8302)^{*}}{11.4623}SPREAD(t-5) - \underset{(-1.2037)}{7.7666}SPREAD(t-6)$$
$$- \underset{(-0.02872)}{0.1948}SPREAD(t-7) - \underset{(-0.93158)}{6.4178}SPREAD(t-8) + \underset{(1.9615)^{*}}{12.169}SPREAD(t-9)$$

$R^2 = 0.4164$ F-Statistic = 2.3439 Significance Level of F = 0.006416 (at 1%)

(2) The estimated model of monthly data from 1989/11 to 1997/09:

$$\underset{(3.0699)^{***}}{10.5892} + \underset{(1.794)^{*}}{0.1832}GM2(t-1) + \underset{(0.7803)}{0.0801}GM2(t-2) + \underset{(0.3143)}{0.0321}GM2(t-3) - \underset{(-0.0784)}{0.00786}GM2(t-4)$$
$$- \underset{(-1.39125)}{0.1406}GM2(t-5) + \underset{(3.2193)^{***}}{0.3247}GM2(t-6) + \underset{(0.553)}{0.6313}SPREAD(t-1) + \underset{(1.1622)}{1.3834}SPREAD(t-2)$$
$$- \underset{(-3.486)^{***}}{4.9593}SPREAD(t-3) + \underset{(1.797)^{*}}{2.2623}SPREAD(t-4) + \underset{(0.5894)}{0.8942}SPREAD(t-5) - \underset{(-3.3958)^{***}}{4.8198}SPREAD(t-6)$$

$R^2 = 0.76737$ F-Statistic = 2.9129 Significance Level of F = 0.0022 (at 1%)

* t-Statistic is significant at 10% level.
** t-Statistic is significant at 5% level.
*** t-Statistic is significant at 1% level.

TABLE 26: GRANGER CAUSALITY TESTS FOR PREDICTOR SPREAD. (Remarks continue.)

(3) The estimated model of monthly data from 1989/08 to 1997/09:

$$\begin{aligned} GM2(t) = {} & \underset{(2.5202)^{**}}{10.1837} + \underset{(2.1688)^{**}}{0.26}GM2(t-1) - \underset{(-0.0454)}{0.0057}GM2(t-2) + \underset{(1.3086)}{0.15857}GM2(t-3) + \underset{(0.2857)}{0.02935}GM2(t-4) \\ & - \underset{(-1.1485)}{0.116}GM2(t-5) + \underset{(3.3745)^{***}}{0.342}GM2(t-6) - \underset{(-2.23817)^{**}}{0.2387}GM2(t-7) + \underset{(0.235)}{0.0262}GM2(t-8) - \underset{(-0.0875)}{0.0098}GM2(t-9) \\ & + \underset{(0.004)}{0.0044}SPREAD(t-1) + \underset{(1.006)}{1.1723}SPREAD(t-2) - \underset{(-3.4967)^{***}}{5.0334}SPREAD(t-3) \\ & + \underset{(2.1372)^{**}}{3.2653}SPREAD(t-4) + \underset{(0.1068)}{0.16932}SPREAD(t-5) - \underset{(-2.3567)^{**}}{3.7268}SPREAD(t-6) \\ & + \underset{(0.34)}{0.5706}SPREAD(t-7) - \underset{(-0.0488)}{0.0833}SPREAD(t-8) + \underset{(1.4493)}{2.2917}SPREAD(t-9) \end{aligned}$$

$R^2 = 0.80871$ F-Statistic = 2.1017 Significance Level of F = 0.0153 (at 5%)

(4) The estimated model of monthly data from 1989/03 to 1997/07:

$$GSET(t) = \underset{(-0.5246)}{-5.0753} + \underset{(4.2721)^{***}}{0.4074}GSET(t-1) + \underset{(1.849)^{*}}{17.7017}SPREAD(t-1)$$

$R^2 = 0.2002$ F-Statistic = 11.9108 Significance Level of F = 0.00002 (at 0.005%)

(5) The estimated model of monthly data from 1989/03 to 1997/08:

$$DMLR(t) = \underset{(-0.5246)}{0.0277} + \underset{(5.87935)^{***}}{0.5097}DMLR(t-1) - \underset{(-1.829)^{*}}{0.0452}SPREAD(t-1)$$

$R^2 = 0.2997$ F-Statistic = 20.5866 Significance Level of F = 0.00000004 (at 0.000005%)

(6) The estimated model of monthly data from 1989/05 to 1997/08:

$$\begin{aligned} DMLR(t) = {} & \underset{(1.698)^{*}}{0.0538} + \underset{(4.943)^{***}}{0.5317}DMLR(t-1) - \underset{(-1.652)^{*}}{0.201}DMLR(t-2) + \underset{(1.729)^{*}}{0.185}DMLR(t-3) \\ & - \underset{(-0.6557)}{0.1791}SPREAD(t-1) - \underset{(-1.973)^{**}}{0.064}SPREAD(t-2) - \underset{(-0.57048)}{0.01874}SPREAD(t-3) \end{aligned}$$

$R^2 = 0.3627$ F-Statistic = 8.3833 Significance Level of F = 0.00000033 (at 0.00005%)

* t-Statistic is significant at 10% level.
** t-Statistic is significant at 5% level.
*** t-Statistic is significant at 1% level.

TABLE 27: GRANGER TESTS FOR PREDICTOR RISK PREMIUM.

	Lag Length				
Dependent Variable	**1 Lag**	**3 Lags**	**6 Lags**	**9 Lags**	**12 Lags**
Growth in M1 (GM1)	0.23447	0.9744	1.58450	1.46914	2.16477**(1)
Growth in M2 (GM2)	0.72018	1.00749	0.62401	0.55537	1.1677
Growth in Credit (GCR)	1.23411	0.37817	0.29378	0.36901	0.36721
Capital Gain on SET (GSET)	1.09615	0.54270	0.80195	0.70687	0.68463
Change in MLR (DMLR)	2.34337	1.07589	0.58246	0.6	0.75923

* F-Statistic is significant at 10% level.
** F-Statistic is significant at 5% level.
*** F-Statistic is significant at 1% level.

(1) The estimated model of monthly data 1990/02 to 1997/09:

$$
\begin{aligned}
GM1(t) = {} & \underset{(0.91184)}{15.5286} - \underset{(-0.5854)}{0.0646}GM1(t-1) - \underset{(-0.9858)}{0.1077}GM1(t-2) + \underset{(1.1992)}{0.1354}GM1(t-3) - \underset{(-1.6488)}{0.19645}GM1(t-4) \\
& - \underset{(-0.4441)}{0.0513}GM1(t-5) - \underset{(-2.12824)^{**}}{0.251}GM1(t-6) - \underset{(-0.2872)}{0.032}GM1(t-7) - \underset{(-1.3837)}{0.155}GM1(t-8) + \underset{(1.2051)}{0.1349}GM(t-9) \\
& - \underset{(-0.67543)}{0.07632}GM1(t-10) - \underset{(-0.26335)}{0.02937}GM1(t-11) + \underset{(3.509)^{***}}{0.4003}GM1(t-12) \\
& - \underset{(-1.46912)}{4.9654}RKPRM(t-1) + \underset{(2.012)^{**}}{7.646}RKPRM(t-2) + \underset{(1.16134)}{4.6731}RKPRM(t-3) \\
& - \underset{(-2.6265)^{***}}{10.6312}RKPRM(t-4) + \underset{(1.6657)^{*}}{6.737}RKPRM(t-5) - \underset{(-0.84465)}{3.394}RKPRM(t-6) \\
& + \underset{(0.44345)}{1.79}RKPRM(t-7) - \underset{(-0.814)}{3.261}RKPRM(t-8) - \underset{(-0.289)}{1.1884}RKPRM(t-9) \\
& - \underset{(-1.181)}{4.818}RKPRM(t-10) + \underset{(2.7386)^{***}}{11.094}RKPRM(t-11) - \underset{(-1.35554)}{5.11}RKPRM(t-12)
\end{aligned}
$$

$R^2 = 0.542299$ F-Statistic = 3.0491 Significance Level of F = 0.00017495 (at 0.005%)

* t-Statistic is significant at 10% level.
** t-Statistic is significant at 5% level.
*** t-Statistic is significant at 1% level.

TABLE 28: GRANGER TESTS FOR PREDICTOR 30-DAY REPO RATE.

	Lag Length				
Dependent Variable	**1 Lag**	**3 Lags**	**6 Lags**	**9 Lags**	**12 Lags**
Prime Rate (MLR)	55.749***(1)	9.866***(2)	3.7158***(3)	1.76*(4)	1.709*(5)
SET Index (SET)	3.102*(6)	0.62173	0.96542	0.9755	0.99

* F-Statistic is significant at 10% level.
** F-Statistic is significant at 5% level.
*** F-Statistic is significant at 1% level.

(1) The estimated model of monthly data from 1989/02 to 1997/08:

$$\underset{}{MLR(t)} = \underset{}{0.61685} + \underset{(3.04117)^{***}}{0.89423}MLR(t-1) - \underset{(47.048)^{***}}{0.08672}REPO30D(t-1) \quad \underset{(7.46653)^{***}}{}$$

R^2 = 0.9997 F-Statistic = 2144.3533 Significance Level of F = 0.000000000

(2) The estimated model of monthly data from 1989/05 to 1997/08:

$$\underset{}{MLR(t)} = \underset{(3.252)^{***}}{0.714} + \underset{(11.727)^{***}}{1.2595}MLR(t-1) - \underset{(-3.1925)^{***}}{0.536}MLR(t-2) + \underset{(1.656)^{*}}{0.1644}MLR(t-3)$$
$$+ \underset{(2.291)^{**}}{0.0479}REPO30D(t-1) + \underset{(0.582)}{0.0181}REPO30D(t-2) + \underset{(0.832)}{0.0195}REPO30D(t-3)$$

R^2 = 0.9997 F-Statistic = 759.82 Significance Level of F = 0.00000000

(3) The estimated model of monthly data from 1989/11 to 1997/09:

$$\underset{}{MLR(t)} = \underset{(2.545)^{**}}{0.7106} + \underset{(11.65)^{***}}{1.353}MLR(t-1) - \underset{(-3.95)^{***}}{0.766}MLR(t-2) + \underset{(2.6)^{**}}{0.5334}MLR(t-3) - \underset{(-2.39)^{**}}{0.4953}MLR(t-4)$$
$$+ \underset{(2.154)^{**}}{0.425}MLR(t-5) - \underset{(-1.4)}{0.1547}MLR(t-6) + \underset{(1.71)^{*}}{0.0395}REPO30D(t-1) + \underset{(0.693)}{0.023}REPO30D(t-2)$$
$$+ \underset{(0.84)}{0.029}REPO30D(t-3) - \underset{(0.792)}{0.0298}REPO30D(t-4) + \underset{(1.0997)}{0.0413}REPO30D(t-5) - \underset{(-1.014)}{0.028}REPO30D(t-6)$$

R^2 = 0.99975 F-Statistic = 343.323 Significance Level of F = 0.00000000

TABLE 28: GRANGER TESTS FOR PREDICTOR 30-DAY REPO RATE. (Remarks continue.)

(4) The estimated model of monthly data 1989/10 to 1997/08:

$$\begin{aligned}MLR(t) = {} & 0.9314 + 1.345MLR(t-1) - 0.76MLR(t-2) + 0.527MLR(t-3) - 0.429MLR(t-4) \\ & (2.5577)^{**} \quad (10.706)^{***} \quad (-3.527)^{***} \quad (2.282)^{**} \quad (-1.81895)^{*} \\ & + 0.267MLR(t-5) + 0.051MLR(t-6) - 0.169MLR(t-7) + 0.213MLR(t-8) - 0.1613MLR(t-9) \\ & \quad (1.118) \quad (0.217) \quad (-0.727) \quad (0.964) \quad (-1.3065) \\ & + 0.413REPO30D(t-1) + 0.0148REPO30D(t-2) - 0.0205REPO30D(t-3) \\ & \quad (1.67)^{*} \quad (0.4165) \quad (0.564) \\ & - 0.0305REPO30D(t-4) + 0.055REPO30D(t-5) - 0.057REPO30D(t-6) \\ & \quad (-0.763) \quad (1.321) \quad (-1.334) \\ & + 0.03REPO30D(t-7) - 0.0078REPO30D(t-8) + 0.00285REPO30D(t-9) \\ & \quad (0.5851) \quad (-0.1549) \quad (0.0835)\end{aligned}$$

$R^2 = 0.998$ F-Statistic = 186.1118 Significance Level of F = 0.00000000000

(5) The estimated model of monthly data 1990/01 to 1997/08:

$$\begin{aligned}MLR(t) = {} & 1.726 + 1.253MLR(t-1) - 0.691MLR(t-2) + 0.51MLR(t-3) - 0.476MLR(t-4) \\ & (3.397)^{***} \quad (9.066)^{***} \quad (-3.0315)^{***} \quad (2.084)^{**} \quad (-1.87799)^{*} \\ & + 0.362MLR(t-5) - 0.089MLR(t-6) + 0.013MLR(t-7) - 0.027MLR(t-8) + 0.117MLR(t-9) \\ & \quad (1.398) \quad (-0.346) \quad (0.0516) \quad (-0.102) \quad (0.453) \\ & - 0.232MLR(t-10) + 0.07MLR(t-11) - 0.023MLR(t-12) \\ & \quad (-0.9184) \quad (0.2932) \quad (-0.1678) \\ & + 0.0415REPO30D(t-1) + 0.0131REPO30D(t-2) + 0.0128REPO30D(t-3) \\ & \quad (1.575) \quad (0.335) \quad (-0.332) \\ & - 0.023REPO30D(t-4) + 0.07REPO30D(t-5) - 0.06REPO30D(t-6) \\ & \quad (-0.54) \quad (1.575) \quad (-1.322) \\ & + 0.01315REPO30D(t-7) + 0.01972REPO30D(t-8) - 0.011REPO30D(t-9) \\ & \quad (0.2446) \quad (0.3352) \quad (-0.178) \\ & - 0.01874REPO30D(t-10) + 0.0429REPO30D(t-11) + 0.0253REPO30D(t-12) \\ & \quad (-0.295) \quad (0.693) \quad (0.624)\end{aligned}$$

$R^2 = 0.999793$ F-Statistic = 114.97 Significance Level of F = 0.000000000000

(6) The estimated model of monthly data from 1989/02 to 1997/07:

$$\begin{aligned}SET(t) = {} & 99.3142 + 0.9477SET(t-1) - 5.3461REPO30D(t-1) \\ & (2.395)^{***} \quad (37.919)^{***} \quad (-1.7613)^{***}\end{aligned}$$

$R^2 = 0.9951$ F-Statistic = 806.2 Significance Level of F = 0.000000000000

TABLE 29: PERFORMANCE OF INTEREST RATE BASED INFLATION PREDICTOR

Period of Prediction	No. of Forecasts	Mean Error	Mean Abs. Err.	RMSE
1992/01 to 1997/07	66	1.2829	9.2524	13.2264
1995/06 to 1997/07	25	-1.15986	7.0526	9.3604

TABLE 30: PERFORMANCE OF OLS SPREAD PREDICTOR(1)

Period of Prediction	No. of Forecasts	Mean Error	Mean Abs. Err.	RMSE
1992/01 to 1997/06	65	-0.39174	3.80548	4.90788
1995/06 to 1997/06	25	-0.30132	2.9935	3.66208

(1) The last model is estimated by using data from 1989/01 to 1997/06 as follows:

$$P(t) = \underset{(9.4805)***}{5.9851} - \underset{(-2.9314)***}{1.7087}SPREAD(t) \qquad R^2 = 0.4744 \qquad F\text{-Stat.} = 8.5932***$$

*** Statistically significant at 1% level.

TABLE 31: PERFORMANCE OF THE ARMA MODEL

Period of Prediction	No. of Forecasts	Mean Error	Mean Abs. Err.	RMSE
1992/01 to 1997/06	65	2.00766	9.4691	15.25886
1995/06 to 1997/06	25	-0.0593	6.9876	8.21776

FIGURES

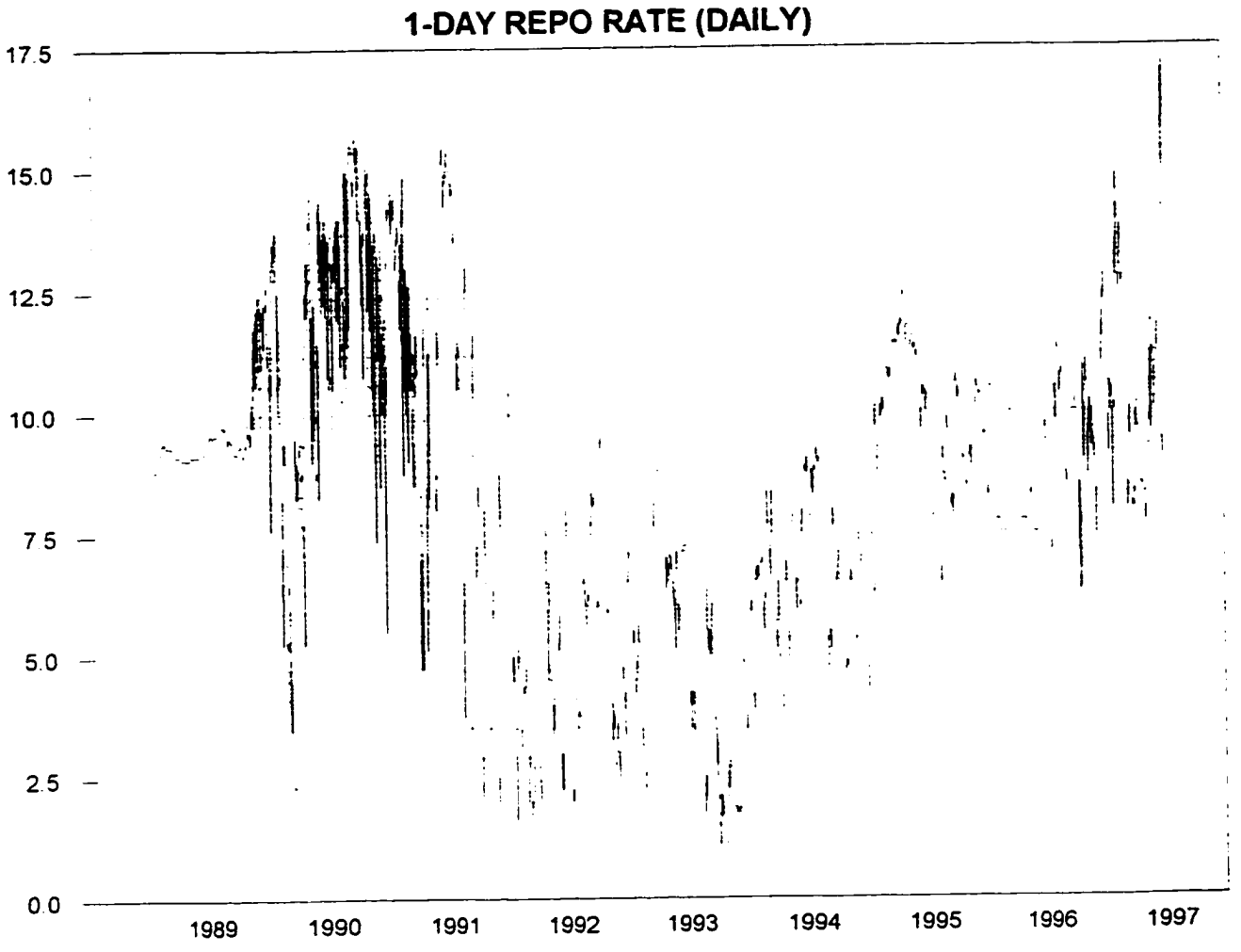

Figure 1: 1-Day Repo Rate (Daily)

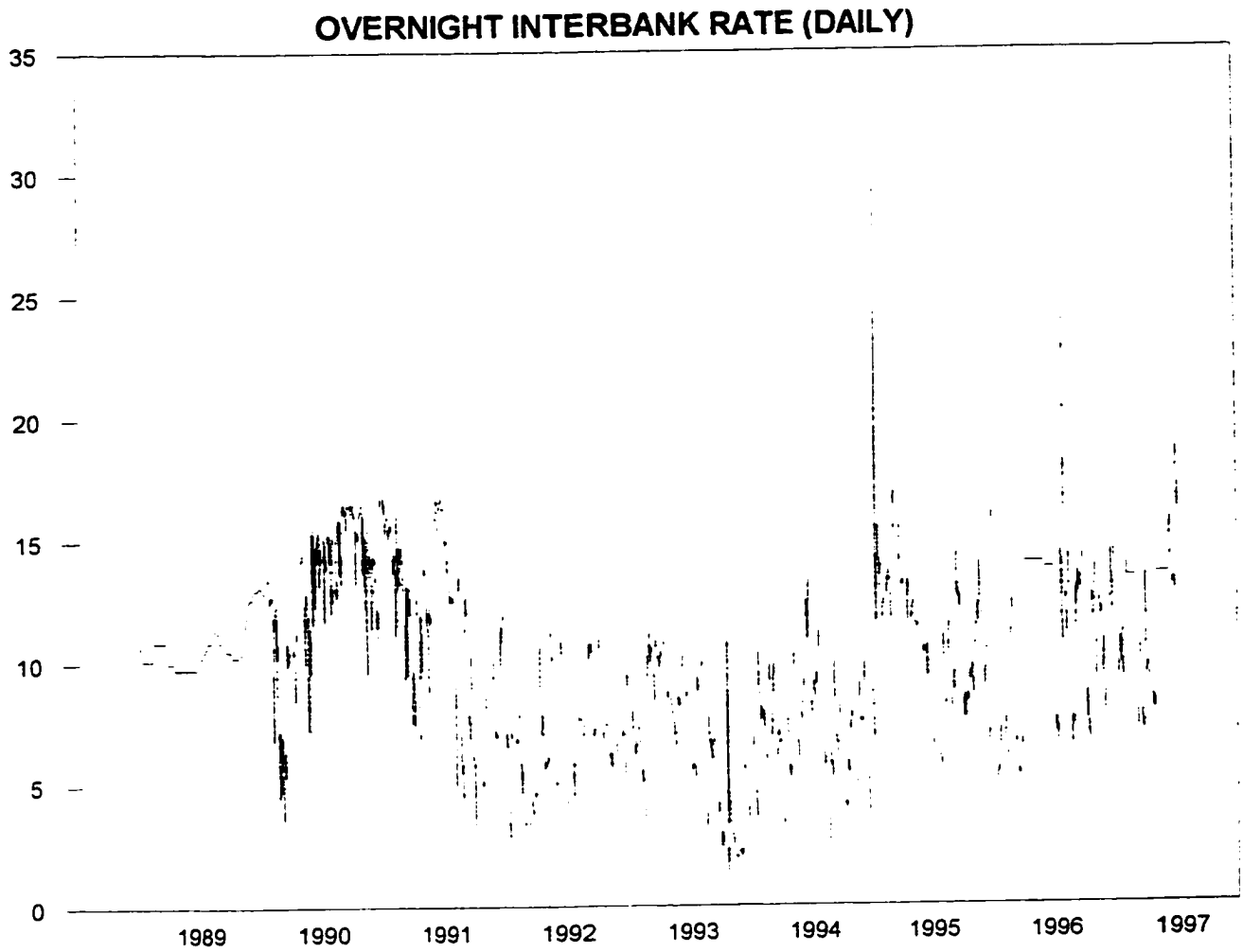

Figure 2: Overnight Interbank Rate (Daily)

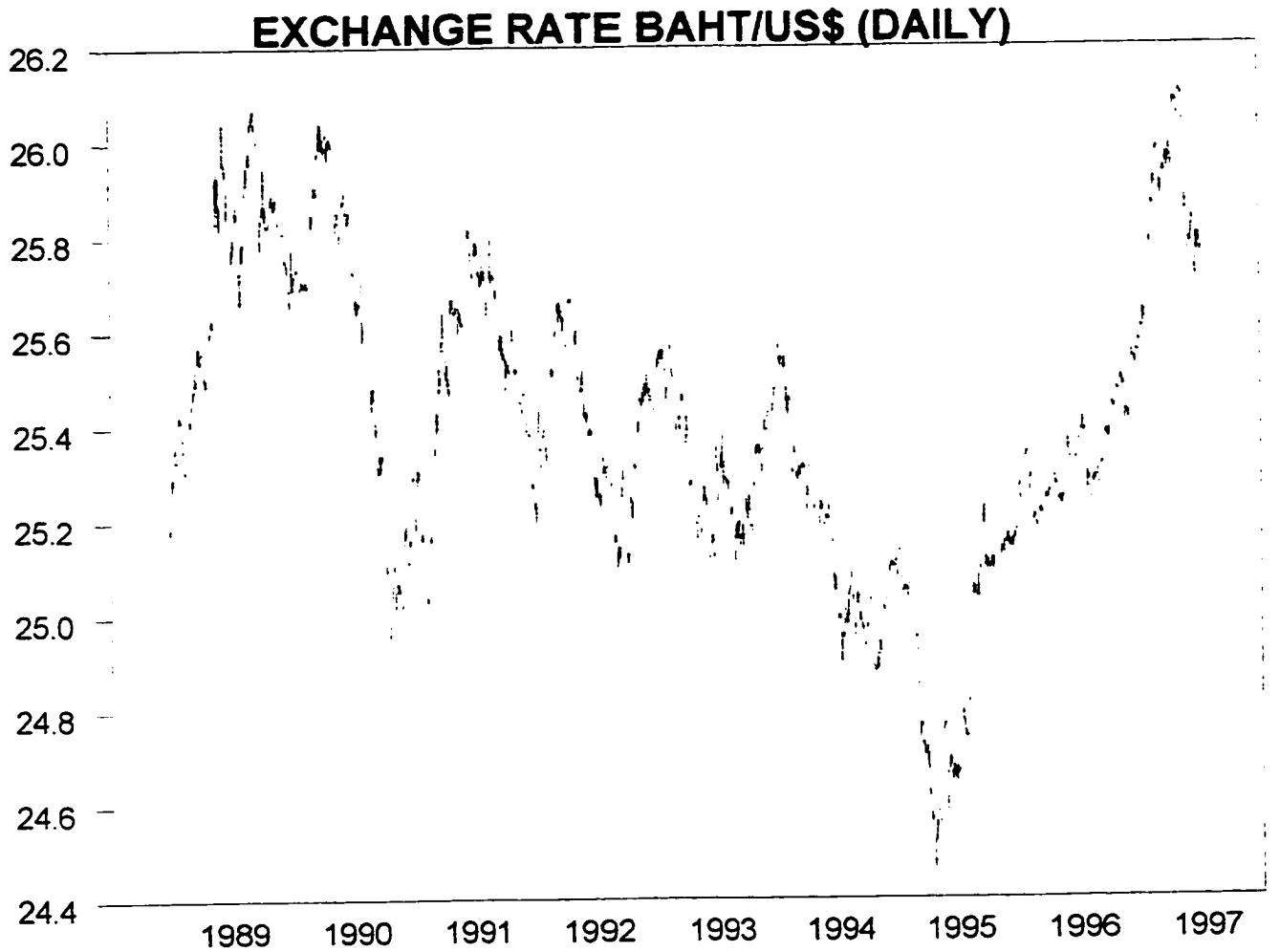

Figure 3: **Exchange Rate Baht/US$ (Daily)**

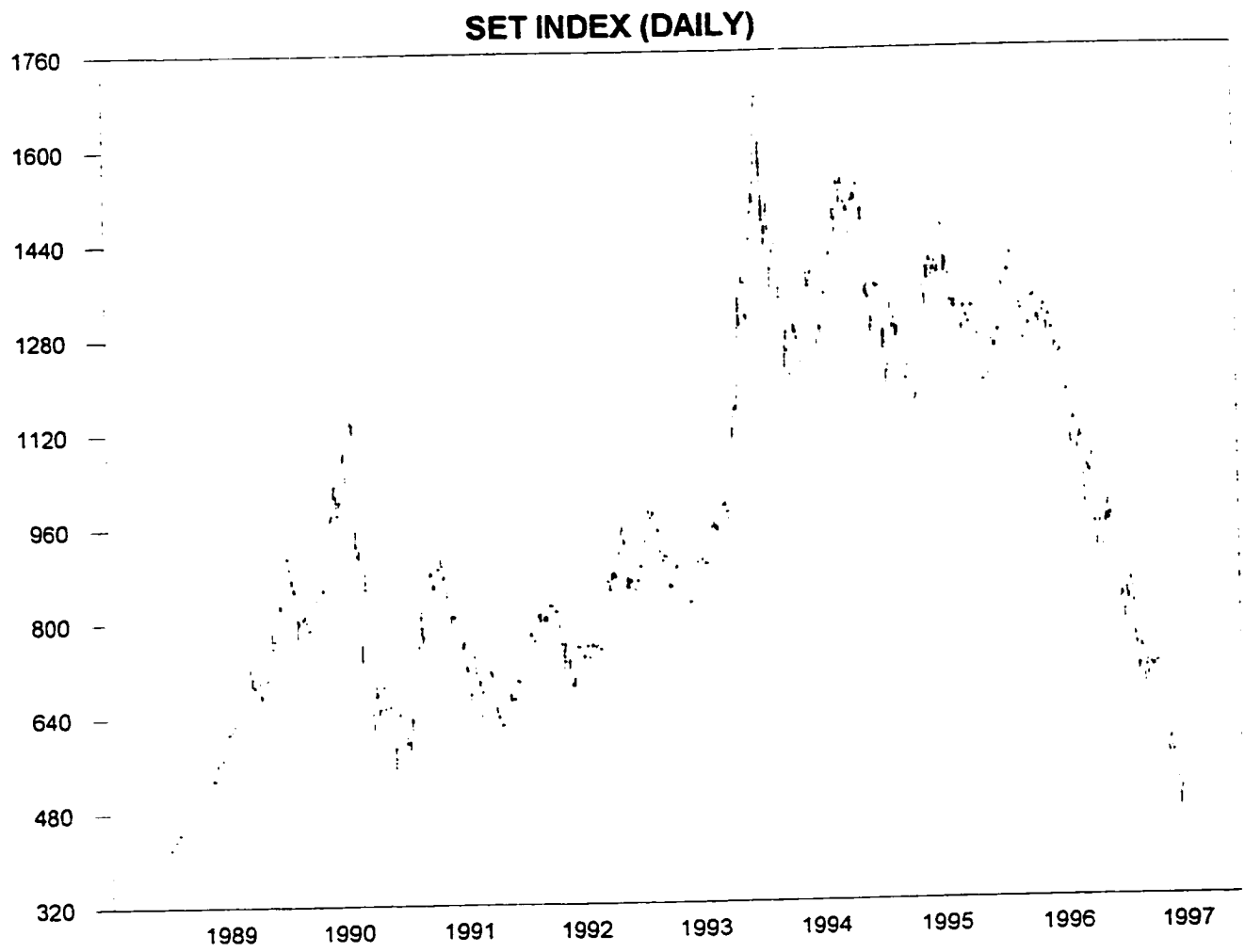

Figure 4: SET Index (Daily)

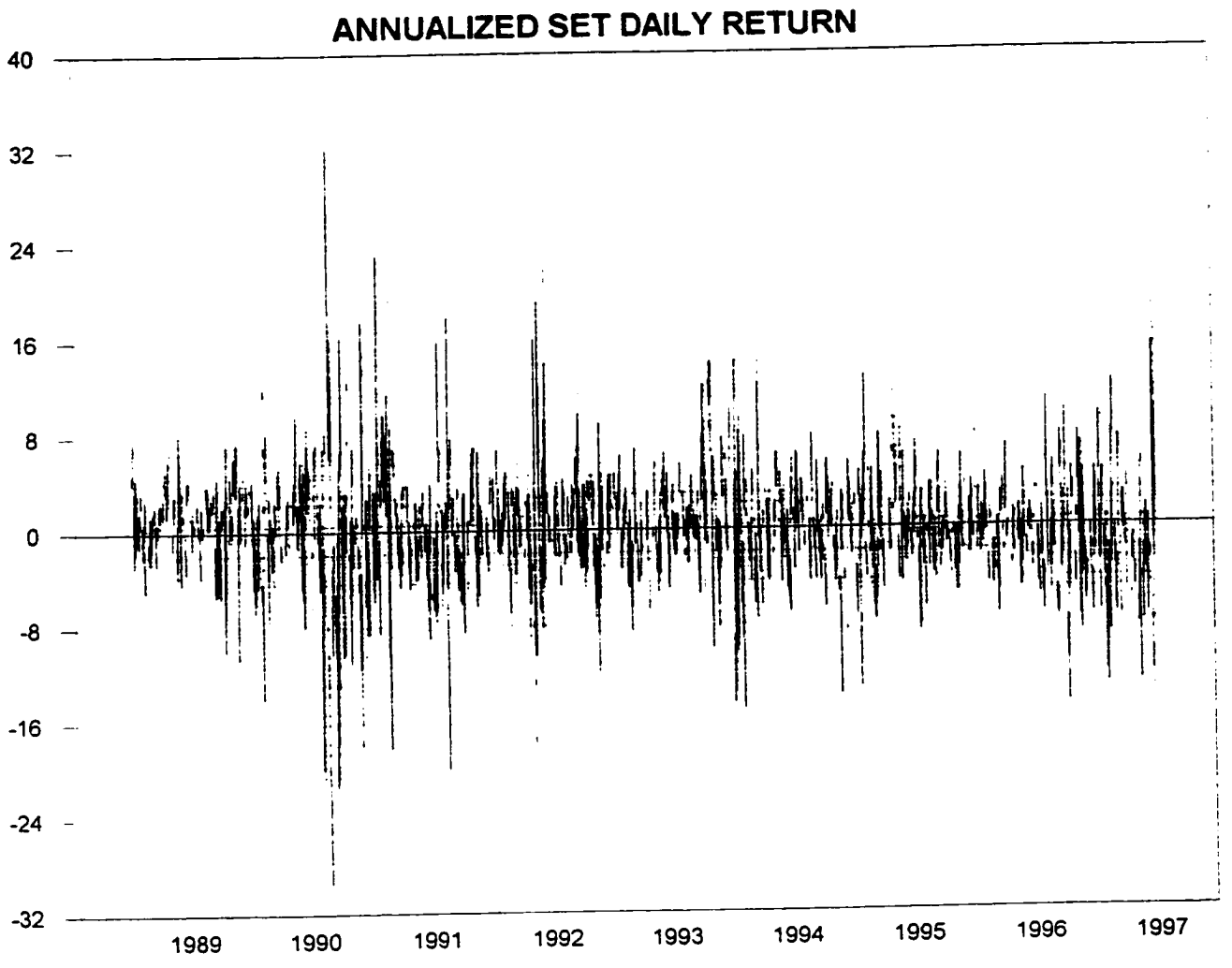

Figure 5: Annualized SET Daily Return

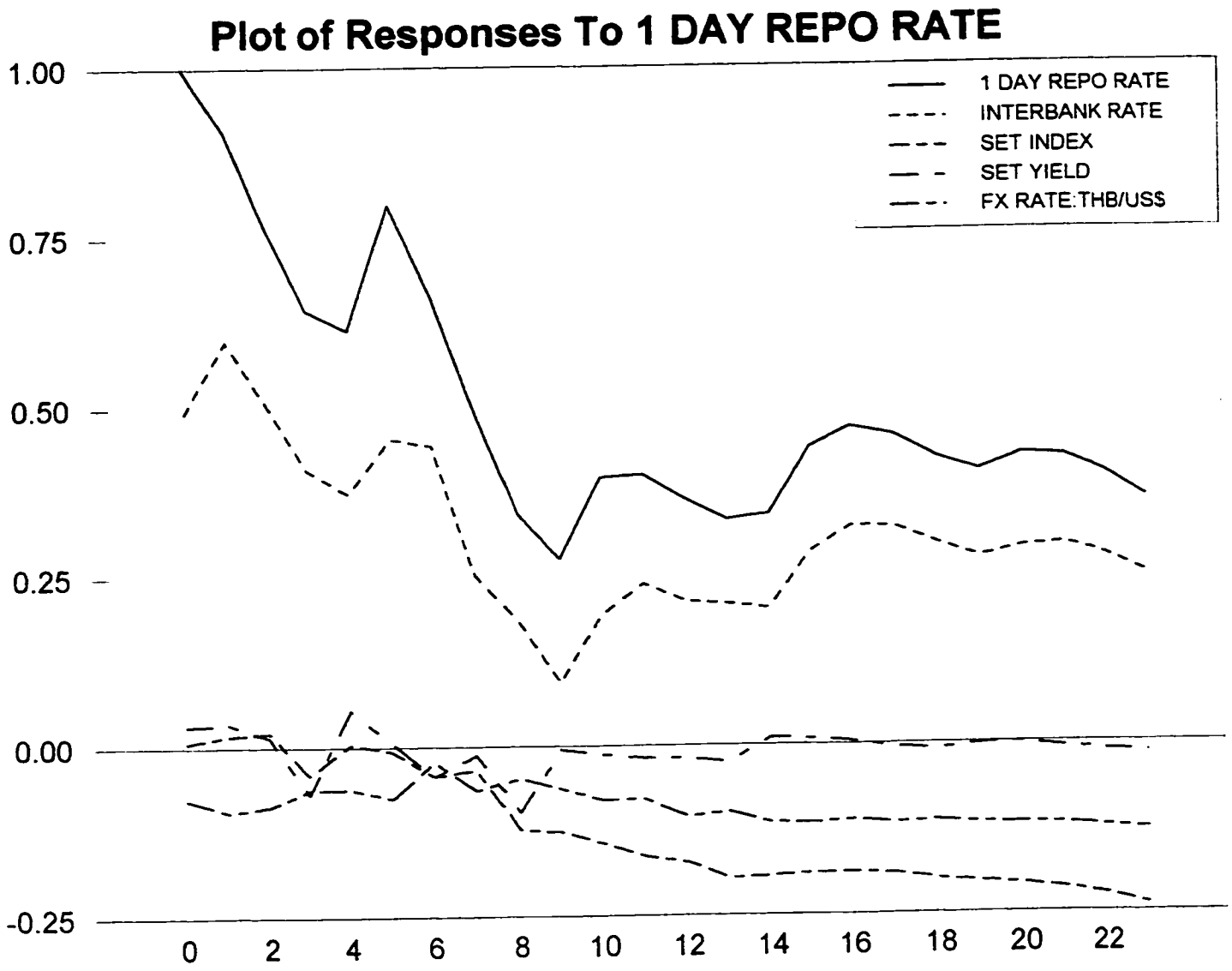

Figure 6: Plot of Responses to 1-Day Repo Rate

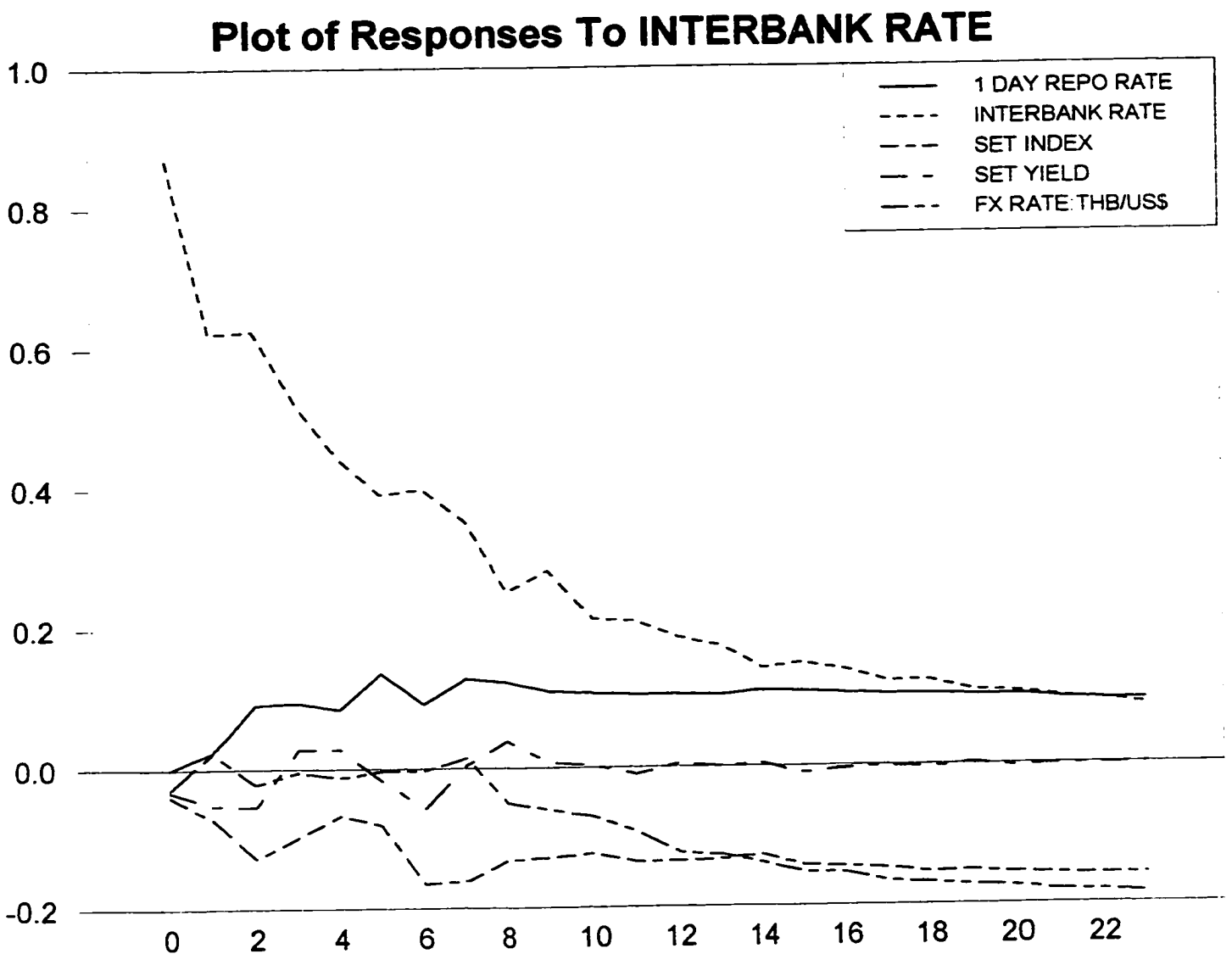

Figure 7: Plot of Responses to Interbank Rate

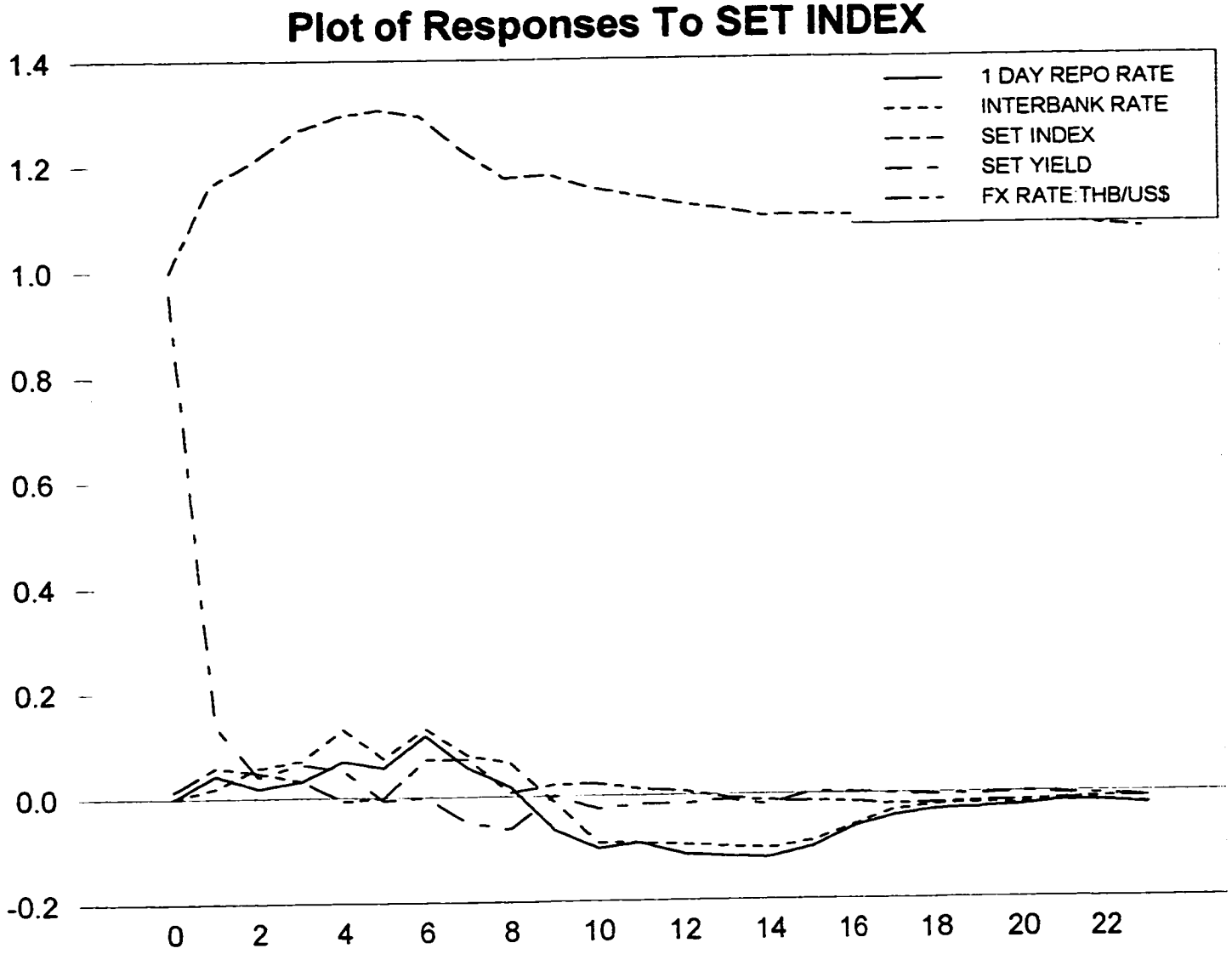

Figure 8: Plot of Responses to SET Index

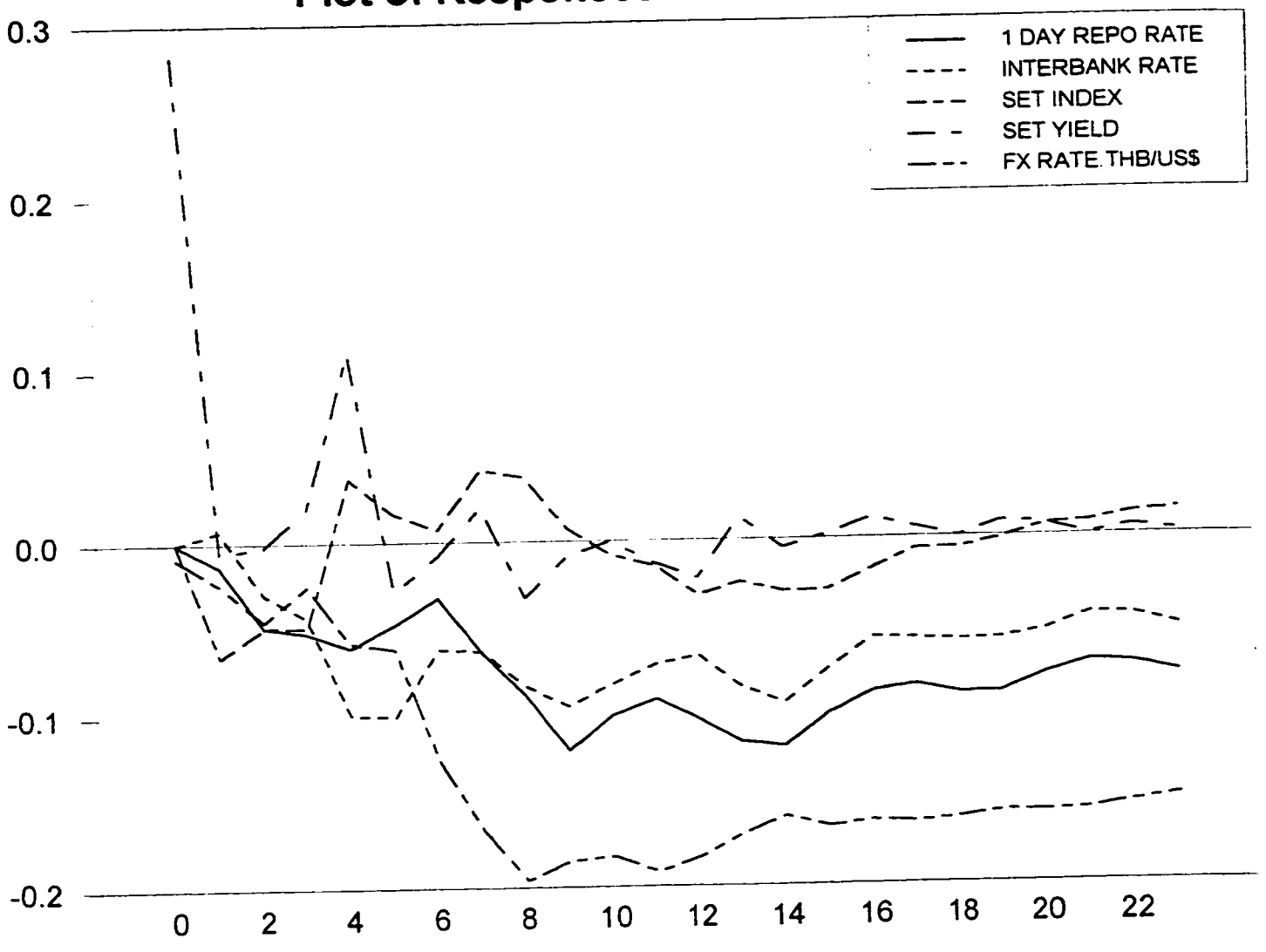

Figure 9: Plot of Responses to SET Yield

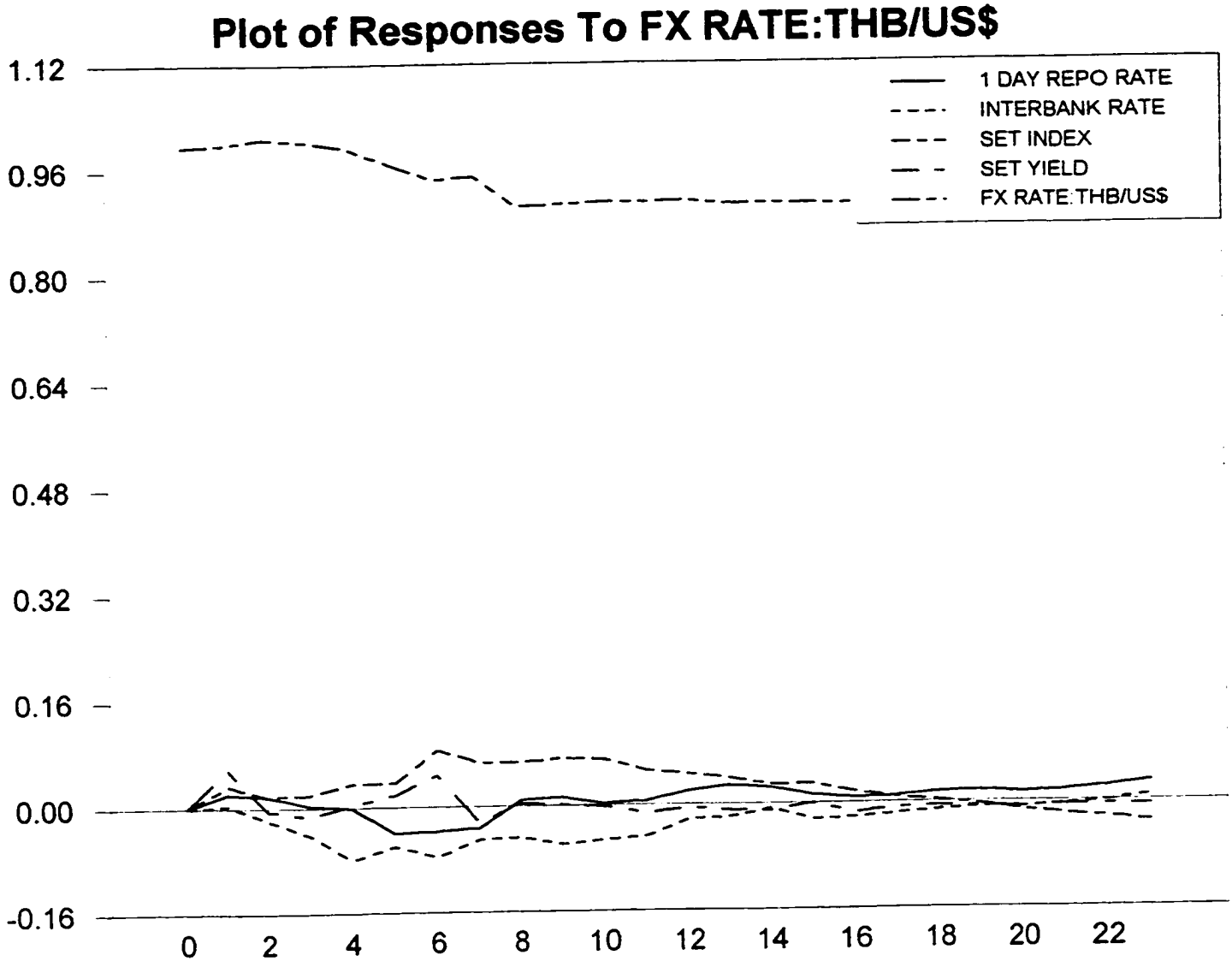

Figure 10: Plot of Responses to FX-THB/US$ Rate

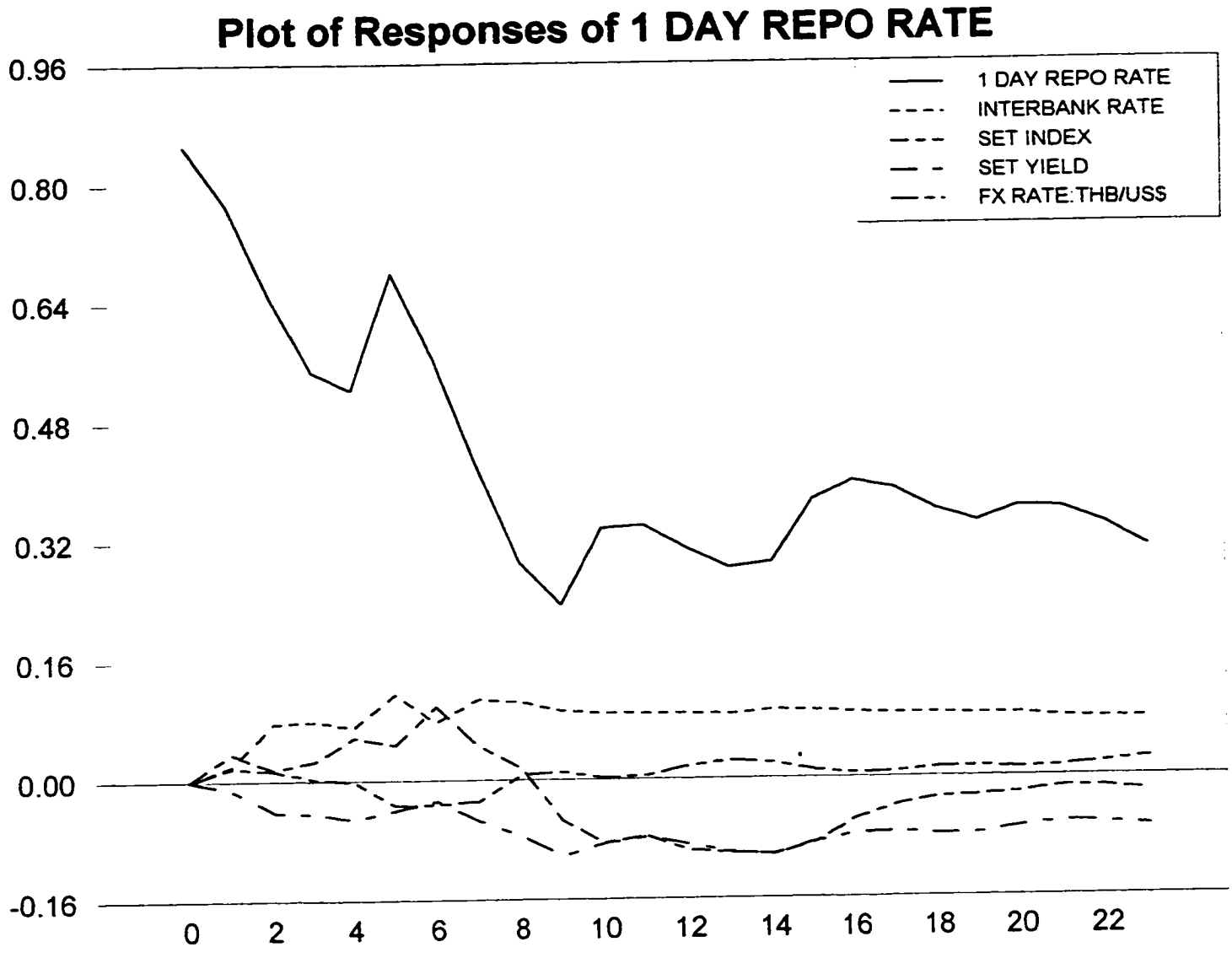

Figure 11: Plot of Responses of 1-Day Repo Rate

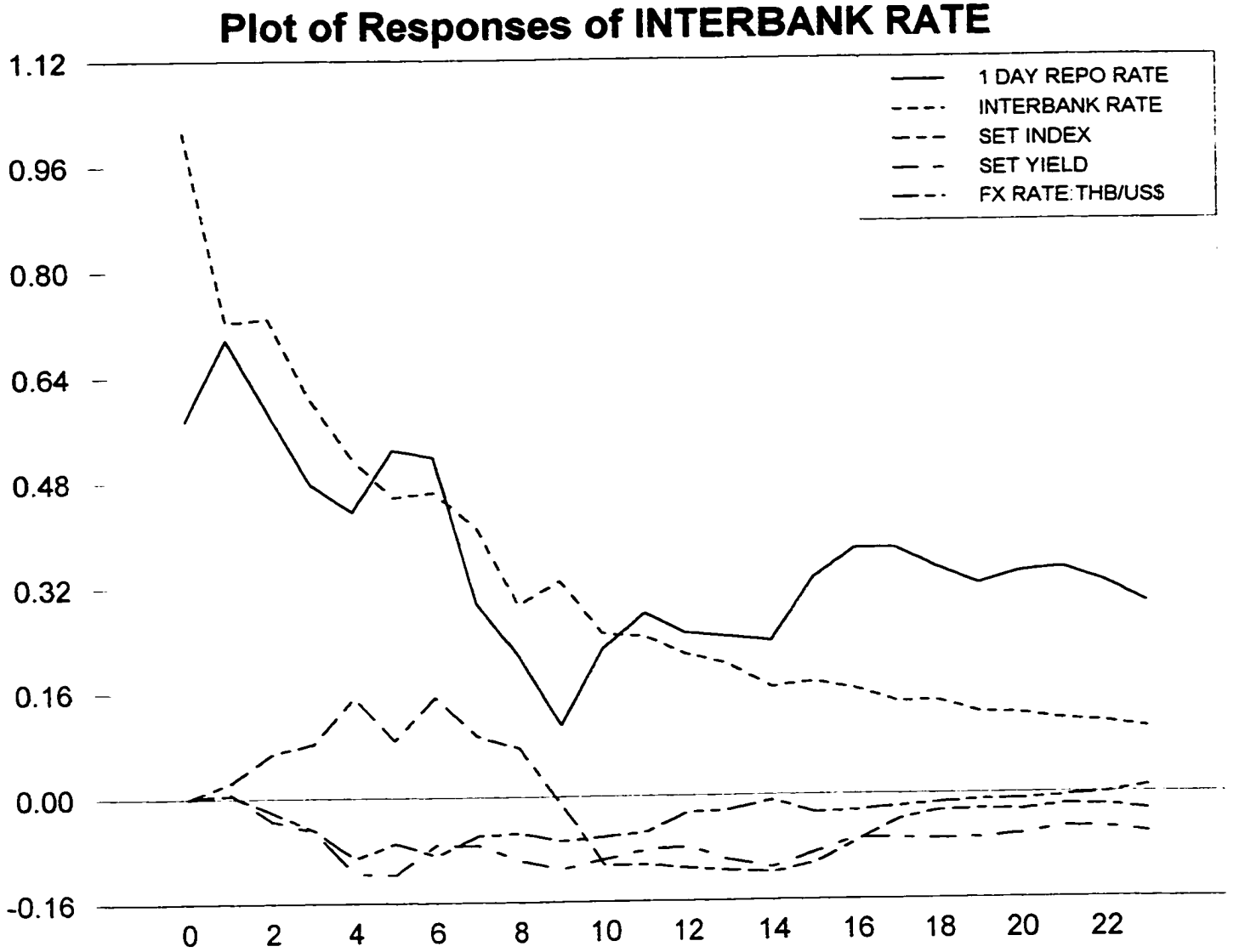

Figure 12: Plot of Responses of Interbank Rate

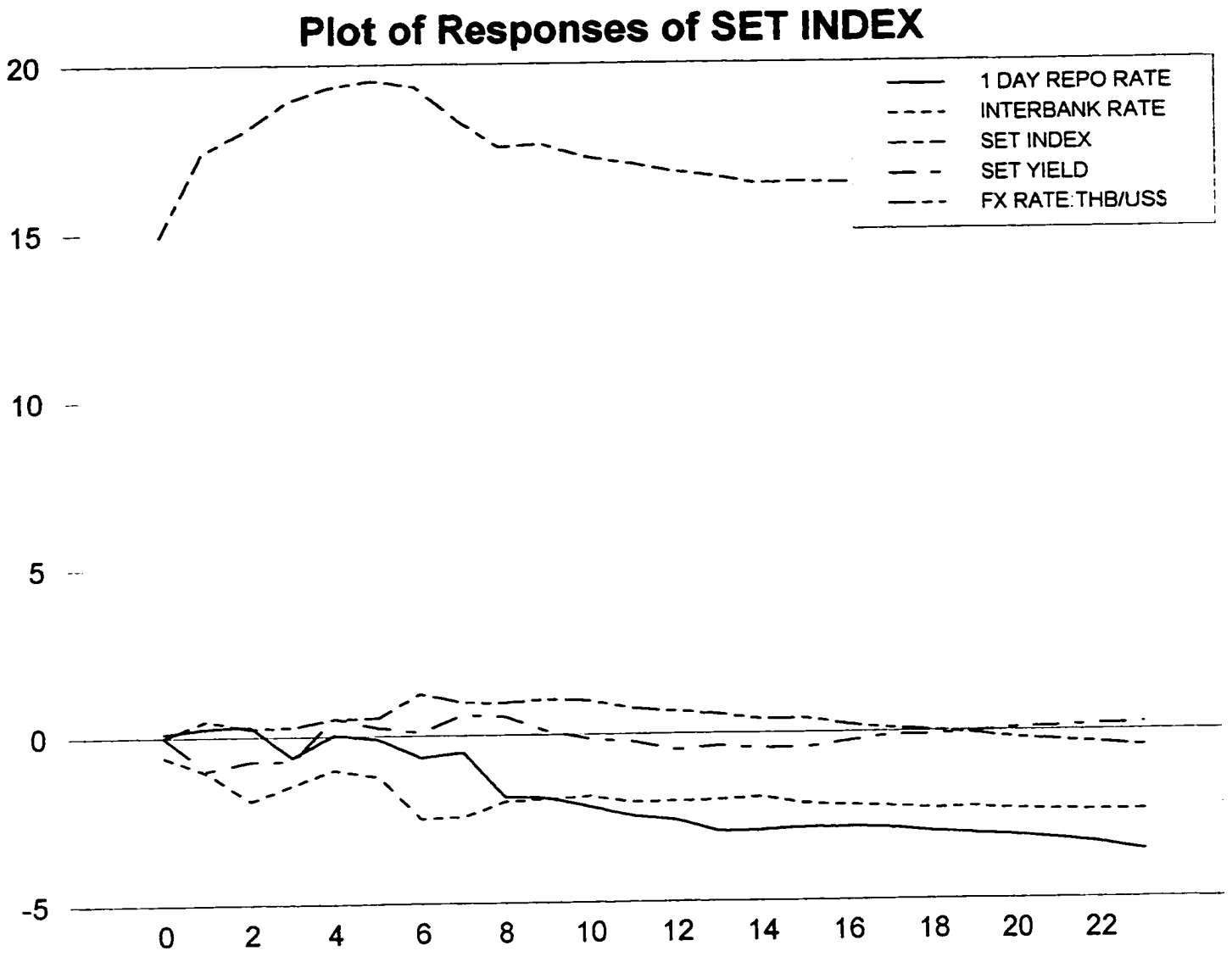

Figure 13: Plot of Responses of SET Index

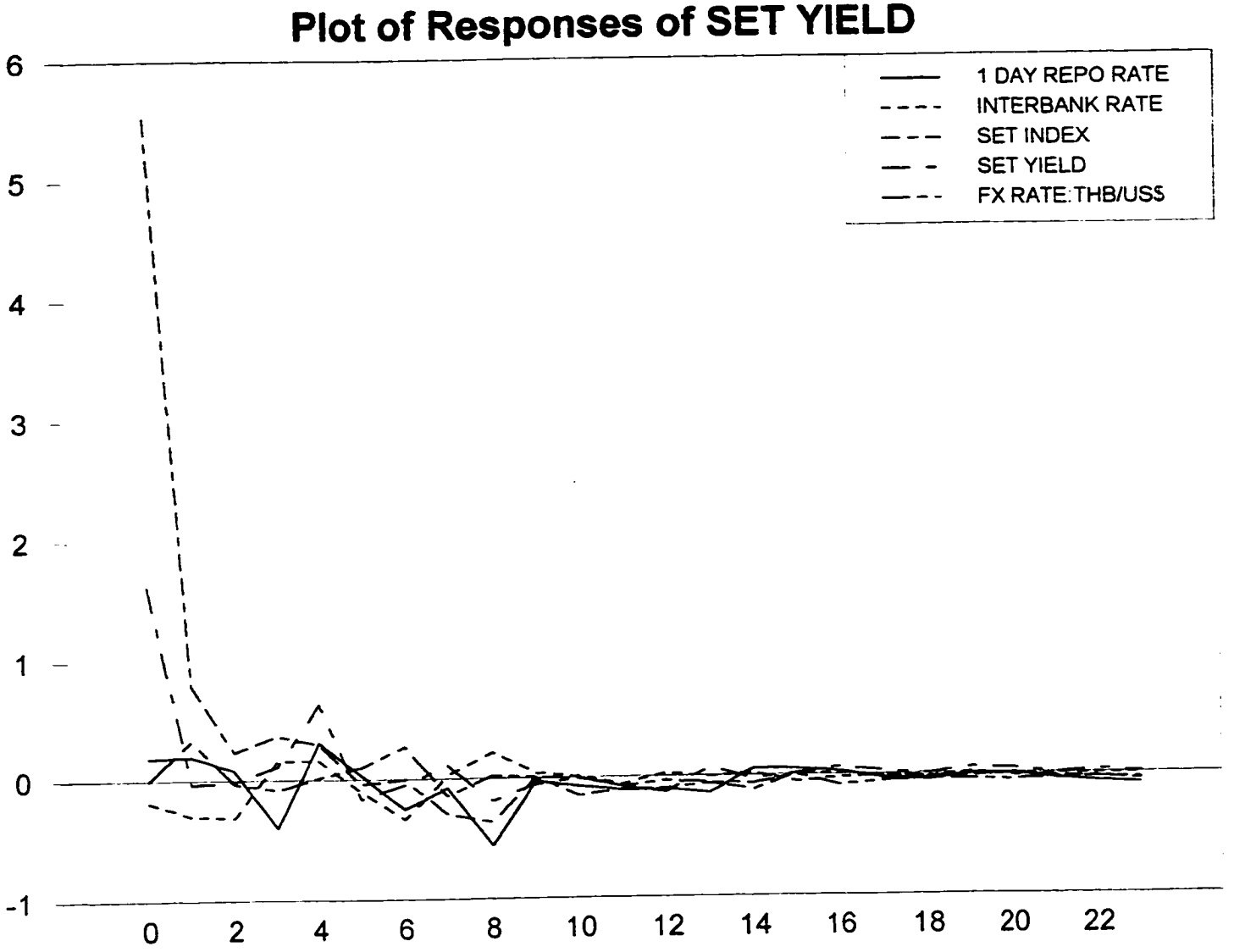

Figure 14: Plot of Responses of SET Yield

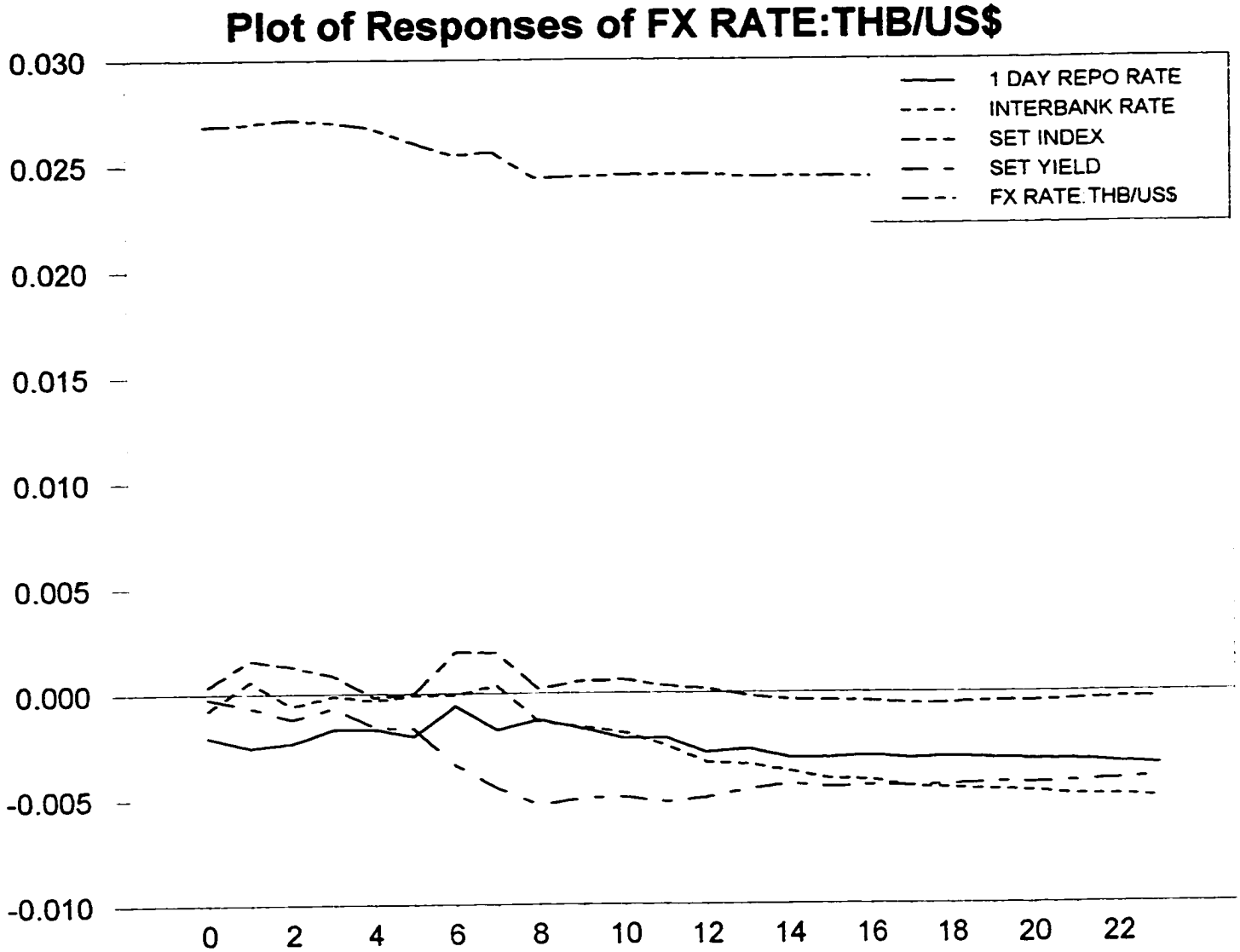

Figure 15: Plot of Responses of FX-THB/US$ Rate

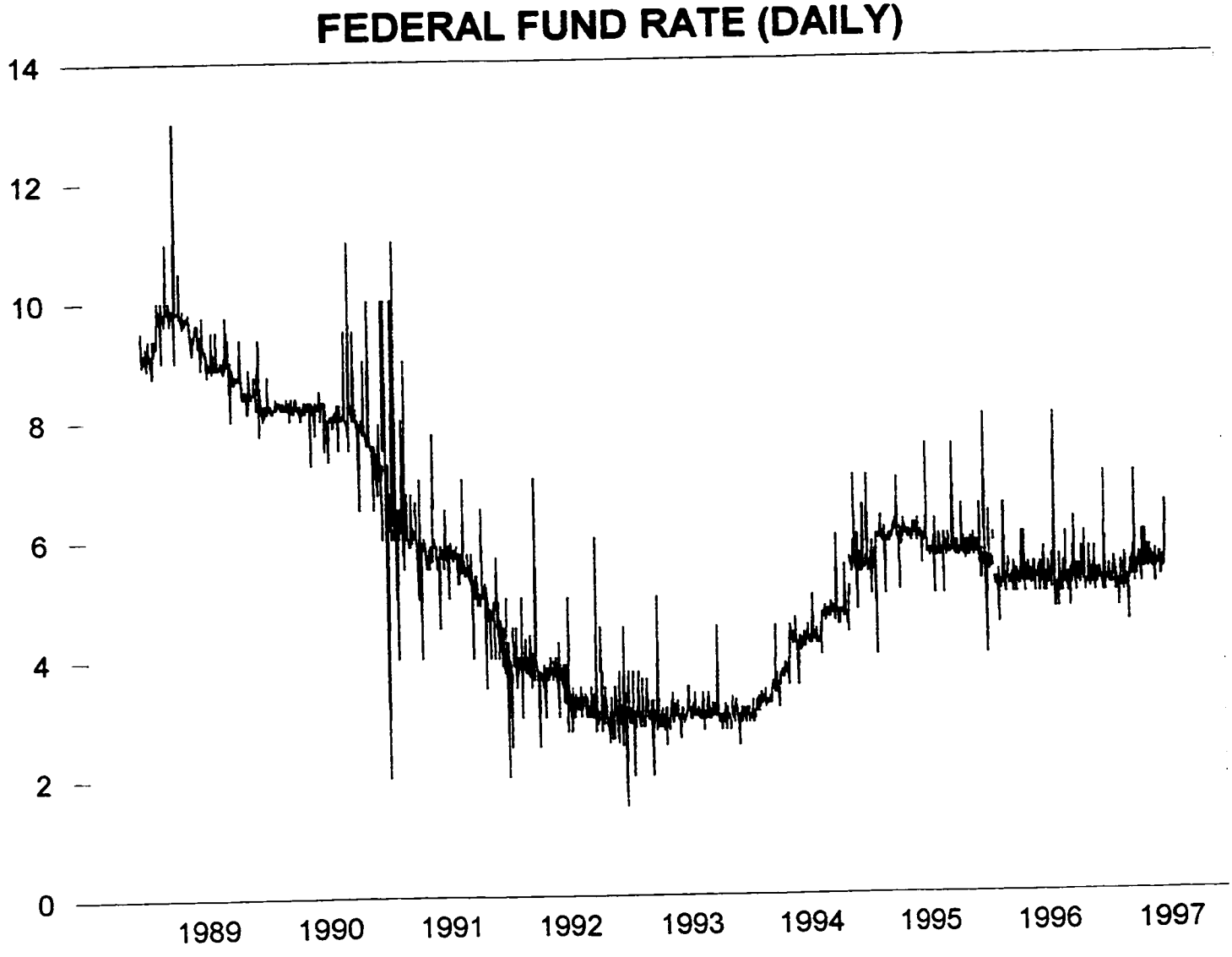

Figure 16: Federal Fund Rate (Daily)

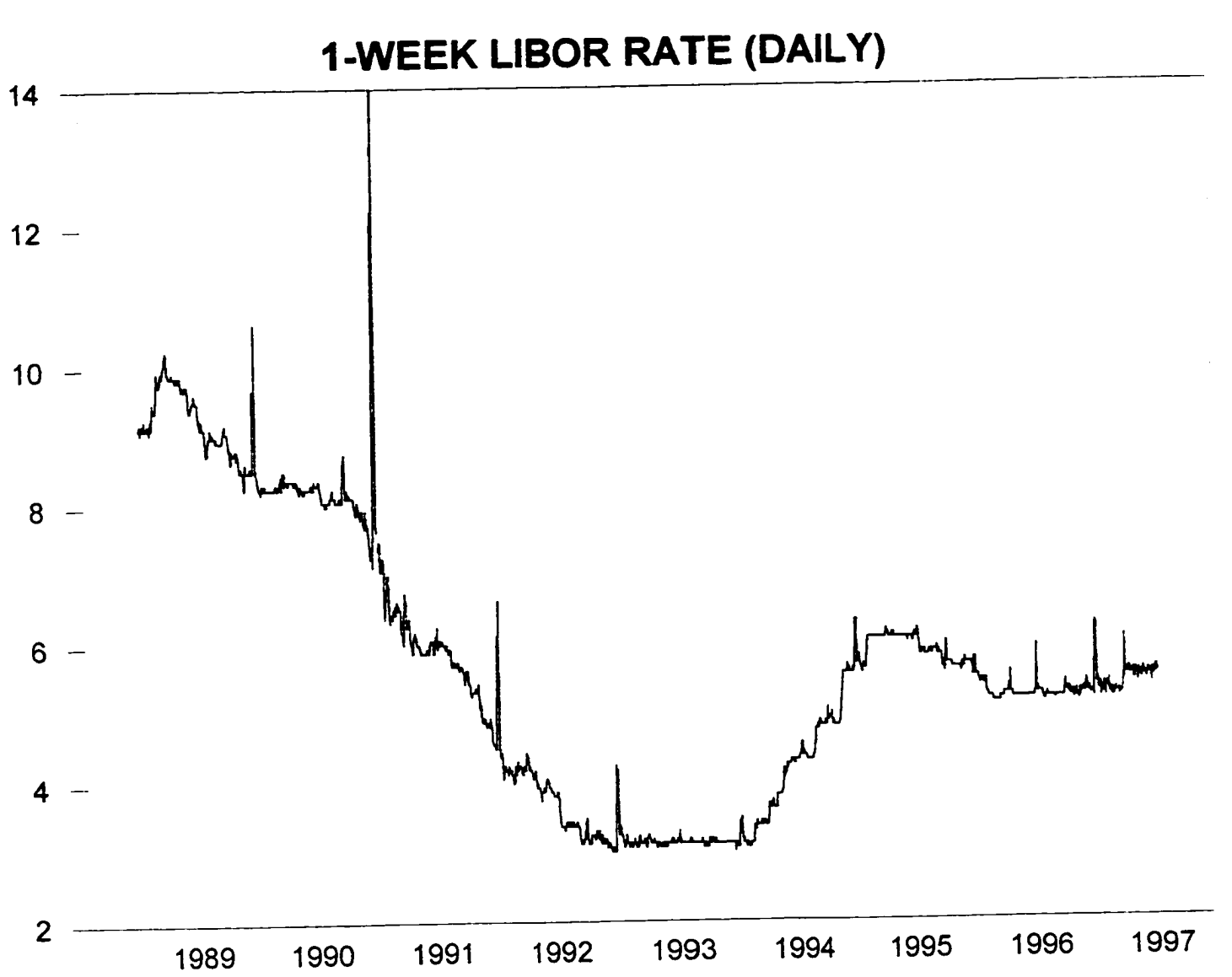

Figure 17: 1-Week LIBOR Rate (Daily)

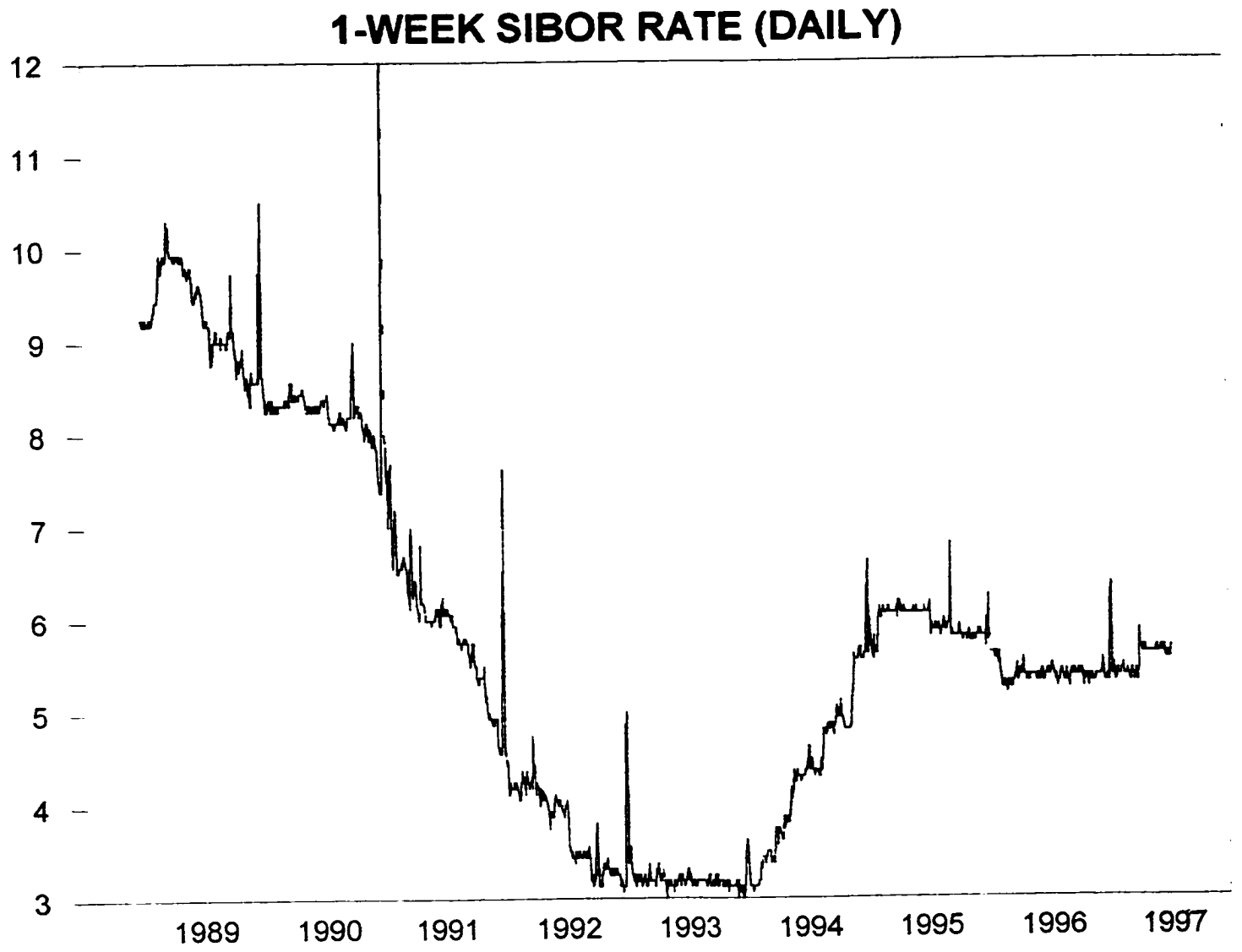

Figure 18: 1-Week SIBOR Rate (Daily)

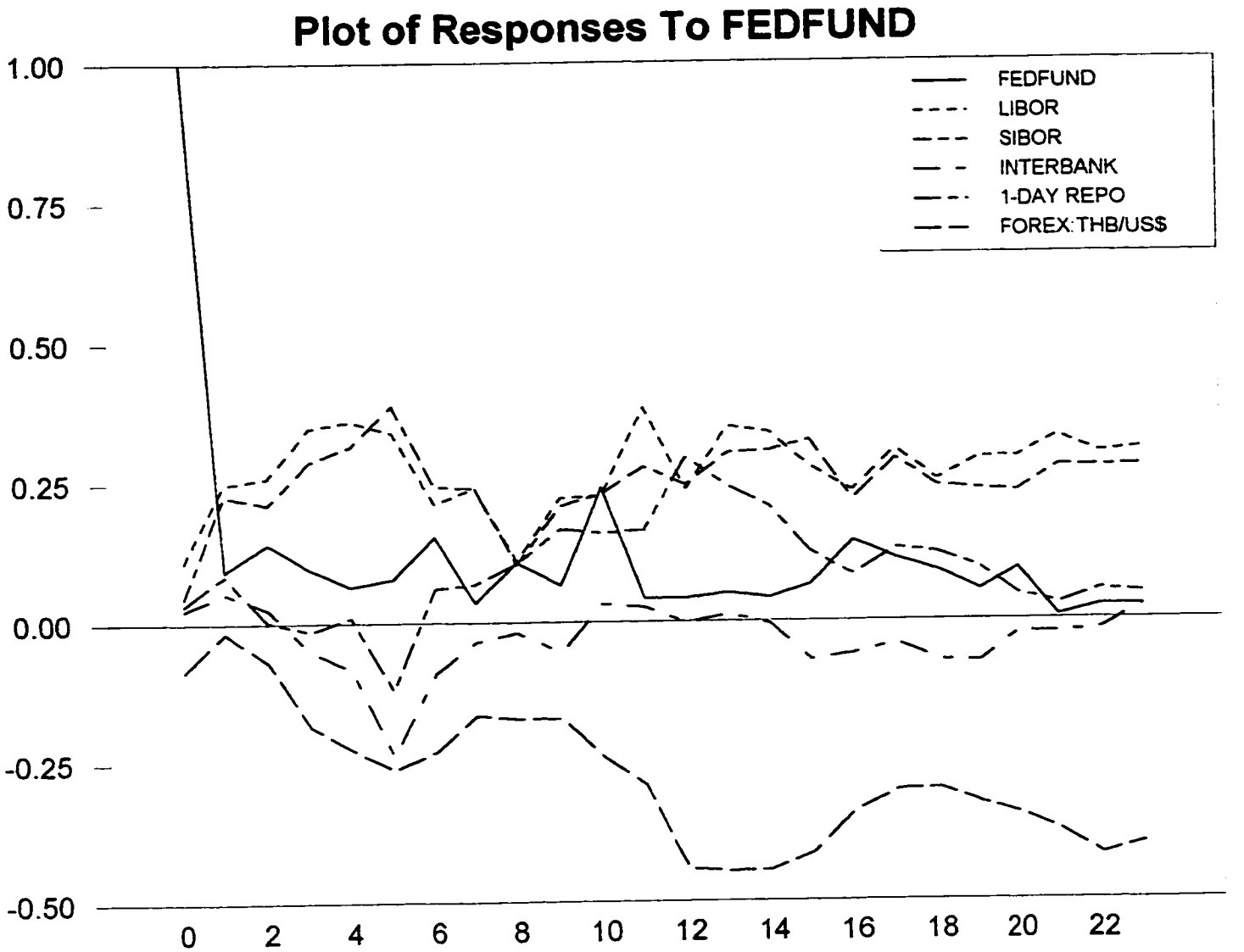

Figure 19:Plot of Responses to Federal Fund Rate

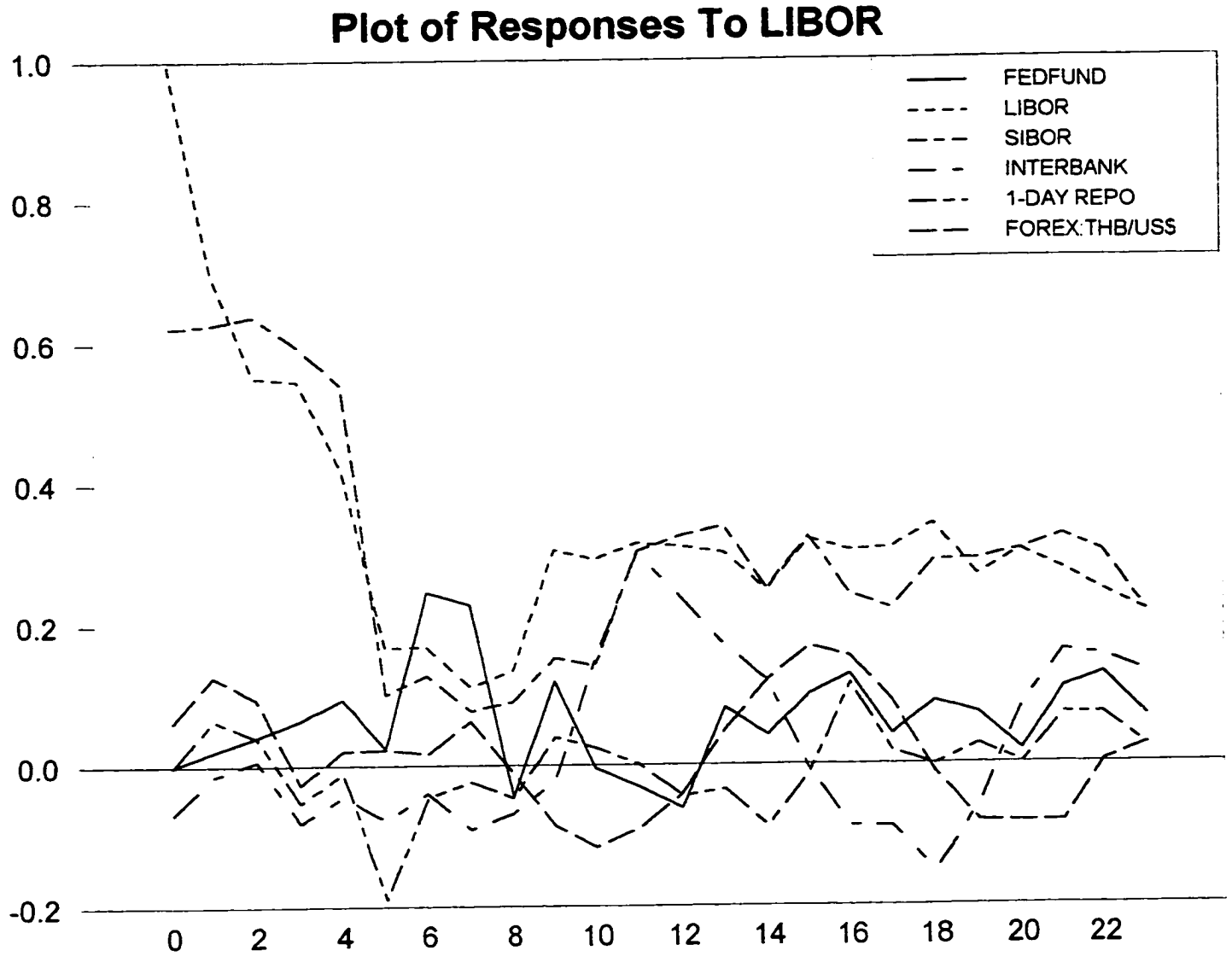

Figure 20: Plot of Responses to LIBOR

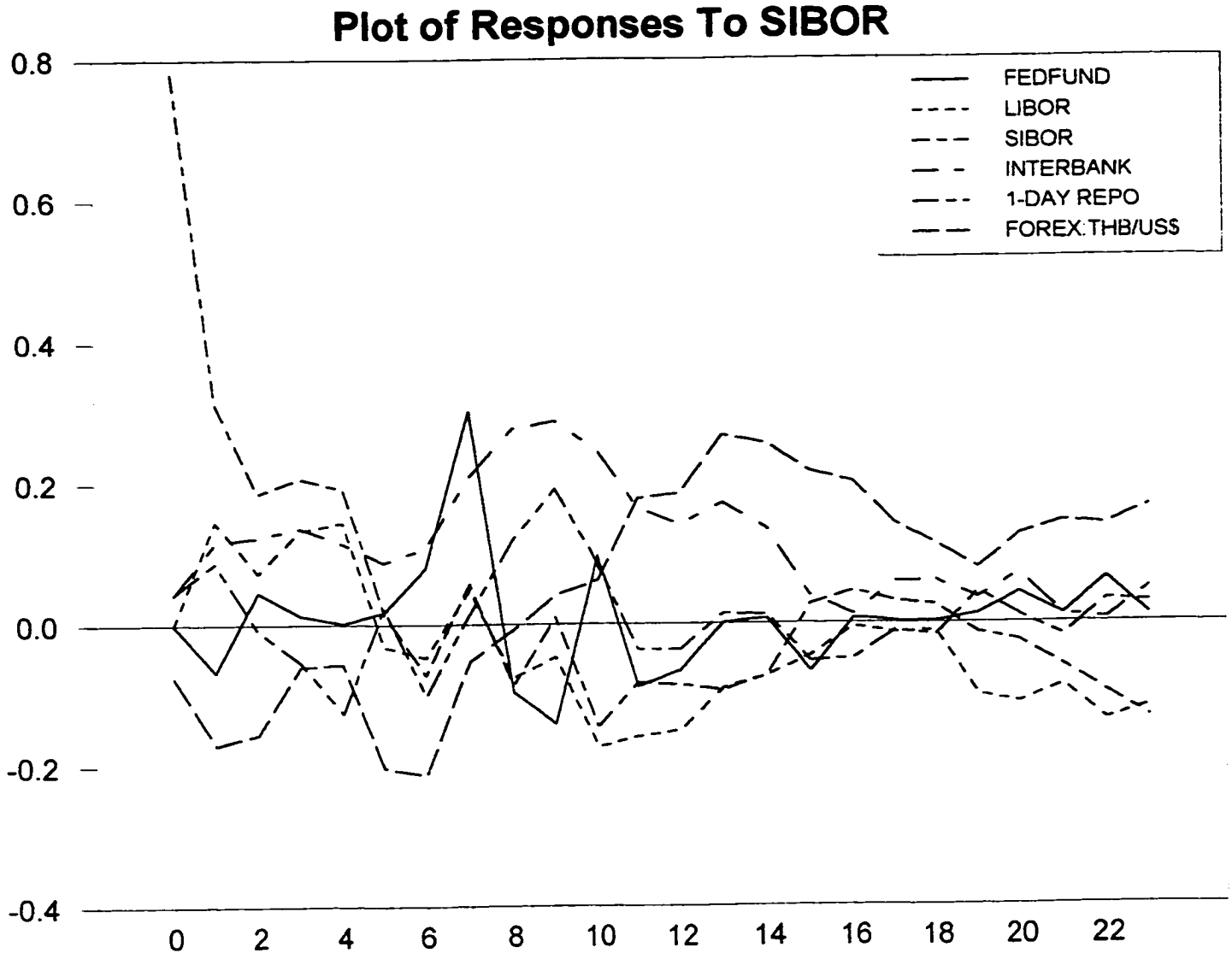

Figure 21: Plot of Responses to SIBOR

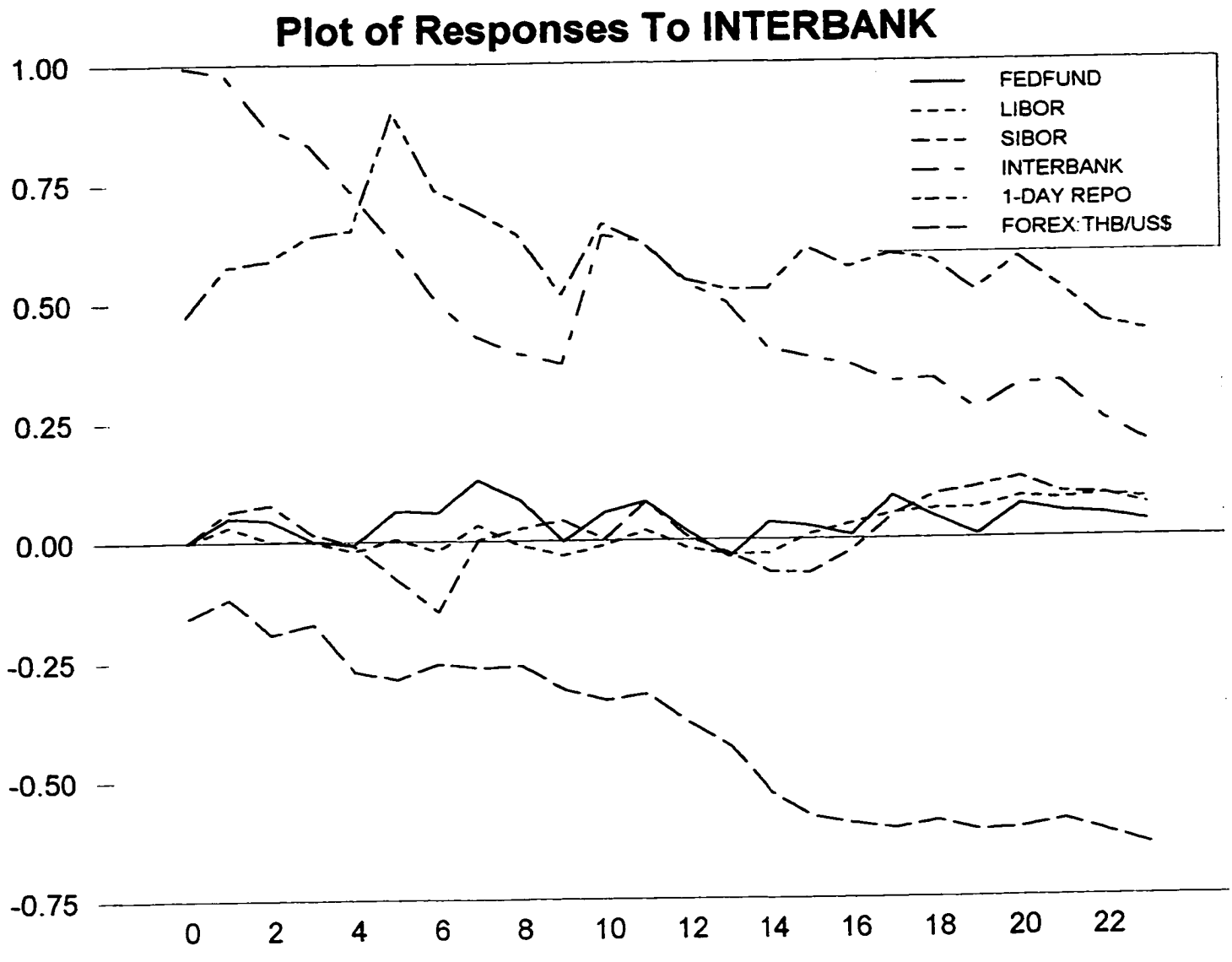

Figure 22: Plot of Responses to Interbank

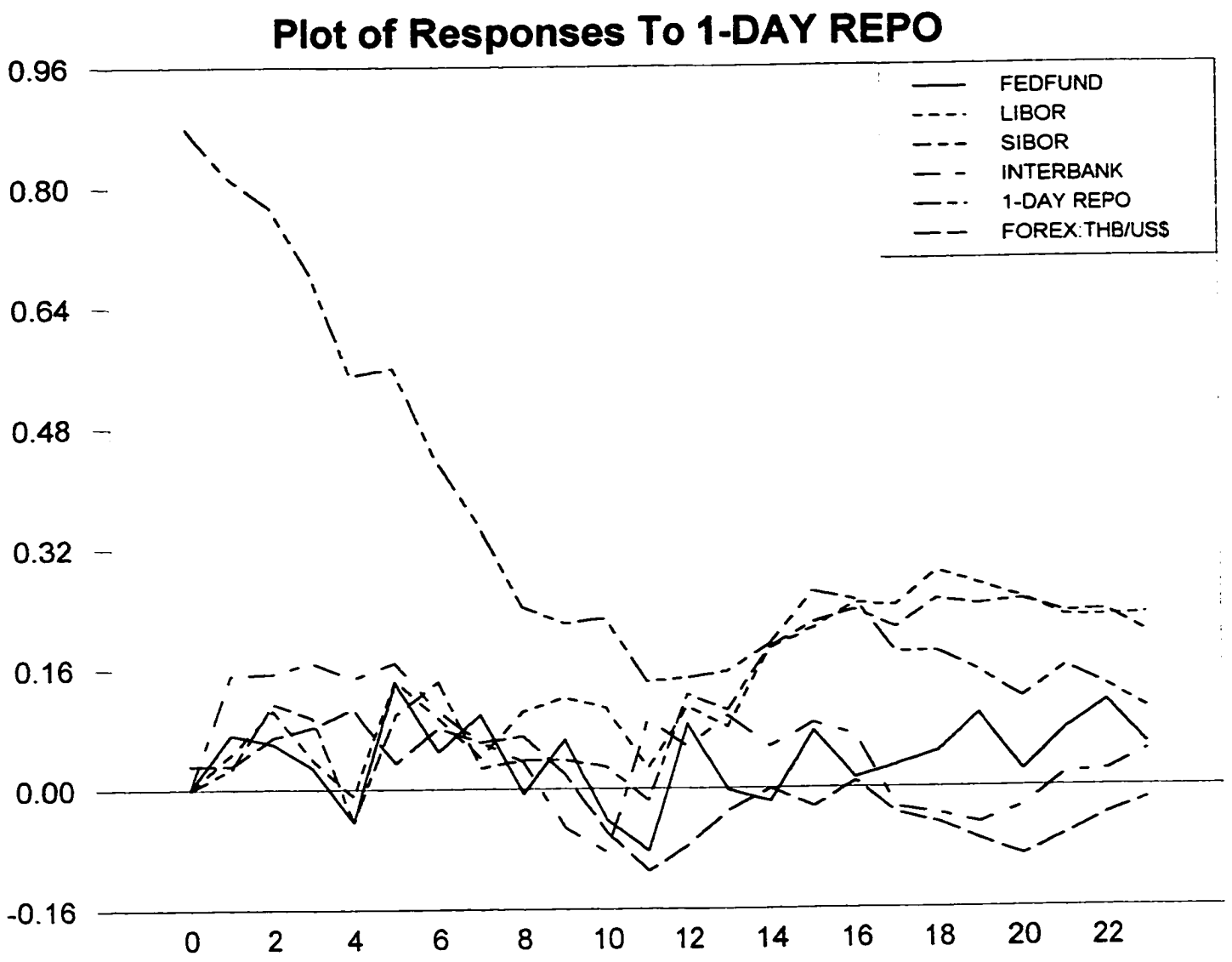

Figure 23: Plot of Responses to 1-Day Repo Rate

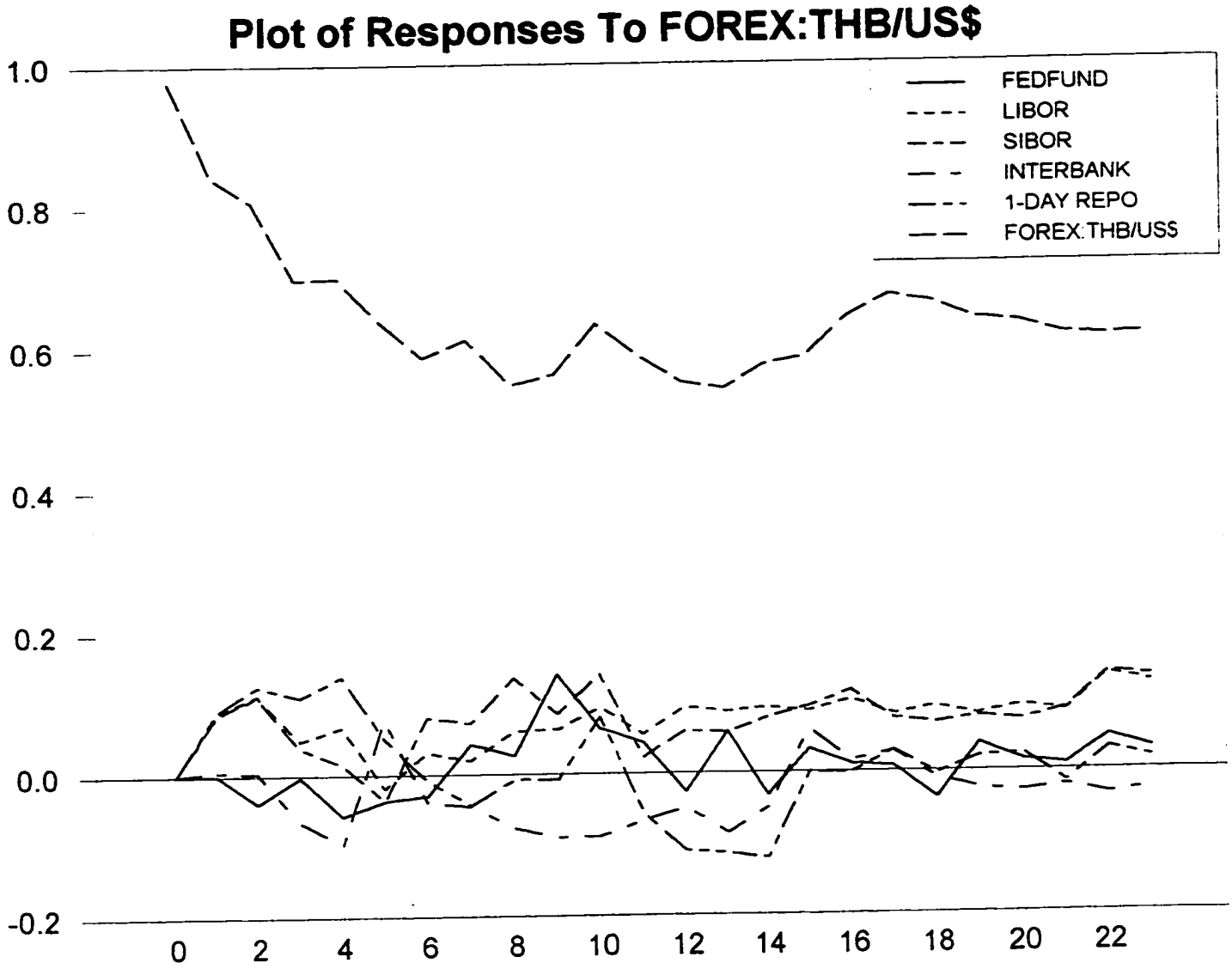

Figure 24: Plot of Responses to FX-THB/US$ Rate

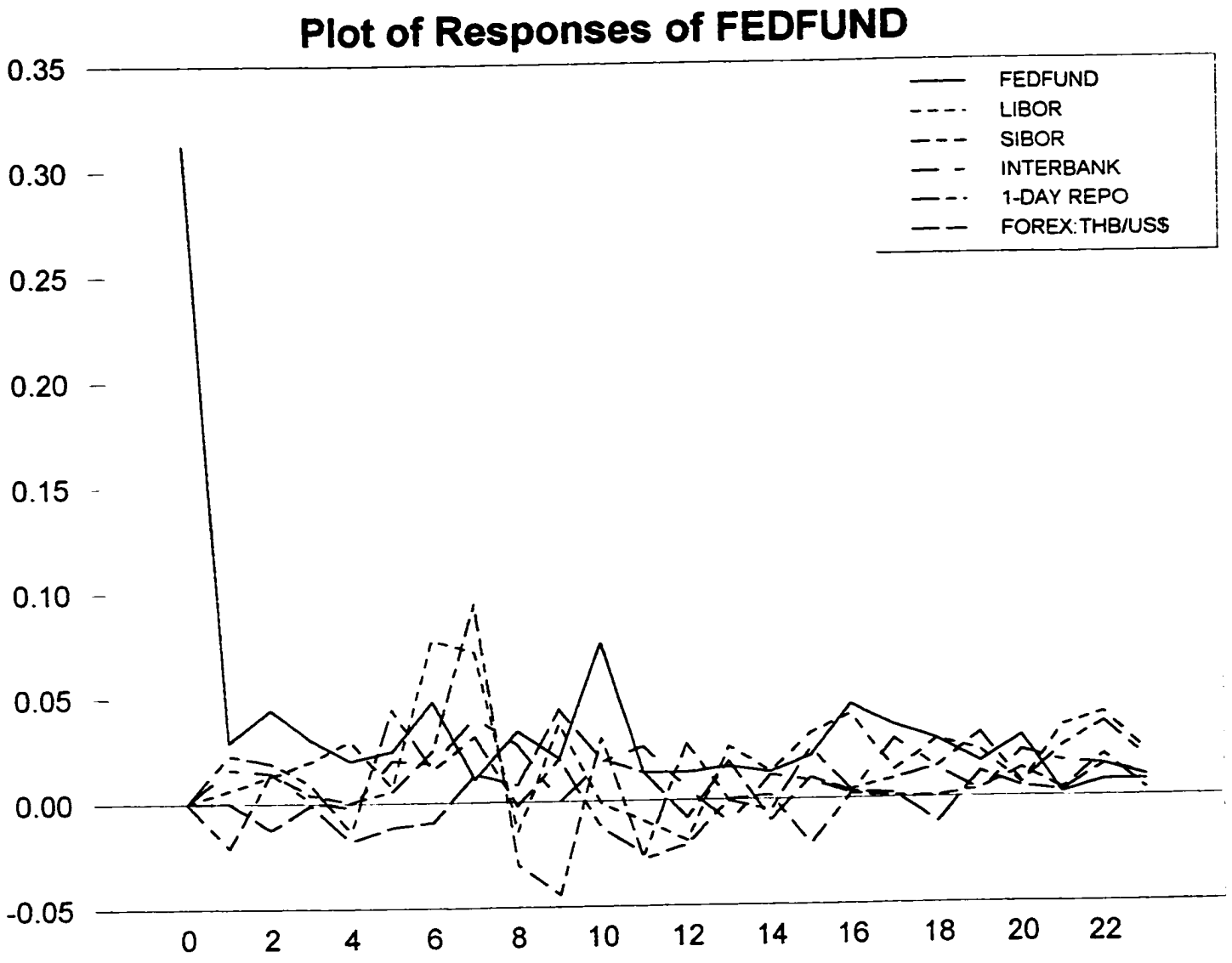

Figure 25: Plot of Responses of Federal Fund Rate

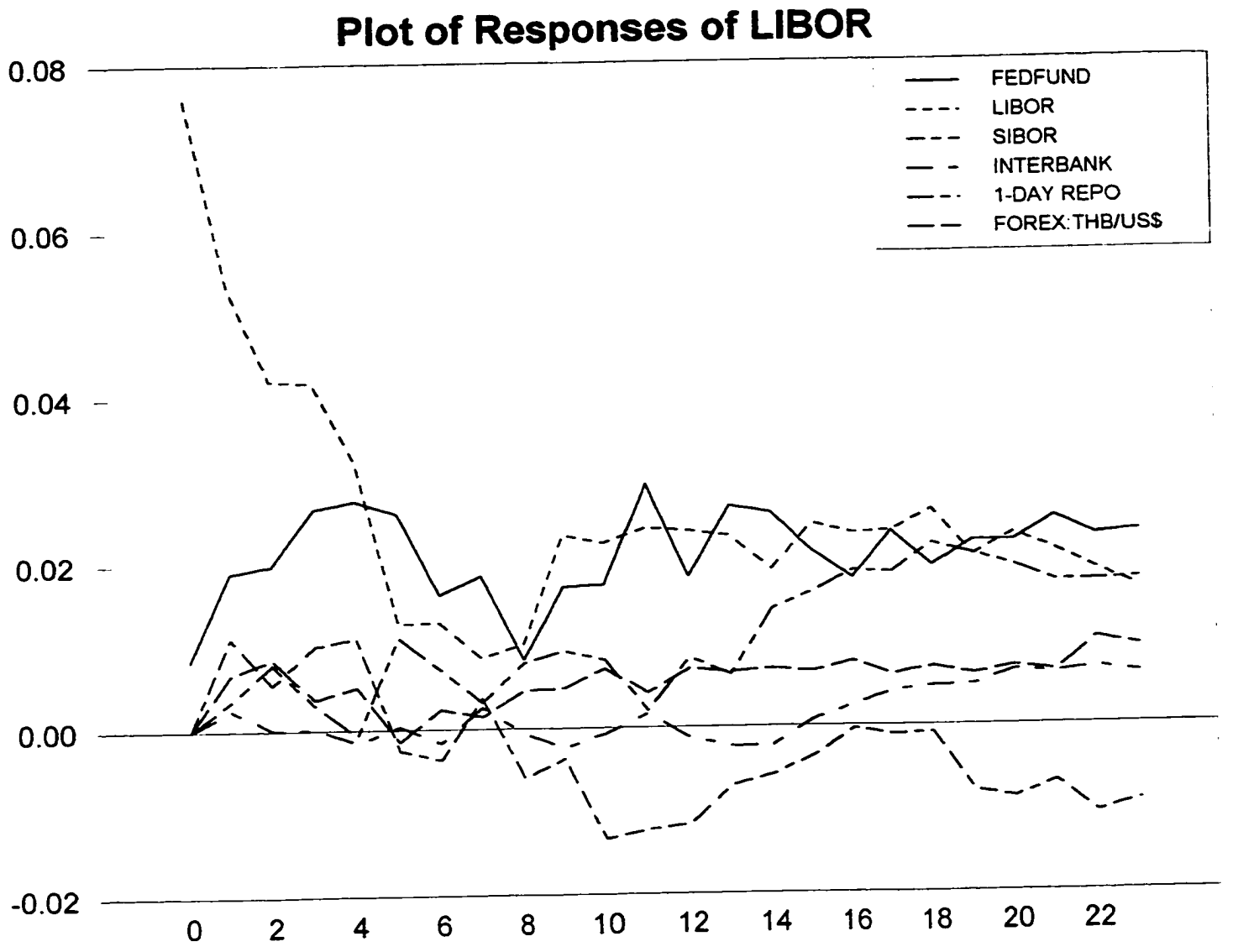

Figure 26: Plot of Responses of LIBOR

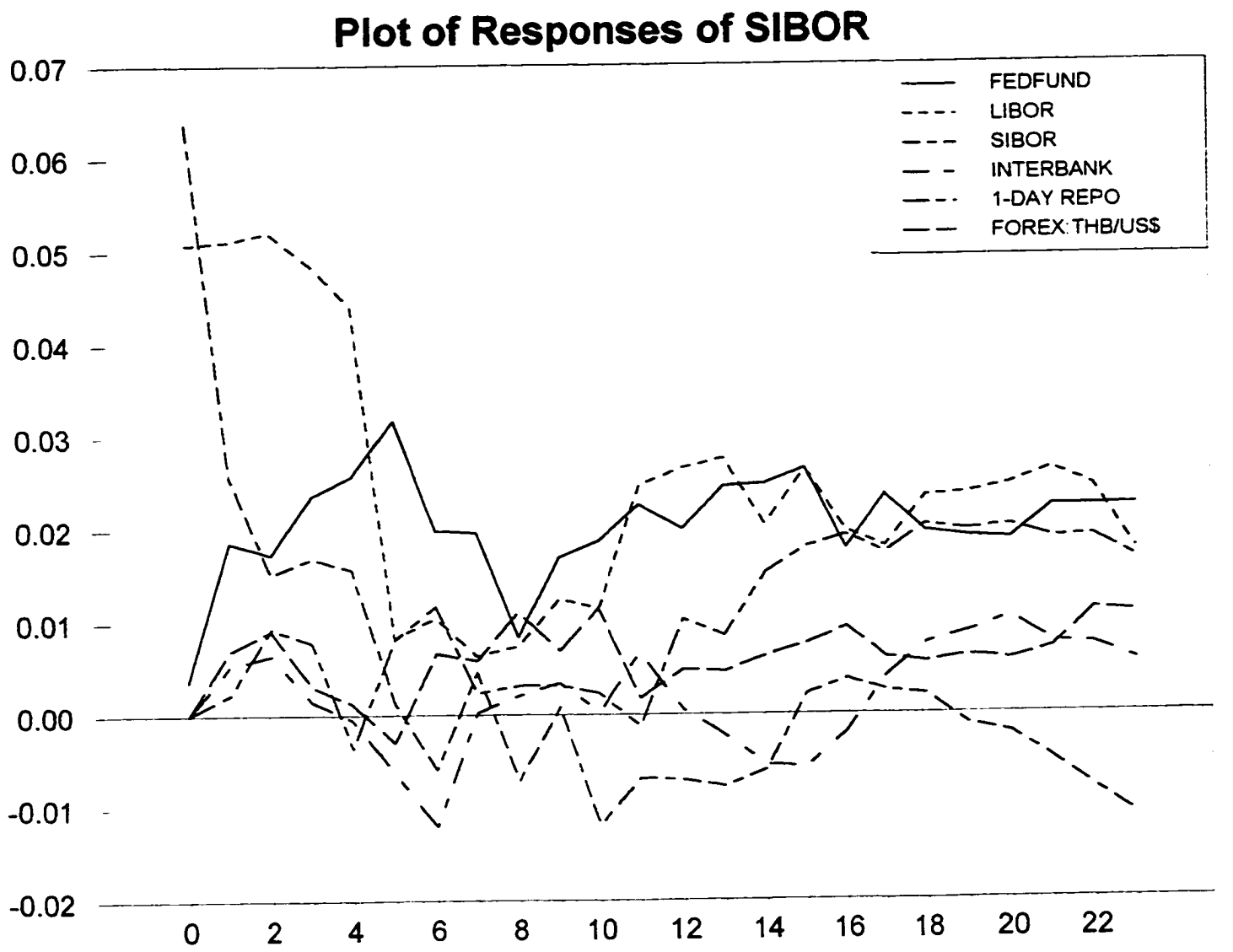

Figure 27: Plot of Responses of SIBOR

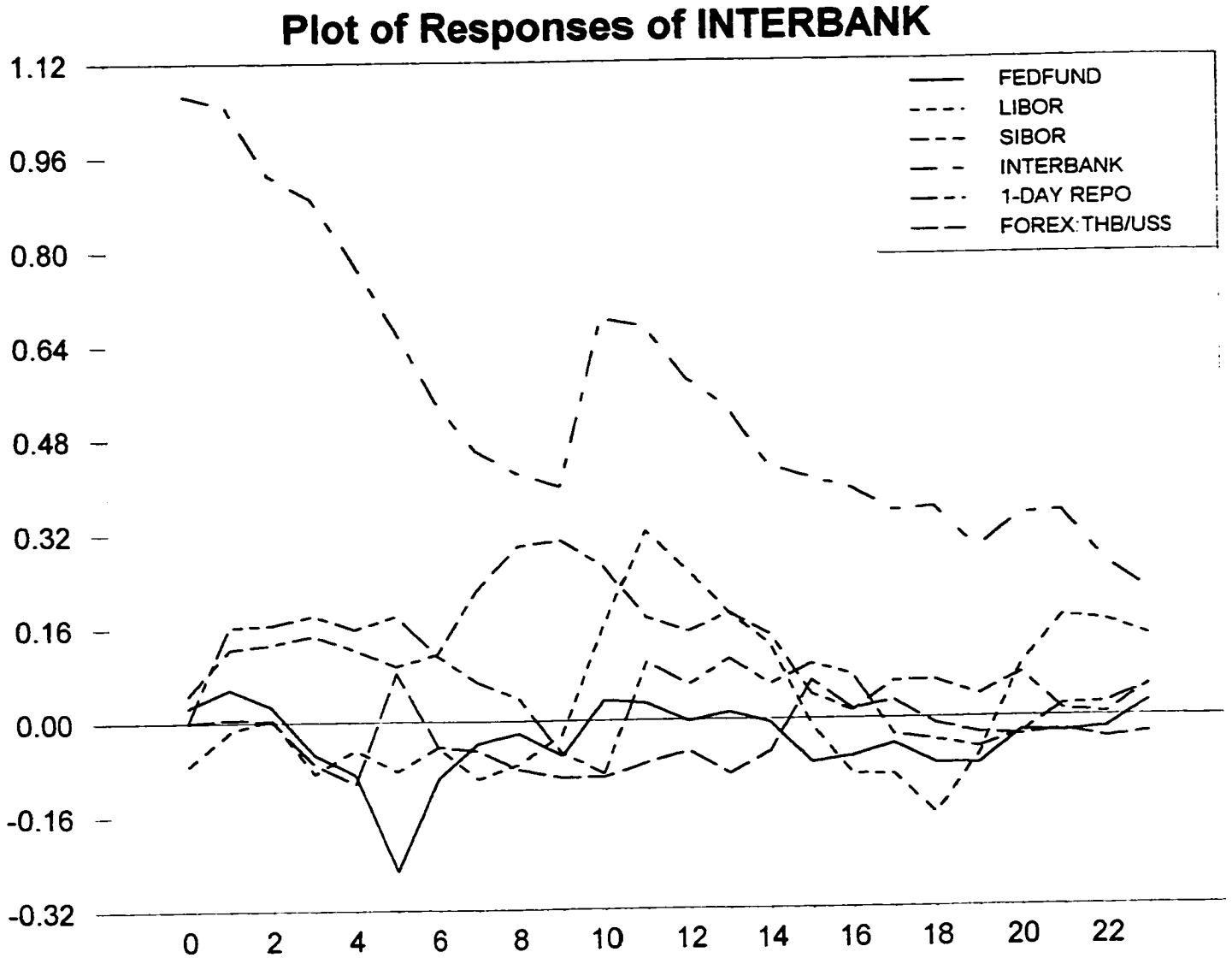

Figure 28: Plot of Responses of Interbank

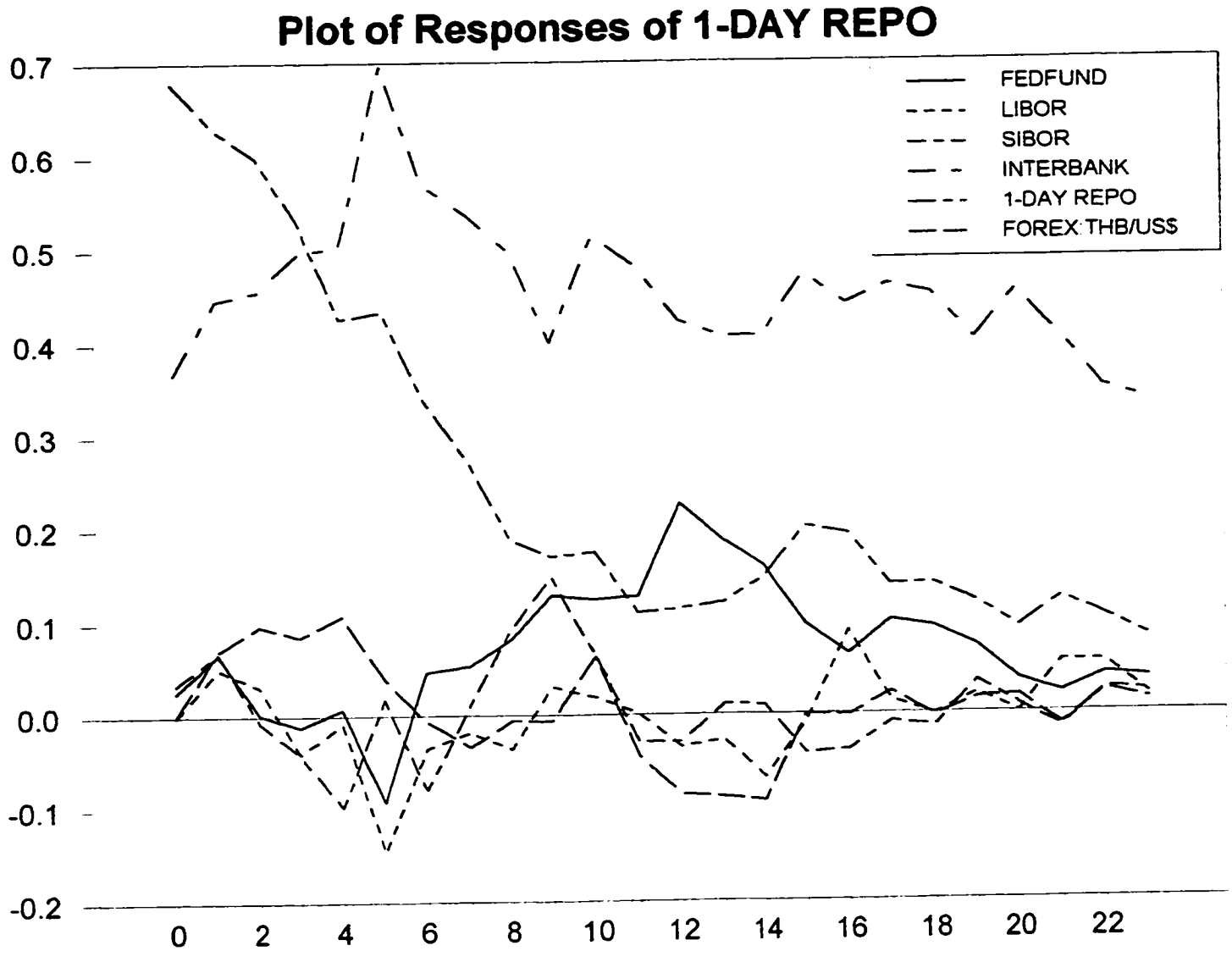

Figure 29: Plot of Responses of 1-Day Repo Rate

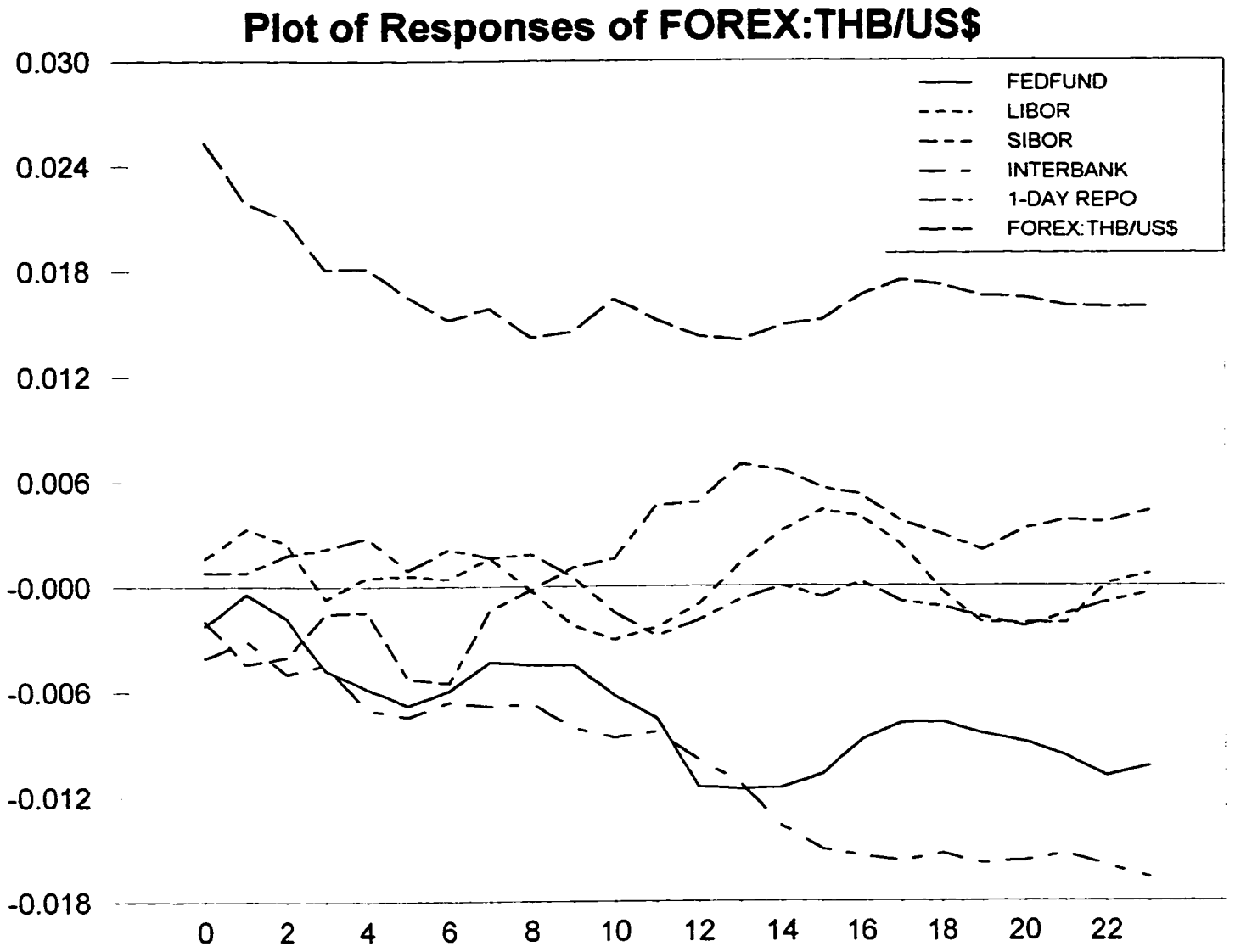

Figure 30: Plot of Responses of FX-THB/US$ Rate

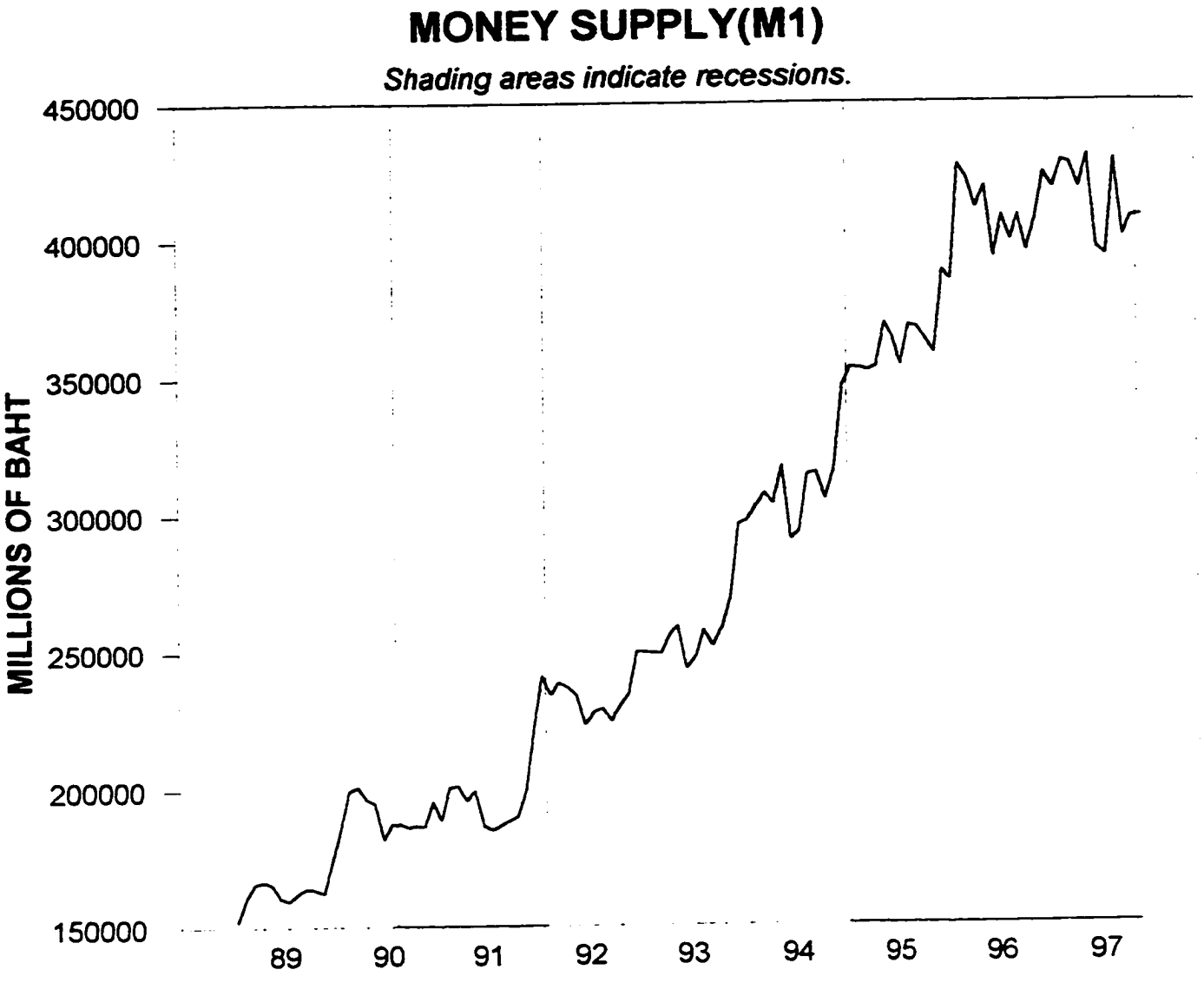

Figure 31: M1 and Business Cycles

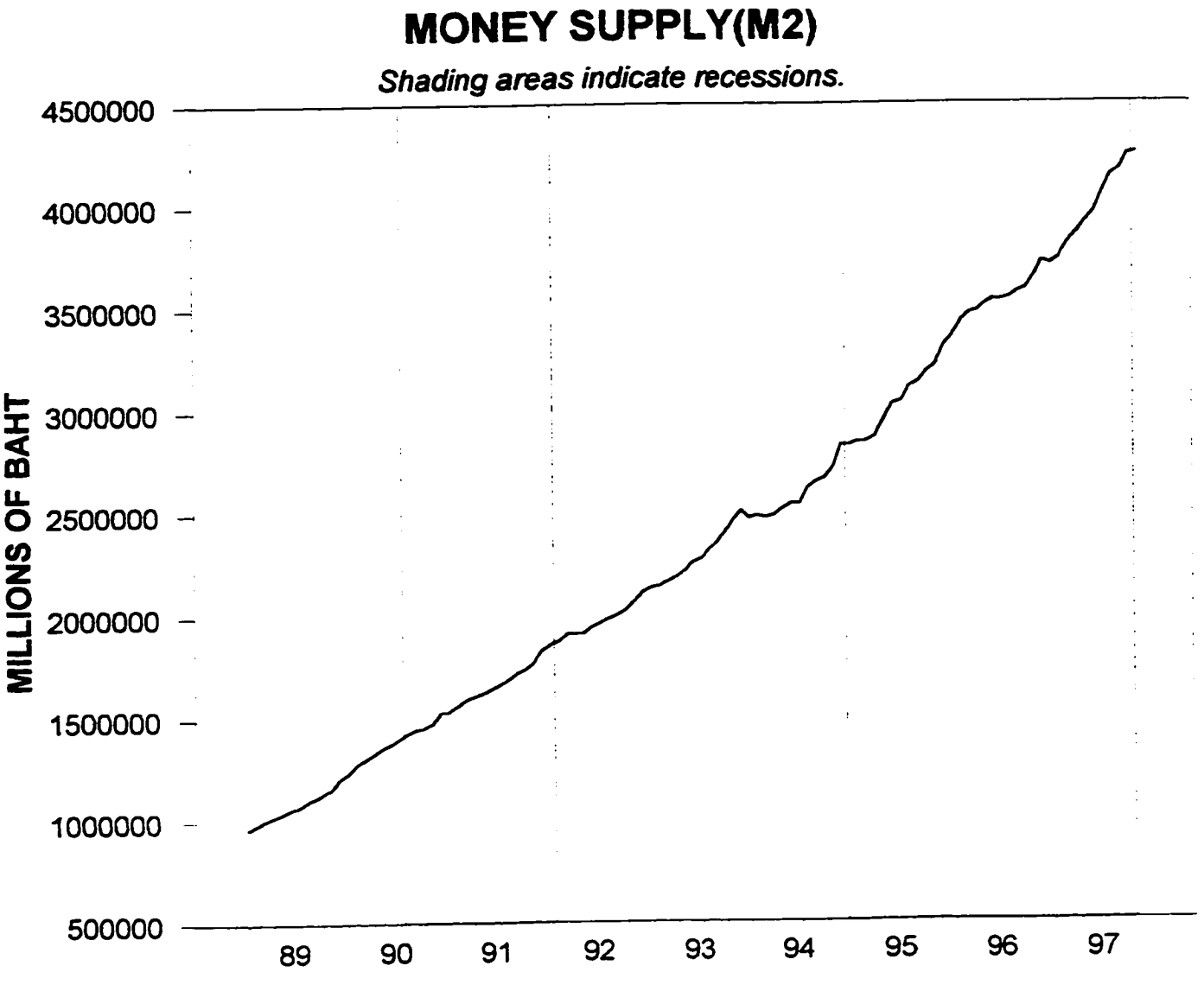

Figure 32: M2 and Business Cycles

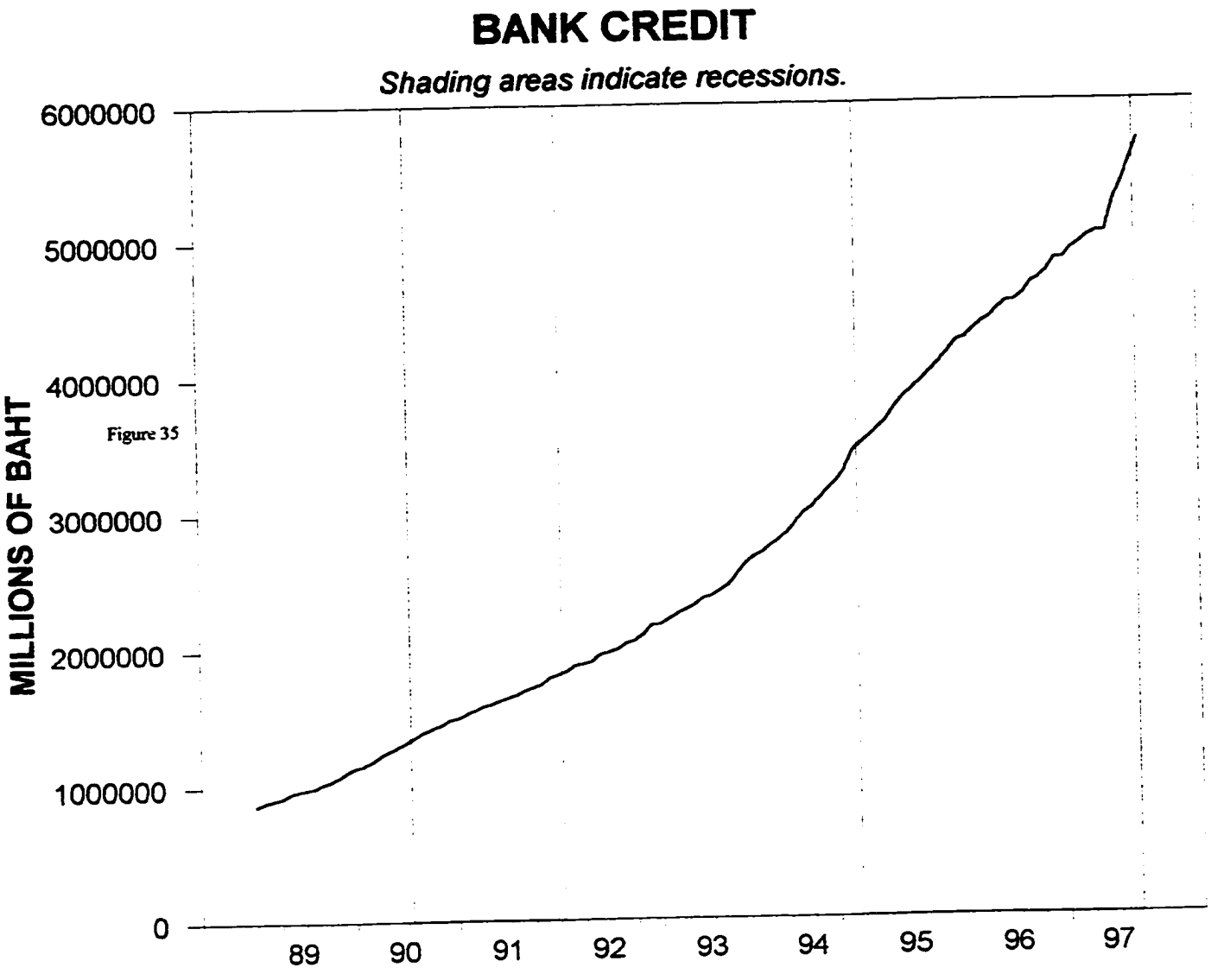

Figure 33: Bank Credit and Business Cycles

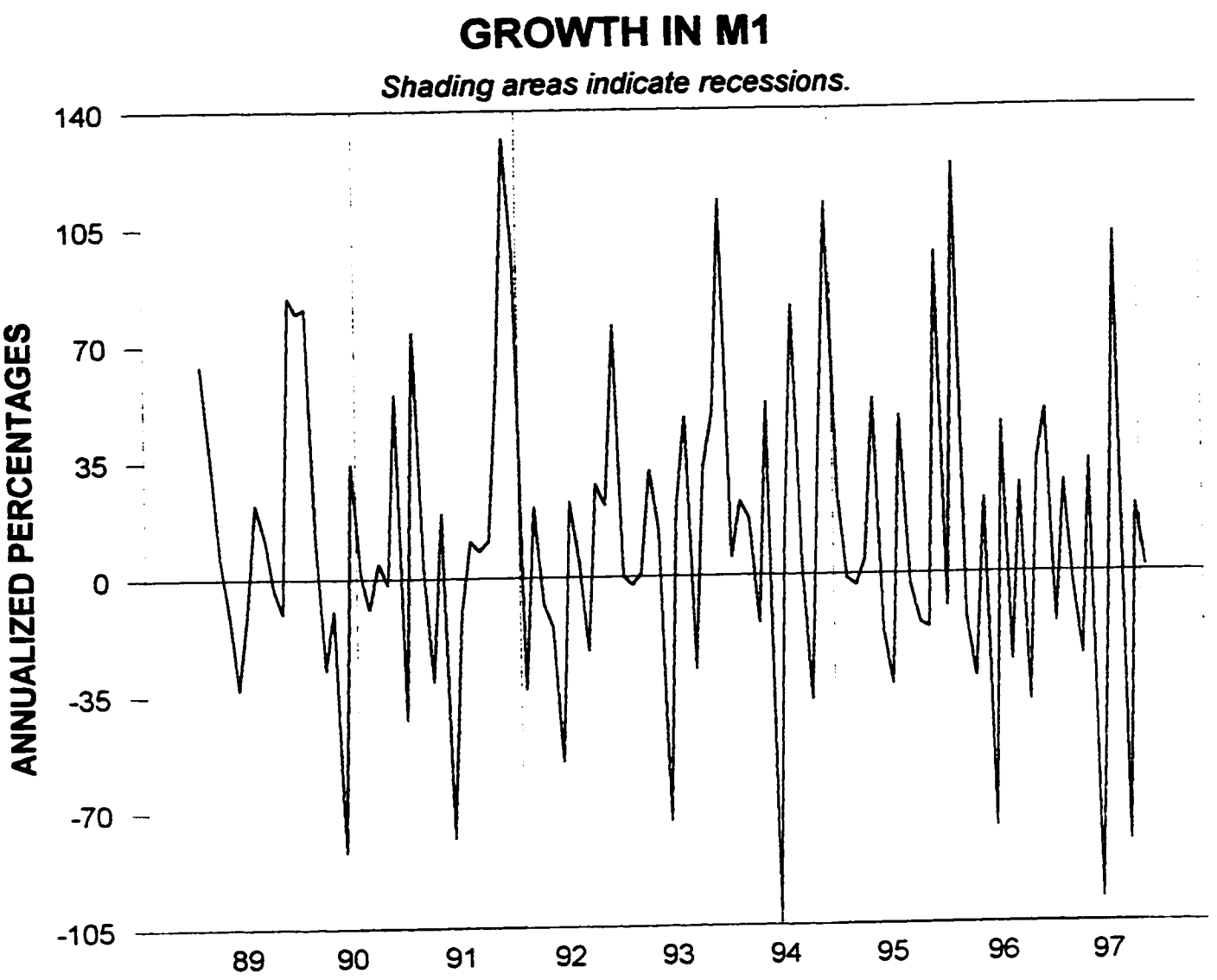

Figure 34: Growth in M1 and Business Cycles

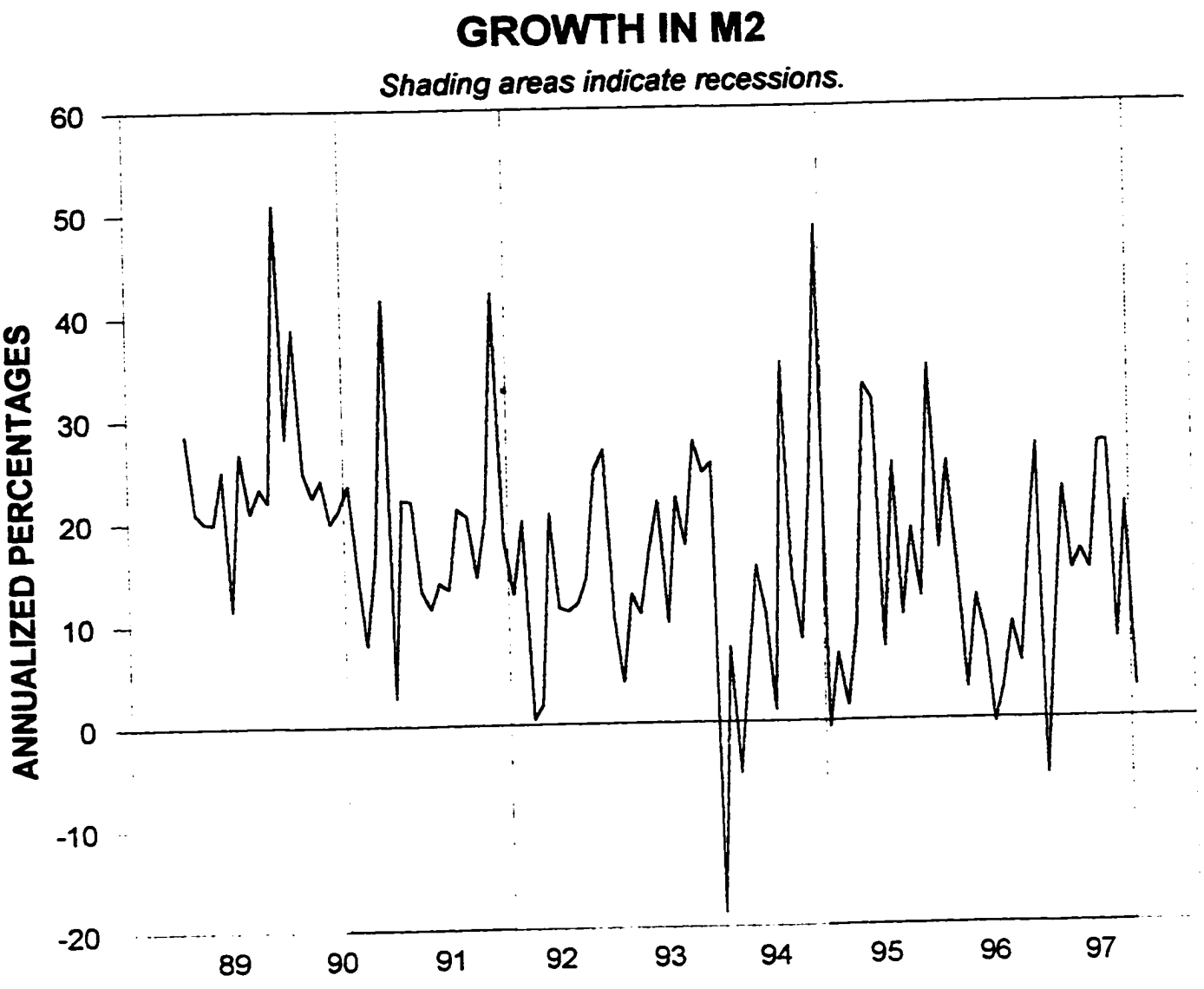

Figure 35: Growth in M2 and Business Cycles

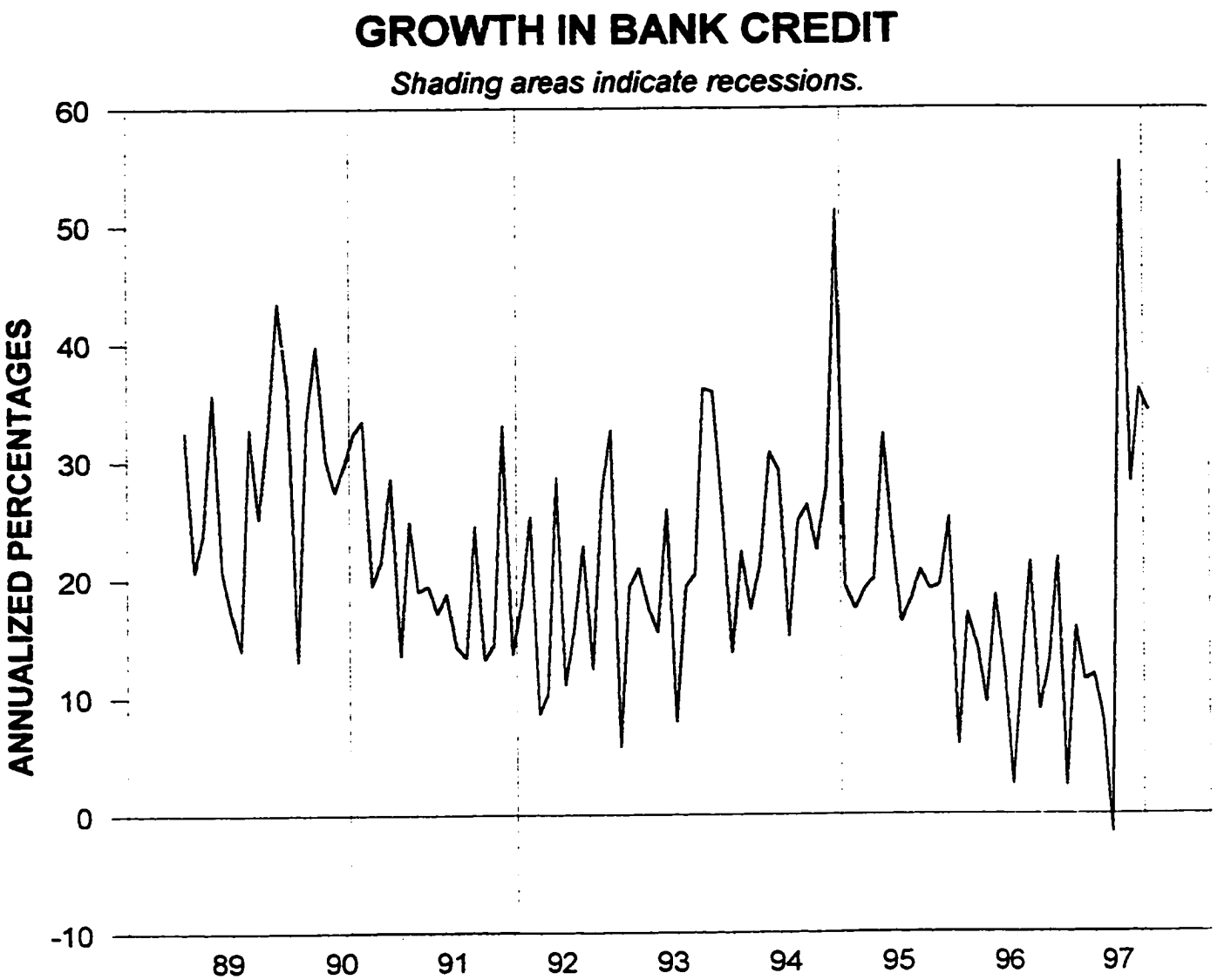

Figure 36: Growth in Bank Credit and Business Cycles

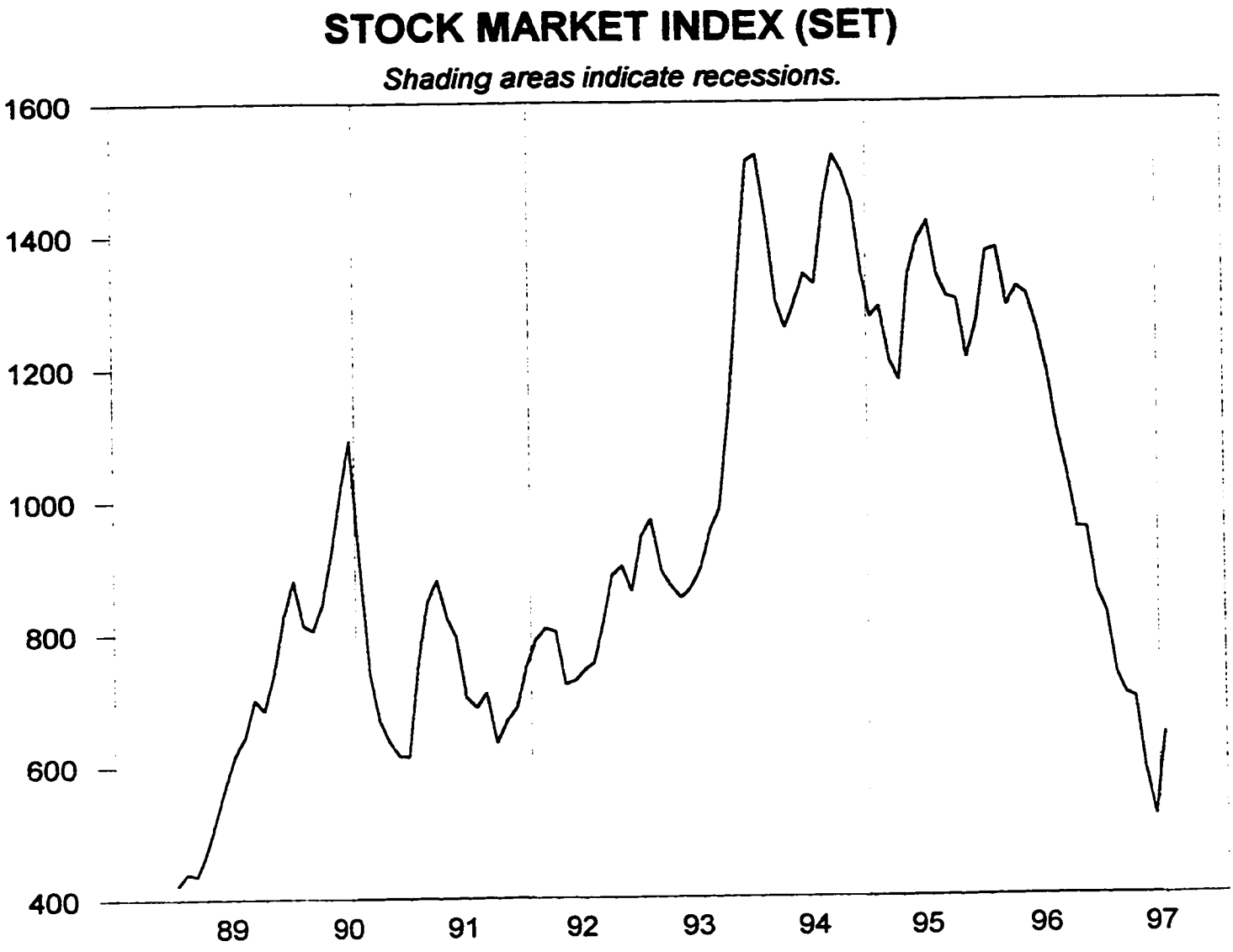

Figure 37: Stock Market Index (SET) and Business Cycles

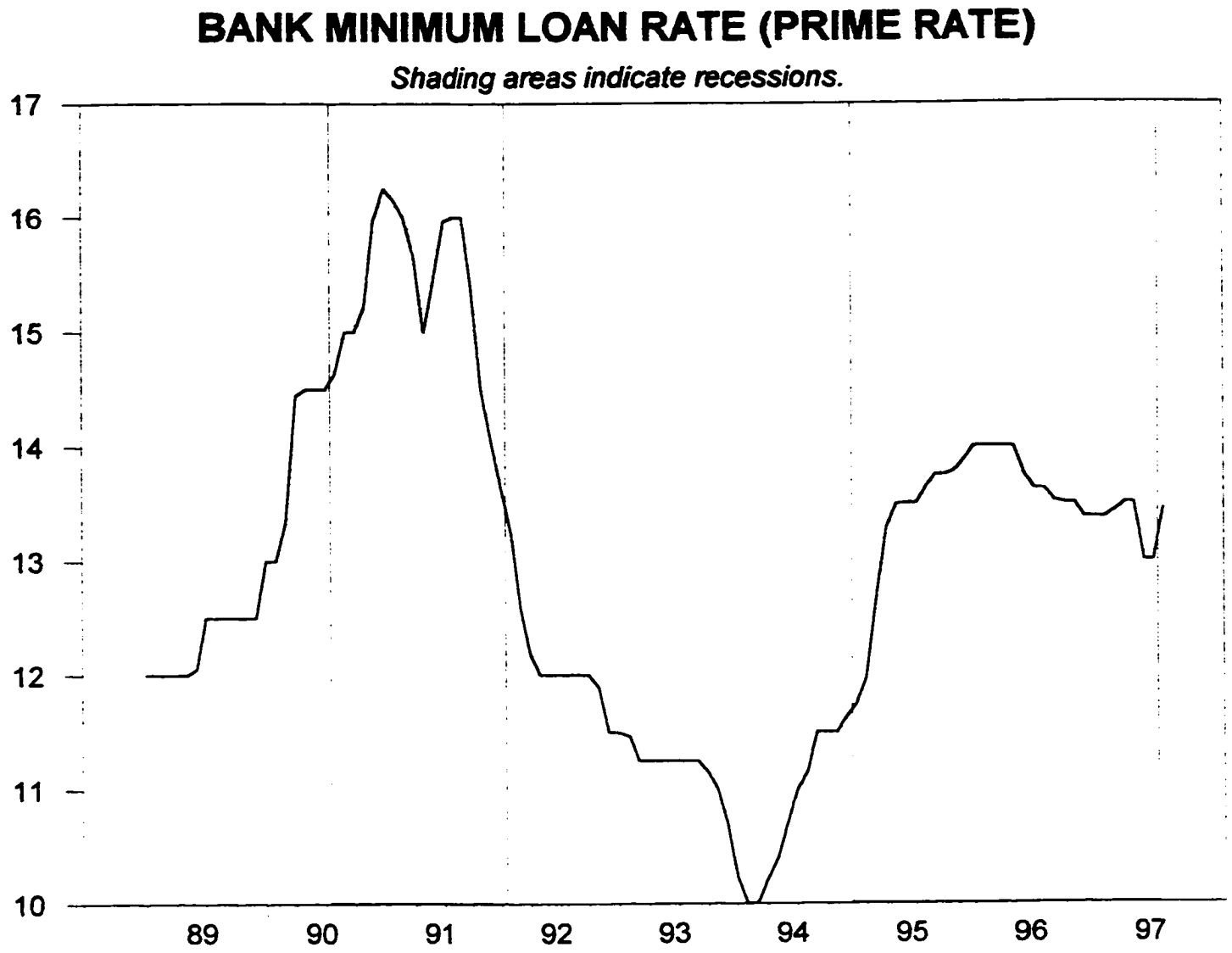

Figure 38: Minimum Loan Rate (Prime Rate) and Business Cycles

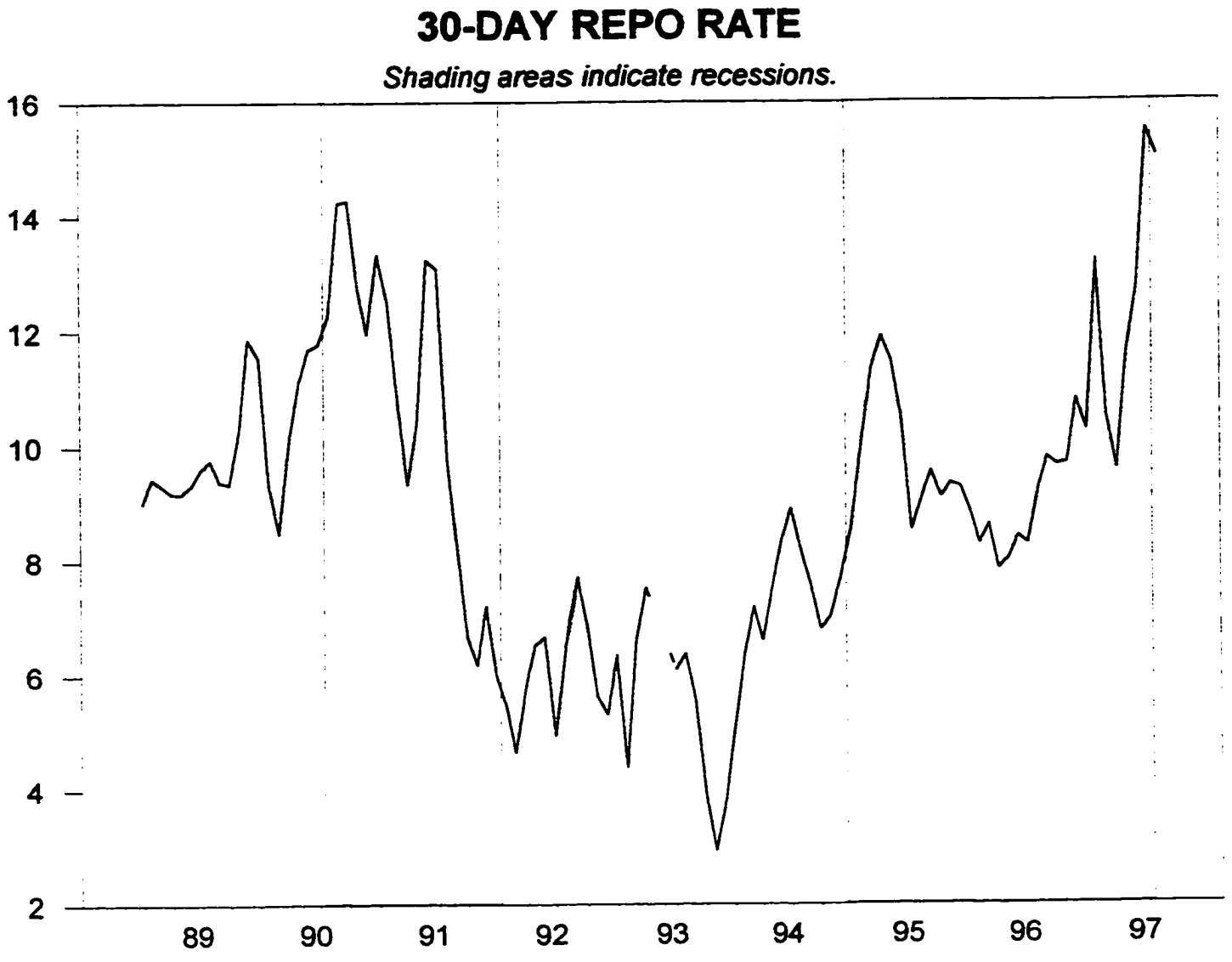

Figure 39: 30-Day Repo Rate and Business Cycles

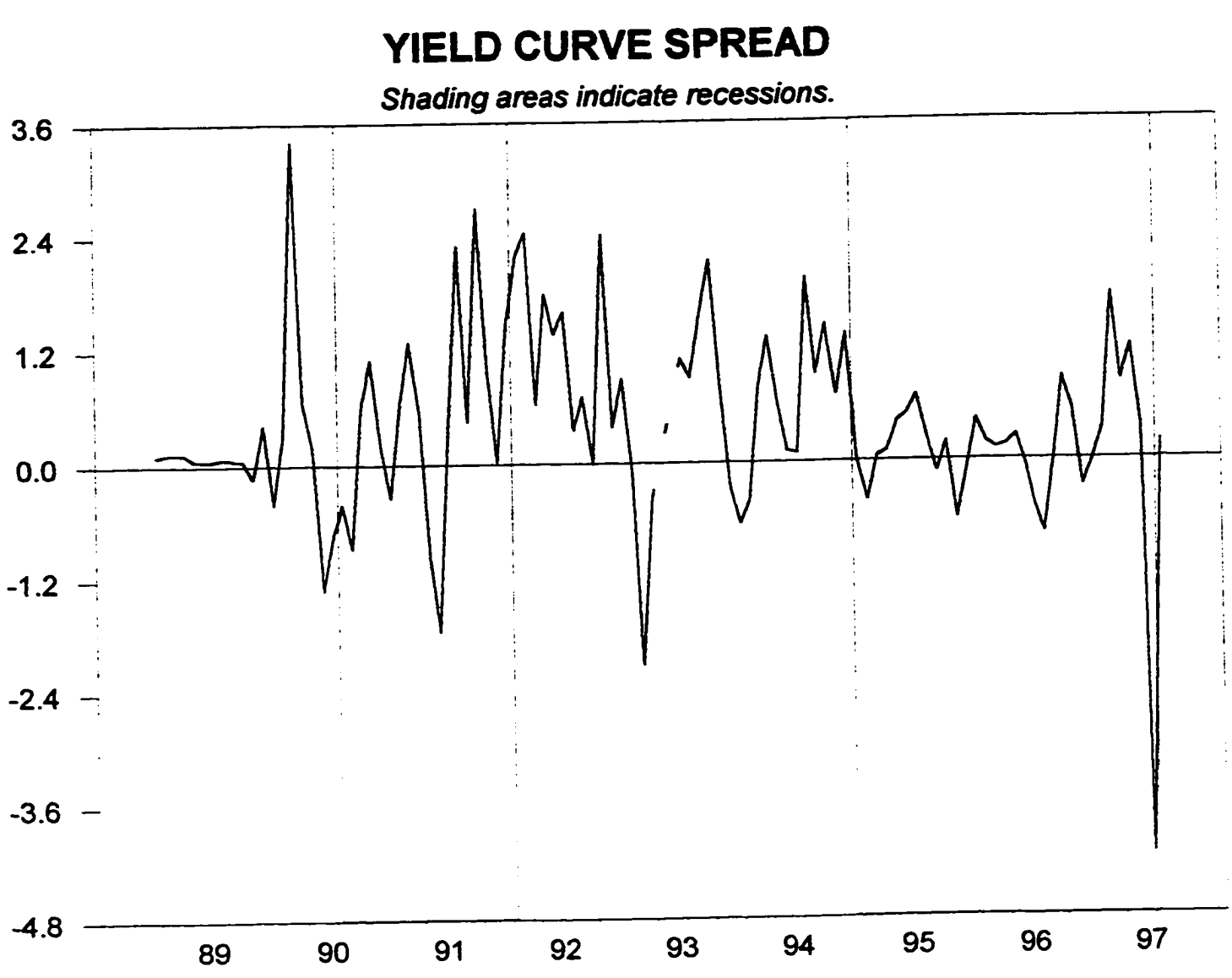

Figure 40: Repo Yield Curve Spread and Business Cycles

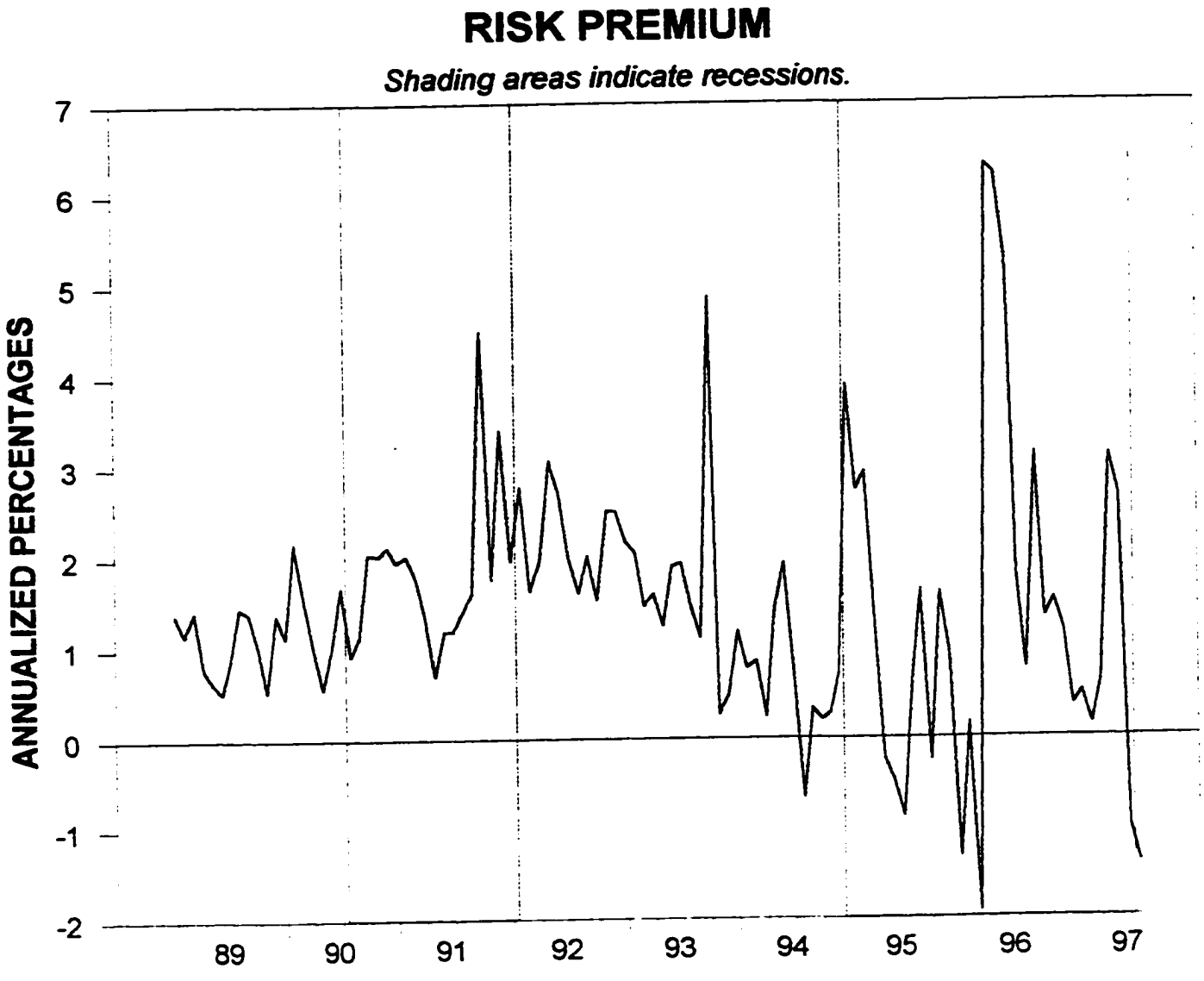

Figure 41: Risk Premium and Business Cycles

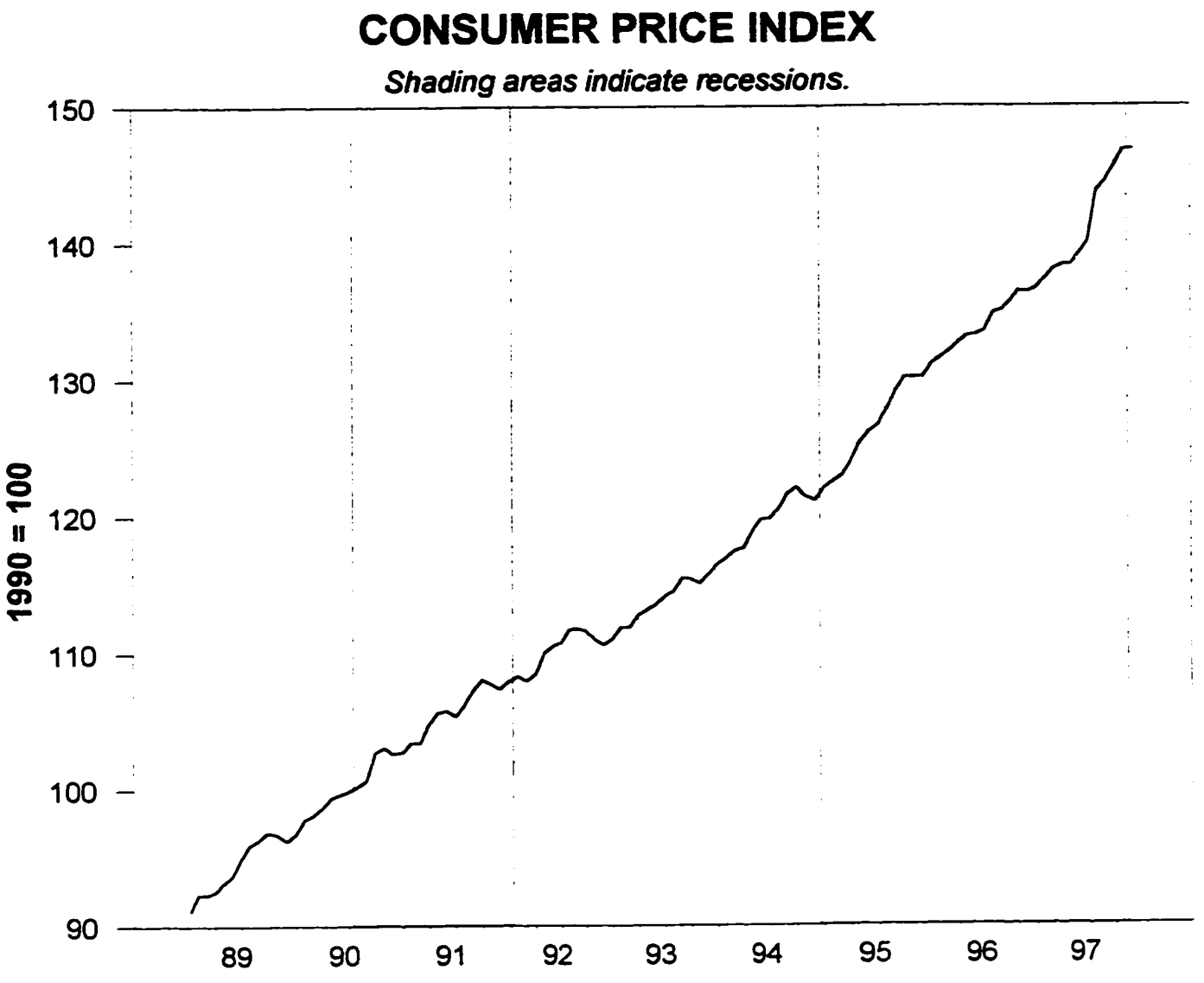

Figure 42: CPI and Business Cycles

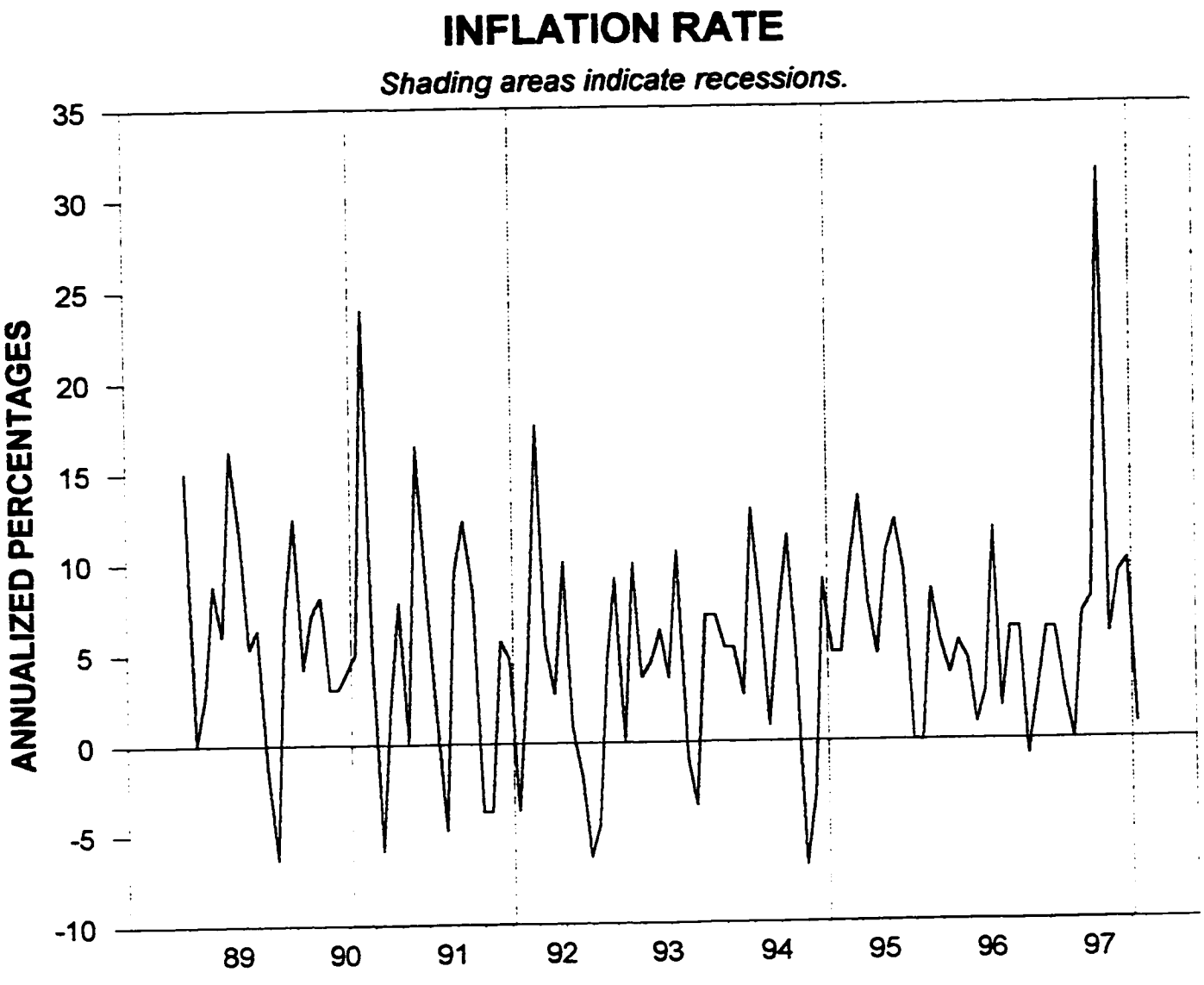

Figure 43: Inflation Rate and Business Cycles

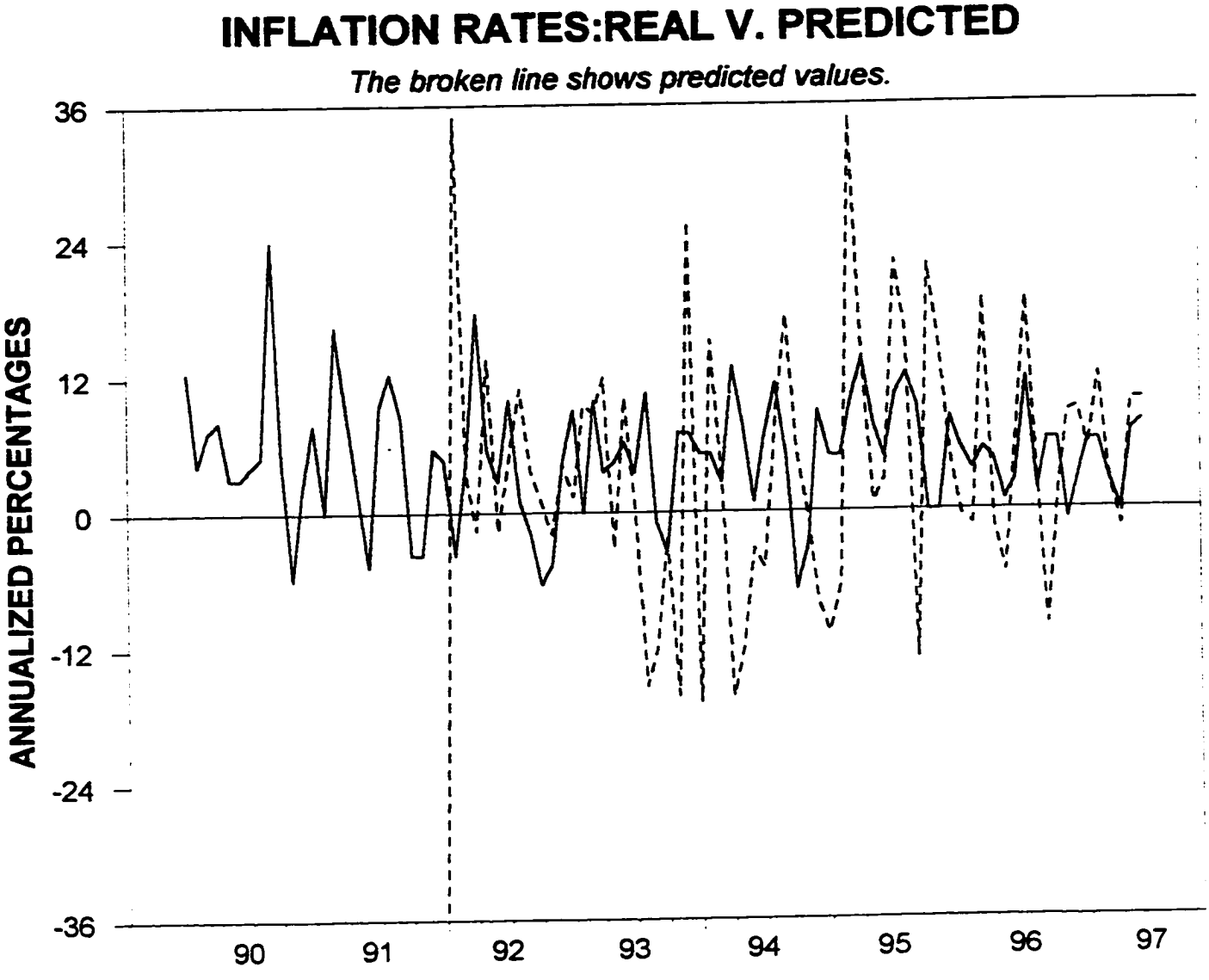

Figure 44: Actual and Predicted Inflation Rates

(The Nominal Interest Rate Model)

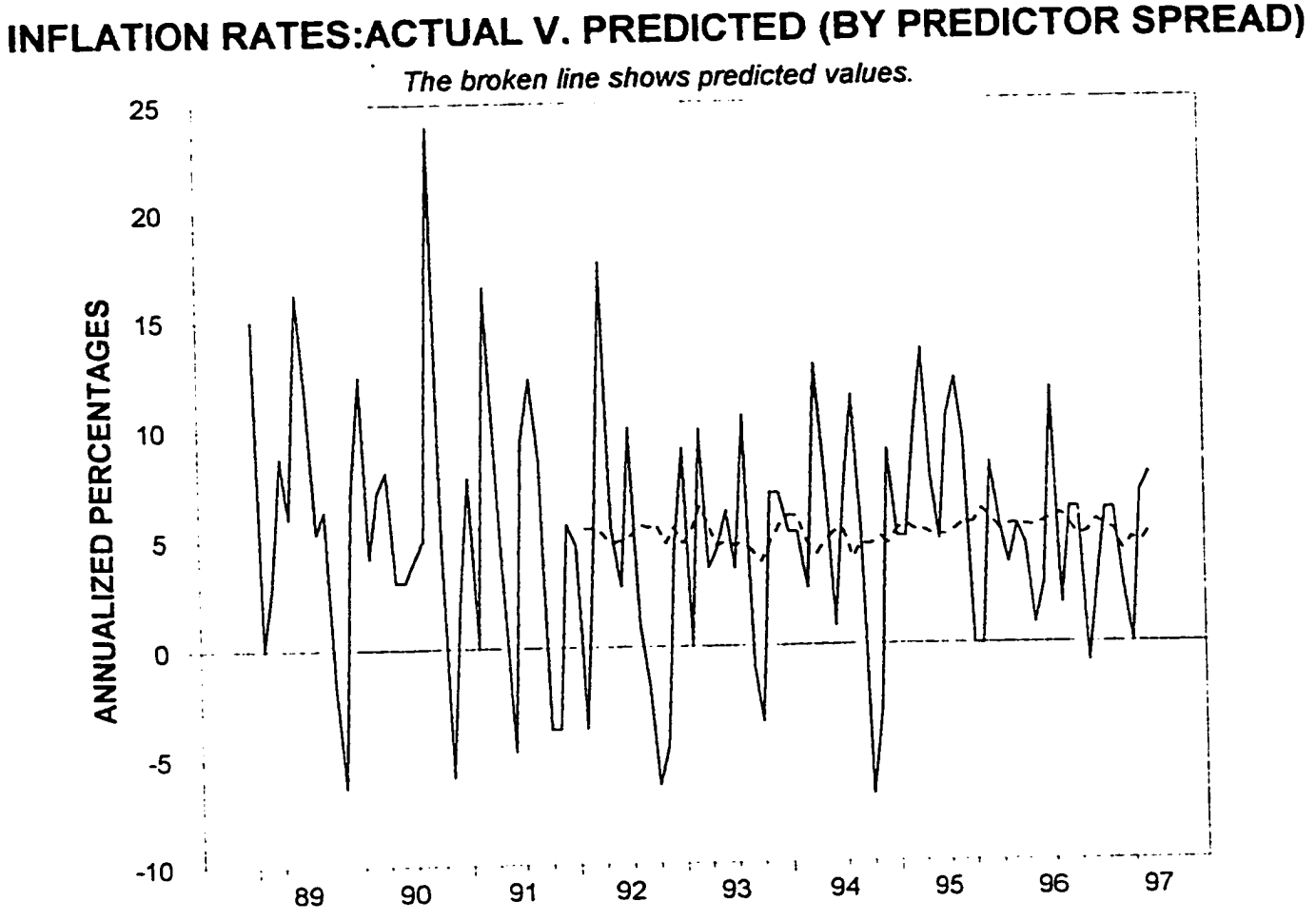

Figure 45: Actual and Predicted Inflation Rates (The Spread Model)

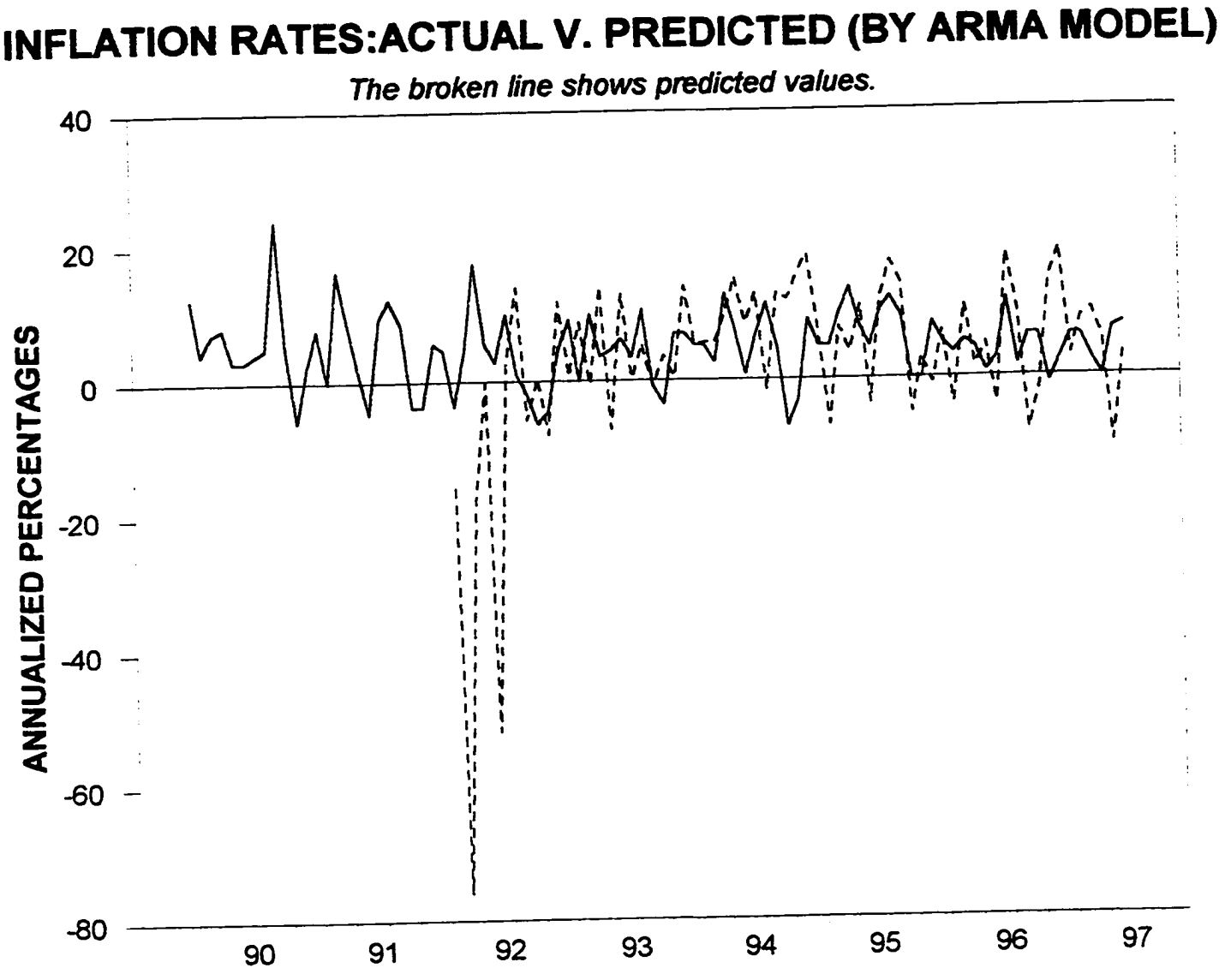

Figure 46: Actual and Predicted Inflation Rates (The ARMA Model)

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IMAGE EVALUATION
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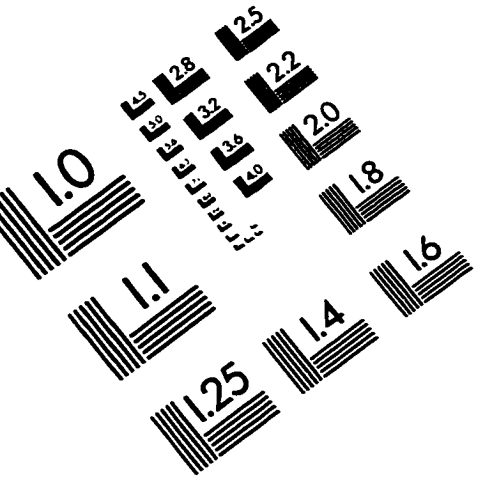

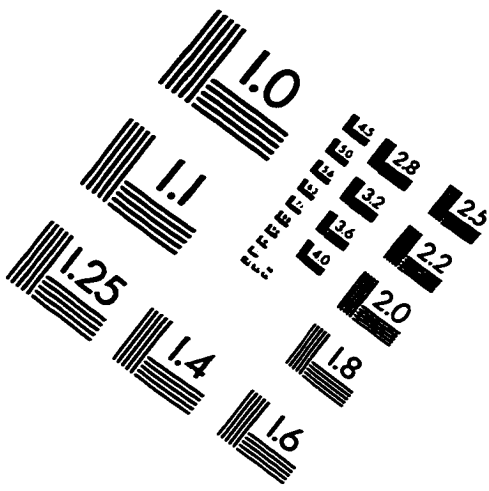

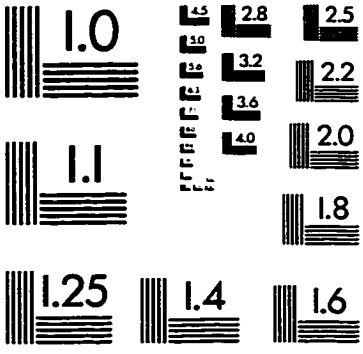

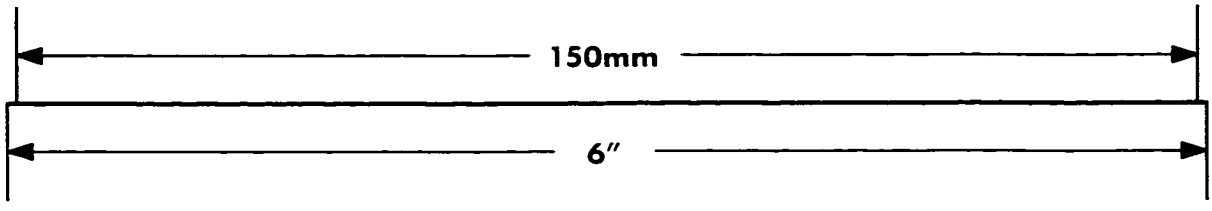

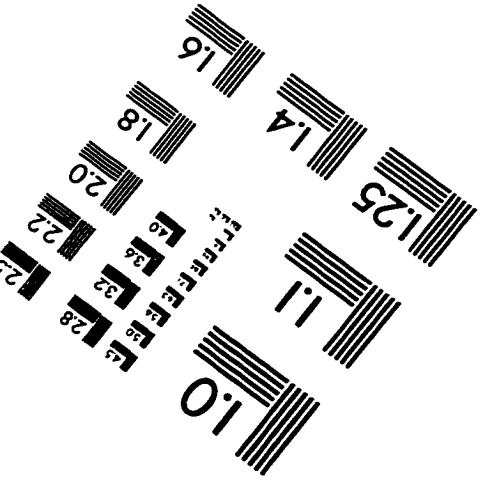

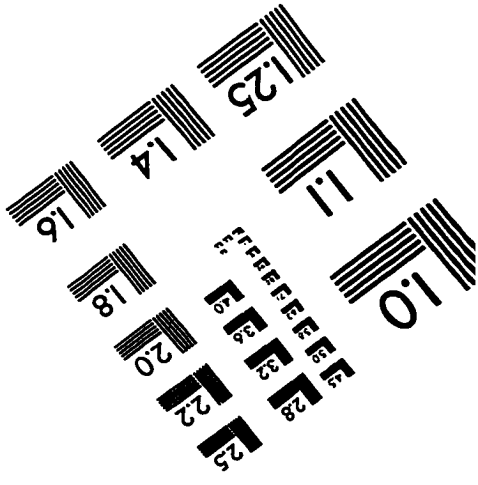

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